POPULATION AND ECOLOGY OF SARUS CRANE (*Grus antigone*, Linnaeus 1758) IN NORTHERN REGION OF RUPANDEHI DISTRICT

Bigya Gyawali

T.U. Registration Number 5-2-22-1181-2005

T.U. Examination Roll No. 18195

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Submitted to

Department of Environmental Science,

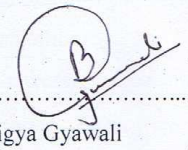
Khwopa College (Affiliated to Tribhuvan University),

Dekocha-5, Bhaktapur, Nepal

Kartik 2072, October 2015

DECLARATION

I hereby declare that the work presented in the thesis has been done by myself, and has not been submitted elsewhere for the award of any degree. All sources of information have been specifically acknowledged by reference to the author(s) or institution(s).



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Bigya Gyawali

Date: 30 October, 2015

RECCOMMENDATION

This is to certify that Ms. Bigya Gyawali has completed this thesis entitled "**POPULATION AND ECOLOGY OF SARUS CRANE (*Grus antigone*, Linnaeus 1758) IN NORTHERN REGION OF RUPANDEHI DISTRICT**" as a partial fulfillment of the requirement of M.Sc. in Environmental Science under my supervision and guidance. This is her original work and to the best of my knowledge, this thesis work has not been submitted for any degree in any institutions.

We therefore, recommend the dissertation for acceptance and approval.

.....

Kamal Raj Gosai
Supervisor,
Faculty,
Department of Environmental Science,
Khwopa College

LETTER OF APPROVAL

On the recommendation of supervisor Kamal Raj Gosai, this dissertation submitted by Bigya Gyawali entitled "**POPULATION AND ECOLOGY OF SARUS CRANE (*Grus antigone*, Linnaeus 1758) IN NORTHERN REGION OF RUPANDEHI DISTRICT**" is approved for the examination and submitted to Khwopa College for the partial fulfillment of the requirements of M. Sc. in Environmental Science.

.....

Rabindra Jyakhwo
Incharge, Department of Environmental Science,
Khwopa College

An Undertaking of Bhaktapur Municipality
KHWOPA COLLEGE
Affiliated to Tribhuvan University
ESTD. 2001

LETTER OF ACCEPTANCE

This dissertation entitled **"POULATION AND ECOLOGY OF SARUS CRANE IN NORTHERN REGION OF RUPANDEHI DISTRICT."** submitted by **Ms. Bigya Gyawali** is examined and accepted as a partial fulfillment of the requirement MSc. degree in Environmental Science.

.....
Mr. Roopak Joshi
Principal
Khwopa College

.....
Mr. Rabindra Jyakhwo
In-charge, Dept. of science
Khwopa College

.....
Kamal Raj Gosai
Dissertation Supervisor
Faculty, Khwopa College

.....
Dr. K.S. Gopi Sundar
Co-supervisor
Director, Program SarusScape,ICF, (USA)
Scientist, Cranes and Wetlands Program, Nature Conservation Foundation (NFC), India

.....
Hem Sagar Baral, PhD
External Examiner
Adjunct Senior Lecturer
School of Environmental Science
Charles Sturt University, Australia

.....
Prof. Dr. Siddhi Bir Karmacharya
Chairman, Research Committee
Khwopa College

Date: 3 November, 2015

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ABSTRACT

The present study was carried out on Sarus Crane (*Grus antigone antigone*) to estimate population of Sarus crane in the Northern region of Rupandehi district, to know breeding success and nest ecology of Sarus in the study area. This survey was carried out in August to October, 2013.Village road was taken as transect. Field observation and informal discussion was conducted to assess population status to know breeding success and assess nest ecology. Nests were visited and measured with a tape without disturbing eggs.

Survey was carried out in 18 VDCs. 95 individuals of Sarus crane were found among which 29 were breeding pairs, 11 were observed in flock and 3 as single individuals and 23 were juveniles. Mean encounter rate of the Sarus was about 9 individuals per 7 sq. km. The maximum flock size was 11 individuals.

Hatching success rate was 63.88 chicks per 100 laid eggs and 127.77 individuals per 100 nests. Among the active nests monitored, at least one egg was found in 18 out of 19 nests. So nesting success was 94.73 %.

Among the 19 nests, 42.10 % were observed in wetland and 5.26 % in agricultural land and 52.6 % were in the interface of wetland and agricultural land. Average area of nest was 2.76 m^2 (n=19).

Key words: *Grus antigone antigone, hatching success, breeding success, habitat preference,*

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ACRONYMS AND ABBREVIATIONS

BCN:	Bird Conservation Nepal
CITES:	Convention on International Trade in Endangered Species of Wild Fauna and Flora
cm:	Centimeter
DNPWC:	Department of National Park and Wildlife Conservation
ICF:	International Crane Foundation
IUCN:	International Union for Conservation of Nature
M:	meter
Mm:	millimeter
Sq.m:	square meter

CHAPTER I: INTRODUCTION

1.1 Background

Sarus Crane is the resident breeding crane in India, Nepal and Southeast Asia, and is the world's tallest flying bird. Three subspecies are recognized, with a total estimated population between 13,000 and 15,000 (BirdLife International, 2012).

Sarus Crane is found primarily in Nepal and Northern India. These cranes require flat open wetland, cultivations, fallows and grasslands for nesting, foraging and physical maintenance (Suwal, 1999). It prefers a mixture of flooded, partially flooded and dry ground for foraging, roosting and nesting.

The tallest of the flying birds, standing at a height of up to 1.8 m (5.9 ft) (Krajewski, 1996), they are conspicuous and iconic species of open wetlands (Vyas, 2002). Sarus Crane is easily distinguished from other cranes by the overall grey color and the contrasting red head and upper neck. Like other cranes, they form long-lasting pair-bonds and maintain territories within which they perform territorial and courtship displays that include loud trumpeting, leaps and dance-like movements. In India they are considered symbols of marital fidelity, believed to mate for life and pine the loss of their mates even to the point of starving to death. The main breeding season is during the rainy season, when the pair builds an enormous nest "island", a circular platform of reeds and grasses nearly two meters in diameter and high enough to stay above the shallow water surrounding it. Sarus Crane numbers have declined greatly in the last century and it has been estimated that the current population is a tenth or less (perhaps 2.5%) of the numbers that existed in the 1850s (Encyclopedia of Life, 2015).

1.1.1 Conservation status

The Sarus Crane is listed as Vulnerable on the IUCN Red List 2012 because it has suffered a rapid population decline, which is projected to continue, as a result of widespread reductions in the extent and quality of its wetland habitats, exploitation and the effects of pollutants. It is listed on Appendix II of CITES and Appendix II of the Convention on Migratory Species (Sarus Crane population fluctuation at various

wetlands at Bharatpur in Rajasthan State of India, 2008). The Sarus Crane *(Grus antigone antigone)* is a non-migrant sub-species of Indian sub-continent (Inskipp, 1991).

The resident crane species of Nepal, *Grus antigone antigone* is listed as globally threatened by IUCN and listed as protected birds by Government of Nepal but isolation of its population in certain area of Nepal. Sarus crane has its major habitat in Nepal outside the protected area, which has become the major challenge to its conservation.

1.1.2 Population status and Distribution

There are thought to be 8,000-10,000 individuals in India, Nepal and Pakistan; 800-1,000 in Cambodia, Laos and Vietnam, 500-800 in Myanmar (unpublished information supplied by Wetlands International Specialist Groups 2006), and in litt. 2005). The population size thus totals 19,000-21,800 individuals, roughly equivalent to 13,000-15,000 mature individuals. The *antigone* subspecies (8,000-10,000 birds) inhabits northern and central India, Nepal and Pakistan (although now thought to be extinct as a breeding species there [Archibald *et al*. 2003]), with occasional vagrants in Bangladesh. Its range has contracted towards the north and west of the Subcontinent (Sundar *et al*. 2000) and its population is considered to be in decline (Archibald *et al*. 2003). The north Indian state of Uttar Pradesh remains the species's stronghold, with a population estimated at over 6,000 individuals (Sundar 2008). Subspecies *sharpii* occurs in South-East Asia where its range has declined dramatically, now being confined to Cambodia, extreme southern Laos, south Vietnam (800-1,000 birds between these three countries [Wetlands International 2006]), and Myanmar (500-800 birds [Wetlands International 2006]. Despite past declines, recent counts have shown some increase in the South-East Asian population; however Population Viability Analysis of cranes in Tram Chin shows the population is highly unstable and prone to extinction if current rates of habitat degradation continue (Archibald *et al*. 2003).

There are probably fewer than 500 in all of Nepal and their range has been slowly shrinking for the last decade (Suwal, 1999). In Pakistan, India's Punjab, and western Bangladesh, the Sarus Crane now occurs rarely (Meine *et.* al, 1996). In Nepal the Sarus Crane has been observed at about 300 m (maximum altitude) at Dhangadi (Johnsgard, 1983).

Uncommon and local resident in the WC Terai: 75-300 m. In 1992 a survey of the Terai showed that the distributional range of the species stretched from Shukla Phanta to Chitwan and that the species was declining due to deterioration of wetlands (Suwal and Shrestha 1992a). Farmlands of Rupandehi and Kapilvastu districts are the only areas where it breeds regularly (BCN & DNPWC, 2010).

1.2 Objectives

Broad objective

Study on population and nesting ecology of Sarus Crane.

Specific objectives

- To assess Sarus crane population in the northern belt of Rupandehi district.
- To know the population trend of Sarus from past to present.
- To assess nest ecology (materials used in nest, nest dimensions)
- To find hatching success and nesting success.

1.3 Rationale of study

Sarus crane, the world tallest flying bird once commonly found in the plain of Nepal, is now threatened. Stealing of eggs of Sarus during the breeding season, killing of Sarus for meat, and retaliatory killing of the bird to protect crops, high use of pesticides and fertilizers, loss of wetlands, habitat destruction, extension of electric wires are some of the threats which have put the number of bird in danger. They have disappeared from eastern Nepal only a few decades ago and small population survive in three districts of Nepal. According to the recent findings Sarus is found in Chitwan district to the eastern proximity and to Bardiya district at the western proximity of the lowland of Nepal. The conservation of Sarus Crane is difficult since they are found outside the protected area of Nepal and proper protection outside the protected area is lacking.

In this context, this study tried to fulfill the research gap on the nesting ecology of the Sarus Crane.

1.4 Limitations

1. The Sarus Crane was not identified as male and female.

2. The eggs that weren't hatched due to the reasons such as "being stolen", "being destroyed by people", "destroyed naturally" were well defined as such. But the reasons that could not be identified in the aforementioned/ any other terms were interpreted as "number of eggs destroyed by unknown reasons."

CHAPTER II: LITERATURE REVIEW

The Sarus Crane (*Grus antigone*) is a globally threatened, declining species breeding largely in privately owned agricultural fields or in wetlands managed for common use (Archibald et al. 2003, Sundar and Choudhury 2003).

Rupandehi is one of the most important areas for the Sarus cranes population where 100 individuals of Sarus cranes were counted (Aryal, 2004).

A total of 867 bird species occur in Nepal. Threatened species inhabiting wetlands is total 40 (27%) (BCN and DNPWC, 2011).

The farmlands of Rupandehi and Kapilvastu districts encompass a large rural area (141,367 ha) where agriculture is the main land use (68%) followed by forests which cover 21.6% of the area (Baral and Inskipp 2005).There are plains in the South and dry Bhabar and Churia hills to the North.This area has the best- known population of the globally threatened Sarus crane *Grus antigone* in Nepal and is the the only known IBA in the country where the species breeds regularly (Suwal, 2002). Dano River is regarded by far the most important lotic ecosystem of Rupandehi district, and provides resting place for more than 100 Sarus cranes during spring time (Hanlon and Giri 2007).

Sarus crane is a globally threatened species that is heavily dependent on farmlands of Lumbini (Inskipp and Baral 2011). Wildlife in the area face threats also from hunting and persecution, nest vandalizing, chick stealing and the use of agricultural pesticides and fertilizers (Suwal 2002, Hanlon and Giri 2007, Paudel 2009). The gradual spread of these activities towards the Lumbini Development Trust is visible (Hanlon and Giri 2007) and currently there is no active mechanism in place to stop this.

The population count done by Aryalin 2003 reported that there are 76 adults and 23 immature in Kapilvastu District (Aryal 2004). A total of 62 distinct individuals were recorded in Kapilvastu District in 16-27 April 2007 with a flock of 23 in the Banganga River grassland (Cox 2008). A 2009 survey of the farmlands of Lumbini IBA which lies in Rupandehi and Kapilvastu Districts found the species density as 0.516 cranes per km^2 and based on this figure the population was estimated to be 503.69 cranes (Paudel

2009a, b). The 2009 species density showed a decline compared to 1994 when a comparable study found a crane density of 0.6 per km^2 (Suwal 1994). The largest count of 104 birds was carried out by the Dano River, Lumbini in April 2009 (Ramond and Giri 2009). Other recent records are from Shukla Phanta where it is a rare visitor or resident, e.g. seen in July 2010 (Jyotendra Thakuri in litt. August 2010), a pair breeding near Kalikitch Tal in 2010(Prakash Man Shresthapers.comm.2010) and five seen in December 2010 (Uba Raj Regmipers. comm. December 2010) and at Jagdishpur Reservoir, Kapilvastu District a total of 11 was seen in December 2006 (Giri 2010a). Two were recorded at Nepalgunj in August 2010 (Shahi 2010). A 1988 survey of the west Terai found the species much more widespread, though uncommon, and extending east to Chitwan (Suwal and Shrestha 1988b); now considered only a vagrant to the park (Baral and Upadhyay 2006, Baral 2006c). In the 1870s it was common in the Terai (Scully 1879) and its range probably extended from east to west Nepal. Drainage of wetlands is the major factor in its decline, but where human disturbance is low, cranes still survive; conversion of farmland to village settlements and other developments, such as housing, road construction and industrialization are more damaging and are now a significant threat. Power lines that stretch across the rural farmland are problems for these low-flying birds (BCN and DNPWC, 2011).

Vandalizing of nests and the theft of eggs or chicks are frequent at some sites, especially in Kapilvastu District (Suwal 2002, Aryal 2004). Water pollution from untreated industrial waste and the use of agrochemicals are also significant threats (Prentice and Shrestha 1989, Aryal 2004). In the Lumbini Crane Sanctuary, the roosting, nesting and feeding grounds of Sarus Crane were found to be degraded due to grass harvesting, grazing and fire, drought and immense human pressure, including the use pesticides, fertilizers, and pollution from domestic waste inhabitscultivation in well-watered country (Paudel 2009 a, b).

Stealing of eggs of Sarus during the breeding season, killing of Sarus for meat, and retaliatory killing of the bird to protect crops, high use of pesticides and fertilizers, loss of wetlands, habitat destruction, extension of electric wires are some of the threats which have put the number of bird in danger. They have disappeared from eastern Nepal only a few decades ago and small population survive in three districts of Nepal. The conservation of Sarus Crane is difficult since they are found outside the protected

area of Nepal and proper protection outside the protected area is lacking. Main threats of Sarus Crane i.e. habitat loss is evidently the biggest pressure on Sarus crane population; other anthropogenic interventions like egg lifting are impending growth of the Sarus population (Aryal, 2004).

Sarus Cranes nest primarily during the rainy season (Sundar and Choudhury 2003). The choice of nesting material depends upon the vegetation around the nest. Hence, all nests in the paddy fields used rice plants; in the wetlands and ponds, *Eleochris, Ipomea*, wild rice plants and other vegetation were appropriated and in the grasslands, nesting material consisted primarily of *Imperata grass* (Aryal 2004).

Average area of the nest was found to be 2.14 sq. m, maximum nest area was 7.28 sq. m and minimum was just few sq. cm (egg was laid on an elevated land). The area of 41.2% of the nests was 1-2 sq. m.Second highest percentage fall in nest area ranging 2-3 sq. m. The nests area ranging 4-5, 5-6 and 7-8 sq. m cover up just 2.9 percent each. But none of nest was found within the range 6-7 sq. m (Gosai, et al. 2013).

Majority of nests were within water bodies. The nesting materials were paddy plants except for the pair at Kharharawa north where the muddy eggs were observed to be on the grassy dykes without any nesting materials.The highest concentration of crane was found in the West section with density of 0.43 crane per sq. km. The East section has slightly lesser density as 0.38 crane per sq. km. The Triveni Section has the least density (0.13 crane per sq. km). Only 5 crane (2 pairs and a single) were observed during the survey along 73.05 km of road travel distance (Chaudhary, 2008).

Nest site selection involves the specific choice of a site to build a nest, and in marsh nesting birds it usually occurs just prior to egg laying (Cody, 1985). Proximate cues in general habitat selection may involve tradition for species with fidelity (Bongiorno, 1970); pressure from conspecifics or protector species, and physical features. Marsh nesting species can nest only when the physical environment is suitable (Tinbergen, 1960; Berger, 1974).

Like all the true wetland birds, Sarus Crane also depends on wetland for its sustenance in terms of food and shelter (Mukherjee, Soni & Parasharya, 1999). Breeding pairs nest

in a wide variety of natural wetlands, along canals and irrigation ditches, beside village ponds and in rice paddies. More than other Crane species, Sarus Cranes also utilize wetlands in open forests as well as open grasslands. Where possible, nests are located in shallow water where short emergent vegetation is dominant, and the use of human-dominated wetlands is common in India. In this case, the fringe area plantation may have been a positive factor in the Sarus Crane favoring the Upper Lake (Nandi, 2006).

The success of Sarus Cranes breeding in rice paddies has been estimated by only one study in western India, which reported that the apparent success of nests in rice paddieswas slightly lower than that of nests in more natural habitats (Mukherjee et al. 2002).

The distribution of Sarus Crane nests between paddy cultivated area and non- cultivable agricultural marshland was statistically non-significant. The proportionate area of paddy cultivable land and non- cultivated agricultural marshland was 0.8 and 0.12, respectively. When the nest distribution in these two microhabitats was compared with reference to the proportionate availability of these microhabitats, it was clear that uncultivable agricultural- marshland was preferred over paddy cultivated area, using the selectivity index (Ivlev, 1961).The selectivity index of paddy crop area was-0.21 indicating that nest distribution in this microhabitat was slightly less than its proportionate availability. On the other hand selectivity index of non- cultivable agricultural marshland was +0.56 indicating a preference of this area for nesting. (Mukherjee, 2000)

The preference for wetlands at both the landscape and territory level in Uttar Pradesh indicates that an increase in the area devoted to rice will force the species to breed in croplands, given its behavior of perennial territoriality. The Sarus appears unique among cranes in its ability to nest in even very small wetlands, sometimes very close to active roads and human habitation, and in nesting frequently in croplands (Allan 1996, Dwyer and Tanner 1992).

All Grus sp. typically laid two eggs (Johnsgard, 1983). The normal clutch size of the Sarus Crane is two (Ali & Ripley, 1983). Blau (1897) reported that in over 100 sets of

eggs, only two consisted of three, the remainder consisted of two eggs. Walkinshaw (1973a) had seen five complete sets of clutches, all having two eggs. However, he gave details of 132 sets of which egg number is given; there were four sets of one, 126 of two and two sets of three, average 1.985 eggs. (Ramchandran and Vijayan, 1994) found 18 percent clutches having one egg and 82 percent clutches having two eggs at Keolado National Park. However, in our study we did not find reduction in clutch size.

Sarus pairs that had more wetlands in their territories were stronger in raising chicks than those that had few or no wetlands. Furthermore, pairs that had wetlands territories converted to agriculture or other land-uses reduced their ability to raise chicks (Gopi Sundar, 2011).

The apparent nest success of visited nests was 51% and 58% for 2000 and 2001, respectively (mean 55%). Nest mortality was due largely to removal of eggs by people both years (41%
An d 32% of visited nests).The success (daily survival rate) of nests closer to roads was lower, suggesting that human-related mortality played a role (Gopi Sundar, 2009).

The effect of habitat on nest success was equivocal, suggesting that rice fields per se are not suboptimal as nesting sites. This result is unique to this area, suggesting that favorable attitudes of farmers still allow Sarus Cranes to nest in rice paddies. Broods hatching later and those in territories with fewer wetlands had a lower probability of survival. Vegetation changes and disturbance during crop harvesting likely decreased brood survival. Maintaining a patchwork of shallow wetlands in rice-dominated landscapes and ensuring that farmers retain a positive attitude toward the species are crucial for survival of Sarus Crane nests and broods (Gopi Sundar, 2009).

CHAPTER III: MATERIALS AND METHODS

3.1 Study area

The study area is Rupandehi district of Nepal. Rupandehi district lies in the Terai Region and is situated in Lumbini zone of Western Development Region. The geographical position is at 27^0 20'-27^0 45' latitude and 83^0 10'-$83^0$30' longitude. Palpa district lies to the North, Kapilbastu district to the west, Nawalparasi district to the east and Uttar Pradesh (a state of India) lies to the south. The district ranges from 100 meters to 1219 meters altitude having 1401 sq.km area. Major rivers of the district are Tinau, Baghela, Dano, Kotlijham, Kanchan, Kothi, Rohini, Tellar etc. It consists of 69 Village Development Committees and 2 municipalities. The maximum temperature is 42.4^0C and minimum is 8.75^oC and average rainfall is 1391 mm of Rupandehi district, Nepal (DDC, 2003).

The Southern belt is defined by the 16 VDCs namely Aama, Amari, Asurena, Bairighat, Betkyuia, Bhagwanpur, Bogadi, Madhuvani, Majhghawa, Pakadi, Pharena, Piparhawa, Rayapur, Rohiniwa,Silhautiya and Simara Marchawar.The research is focused at the Northern belt of lowland of Rupandehi district which covers 18 VDCs namely Sadi, Jogada, Bishnupura, Suryapura, Manmateriya, Dayanagar, Dhamauli, Ekala, Khudabagar, Kamhariya, Harnaiya, Mainahiya, Hattibangain, Gonaha, Maryadpur, Basantapur, Dhakdahi and Pokharvindi indicated in the map below.

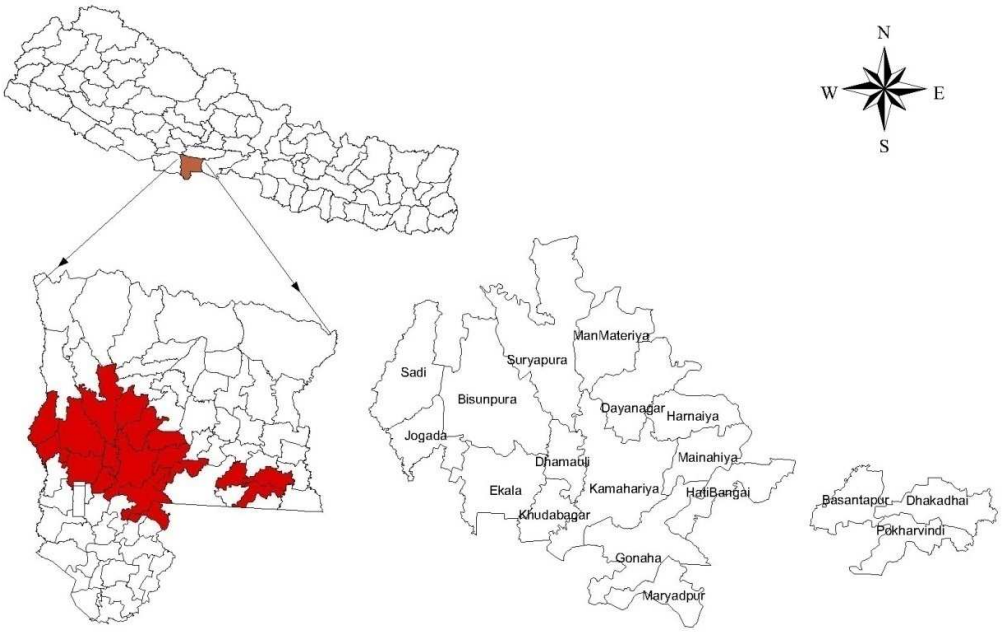
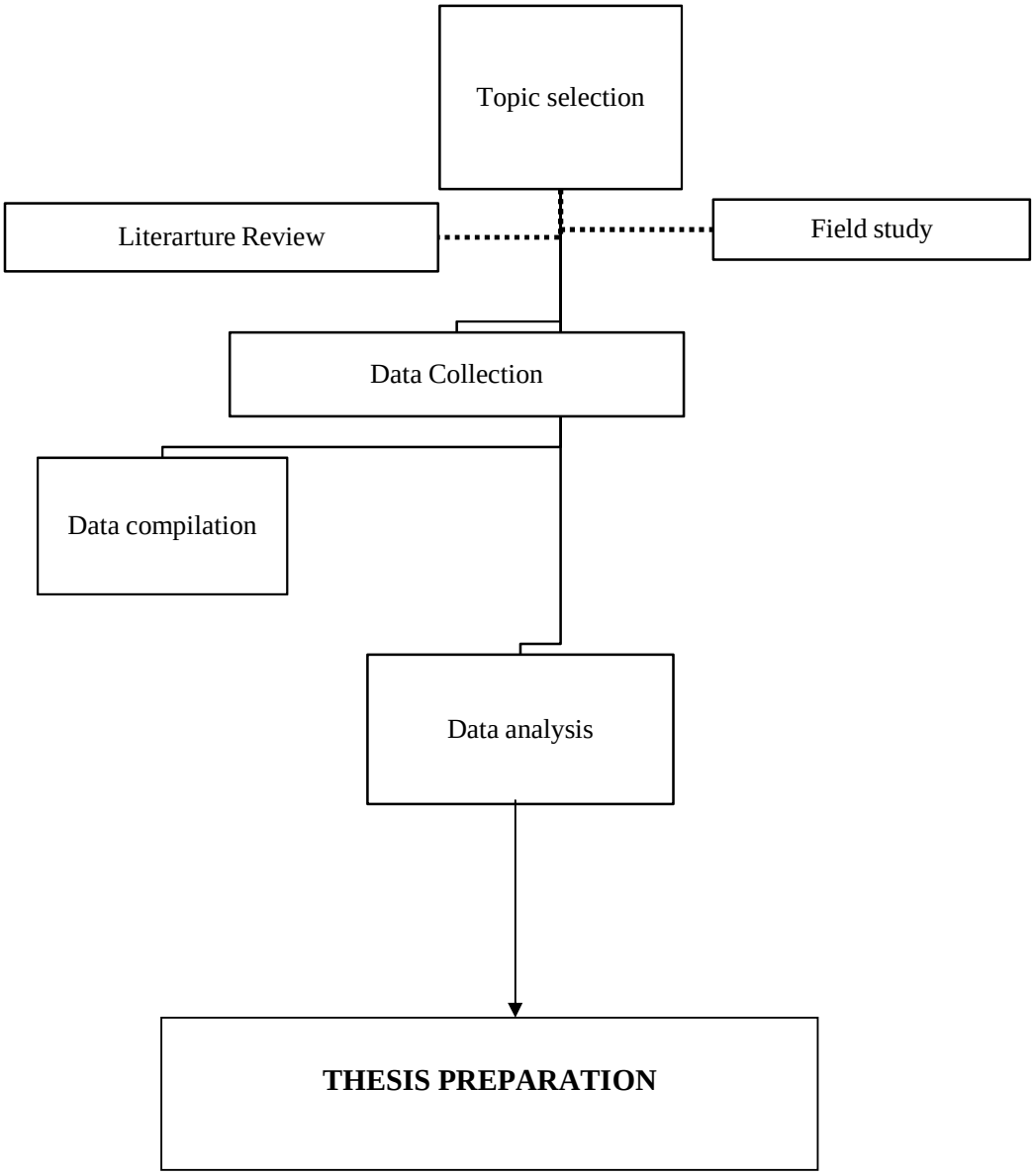


Fig.1-Map of study area

3.2 Study time

Intensive field survey was carried out from August to October, 2013.

3.3 Research Design



3.4 Methods

3.4.1 Literature review

Pertinent reports, thesis, journals, articles were searched and pertinent parts were incorporated in final report. Population trend is particularly based on review of previous literatures of the researches conducted for population count. Nevertheless, the population counts at different timeline from different researchers were not conducted with the similar methodology.

3.4.2 Field Study

Estimation of population

This intensive study was carried out in mid of August to mid of September 2012. It is the season when the birds lay eggs and remains near their nest which would help avoid double counting of same individual (Aryal, 2004).

Road as transect was adopted to collect the data of population status because of the large body size and open habitat of the bird under study (Bibby et al. 1992 in Shrestha 1996). Canals, wetlands, agricultural lands, reservoirs, etc were visited Transects were covered on motorcycle and bicycle. In the case of motorcycle, the speed was maintained at 10 km per hour (Shrestha, 1996). The researcher stopped at 1 km interval to search for Sarus Cranes (Chaudhary, 2008). Birds seen in a width of 150 m was maintained for this bird (Sundar and Kittur SA, 2012). A binocular (50*7, Nikon) was used to search for Sarus Cranes (Chaudhary, 2008). Population data were recorded on standardized data sheets (Aryal et. al. 2004). Population was classified as pairs or pairs with juveniles and in single and flocks. Field observations were conducted between 07:00 and 18:00 hours with an assumption that the bird's activity started in the dawn and even the birds which fly away from the nest (one among the two parents) returned to the nest. Locations of the cranes were marked on maps.

Habitat (agricultural marshland and nonagricultural marshland) was also noted. Paddy fields were noted as "agricultural land" that is used by the crane as sub-optimal nesting habitat. Non-agricultural marshlands were noted as the major habitat of the crane that is denoted by "wetland" which includes fallow land, water canal and ponds. Agricultural land adjoining wetland was categorized as "agricultural land+ wetland".

3.4.4 Nest status

3.4.4.1 Eggs and nests of the bird

Clutch size and nests

Nests of the bird were approached on foot. During nest visits, the nests were examined, photographed and measured (Mukherjee, 2000).

- Nest Productivity

The nesting success of the cranes was studied in terms of their productivity at individual nests. Hatching success was calculated. Nests were located by field researches based on information collected in the preliminary survey and the conversation done with farmers.
Nesting Success= (number of nests with at least one egg hatched*100/ Total number of nests observed
Hatching Success=No. of eggs that were hatched / Total number of eggs observed * 100

Nests (3-5 in numbers) were visited in 3-5 days interval for at least two times. For nest productivity, inspecting the nests and around nest and monitoring the pairs were done until chick showed up was done intensively to record the fate of nest.

CHAPTER IV: RESULTS

4.1 Population status

4.1.1 Population

There were 95 Sarus Cranes in the Northern Region of Rupandehi District in 248 transects

those were laid in 18 VDCs (Table 1). Among the cranes, 58 were adults in pair (Breeding individuals) and 23 were juveniles and 11 were adults in flock and 3 in single spotted while foraging.Highest number (n=26) of Sarus crane was observed in Kamahariya VDC and Sarus Crane and in in Manmateriya, Pokharvindi and Basantapur VDC the birds were not recorded. The density of Sarus Crane in the Northern belt of Rupandehi district was 1.27 individuals per sq. km.

Table-1-Population

S.N.	VDC	Population
1.	Mainahiya	7
2.	Kamahariya	26
3.	Khudabagar	4
4.	Dhamauli	16
5.	Dhagdahi	4
6.	Suryapura	3
7.	Bishnupura	11
8.	Jogada	3
9.	Sadi	2
10.	Hatibangain	3
11.	Gonaha	4
12.	Maryadpur	4
13.	Ekala	2
14.	Manmateriya	0
15.	Pokharvindi	0
16.	Basantapur	0
17.	Dayanagar	4

18.	Harnaiya	2

Sarus cranes were observed only in 64 transects among 248 transects. Sarus cranes were observed in the highest number in one of the transects laid in Kamhariya VDC in, that is 14 individuals (11 in flock and 2 in pair with a chick) followed by 6 individuals in one of the other transects laid in Dhamauli VDC.

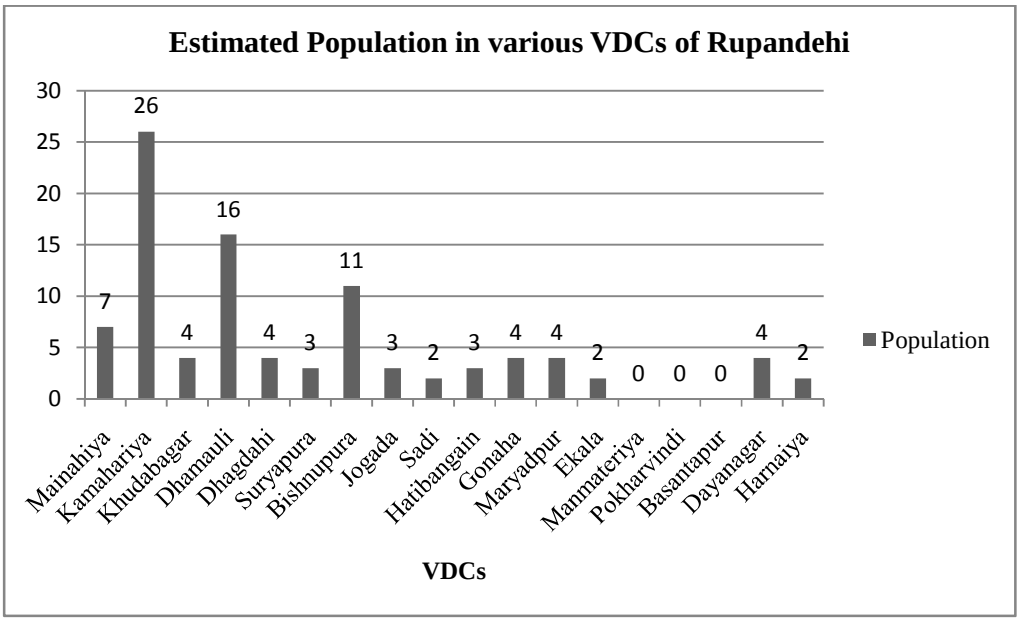


Figure 2- Population of Sarus crane

4.1.2 Population Dynamics in Rupandehi district

Shrestha, 1995 and Shrestha in 1996 estimated population as 128 and 131 individuals respectively. Suwal, 1999 estimated 50-75 individuals and Aryal, 2004 estimated 100 individuals. Suwal, 2007 estimated about 200 individuals and Gosai, 2011 estimated 140 Sarus Cranes. Manandhar, 2014 estimated 172 Sarus Cranes and Gosai et.al. 2013 estimated 95 individuals in the Southern Region of Rupandehi district, where as this research estimated 95 in the Northern Region of Rupandehi. This study and the study done by Gosai et al was conducted at the same time in a separate group but as a team, so the total population of Sarus Cranes in Rupandehi adding popualtion of Northern

belt, 95 individuals and Southern belt (with reference to VDCs noted in study area), 95 individuals for the year is estimated to be 190.

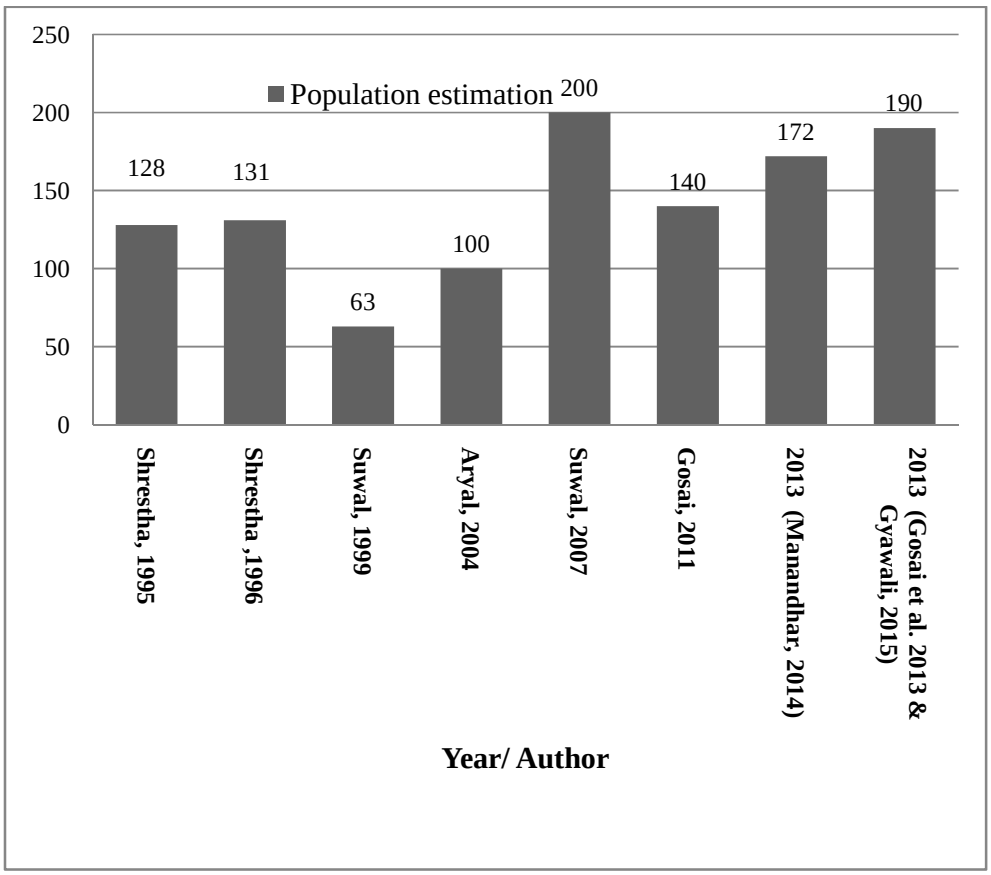


Figure 3- Population estimated by various researchers in various years in Rupandehi

4.1.3. Clutch size

Among 19 nests monitored, clutch size of 2 was found in 18 nests. The clutch size of two was estimated adding total number of eggs observed in each nest at repetitive visits.

4.2 Nest status

4.2.1 Nest dimension

The average area of nest was found to be 2.76 m^2; the largest was 3.86 m^2 in Majarhawa, Suryapura VDC and the smallest was 1.86 m^2 in Kumrahiya village of Dhamauli VDC.

4.2.2 Nest distribution

18 nests were in active stage and 1 was in inactive stage. Nests were present in nine VDCs. The highest number of nests were found in Dhamauli VDC (n=5), where all the nests were active, followed by Kamahariya VDC (4 nests), where 3 were active and 1 was inactive.

Table-2- Active and inactive nests

S.N.	VDC	Active	Inactive
1	Dhamauli	2	3
2	Kamahariya	3	1
3	Mainahiya	3	0
4	Bishnupura	2	0
5	Dayanagar	0	1
6	Dhagdahi	1	0
7	Suryapura	1	0
8	Hatibangain VDC	1	0
9	Gonaha VDC	1	0

4.2.3 Vegetations used for nest building

The vegetationsused for nesting building were *Oryza sativa, Elaeocharis dulces, Cynodon dactylon* as well as *Cympogon microtheca.* The frequency of *Oryza sativa* was the highest (24%) followed by *Elaeocharis dulces* (18.5%) and *Cynodon dactylon* (9.2%).

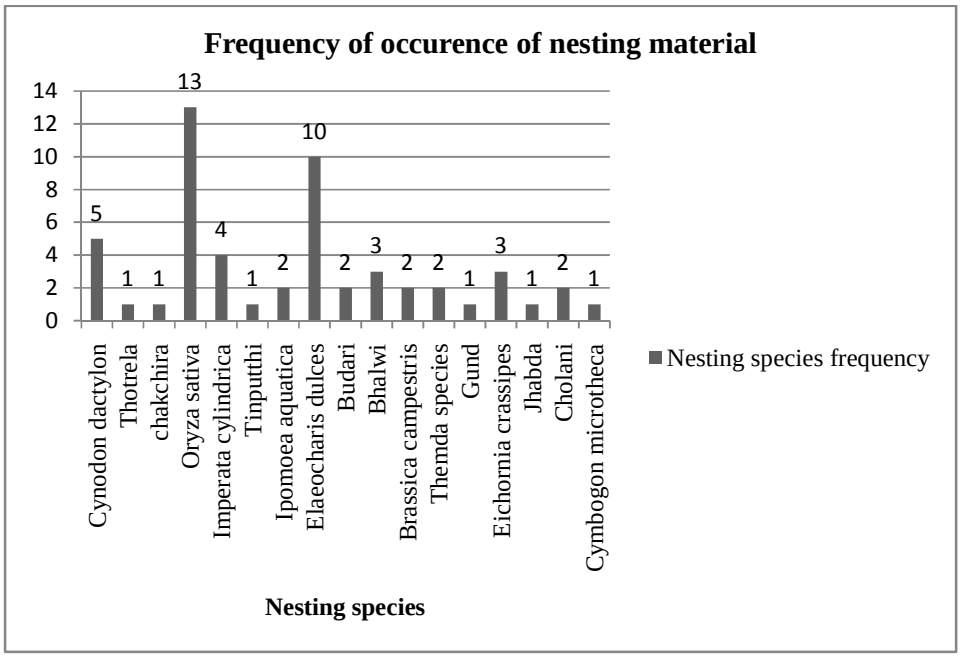


Figure 4- Frequency of occurrence of nesting species

4.2.4 Nesting habitat

Nests were built more in wetlands. Among the 19 nests, 42.10 % were in wetlands and 5.2 % in agricultural land and 52.6% were observed in interface of wetland and agricultural land.

Table: 3 Nesting habitat of Sarus crane

Habitat type	Frequency	Percent
Wetland	8	42.1
Agricultural land	1	5.3
Wetland+ agricultural land	10	52.6
Total	19	100

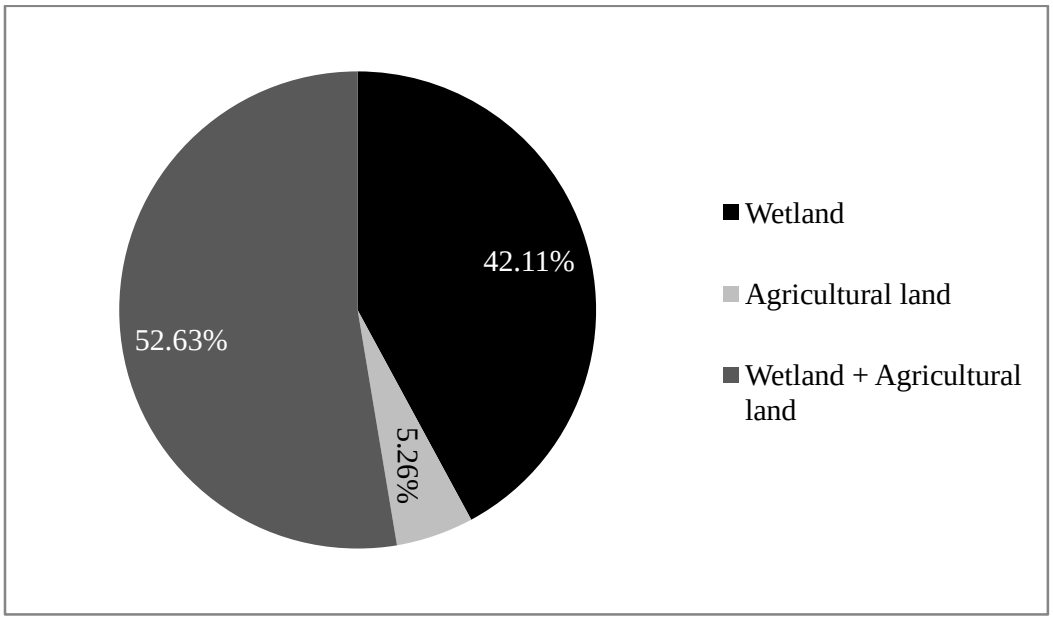


Fig 5- Habitat used for building nests

4.3 Hatching success and breeding success

4.3.1 Hatching Success

In 36 eggs of 18 nests (among the 36 eggs, 2 were damaged naturally, 3 were destroyed by people (as per conversation) and 5 were stolen and 3 eggs were destroyed by unidentified cause).Hatching success was 23 individuals in 18 nests. So, hatching success rate were 63.88 Chicks per 100 eggs laid and 127.77 individuals per 100 nests.

Table - 4 Description of Hatching Success

Parameter	Sub- Parameter	Quantity	Total	Remark
*Total Nest		18	18	Presence of at least 1 egg
Total Eggs Laid	Eggs in first visit	28		
	Eggs added in second visit	8	36	
Damaged	Naturally Damaged	2		
	No. of eggs destroyed by people	3		
	Stolen	5	10	
No. of eggs destroyed by unknown reasons		3	3	* *May be natural / anthropogenic cause
Incubating		0	0	
No. of Hatching Success			23	
Hatching success per 100 laid egg		{(23/36)*100}=58.33 %	63.88 chicks per 100 eggs laid	
Hatching success per 100 active nests		{(23/18)*100}	127.77 Chicks per 100 Nest	

Note:* *Here nest in which minimum one eggs was laid is only included. Those nests, in which even one egg was not laid they are not included even though they were active nests.*

***The nest where the reason of damage of eggs were not identified*

4.3.2 Nesting Success:

Among the active nests monitored, at least one egg was observed in 18 out of 19 nests. So, nesting success was 94.73%. 36 eggs were observed in 18 nests.

CHAPTER V: DISCUSSION

5.1 Population status

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The estimated Sarus Crane population was 172 in Rupandehi according to Manandhar, 2014 which compares well with 190 individuals, the total population of Sarus crane observed in this resesarch in Rupandehi district in 2013.

Clutch size of 2 was found in 18 nests that are 94.73% of the nests had two eggs. Handschuh, 2010 reported clutch size two in 86% (n=146) of 171 nests and one egg in 12.9 % (n= 22). The result was similar to Handschuh, 2010.

5.2 Nest status

According to Manandhar, 2014, the predominant nest materials were Thoti, Katara, Water hyacinth in wetland's nest and Dubo, Gahachira, Rice, Thothi, Paspalum, Kerunga, Siru were predominant nest material used in agricultural land by Sarus Crane. In this research, the vegetations used for nesting building were observed to be *Oryza sativa, Elaeocharis dulces, Cynodon dactylon* as well as *Cympogon microtheca.* The frequency of *Oryza sativa* was the highest (24%) followed by *Elaeocharis dulces* (18.5%) and *Cynodon dactylon* (9.2%). The results are not so far from Manandhar's , so makes to realise that the cranes are using aquatic flora, both cultivated and natural, found in the vicinity.

The average area of nest was similar to the finding of Gosai et al (2.14 m^2). This research found that the average area of nest is 2.76 m^2. There is no significantchange in the area of nest in the North and Southern Region of Rupandehi district.

5.3 Nesting habitat

Wetland was preferred more for nesting. Among the 19 nests, 42.10 % were in wetland and 5.26 % in agricultural land and 52.6 % in the interface of wetland and agricultural

land. In the study conducted by Yaseen et al. 2014 observed 52% of the nest in wetland. Hence, there was similarity in the nesting habitat of the species.

5.4 Hatching success and nesting success

Among the previously monitored 36 eggs of 18 nests in the first visit (August 2013), 2 were damaged naturally, 3 was destroyed by people and 5 were stolen and 3 eggs were destroyed for unknown reasons (natural/ anthropgenic) total hatching success rate as 23 individuals in 18 nests, So, hatching success rate is calculated to be 63.88 Chicks per 100 laid eggs and 127.77 individuals per 100 nests.This is higher than the figure of most of the Southern belt.
So, hatching success rate as 52.4 Chick per 100 laid eggs and 106.7 (~107) individual per 100 nests (Gosai et al 2013).

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Among the active nests monitored, at least one egg was found in 18 out of 19 nests. So nesting success was 94.73%. In the study done by Gosai et al. they observed 100% nesting success. The results confirm the results of other researches.

CHAPTER VI: CONCLUSION AND RECCOMMENDATION

6. 1 Conclusion

The total population estimated in the Northern belt was 95 individuals. Among them 72 were adults and 23 were juveniles. The density of Sarus crane in the Northern belt of Rupandehi district was 1.27 individuals per sq. km. The average nesting area was 2.76 m^2. Clutch size of the Sarus was 2 eggs.

Sarus cranes have higher affinity to wetlands and its vicinity, which is mostly rice field as an agricultural land. Among the 19 nests, 42.10 % were in wetland and 5.263 % in agricultural land and 52.6 % in the interface of wetland and agricultural land. Frequency of *Oryza sativa* was the highest (24%) followed by *Elaeocharis dulces* (18.5%) and *Cynodon dactylon* (9.2%).The maximum size of nest was 3.8 m^2 in Majarhawa village of Suryapura VDC and the minimum size of nest was 1.86 m^2 in Kumrahiya village of Dhamauli VDC.

Hatching success rate was 63.88 Chicks per 100 laid eggs and 127.77 individuals per 100 nests. Nesting success was 94.73%. 36 eggs were observed in 18 out of 19 nests. In some of the nests 1 more egg was laid due to damage/breakage/stealth of previously laid eggs.

6.2 Recommendations

- Hatching success of the crane in the Northern belt was found good. Population of Sarus in the following year will give the actual survival population. So, the study of the bird should be carried out in the following years as well to understand the fate of the hatched chicks.
- Nests of Sarus were also found in the interface of wetland and paddy field and the rice plants were used mostly for nest building so the wetlands should be protected. In the meantime, the farmers should also be friendlier with the bird and its nest.

REFERENCES

Ali, S. & Ripley, S. D. (1969).Handbook of the birds of India and Pakistan.(2). Bombay: Oxford University Press.

Altmann, J. (1974). Observational study of behavior: sampling methods.Behavior, 49: 227- 265.

Aryal, A. (2004). *Status and Population of Sarus Crane (Grus anigone antigone) in Lowland of West-Central Region of Nepal.* The Biodiversity Research and Training Forum.

Aryal, A., Shrestha, T. K., Sen, D. S., Upreti, B., Gautam, N.(2009). Conservation regime and Local Population Ecology of Sarus Crane (*Grusantigoneantigone*) in Western Central Region of Nepal.*Journals of Wetlands Ecology*, Vol.3, p 1

Baral, H.S. and Inskipp, C.(2005). Important Bird Areas in Nepal: key sites for conservation. Bird conservation Nepal and Bird Life International, Kathmandu and Cambridge.pp.56-146

Baral, H. (2009).Updated status of Nepal's wetland birds.*BankoJanakari*,19 (3). doi:10.3126/banko.v19i3.2209

BCN & DNPWC.(2011). The State of Nepal's Birds 2010.Bird Conservation Nepal and Department of National Parks and Wildlife Conservation, Kathmandu.

Bird Life International.2012. *Antigone antigone*. The IUCN Red List of Threatened Species 2012:e.T22692064A38451823. http://dx.doi.org/10.2305/IUCN.UK.2012-1.RLTS.T22692064A38451823.en . Downloaded on **02 November 2015**.

Bishop, K. (1999). Birds of the Indian Subcontinent by Richard Grimmet, Carole Inskipp and Tim Inskipp.*EMU, 99*(2), 153.doi:10.1071/mu99018a_br

Bhandari, B. (1996).*An Inventory of Nepal's Terai Wetlands* (1st ed.). Kathmandu: IUCN Nepal.

Blaauw, F.(1897).*A monograph of the cranes*. Leiden: Brills

Bongiorno, S.(1970). Nest-site selection by adult laughing gulls (Larusatricilla). *Animal Behaviour*, *18*, 434-444.doi:10.1016/0003-3472 (70)90037-0

Burger, J. (1974). Breeding adaptations of Franklin's gull (laruspipixcan) to a marsh habitat.*AnimalBehaviour*, *22*(3), 521-567.doi:10.1016/s0003-3472 (74)80001-1

Campbell, B., & Lack, E. (1985).*A dictionary of birds*.Calton, Staffordshire: T. & A.D. Poyser.

Chaudhary, N. (2008). *Habitat, Territorialy and Breeding Success of Sarus Crane (Grus anitgone antigone) in West Nepal.* Bhaktapur: Khwopa College.

Chauhan. R and Devendra K. (2001).An unusual clutch size in Sarus Crane (*Grusantigoneantigone*) at Kodiaya Wetland, Uttar Pradesh, *Zoo's Print Journal*. 21(2):2166

Choudhury, B.C. , Kaur, J. & Gopi Sunder, K.S., (1999).Sarus Crane Count-1999. Forest Research Institute University, Dehradun, Uttarakhand.
Cody, M. (1985).*Habitat selection in birds*. Orlando: Academic Press.

DDC. (2003). *District Profile of Rupandehi.* Kathmandu, Nepal: HMG Nepal, Rupandehi.

Encyclopedia of Life,.(2015). *Sarus Crane (Grusantigone) - Information on Sarus Crane - Encyclopedia of Life*. Retrieved 21 February 2015, from http://eol.org/pages/915318/overview

Gopi Sundar, K.(2011).Agricultural intensification, rainfall patterns, and large water bird breedingsuccess in the extensively cultivated landscape of Uttar Pradesh, India.*Biological Conservation*, 144 (12), pp. 3055-3063.

Gosai K. R. (2011). Population Survey of Sarus Crane in RupandehiDistrcit, Unpublished Research

Gosai, K., Shrestha, T. K. Shrestha, S. M. & Gyawali, B. (2013). *Populationdynamics and behavioral ecology of Sarus Crane (Grusantigoneantigone) in Rupandehi District, Nepal*

Handschuh, M. (2010).*Clutch size of Sarus crane Grusantigone in the Northern Plains of Cambodia and incidence of clutches of three eggs.*. Retrieved 7 March 2015, from http://www.accbcambodia.org/de/Handschuh,%20Vann%20&%20Rainey%202010.pdf

Hanlon, D. and Giri, D. (2007) Exploring the farmlands of Lumbini IBA. *Danphe* 16(1): 71-72.

Inskipp, C. I. (1991). *A Guide to the Birds of Nepal* (Second ed.). UK: Christopher Helm (publishers) Ltd, UK.

Iucnredlist.org,.(2015).*Search Results*. Retrieved 19 February 2015, from http://www.iucnredlist.org/search

Jha, K., & McKinley, C. (2014).Demography and Ecology of Indian Sarus crane in Uttar Pradesh, Northern India, *3*, 8-18. Retrieved from http://www.ajcb.in/journals/full_papers_july_2014/AJCB-Vol3-No1-Jha-McKinley.pdf

Johnsgard, P. (1983). *Cranes of the world*.Bloomington: Indiana University Press.

K. S. Gopi, S. (2009). Are Rice Paddies Suboptimal Breeding Habitat for Sarus Cranes in Uttar Pradesh, India? .*Condor*, *111*(4), 611-623. doi:10.1525/cond.2009.080032

Manandhar, S. (2014). Ecological Studies of Sarus Crane (*Grus antigone)* in Western Nepal. Khwopa College, Bhaktapur.

Maps.oiseaux.net,. (2015). *Grue antigone: Distribution*. Retrieved 27 January 2015, from http://maps.oiseaux.net/grue.antigone.html

Meine, C. D. (1996). *The Cranes: Status Survey and Conservation Action Plan.* Switzerland and Cambridge: UK.

Mukherjee, A., Soni, V., &Parasharya, B. (1999).Diurnal use of reservoirs by the Indian Sarus Crane (*Grusantigone*) during summer months.*Zoos' Print Journal*, *14*(7), 72-74. doi:10.11609/jott.zpj.14.4.72-4

Mukherjee Aeshita, V. C. (2000). Nest and Eggs of Sarus Crane (Grus Antigone Antigone LINN). *Zoo's Print Journal* , 75-85.(Richard D. Gregory, Bird census and survey techniques)

Nandi, P. (2006). Retrieved 7 March 2015, from http://jncc.defra.gov.uk/PDF/pub07_waterbirds_part3.5.18.pdf

Paudel, S. (2009a) Study on threats to Sarus Crane *Grus antigone antigone* in farmlands in Lumbini, an Important Bird Area of Nepal – AEC/OBC Award 2007. *BirdingASIA* 12: 9-10.

Salim Ali., (1968).*Hand book of the birds of India and Pakistan together with those of Nepal Sikkim Bhutan and Ceylon by Salim Ali and S Dillon Ripley*. Bombay: Oxford University Pr.

Sarus Crane population fluctuation at various wetlands at Bharatpur in Rajasthan State of India. (2008) (1st ed.). Retrieved from http:////www.wetlandpark.gov.hk/pjs0708/report/Project%203

Shrestha, D. (2015). Distribution and habitat utilization of sarus crane (*Grus antigone antigone* linnaeus, 1758) during dry season in rupandehi district, nepal . Khwopa College, Bhaktapur.

Shrestha, P. (1996). *Population Status of Sarus Crane in Nepal.* Mexico State University. Las Cruces: Mexico State University.

Sundar, K. S. G and B.C. Chaudhary (2008). *Impact of land use changes on the ecology and habitat of the Sarus crane (Grus antigone antigone) in the Indo-Gangetic flood plains*. Dehradun: Wildlife Institute of India.

Suwal, R. N. (1999). *Study on Habitat Preference, Movements, Nesting ad Population Dynamics of Sarus Crane of Lumbini.* Tribhuvan University, Central Department of Zoology. Kathmandu: Institute of Science and Technology.

Suwal, R. N. (2002) Standing tall with Sarus Cranes. *Danphe* 11(1): 15-16.

Suwal, Y. (2007). *Sarus Crane (Grus antigone antigone): Population and Socio-cultural Relation In Rupandehi District.* Bhaktapur: Khwopa College.

Tinbergen, N. (1961).*The herring gull's world*. New York: Basic Books

The Indian sarus Crane Grus a.antigone: A Literature Review. (2003). *Journal Of Ecological Society, 16*, 16-41

Verheugt (editor), W. (1995).*Biodiversity Profiles Project.Biodiversity Assessment of Terai Wetlands* (1st ed.). Kathmandu: His Majesty's Government of Nepal, Ministry of Forsts and Soil conservation , Department of National Parks and Wildlife Conservation.

Walkinshaw,L. H. (1973a).Cranes of the World.Winchwster Press, New York.

Yaseen, M.,Saxena, R., &Dubey, S. (2014).*Journal of Chemical, Biological and Physical Sciences (JCBSC).Jcbsc.org*. Retrieved 2 March 2015, from http://www.jcbsc.org

Zalinge, R., Evans, T., &Visal, S. (2008).*A review of the status and distribution of large waterbirds in the Tonle Sap Biosphere Reserve* (1st ed.). Retrieved from http://www.wcscambodia.org/

ANNEXES

Annex-1: Status of clutch size at the surveyed nesting sites

S.N.	Location	Total no. of eggs laid in first attempt	No. of eggs hatched	No. of eggs added in second attempt	No. of eggs stolen	No. of eggs destroyed by people	No. of eggs destroyed naturally	No. of eggs destroyed by unknown reasons
1	Mainahiya VDC, Mainahiya	2	2	0	0	0	0	0
2	Mainahiya VDC, Gadshara	1	2	1	0	0	0	0
3	Kamahariya VDC, Sukrauli	2	0	0	0	2	0	0
4	Kamahariya VDC, Aglauwa	1	1	1	0	1	0	0
5	Kamahariya VDC, Barewa	2	0	0	2	0	0	0
6	Kamahariya VDC, Barewa	0	0	0	0	0	0	0
7	Dayanagar VDC, Dhamshar	2	2	0	0	0	0	0
8	Dhamauli VDC, Ahirauli	2	2	0	0	0	0	0

9	Dhamauli VDC, Dubihawa	2	2	0	0	0	0	0
10	Dhamauli VDC, Kumrahiya	2	0	0	2	0	0	0

S. N.	Location	Total no. of eggs laid in first attempt	No. of eggs hatched	No. of eggs added in second attempt	No. of eggs stolen	No. of eggs destroyed by people	No. of eggs destroyed naturally	No. of eggs destroyed by unknown reasons
11	Dhamauli VDC, Ahirauli-D	2	2	0	0	0	0	0
12	Dhagdhai VDC, Dhagdhai	2	2	0	0	0	0	0
13	Dhamauli VDC, Amauli	2	2	0	0	0	0	0
14	Suryapura VDC, Majarhawa	1	2	1	0	0	0	0
15	BishnupuraVDC,Lundihawa	1	1	1	0	0	0	1
16	Hatibangain VDC, Bairihawa	1	1	1	0	0	0	1

17	Gonaha VDC, Siwapur	1	0	1	0	0	1	1
18	Mainahiya VDC, Maithawal	1	1	1	0	0	1	0
19	Bishnupura VDC, Pauwa	1	1	1	1	0	0	0
Total		28	23	8	5	3	2	3

Annex-2 Frequency and percentage of occurrence of nesting plant species

S.N.	Nesting Species name	Frequency of occurrence	Percentage
1	*Cynodon Dactylon*	5	9.25
2	*Oryza sativa*	13	24.07
3	Thotrela	1	1.85
4	Chakchira	1	1.85
5	*Imperata cylindrica*	4	7.40
6	Tinputthi	1	1.85
7	Ipoema cylindrica	2	3.70
8	*Elaeocharis dulces*	10	18.51
9	Budari	2	3.70
10	Bhalwi	3	5.55
11	*Brassica campestris*	2	3.70
12	Themda species	2	3.70
13	Gund	1	1.85
14	*Eichhorniacrassipes*	3	5.55
15	Jhabda	1	1.85
16	*Cympogon microtheca*	1	1.85
17	Cholani	2	3.70
Total		54	100

Annex-3 Data sheet for population survey

Transect/ Rep. No.	Location:	Habitat Type:	Date:	St. Time:	End Time:

Transect bearing Angle:

S.N	GPS Location		Way Point	Side		Bearing Ang.	Number			Dist. (m)	Nest (Y/N) (Num.)	Habitat Type
	Lat.	Long.		L.	R.		M	F	Juv.			

Annex- 4 Data sheet for nest survey

Transect /Rep. No.	Location:	Habitat Type:	Date:	St. Time:	End Time:

S. N	GPS Location		W. P.	Nest Size L_1/B_1, L_2/B_2,.. (cm)	Active/ Inactive	Material	Height Above H_2O (cm)	Egg No. E_1, E_2,.. L / B (cm)	Crop Damage Y/N	If Crop Damage #Area		Habitat Type
										L (cm)	B (cm)	
	Lat.											
	Long.											
	Lat.											
	Long.											
	Lat.											
	Long.											
	Lat.											
	Long.											
	Lat.											
	Long.											

Annex-5 Photographs

Photo 5 Researcher measuring dimension of nest; Sukrauli, Mainahiya VDC

Photo 6 A flocks of 11 Sarus foraging in rice field; Kenauli, Kamahariya VDC

Photo 7 A pair of Sarus crane; Dhamsar, Dayanagar VDC

Photo 8 Two nests in a wetland at a distance about 2 m, active in the background and inactive in the front; Barewa, Kamahariya VDC

Photo 5 A pair of eggs laid by the edge of water canal; Dubihawa, Dhamauli VDC

Photo 6 The nesting site in the middle of ricefield; Mainahiya, Mainahiya VDC