

Original Research Article

<https://doi.org/10.20546/ijcmas.2020.908.297>

## Local People Perception towards Conservation and Management of Sarus Crane (*Grus antigone antigone* L.) in Central Gujarat Region

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### ABSTRACT

#### Keywords

Socio-economic, Farmers, Nest location, Community involvement, Awareness

#### Article Info

Accepted:

22 July 2020

Available Online:

10 August 2020

The present socio-economic study was conducted to know the local perception and conservation mindset of local peoples towards sarus crane. Total 15 peoples representing 73 family members from 8 villages of two tehsils from two districts of central Gujarat were interviewed. All respondents engaged in agriculture or related occupation. These farmers possess small landholdings and low annual income. Farmers from this 8 village sighted a total of 266 sarus cranes. Sarus crane prefers a faraway corner of a farm as a nest location with minimum disturbance. Farmers believe that disturbing them can bring bad omen to them. Farmers feel pleasant and happy with the presence of sarus crane in their field. Farmers also conserve the sarus crane by protecting the nest and protecting eggs from stealing and chicks from dogs. The soil sample analysis suggests that this soil is rich in sodium, which is indirectly beneficial for sarus crane as farmers will use little or no chemical fertilizers in the field. Due to the welcoming approach of locals, the agricultural landscape of central Gujarat became an important breeding site for sarus cranes. Community involvement through awareness and educating the youngsters about the importance of the species is the key for Sarus conservation.

### Introduction

Sarus Crane (*Grus antigone antigone* L.) is listed as 'Vulnerable' species globally under IUCN red list of threatened species (Bird Life International, 2016) and in schedule IV of the Wildlife (Protection) Act, 1972 (WPA, 1972). It is the only resident breeding crane species in India and Gujarat is ranked third most

important State of the global sarus crane population (Kumar *et al.*, 2019; Singh and Tatu, 2000). Sarus Crane is an elegant bird, predominantly grey, with long, pale red legs, brick red naked head and neck. Juveniles have buff feathers on their head and slightly darker plumage. Cranes are among the world's tallest birds, ranging in length from 90cm to more than 150cm and weight ranges from about

6,800 to 8,000 grams (Ali, 1941; Ali and Ripley, 1969; Prasad *et al.*, 1993). Male and female Cranes of all species are identical in their external features, but the male is slightly larger than the female (Johnsgard, 1983; Meine and Archibald, 1996).

Sarus cranes as a monogamous species make pair for a lifetime. During the breeding season, they exhibit peculiar ludicrous dancing display and capering to attract mates, spreading their wings and prancing and leaping in the air around each other (Ali, 1941). Characteristic loud trumpeting sounds may accompany these dances (Rana and Gulati, 2019). Although considered territorial, Sarus cranes form big flocks in the non-breeding season depends on the wetland area. Sarus cranes utilize the wetland and marshlands areas as a breeding ground (Walkinshaw, 1973a; Ali and Ripley, 1983; Gole, 1989; Latt, 2001). Wetland microhabitats such as pondles, taali, paddy fields and canal seepage are selected by this bird for nest construction during the rainy seasons. These birds nest on the ground, which is circular or oblong in shape with a broad base and depression in the centre and bulky nest is formed from wetland vegetation and submerged in water (Mukharjee *et al.*, 2000; Tomar and Chouksey, 2018). It is an omnivore bird species which generally consumes grains, shoots and other vegetation as well as insects, molluscs and small reptiles (Ali, 1941; Jha and Mckinley, 2014).

Sarus crane is a wetland dominant species which is living in harmonious relationship with humans from time immemorial. With growing human population, change in human behaviour, egg theft and the hunting of cranes for meat., loss of natural habitat and change in cropping pattern leads to conflict between humans and sarus cranes (Tariq and Aziz, 2015; Darapuri, 2014, Meine and Archibald, 1996, Gosai *et al.*, 2016). The cultural of the

local people and the ability of sarus crane to track the habitat changes are major reasons which help them survive in the agricultural landscape of Gujarat (Borad *et al.*, 2001a). Crop production is based majorly on soils. The important property of soils is their chemical fertility and physical condition, which responsible for the potential to produce crops. Soils play a major role in the life and development of lands. They provide a vital substratum for people, animals, plants and micro-organisms and act as a key factor of the ecosystems, especially for water and nutrients cycling (Malav *et al.*, 2018).

### **Materials and Methods**

Tarapur and Matar tehsil from Anand and Kheda districts of central Gujarat was selected. Tarapur and Matar is mainly agricultural landscape; Tarapur is located at 22.49°N 72.66°E and Matar at 22.75°N 72.68°E. This region received southwest monsoon but major areas of both the districts have canal irrigation facility and therefore irrigated farming is practiced. Paddy is extensively cultivated in this region. Paddy fields act as temporary wetlands and provide an alternative to natural habitat for the sarus crane.

Presence of sarus crane is well established in agricultural landscapes of these areas (Parasharya *et al.*, 1989). To know the local perception of people about sarus crane socio-economic study was conducted. Fifteen peoples from eight villages were interviewed as per preset questioner form (Form 1) in the months of January to March of 2017. Post monsoon and winter are the most suitable time to sight the sarus crane (Sundar, 2005) and this duration was selected to know the local perspective. Paddy (*Oriza sativa* L.) occupies 51% of the total cultivated land during monsoon season in Matar tehsil (Borad, 2001a) and the same trend can

observe in Tarapur. It is important to know that presence of sarus crane can affect the different agricultural operation such as paddy transplanting, harvesting and other cultural operations.

Soil samples were collected from thirteen sites, where direct sarus cranes were sighted from selected villages. In the study area, surface soil samples (0–30 cm) were taken at regular intervals from the farm. Triplicate samples were collected, air-dried, passed through a 2 mm sieve and then analyzed for nutrients. Soil parameters such as Soil pH (Jackson, 1973), available nitrogen (N) (Subbhiah and Asija, 1956), available phosphorus (P), (Oslen *et al.*, 1954), available sulphur (S) (Chesnin and Yien, 1950), total organic carbon (TOC) and total organic matter (TOM) (Walkley and Black, 1934) were estimated to know the fertility status of the farm soil.

## **Results and Discussion**

### **Local perception (Table 1)**

The study was carried out to understand the local perception about conservation and management towards Sarus crane through the questioner based interview of local people. During field visit whenever Sarus crane is observed the surrounding or nearby village people is interviewed. There were 2 districts taken for the study, they were Kheda and Anand. In Kheda district from Matar tehsil 4 villages and from Anand district's Tarapur tehsil 4 villages were considered for the study. Fifteen peoples from eight villages were interviewed from which 14 were males and 1 was the female respondent. All fifteen respondents follow the Hindu faith.

The respondents have different peoples from age group 28 to 60 years. 1 person each of age 28, 38, 45 and 55 years, 3 persons each of age 35, 40 and 50 and 2 persons of 60 years of

age. 14 males were from of age group 28-60 and 1 female was of age 40 years. 3 persons interviewed each from Bamangam and Moraj, 2 persons each from Saath, Rel and Kanavada, and 1 person each from Chanor, Jichka and Limbasi. On the educational qualification basis, 6 people were 10th pass and 2 people were 12th pass from a total of 8 people interviewed from Tarapur tehsil. In Matar tehsil out of 7 people; 6 were 10th pass and 1 was 12th pass. As of occupation, 12 people are indulged in agriculture 2 people practised agriculture and livestock and 1 person was in labour and agriculture.

Surveyed 15 peoples represent 73 total family members. Average Annual Income of individual correspondent varies from 1.5 to 2.6 lakh /Person from agricultural and livestock background but 0.8 lakh for the labour. Two types of house accommodation were categories, 14 families' having pucca/permanent house and one with Kutcha houses. In the survey, it was found that in Tarapur tehsil there were 7 families with pucca house type of accommodation and 1 with Kutcha house, all 7 respondents from Matar tehsil posses' pucca accommodation for families.

The respondent cultivates six crops on the farm; 1. Wheat (*Triticum aestivum* L.), 2. Rice (*Oryza sativa* L.), 3. Bajra (*Pennisetum glaucum* (L.) R.Br.), 4. Tobacco (*Nicotiana tabacum* L.), 5. Jowar (*Sorghum bicolor* (L.) Moench), and 6. Maize (*Zea mays* L.). Five types of cropping pattern were observed during survey namely, 1). WRBT - Wheat, Rice, Bajra and Tobacco; 2). RJB - Rice, Jowar and Bajra; 3). WR – Wheat and Rice; 4). WRB - Wheat, Rice and Bajra 5). WRM - Wheat, Rice and Maize. From the results we can interpret that 100% respondents with agricultural occupation cultivate rice in their fields and 60.00 % of the people take WR combination in their agriculture field, 13.33 % farmers adopt RJD and WRM combination respectively and 6.66% of farmer adopt

WRBT and WRM combination of cropping pattern respectively. The average landholding amongst the respondents varies from 1.91 ha/family to 3.75 ha/family.

During the last four months of the study period, a total of 266 Sarus cranes sighting were claimed by the 15 respondent. 171 sightings were claimed from Tarapur tehsil and 95 from Matar tehsil. In the relation of making a nest of Sarus Crane the information was taken from the respondent, most of the time Sarus Crane make their nest in the corner of the fields because of the disturbance from agricultural practices. 46% of the respondent (7) agrees on that Sarus crane construct nest on corner site of the farm, 27% (4) respond that the crane made nests randomly and 27% (4) respondent were unaware about nest location. The respondent also mentioned that Sarus prefer the corner of the field with fewer disturbances and less movement and generally open area without tree covering.

When the question asked regarding the appearance of Sarus Crane, most of the farmers said they mainly have seen in the season of winter and monsoon. As the farmers were all native of these regions they were all familiar of these bird species they called it "SARUS BELADI" which means a Pair of Sarus crane. They also confirm that nest often found in paddy and wheat fields. Mostly the Sarus Crane can be seen in the field during dusk and dawn time.

Shape described by farmers as of saucer shape and mostly made up of grass, twigs and agricultural remains. Pair of Sarus crane takes around 10-12 days to construct their nest with equal efforts and accommodate the nest for around 40-50 days in between of their breeding period. Farmers also mentioned that sometimes they make more than 1 nest if the first one destroyed or observed disturbance. Generally female spends most of the time to protect their eggs and young ones from

different threats like human stealing, dogs (*Canis lupus familiaris*), trampling of the nest by Blue bull (*Boselaphus tragocamelus*) or wild boar (*Sus scrofa* L.) and eggs eaten by snakes.

Every farmer responded that with the presence of Sarus Crane in the field they feel very pleasant and recreational. They believe that Sarus crane pair is a symbol of love deity and disturbing them can bring bad omen and leads to fighting between the couple. Farmers believe hunting of Sarus crane as a "MAHA PAAP" literally means 'great sin' according to mythology. Farmers also mentioned about protective measures taken by them to protect nesting pair, they avoid unnecessary movements from roosting corner and try to keep dogs, Blue bull and wild boar away from the nest whenever possible.

### **Soil analysis**

Soil samples of 13 stations were analyzed from where the direct sighting of Sarus crane was recorded during field trips. The soil sample was analyzed for different soil parameter such as Soil pH, TOC, TOM, S, P, N. Soil pH of station ST 1, ST 4, ST6, ST 8, ST 9, ST 11 and ST 12 ranges around 7, followed by pH range 8 for stations ST 3, ST 7, ST 10 and ST 13. Station ST 2 recorded with pH 9 and ST 5 with the highest pH 10. The total mean pH of stations was 7.69 with SD 0.947. Mean total organic carbon (TOC) and mean total organic matter (TOM) was 2.11 and 3.63 with SD 0.870 and 1.501 respectively. The mean sulfur (S) contain found in sample was 30.52 with SD 17.388. The mean phosphorous (P) contain was 0.89 with SD 0.346 and mean nitrate (N) contain was 2.97 with SD 1.772 (Table 2). These soil nutrient parameters from all stations indicate that being fertile soil it is good for agricultural enterprises such as farming and animal husbandry. Indirectly we can also conclude that Sarus crane prefers areas with good soil fertility.

**Table.1** Socio-economic status of the respondents

District- Tehsil	Name of Village	No of Respondent/village (Total Family members)	Average Annual Income/ Person (in Lakhs)	House Kacha (K)/Pakka(P)	Occupation of Respondent *	Land holding (Ha)	Cropping Pattern** (No of farmers involved)	Total numbers of Sarus crane sighted by Res.	Nest location in farm***
<b>Anand- Tarapur</b>	Jichka	1(3)	1.5	1 (P)	A (1)	3.75	WRBT (1)	20	CO (1)
	Moraj	3(14)	1.8	3 (P)	A (2), AL(1)	1.91	WR (2), RJB (1)	65	CO (1), RA (1), UA(1)
	Rel	2(12)	2.5	2 (P)	A(1), AL(1)	3.75	WR(1), WR (1)	50	CO (1) UA(1)
	Sath	2(10)	2.5, 0.80	1(P), 1(K)	A(1), L(1)	1.50	WRB (1), WRM (1)	36	UA(1) RA (1)
<b>Kheda- Matar</b>	Bamangam	3(15)	2.6	3 (P)	A (3)	2.91	WR (3)	55	CO (2) UA(1)
	Chanor	1(8)	2.5	1 (P)	A (1)	2.50	WR (1)	20	CO (1)
	Kanawada	2(8)	1.75	2 (P)	A (2)	3.12	WR (1), RJB (1)	15	RA (2)
	Limbasi	1(3)	2.5	1 (P)	A (1)	2.50	WRB (1)	5	CO (1)

(Note: \*A-Agriculture, AL-Agriculture and Livestock, L-Labor and Agriculture; \*\*WRBT-Wheat, Rice, Bajra, Tobacco; RJB - Rice, Jowar, Bajra; WR - Wheat, Rice; WRM-Wheat, Rice, Maize; WRB- Wheat, Rice, Bajra. )

**Table.2** Physico-chemical properties of the soil samples collected during study time

Stations	Station Location (Latitude, Longitude)	Direct sighted Sarus crane	pH	TOC (%)	TOM (%)	S (mg/kg)	P	N
ST 1	22°28'31.68"N 72°37'14.93"E	2	7.00	2.27	3.91	40.24	0.86	1.16
ST 2	22°28'12.10"N 72°34'54.31"E	2	9.00	0.83	1.43	26.60	0.70	2.12
ST 3	22°27'1.56"N 72°32'37.52"E	3	8.00	3.72	6.42	22.30	0.85	2.95
ST 4	22°25'55.72"N 72°33'0.60"E	2	7.00	1.66	2.85	30.16	1.40	4.17
ST 5	22°25'56.75"N 72°34'0.91"E	2	10.00	1.86	3.21	86.00	1.83	1.04
ST 6	22°25'4.64"N 72°34'46.42"E	1	7.00	2.07	3.57	24.42	0.65	5.82
ST 7	22°26'0.85"N 72°37'27.91"E	2	8.00	1.24	2.14	22.17	0.74	5.18
ST 8	22°27'4.37"N 72°38'20.75"E	3	7.00	3.10	5.35	24.46	0.66	5.47
ST 9	22°29'44.88"N 72°31'31.65"E	2	7.00	3.33	5.74	26.98	0.70	1.19
ST 10	22°32'46.66"N 72°31'52.34"E	3	8.00	2.48	4.28	24.73	0.75	2.09
ST 11	22°31'27.55"N 72°37'45.65"E	2	7.00	1.61	2.77	20.44	0.70	1.19
ST 12	22°35'9.16"N 72°37'1.14"E	4	7.00	1.15	1.98	23.81	0.96	2.12
ST 13	22°35'36.23"N 72°35'2.34"E	5	8.00	2.07	3.56	24.50	0.72	4.17
		Mean	7.69	2.11	3.63	30.52	0.89	2.97
		SD	0.947	0.870	1.501	17.388	0.346	1.772

### Local perception

An agricultural ecosystem is highly productive concerning grains, green fodder or invertebrate prey which ensures food to birds of diverse food habits (O'Connor and Shrub, 1986; Dhindsa and Saini, 1994; Borad *et al.*, 2000). Most of the cranes nest in wetlands, sometimes man-made (White, 1987). Total of 260 bird species have been recorded in

intensively cultivated areas in western India (Parasharya *et al.*, 1996). The Sarus Cranes nested within agricultural marshland in central Gujarat and almost 97.14 per cent nests were located within agricultural marshland (Mukhrjee, 2000) and recorded that survival of the nest within paddy cultivated area was very less and farmers scared territorial pairs to avoid nesting in their fields but contradicting this, during present



study farmers like the presence of Sarus crane and avoid to disturb them during roosting the time, which creates safe microhabitats and it is beneficial for the Sarus Crane to survive in agricultural landscapes.

Gole (1989) observed that the cranes disappeared from highly modern agricultural landscape of Punjab and Haryana but was found numerous in the so-called 'backward areas of the country'. Our study also supports this opinion as this study was also focused on the villages which can consider as backward with low landholding and low annual incomes of the respondent. However, the strong morals and beliefs about bird mythology play a significant role in the survival of Sarus Crane. The present study highlights the importance of Agricultural landscape and positive attitudes of farmers for sustaining good and viable population.

The breeding season is defined as the period between the initiation of the first clutch and the last clutch in the population (Campbell and Lack, 1985). The breeding season of the Sarus crane in northwestern India and particularly in central Gujarat region coincides with the south-west monsoon (Ali and Ripley, 1983; Parashrya *et al.*, 1989; Mukherjee, 2000). Changing monsoon patterns directly affecting the paddy cultivation and the lifecycle of sarus cranes (Sundar 2011). Gromadzki (1995) opined that legally protected areas can sustain only a proportion of the crane population and strongly recommended general protection measures must be taken for the protection of small breeding sites. Sarus crane utilizes different crops fields such of Soybean, Paddy, Sorghum, Mustard, Wheat, Coriander, Masoor pulse, Maize, Arhar, Linseed, Cotton and Saunf field (Vyas 2002, Malek *et al.*, 2020). Within Gujarat state, the crane density is highest in the paddy growing area of central Gujarat, particularly in Kheda, Anand and

Ahemadabad districts (Vaishnav, 1985; Parasharya *et al.*, 1989; Mukherjee *et al.*, 2000). The paddy agroecosystem provides both feeding and breeding ground for the cranes. The cranes have adapted to this manmade habitat and live in harmony with human beings. Ability to track habitat changes and the cultural heritage of the local people is responsible for this adaptability of the sarus crane to the agricultural landscape, cranes nested within a range of 100±200 m distance from the human settlements. (Suwal, 1999; Borad *et al.*, 2001a; Shrestha, 2015). Attributes such as weather, availability of food and water, and predation on the breeding ground effects on the annual variation of the nest or the survival of chick (Drewien *et al.*, 1995).

The nest is roughly circular to oval in shape and the size of a nest on average varies from 1.5 m<sup>2</sup> to 3 m<sup>2</sup> (Borad *et al.*, 2001a; Aryal *et al.*, 2009; Gosai *et al.*, 2013; Gyawali, 2015). In paddy fields, the water level was never more than the bund height. Hence the nest material requirements in this microhabitat were lowest. The significance of specific water depth around the nest was chiefly to prevent the approach of ground predators to the nest. Water is an important factor affecting nest survival, by limiting movements of mammalian predators and hence their encounters with nests (Walkinshaw, 1973b; Sargeant and Arnold, 1984). Sandhill Cranes preferred a cover with a structure and density with a clear view while incubating for free movement (Walkinshaw, 1950; Bennett, 1978). Nesting materials depend on the vegetation found around the nests; however, *Oryza sativa*, *Cynodon dactylon*, *Eleocharis* spp., *Ipomea* spp., *Imperata* spp., etc. were extensively used for making nests (Suwal, 1994; Aryal, 2004; Baral, 2009; Gyawali, 2015). While nesting within the paddy crop, the cranes had no other option but to use paddy plants as nesting

material. This was because of the removal of the weeds. The cranes generally collect nest material from the surrounding and use the weeds removed from the paddy fields while nesting on the bund (Walkinshaw, 1973a; Ramchandran and Vijayan, 1994). The nest built on the bund, before transplantation of paddy seedlings, also showed a very high diversity of aquatic plants as nesting material. The Sandhill Crane also incorporated different plant material in its nest while nesting in different microhabitats (Walkinshaw, 1973b).

Several pairs nested on the same site every year and it is also reported for Whooping Cranes (Kuyt and Goossen, 1987; Kuyt, 1993). Villagers revealed in the interview that in several places the cranes nested in the same field every year unless disturbed seriously. Re-nesting near the original site is a common phenomenon of the sarus crane (Borad *et al.*, 2001a). Nest site fidelity is a common tendency in sarus crane (Walkinshaw, 1973a; Gole, 1987). The total period of the nest site fidelity shown by the cranes for a particular site indicated its suitability concerning disturbance (Walkinshaw, 1949; Bennett and Bennett, 1990). Long term nest site fidelity within the paddy fields was attributed to the cultural heritage of the people (Parasharya *et al.*, 1989; Harris, 1994; Harris and Mirande, 2013).

As cranes nest in the paddy cultivated area, the conflict increases between farmer and crane due to the cranes' nesting activity causing economic damage to crops. With modernization in agriculture, drastic changes are likely to occur in cropping pattern, farm size and structure, farm practices and pesticide uses (O'Connor and Shrubbs, 1986; Paudel, 2009). The consequence of this modernization will be a drastic decline in suitable nesting sites. Daniels (1994, 1998) advocated retaining the non-cultivated

patches within the agricultural landscape for conserving avian biodiversity. Due to the availability of habitat in the roosting site these birds prefer to forage in agricultural land (Gulati and Rana, 2019). Sarus crane is an omnivore species and in contrast to farmer's estimate of the damage total yield loss may be considered negligible which ranges from 0.2 to 13.6% per field. Educating farmers is a key to encourage mutual co-existence of Sarus crane with agriculture. Damage compensation scheme can also be introduced through government or other agencies for farmers (Ali and Ripley, 1983, Parasharya *et al.*, 1986, Borad *et al.*, 2001b).

Sarus has is an iconic bird of mythological and cultural importance. It also has economic significance and ecological importance in marshland. The ancient Hindu scriptures considered the Sarus meat as a taboo (Board *et al.*, 2001b). Sarus crane considered as a symbol of marital virtue in Gujarat and believed that the death of one partner leads to the death of pair mate (Kumar and Kanaujia, 2017b; Verma, 2018b). The most significant results of the Sarus crane conservation can be achieved if active participation of the local community can be increased (Kumar and Kanaujia, 2017a). Community conservation is considered an important contemporary tool for nature conservation (Adams and Hulme, 2001; Prakash and Verma, 2016). Education is a vital part of wetland conservation; it should be integrated into village-based education and developmental programs (Meine and Archibald, 1996; Davis, 1998; Kaur *et al.*, 2008). Verma (2018a) recorded a positive correlation between sarus crane and agriculture and a positive correlation between the crane numbers and the area of agricultural land. The rice fields are not suboptimal nesting site for the bird but favorable attitudes of farmers still allow Sarus Cranes to nest in paddy fields (Sundar, 2009).



## Soil analysis

Alluvial sandy loam to sandy clay soils are found in the Kheda and Anand district and these soils are the most productive in the state and contain a fairly good amount of potassium. Nitrogen, phosphorous and potassium are essential for the growth and survival of the plants. Many districts of Central Gujarat such as Kheda show medium nitrogen fertility index (1.67-2.33) and Anand show high nitrogen fertility (2.73) while for phosphorous both the district show lower fertility index 1.49 and 1.53 respectively for Kheda and Anand. (Ghosh and Hasan, 1980), GOG, 2020) Malav *et al.*, (2018) assessed different Selected Parameters in Soils of Kheda and Anand, and concluded that ph of Matar tehsil soil ranges from 7.27 to 8.10 and for Tarapur 7.70 to 8.35; the Status range of Organic Carbon (OC) for Matar was 0.23 to 0.65 % and for Tarapur 0.25 to 0.71 % and available S ranges from 1.53 to 66.4 mg/kg for Matar and 1.50 to 19.1 mg/kg for Tarapur.

Sulphur is an important nutrient for plant growth and development, as it is very important for synthesizing of S-containing amino acids (cysteine, cystine, methionine) and enzymes, and it is required for different of proteins, chlorophyll, oil and vitamins (Zhao *et al.*, 1997; Havlin *et al.*, 2000; Tiwari and Gupta, 2006). It increases crop yield with improving product quality and available S also have a positive association with organic carbon (Kour and Jalali, 2006; Kour *et al.*, 2014). Sulphur deficiencies were not common before the introduction of high yielding varieties. Surveys made to delineate S deficient areas in different parts of the country revealed that S deficiency varies from 5 to 83 % with an overall average of 41 % (Singh, 2001).

It is concluded that positive attitude and mythological beliefs of local people play a

significant role in sarus conservation. These areas have tremendous potential as the locals are favoring sarus cranes in the fields. Village level participation should be encouraged with awareness programs. Educating youth to increase future participation is a key for sarus conservation as landholdings generally transferred generation to generation. Physico-chemical properties of the soil samples indicate about good soil fertility status of the area. Little no use of chemicals should be promoted to restrict the harmful chemical from entering the sarus sustaining ecosystem.

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**How to cite this article:**

Saiyed, S. A., S. S. Malek and Soni, H. B. 2020. Local People Perception towards Conservation and Management of Sarus Crane (*Grus antigone antigone* L.) in Central Gujarat Region. *Int.J.Curr.Microbiol.App.Sci*. 9(08): 2592-2604. doi: <https://doi.org/10.20546/ijcmas.2020.908.297>