

**VULTURE OCCURRENCE AND PEOPLE'S WILLINGNESS TO
PROVIDE LIVESTOCK CARCASSES FOR THE
SUSTAINABILITY OF VULTURE SAFE FEEDING SITE
GAIDAHAWA, RUPANDEHI, NEPAL**



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DECLARATION

I hereby declare that the work presented in this 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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LIST OF ABBREVIATIONS

| Abbreviated form | Details of abbreviations |
|-------------------------|---------------------------------------|
| NSAID: | Non-Steroidal Anti-inflammatory Drugs |
| Rs: | Rupees |
| VSFS: | Vulture Safe Feeding Sites |
| VSZ: | Vulture Safe Zone |

ABSTRACT

Vultures are scavengers and help to maintain clean environment. Vultures mostly depend on the livestock carcass and the Vulture Safe Feeding Site (VSFS) was established for providing the diclofenac free carcass to the vultures. However, the sustainability of these VSFS in the future is unknown. This study counted the number of vultures of different species through direct count method, and estimated local people's willingness to provide old livestock to the VSFS using a questionnaire survey. Vultures were counted during autumn and winter season and questionnaire survey was performed in 310 households that have livestock in the year 2022. White-rumped vulture, Himalayan vulture, Egyptian vulture, Cinereous vulture and Slender-billed vulture were observed in VSFS of Gaidahawa. Vulture abundance was higher during winter than it was during autumn. Out of the total households with livestock, very few (17%) respondents were willing to give their old livestock to VSFS. Nearly half of the respondents had positive attitude towards VSFS, however, respondents near to VSFS were comparatively unhappy towards the VSFS than the respondents living far from VSFS. Nearly half respondents mentioned the main cause of vulture population decline was due to food scarcity. This study assumed that the management of VSFS is poor in Gaidahawa, and in future the VSFS might have difficulty to get old livestock to sustain the vulture in the site. This study recommends that the VSFS needs to encourage local respondents to provide old livestock, raise awareness, provide transportation facility to carry livestock and make immediate management plan and policy for VSFS of Gaidahawa.

1. INTRODUCTION

1.1 Background

Vultures are scavengers that feeds on carcass and play vital role in environment and human health well-being (Prakash et al. 2003, Ogada et al. 2012). It scavenge the carcass faster than other scavengers, and effectively remove the diseases due to its highly specialized digestive system (Houston and Cooper 1975, Ogada et al. 2012). Globally, 23 species of vulture are existing, out of which seven species are New World vultures and remaining 16 species are Old World vultures (Ogada et al., 2012). Among the Old World vulture species, nine species have been recorded from South Asia including Nepal (DNPWC 2015, Dhakal 2016). Among nine species recorded in Nepal, Himalayan vulture (*Gyps himalayensis*), Slender-billed vulture (*G. tenuirostris*), White-rumped vulture (*G. bengalensis*), Red-headed vulture (*Sarcogyps calvus*), Egyptian vulture (*Nephron percnopterus*), and Bearded vulture (*Gypaetus barbatus*) breed in Nepal, however, the Long-billed vulture (*G. indicus*) is vagrant and other two species Griffon vulture (*G. fulvus*) and Cinereous vulture (*Aegypius monachus*) are winter visitors (DNPWC 2015, Bhusal et al. 2019, Dhakal et al. 2019).

Among the vulture species, Egyptian vulture and their suitable area are still available in mountainous area of western and central region of Nepal while rare in east (Sharma et al. 2023). White-rumped vulture were observed decreasing in number from 2002 to 2011 and most remaining were found in western regions of the country (Chaudhary et al. 2012). Slender-billed vulture are found concentrated in western Tarai and Mid-hill (Galligan et al. 2020) and Cinereous vulture are uncommon in west-center and occasionally seen in east (Rana et al. 2020). Himalayan vulture are altitudinal migrants and widely distributed throughout Nepal, Bearded vulture are the only resident of Himalayas and Griffon vulture are rare and mostly seen in west of Nepal (DNPWC 2015, Inskipp et al. 2021). The White-rumped vulture, Red-headed vulture and Slender-billed vulture are Critically Endangered and had population estimate of 2000, 400 and 75, respectively (DNPWC 2015, Birdlife International 2021b, 2021c, 2021g). The Egyptian vulture and Cinereous vulture are Endangered species and had population estimate of <1000 and 100 respectively (DNPWC 2015, Birdlife International 2021a, 2021e). Himalayan vulture and Bearded vulture are listed as Near Threatened and had population estimate of <10,000 and <500 respectively (DNPWC

2015, Birdlife International 2021d, 2021f). Griffon vulture is categorized as least concern and had population estimate of 80,000-900,000 mature individuals (BirdLife International 2021h). Indian vulture is least concern and had population estimate of 5,000-15,000 mature individuals (BirdLife International 2021i, Inskipp et al. 2021).

Vultures were listed in conservation status of Nepal due to their catastrophic decline in population (DNPWC 2015). Across Indian subcontinent Diclofenac residue in livestock carcass was the major cause of dramatic decline of vulture population (Oaks et al. 2004), vultures died due to renal failure and visceral gout within 36-58 hours of administration of diclofenac (Oaks et al. 2004). In order to minimize diclofenac threat in vultures, Governments of India, Pakistan and Nepal banned the production and importation of veterinary diclofenac in 2006 and Bangladesh in 2010 (Cuthbert et al. 2011, DNPWC 2015). Despite these bans illegal use of diclofenac continued for many years (Cuthbert et al. 2011). In addition, legally available nonsteroidal anti-inflammatory drugs (NSAID) such as ketoprofen, aceclofenac, flunixin, carprofen, piroxicam and phenylbutazone are identified as new threats to vulture (Naidoo et al. 2010, Cuthbert et al. 2011, Galligan et al. 2016). Only Meloxicam is found to be safe alternative for vulture (Jimenez-Lopez et al. 2021).

To minimize the diclofenac threats and conserve vulture, Government of Nepal, endorsed first Vulture Conservation Action Plan (2009-13) which suggests to establish a breeding center, Vulture Safe Zone (VSZ) and Diclofenac Free Zone program (DNPWC 2009, DNPWC 2015). VSZ was established to cease the use of diclofenac and provide diclofenac free carcass to vultures (DNPWC 2015, Bhusal 2018). Within these VSZ, six Vulture Safe Feeding Sites (VSFS), popularly called Jatayu Restaurants were established between 2007 and 2013 (DNPWC 2015, Bhusal 2018). VSFS are managed by local communities to provide diclofenac free carcass of cattle to vulture (Chaudhary et al. 2012, Bhusal 2018). These VSFS are in six locations of Nepal including Pithauli, Gaidahawa, Lalmatiya, Bijauri, Beli and Ghachok, to provide safe food to the vultures (DNPWC 2015, Bhusal 2018). In VSFS, old and unproductive cattle were collected from nearby villages and kept for at least seven days to ensure they are diclofenac free and fed to vultures after their natural death (DNPWC 2015).

Vultures are nature's scavengers and feed on both, wild animal and livestock carcasses, however, domestic livestock carcasses is the primary food source of vultures (Oaks et al. 2004, DNPWC 2015). These livestock carcasses availability and animal husbandry practices in any area typically determined the vulture distributions near to it (Mateo-Tomás et al. 2012) and in addition, different carcass disposal mechanism also determined vulture distribution by limiting vulture food availability (Dupont et al. 2012). In Pokhara Valley vultures were abundantly distributed in landfill, nearby Dovilla, Ghachowk (VSFS), which likely provide abundant carcasses for them (Dhakal et al. 2022). VSFS provide carcasses and slow down the local vulture population decline by the removal of diclofenac (Gilbert et al. 2007, Dhakal et al. 2022). Similarly extensive road transect monitoring of vulture population in Nepal before and after the implementation of VSFS program shows partial rebound from about 2013 to 2018, it might be due to VSFS (Galligan et al. 2020).

Among all VSFS, Gaidahawa VSFS was established in 2009, in Rupandehi District. Rupandehi with other fifteen districts (Jhapa, Ramechhap, Dhanusa, Nawalparasi, Palpa, Kapilbastu, Argakhachi, Pyuthan, Dang, Baki, Bardia, Kailali, Kanchanpur, Kaski and Myagdi) had been announced as Diclofenac Free Zones, by 2010 (Bhusal 2018). Out of nine species, seven species (White-rumped vulture, Himalayan vulture, Red-headed vulture, Egyptian vulture, Cinereous vulture, Slender-billed vulture, Griffon vulture) have been recorded at this VSFS and might be prime VSFS for vulture species (Dhakal 2016). For the long-term conservation of any endangered species, it is essential to identify the local views, interests and knowledge towards it (Cortés-Avizanda et al. 2018). Social dimensions are also required for the sustainability of VSFS. Besides local people attitude, vulture distribution and occurrence greatly affected by livestock carcass availability, animal husbandry practices near VSFS (Dhakal et al. 2022). Such information are important for developing policy and to make further conservation program. However, we have limited information on vulture occurrence in VSFS, local people's willingness, to give old livestock to VSFS, attitude towards VSFS and animal husbandry practices near VSFS of Gaidahawa, Rupandehi, thus these research work was conducted.

1.2 Objective

1.2.1 General objectives

The general objective of the study was to count the number of individuals of vulture species, and the sustainability of Vulture Safe Feeding Site (VSFS) at Gaidahawa, Rupandehi District, Nepal.

1.2.2 Specific objectives

The study had following specific objectives:

- To count the number of individuals of vultures' species at VSFS.
- To identify the perception of local people towards VSFS.

1.3 Justification of the study

Vultures are nature's most successful scavengers that provide free and highly effective sanitation service (Ogada et al. 2012). However, there had been catastrophic decline in *Gyps* species number, since early 1990s, across India, Nepal and Pakistan (Prakash et al. 2003, Chaudhary et al. 2012, Oaks et al. 2004). Diclofenac drug residues in carcass, which cause renal failure and visceral gout in vultures, was the major cause of vulture population decline (Oaks et al. 2004). To minimize vulture population decline, Government of Nepal banned the production and use of veterinary diclofenac, in 2006. Six community managed VSFS were established in Pithauli, Rupandehi, Dang, Kailali, Kaski and Sunsari districts between 2007 and 2013 (DNPWC 2015). VSFS in Gaidhawa, Rupandehi was established in 2009 to provide diclofenac free carcass for vultures (Bhusal 2018). A regular monitoring of vulture population is important for their conservation (Chaudhary et al. 2012), and their count data provides knowledge on the current abundance, which are necessary for guiding conservation action and policy (Baral et al. 2004). Domestic livestock carcass is the primary food sources of vulture in South Asia (Oaks et al. 2004). In addition to carcass availability perception of local people near VSFS, and their willingness to provide their old livestock to vulture safe feeding sites are important for long term conservation of these species (Cortés-Avizanda et al. 2018). The findings of this work can provide information about the vulture abundance of different species in VSFS of

Gaidahawa. It also helps to estimate carcass availability to VSFS. Eventually, it aids in the conservation of vultures species and provide information for policy.

2. LITERATURE REVIEW

2.1 Global vulture distribution

The Old World (16 species) and New World (7 species) vultures are two families of raptors that have separately developed. Although the two vulture groups (Accipitridae and Cathartidae) belong to separate bird families, they share many morphological traits and are both obligate scavengers (Chung et al. 2015). California condor (*Gymnogyps californianus*), Andean vulture (*Vultur gryphus*), King vulture (*Sarcoramphus papa*), Black vulture (*Coragyps atratus*), Lesser yellow headed vulture (*Cathartes burrovianus*), Turkey vulture (*Cathartes aura*), Greater yellow headed vulture (*Cathartes melambrotus*) are the seven New World vultures (Santangeli et al. 2022). White-rumped vulture, Red-headed vulture, Himalayan vulture, Slender-billed vulture, Egyptian vulture, Cinereous vulture, Griffon vulture, Bearded vulture, Indian vulture, Cape vulture (*Gyps coprotheres*), White-headed vulture (*Trigonoceps occipitalis*), Lappet-faced vulture (*Torgos tracheliotos*), White-backed vulture (*G. africanus*), Hooded vulture (*Necrosyrtes monachus*), Ruppell's vulture (*G. rueppellii*) and Griffon vulture are the Old World vultures (Santangeli et al. 2019). Vultures were widespread throughout world however, declined of vulture populations first emerged in Europe, then Asia and most recently in Africa (Green et al. 2004, Santangeli et al. 2022). During 19th century, the California condor in North America and several populations of bearded vultures in Europe were already on the verge of extinction (Mingozzi and Estève 1997, Ogada et al. 2012). In recent decade, particularly in Asia and Africa (which are vulture-rich regions), especially in west African region, large population declines had been observed (Henriques et al. 2018). In Middle East, declining population trends were reported from the United Arab Emirates and Israel (Ogada et al. 2012). In south-east Asia vulture population decline occur much earlier than south Asia and by 2000s, White-rumped vulture, Slender billed vulture and Red-headed vulture population were only recorded from Myanmar (Clements et al. 2013). There had been significant decline in numbers from central and southern regions of Myanmar (Hla et al. 2011). In Cambodia White-rumped vulture and Red-headed vulture population decline started since 2010 and Slender billed vulture since 2013 (Loveridge et al. 2019). During the mid-1990s catastrophic decline of *Gyps* vulture population were recorded throughout the Indian subcontinent

(Prakash et al. 2012). Population decline of vulture population by 95% was detected at Keoladeo National Park, India (Oaks et al. 2004). According to Oaks et al. (2004) study in vulture of Pakistan found that 34-95% population decline were associated with renal failure and visceral gout. A survey conducted to find the change in population of White-rumped vulture and Indian vulture across India found that, there had been catastrophic decline (>92%) in number, since early 1990s (Prakash et al. 2003). Similar rapid decline were also noted from Nepal (Baral et al. 2004).

2.2 Vulture distribution and population in Nepal

All species in Nepal, with the exception of Bearded vulture live in the lowlands, whereas all species, with the exception of Indian vulture, live in the mid-hills. All species live in the Himalayas, with the exception of Indian vulture, Red-headed vulture, Slender-billed vulture and White-rumped vulture (DNPWC 2015). White-rumped vulture is common in the west while rare in east and center region and reported from 75 m to 1800 m elevation in Nepal (Inskipp et al. 2021). White-rumped vulture declined by 91% with estimated annual rate of decline of 14% a year (Chaudhary et al. 2012). In Rampur valley six colonies were found that supported 72-102 White-rumped vultures during breeding season and 50% breeding success were observed in occupied nests (Baral et al. 2005). In Upper Mustang Bearded vulture number decreased between 2002 and 2008 and it might be due to use of veterinary drug diclofenac (Acharya et al. 2010). White-rumped vultures were studied in Rampur valley from 2002 and 2012 and found in danger of disappearing within two decade (Baral et al. 2013). During lowland road transect surveys maximum five individuals was recorded in 2002, none recorded from 2010-2013 and two was recorded in 2015 (Chaudhary et al. 2012, Inskipp et al. 2021). However, partial recovered of Slender billed vulture and White-rumped vulture were observed from 2010 onwards (Galligan et al. 2020). Population and breeding success of Red-headed vultures were studied in central west Nepal and in total 24 individuals and no nest were recorded, and found rapid population decline across its range (Subedi and DeCandido 2015). Himalayan vulture are widely distributed and recorded from elevation 75 m – 6100 m (Inskipp et al. 2021). Himalayan vultures were studied in Khopde, Far-west Nepal and 310 individuals were observed and 90.9% success rate of their nest were observed (Joshi et al. 2015). Vultures were counted in Annapurna

Conservation Area between 2001 and 2006, but no evidence were found that population are facing same magnitude of decline as *Gyps* species in lowland (Virani et al. 2008). During Egyptian vulture study in central west Nepal, maximum population were observed in Kaski-175, followed by Arghakhanchi-24, Salyan-7, Pyuthan-6, Palpa-5 respectively and breeding success was 62.5% (Subedi and DeCandido 2015). Egyptian vulture population recovered from mid-2000s after the 2006 ban on veterinary diclofenac (Galligan et al. 2014). Cinereous vulture also known as Raj Giddha and winter visitor or passage migrant, were found with lowest relative abundance in Pokhara Valley (Dhakal et al. 2022). It is common resident in the Himalayas and recorded from elevation 250 m – 5600 m and inhabits mountains and Trans-Himalayan Tibetan steppe desert (Inskipp et al. 2021). Griffon vultures are passage migrants and winter visitor and 90 individuals were observed in Pokhara Valley (Dhakal et al. 2022). Indian vulture, categorized as Critically Endangered were recorded only from Asia (Ogada et al. 2012). In Nepal, Indian vulture was first record in Pithauli VSFS near Chitwan National Park (Subedi and Candido 2013).

2.3 Local people attitude

Local stakeholder's perception, interest are critical for long-term conservation of endangered species, yet, social dimensions are often overlooked. Socio-economic variables were explored in Rampur Valley and found that majority of local people had positive attitudes towards vulture and destruction of nesting habitat were major threats to vultures (Baral and Gautam 2007). Similarly the majority of respondents in Ramechhap, eastern mid-hills District, of Nepal were found to have positive attitude towards vulture conservation (Phuyal 2016). In Pokhara Valley majority (86%) of respondents recognized vultures as important carcass feeder and majority of respondents suspected that habitat loss was major threat for vulture followed by toxic food use, poisoning and food scarcity and this information can be helpful to make future conservation program (Dhakal et al. 2022).

2.4 Vulture safe feeding sites

In order to conserve the vulture, Government of Nepal endorsed the first Vulture Conservation Action Plan (DNPWC 2015). Under this VCAP, integrated approach was established that included: advocating bans on NSAIDs, swapping diclofenac with

meloxicam, maintaining VSZ (DNPWC 2009). Vulture Safe Zone (VSZ) is a pioneer idea in world that work with local communities. It is a region that is fully free of diclofenac usage and big enough to include mean feeding range for one or more vulture nesting colonies (DNPWC 2015, Bhusal 2018). Six Vulture Safe Feeding Sites (VSFS), popularly known as Jatayu restaurants were established within VSZ (DNPWC 2015, Bhusal 2018). Pithauli, Nawalparasi was the world's first community managed VSFS established in 2006 (Chaudhary 2019).

After implementation of VSFS program vulture population recovery were observed across lowland of Nepal, onward 2013, in critically endangered *Gyps* species (Galligan et al. 2020). The second confirmed appearance of Indian vulture was after seven years in VSFS of Pithauli, Nawalparasi and suggest that VSFS are benefitting such critically endangered vulture species (Chaudhary 2019). Similar recovery of vulture population, were also observed in Pokhara, Kaski District area such as landfill, nearby Dovilla, Ghachowk (VSFS) (Dhakal et al. 2022). In spite of this recovery, the unusual predatory behavior such as attacking the live animal was recorded in the White-rumped vultures in the VSFS of Ghachowk, Kaski (Gautam et al. 2022). The establishment of these VSFS and their management were found to change and modify the vultures foraging behavior, consistently reducing home-range, time in flight and mean daily distance travelled (Gilbert et al. 2007).

3. MATERIALS AND METHODS

3.1 Study area

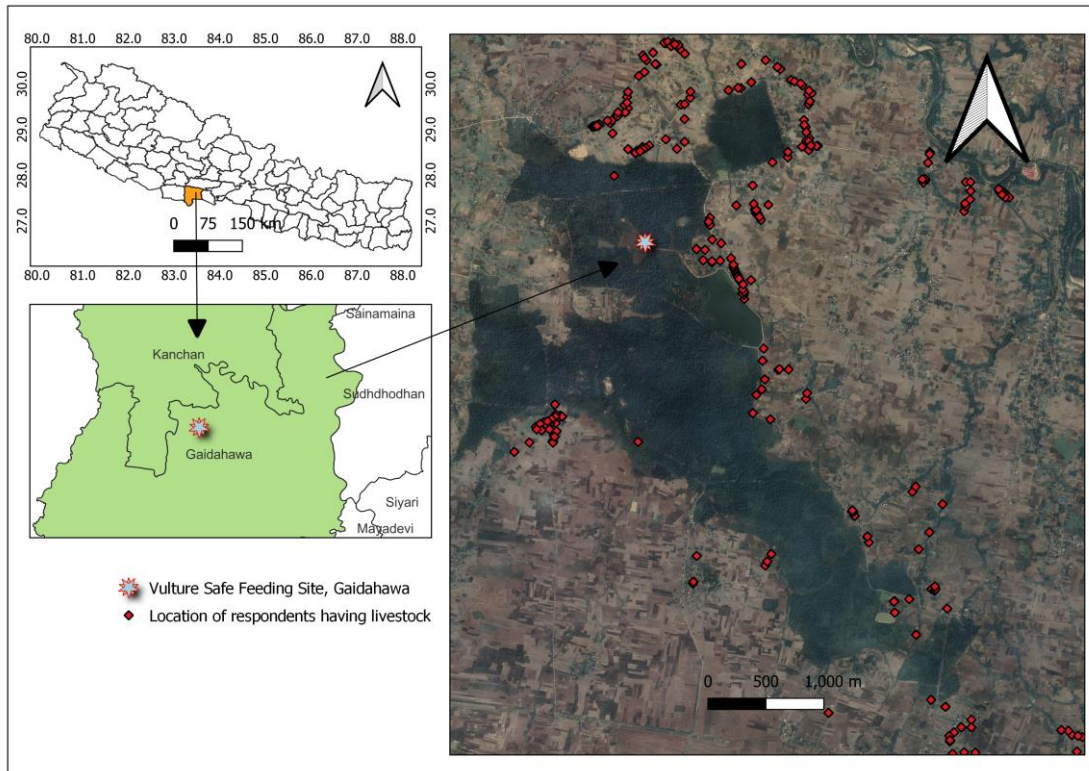


Figure 1: Vulture Safe Feeding Site, Gaidahawa, Rupandehi with neighbor Kanchan Rural Municipality and location of respondent's household, 2022.

Gaidahawa Rural Municipality ($27^{\circ}33'20''$ - $27^{\circ}33'35''$ N and $83^{\circ}16'23''$ - $83^{\circ}16'43''$ E) lies in Rupandehi District and comprises area of 96.8 km^2 . It is surrounded by Kapilvastu Municipality in west, Kanchan Rural Municipality and Sainamaina Urban Municipality in north, Sudhodhan Rural Municipality in east and Mayadevi Rural Municipality and Lumbini Sanskritik Urban Municipality in south respectively. It has nine Wards and Vulture Safe Feeding Sites (27.59957° N and 83.27329° E) lies in Ward-4. In Gaidahawa, Vulture Safe Feeding Sites was established in 2009. VSFS lies close to Gaidahawa Lake and 5 km north from Lumbini, the birthplace of Lord Buddha. The maximum mean temperature of the area is 31°C and the minimum mean temperature is 18.2°C . The area has forest with Sal (*Shorea robusta*), Chir (*Pinus longifolia*), Khair (*Acacia catechu*), Simal (*Bombax ceiba*), Sisao (*Dalbergia sisoo*), Bair (*Zyiphus jujuba*) (Dhakal 2016). Gaidahawa is home to more than 150 species of bird, 20 species of reptiles and amphibian and 75 species of flora. The fauna of this

area are Blue-bull (*Boselaphus tragocamelus*), Sloth bear (*Melursus ursinus*), Rhesus monkey (*Macaca mulatta*), etc. and the bird species include Sarus crane (*Grus antigone*), Asian woolly-necked storks (*Ciconia episcopus*), White-rumped vulture, Himalayan vulture, Griffon vulture, Red-headed vulture, Egyptian vulture, Cinereous vulture, Slender-billed vulture, etc. (Dhakal 2016). Gaidahawa Rural Municipality contains 9 Ward and the four neighbor Wards of VSFS are Ward-3, 4 and 7 (Gaidahawa Rural Municipality) and Ward-4 (Kanchan Rural Municipality). Yadav, Muslim, Lodh, Kahar and Tharu are the major caste/ethnic group of Gaidahawa. Livestock farming and agriculture are the major occupations. Buffalo, cow, sheep, goat and pig are most farmed livestock in study area.

3.2 Methods

3.2.1 Vulture counts

Direct observation was performed at carcass dumping sites of VSFS for vulture count. The field was visited during autumn (Mid-September to Mid-November) and winter (Mid-January to Mid-March) for 2 weeks, and these observation was conducted only during carcass available days. The survey was conducted from 1 October 2022 to 22 October 2022 during autumn and from 20 February 2022 to 27 February 2022 during winter. In every visit carcasses were available at carcass dumping sites of VSFS. In each visit, the number and types of vultures were recorded from 7:00 am - 2:00 pm. Vultures were observed from a vantage point that provide a clear view of whole site. Vulture counts were started after they arrive to feed on carcass. All the individual vultures, feeding on carcasses and roosting were counted. Two observers carried out the count, one observer counted feeding vulture and the other counted roosting vultures. Communication between observers avoided double count. Total number of individual vulture were recorded.

3.2.2 Questionnaire survey

The questionnaire survey was conducted in four Ward that were near Vulture Safe Feeding Site (VSFS). The four neighbor Ward were 3, 4, and 7 (Gaidahawa Rural Municipality) and Ward-4 (Kanchan Rural Municipality). Out of total 1,600 livestock farmed household, interviewed were performed in 310 households, and the sample size for interview was based on 5% margin of the error at 95% confidence interval

(Krebs 2014). The number of interviewed households varied according to Ward (80, 68, 80 households in Ward-4, 3 and 7 respectively, Gaidahawa Rural Municipality and 94 households in Ward-4, Kanchan Rural Municipality). The interviewee households were selected at first by random sampling method and from randomly sampled household, systematic sampling method was used. The interviewee household without livestock was excluded and interviewed was done in adjacent livestock farming household.

Interview was conducted from 8 August, 2022 to 5 November, 2022. The survey was performed for only one adult (≥ 16 years old) per household, and there was no discrimination based on education level, gender, age, ethnicity or religion. Demographic data such as age, gender, education, religion and occupation were collected. Respondents within 2 km (near) and far from 2 km (far) were interviewed. Respondents were asked whether they had livestock, how they managed their livestock carcass and whether they provide their old livestock to VSFS. In addition, respondents' perception towards vulture and VSFS were collected.

The questionnaire survey was also conducted in two agro-vet and veterinary shops near VSFS, Gaidahawa. Respondents were asked whether they were informed about diclofenac drug ban and different NSAID drugs available in shop and their costs.

3.2.3 Data analysis

For analysis Chi-square and Mann-Whitney U tests were used for categorical and continuous data, respectively. The Chi-square test was used to examine the variation in local response to provide old livestock, with gender, education level, occupation types, distance from VSFS and number of livestock owned. All analyses were performed in R program (R Core Team 2021) with significance established using $\alpha=0.05$.

4. RESULTS

4.1 Vulture counts

Five different vulture species were recorded during carcass feed in VSFS of Gaidahawa (Table 1). The White-rumped vulture was recorded with higher number (autumn: 45; winter: 50), and followed by Himalayan vulture (autumn: 8; winter: 34),

Egyptian vulture (autumn: 3; winter: 6), Cinereous vulture (autumn: 1; winter: 5) and Slender-billed vulture (autumn: 0; winter: 2), respectively (*for range see* Table 1). The higher Shannon diversity index (H) value was found during winter season (1.006) than in autumn (0.431). Similarly, higher vulture evenness value was found during winter (0.625) than in autumn (0.310).

Table 1: Total number of vulture species recorded in Autumn and Winter in Vulture Safe Feeding Site, Gaidahawa, Rupandehi in 2022.

| S.N. | Common name | Scientific name | Number sighted (Range) | |
|------|------------------------|------------------------------|------------------------|---------|
| | | | Autumn | Winter |
| 1 | White-rumped vulture | <i>Gyps bengalensis</i> | 23 – 45 | 36 – 50 |
| 2 | Himalayan vulture | <i>Gyps himalayensis</i> | 4 – 8 | 22 – 34 |
| 3 | Egyptian vulture | <i>Neophron percnopterus</i> | 1 – 3 | 3 – 6 |
| 4 | Cinereous vulture | <i>Aegyptius monachus</i> | 1 | 1 – 5 |
| 5 | Slender-billed vulture | <i>Gyps tenuirostris</i> | 0 | 1 – 2 |

A higher number of individuals of vultures were recorded during winter (67%) than in autumn (32.9%). The vulture species with higher relative abundance was found for White-rumped vulture (autumn: 88.6%; winter: 55.2%), followed by Himalayan vulture (autumn: 7%; winter: 68%), Egyptian vulture (autumn: 2%; winter: 10%), Cinereous vulture (autumn: 0.3%; winter: 6%) and lowest was Slender billed vulture (autumn: 0%; winter: 1%) in the VSFS of Gaidahawa.

4.2 Competitors of vulture during carcass feed

During carcass feed House crow (*Corvus splendens*), Jungle crow (*Corvus macrorhynchos*), Dogs (*Canis lupus*), Grey mongoose (*Urva edwardsii*) and Eagle (*Ictinaetus malaiensis*) were found competing with vulture. Crows were the major

competitors (87%, n=308), followed by Dogs (9%, n=31), Grey mongoose (3%, n=11) and Eagle (1%, n=4), respectively. The average number of vulture and other scavengers (Crow, Dog, Grey mongoose, and Eagle) were 54.5 and 25.5, respectively, and there was variation between the abundance of vultures and other scavengers ($W=3$, $p<0.001$) that were visiting the livestock carcass.

4.3 Demographic and socio-economic characteristics of respondents

Interviewed were taken with 310 local people, living near VSFS, Gaidahawa. Among these respondents literate respondents were comparatively higher than illiterate. In the study area majority (n=226) respondents had farming based livelihood (people whose primary vocation is farming) while other 84 respondents had business, foreign employment, teacher, labor, government service for livelihood. The majority of respondents' age group was 32-40 (21%), followed by 16-24 (18%), 24-32 (16%), 40-48 (13%), 48-56 (12%), 56-64 (9%) and 64-72 (8%), respectively. In study area, there was no variation among respondents with education between male and female ($\chi^2=2.165$ df=1, $p=0.1411$). More females were participated for interview within 2 km from VSFS than far from it ($\chi^2=8.789$, df=1, $p=0.003$). Similarly, more farmer having livestock, were found far from VSFS than near to it ($\chi^2=4.056$, df=1, $p=0.044$).

Table 2: Demographic and socio-economic information of respondents (n=310) living near Vulture Safe Feeding Site, Gaidahawa, Rupandehi in 2022.

| Variables | Comparison |
|---------------------------|--------------------------------------|
| Age | Median=36 (range: 16-83) |
| Gender | Male=51%; Female=49% |
| Education | Literate=64%; Illiterate=36% |
| Religion | Hindu=96%; Buddhist=2%; Muslim=2% |
| Occupation | Farmer=73%; Other=27% |
| Distance from VSFS | ≤ 2 km=52%; > 2 km=48% |
| Number of livestock owned | ≤ 5 =51%; > 5 =49% (Median=5) |

4.4 Respondent's willingness to provide old and unproductive livestock to VSFS

Among total cattle owner, only few (17%, n=16) were willing to provide old and unproductive livestock to VSFS. Comparatively, respondents within 2 km from VSFS (n=13) were more willing to provide their old and unproductive livestock than far from 2 km (n=2).

Table 3: Respondents willingness to provide their old and unproductive livestock to Vulture Safe Feeding Site, Gaidahawa, Rupandehi in 2022.

| Variables | Comparison | Statistics |
|------------|---------------------------------------|--------------------------------------|
| Gender | Male (n=157); Female (n=153) | $\chi^2 = 0.337$, df = 1, p = 0.561 |
| Occupation | Farming (n=226); Other (n=84) | $\chi^2 = 0.730$, df = 1, p = 0.392 |
| Education | Illiterate (n=112); Literate (n=198) | $\chi^2 < 0.001$, df = 1, p = 1 |
| Distance | ≤ 2 km (n=161); > 2 km (n=149) | $\chi^2 = 6.225$, df = 1, p = 0.012 |

Among total respondents there was no variation on the local people willingness to provide old and unproductive livestock, with socio-economic variable gender, occupation and education (Table 3). Variation on willingness to provide old cattle among local people was found only with variable distance (Table 3).

4.5 Livestock available near VSFS

Buffalo was the major livestock farmed by (52%, n=223) respondents. Goat (23%, n=96) was second most farmed livestock followed by cow (22%, n=92), pig (4%, n=15) and sheep (1%, n=1), respectively. There is decreasing trend in number of cow farmed household near VSFS ($\chi^2=54.017$, df=1, P<0.001).

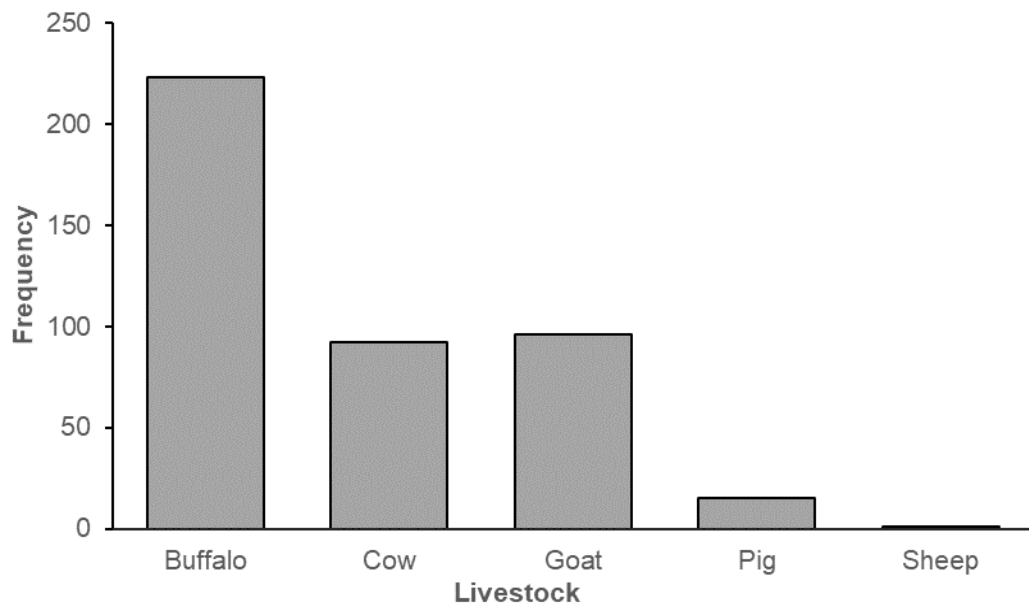


Figure 2: Different livestock farmed near Vulture Safe Feeding Site, Gaidahawa, Rupandehi in 2022.

4.6 Livestock carcass disposal mechanism

Out of 310 respondents, half of respondents (52%; near=91; far=69) buried their livestock carcass immediately after their death while other (34%; near=32; far=75) dumped their livestock carcass near jungle. Only few (14%) responded to provide their livestock carcass to VSFS. Comparatively, more respondents near (≤ 2 km) to VSFS ($n=38$) wanted to provide their livestock carcass to VSFS than far (>2 km) respondents ($n=5$). There was significant variation ($\chi^2= 45.234$, $df = 2$, $p < 0.001$) in carcass disposal mechanism near (≤ 2 km) and far (>2 km) from VSFS, among the respondents.

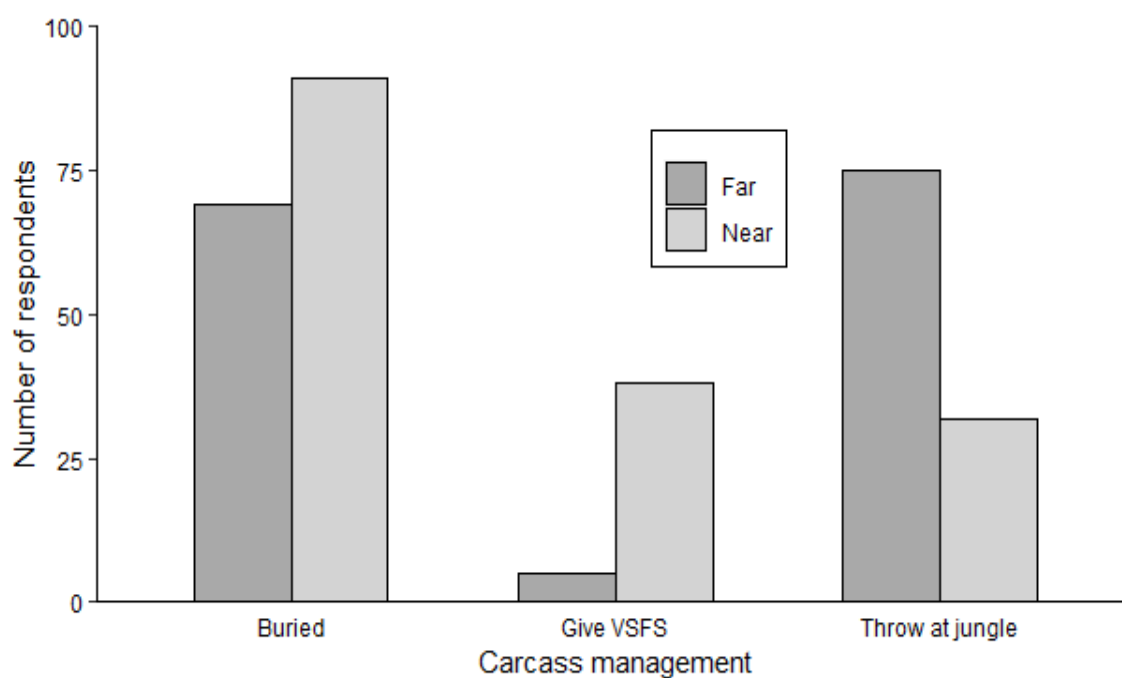


Figure 3: Livestock carcass disposal mechanism near (≤ 2 km) and far (>2 km) from Vulture Safe Feeding Site, Gaidahawa, Rupandehi in 2022.

4.7 Local people perception towards vulture importance and population trend

In total respondents, most respondents (74%, $n=232$) were aware of vulture importance. Few (8%, $n=25$) considered vulture as useless and remaining (17%, $n=53$) responded that they were unaware of any vulture importance (Figure 4A). Majority of respondents (76%) believed that vulture are important for environment sanitation while few (2%) believed vulture had medicinal importance. There was no variation ($\chi^2= 5.142$, $df = 2$, $p = 0.076$) in people perception towards vulture importance with education level. Respondents living near (≤ 2 km; $n=123$) and far (>2 km; $n=109$) from VSFS were equally aware of vulture importance ($\chi^2= 0.591$, $df = 2$, $p = 0.744$).

Among total respondents, most respondents (72%, $n=225$) believed that vulture population had decreased. Only few (11%, $n=35$) responded that vulture population had increased, while remaining (16%, $n=50$) responded that vulture population were same as before (Figure 4B). Both literate ($n=198$) and illiterate ($n=112$) respondent had similar ($\chi^2= 0.123$, $df=2$, $p = 0.940$) perspective, that is vulture population are decreasing.

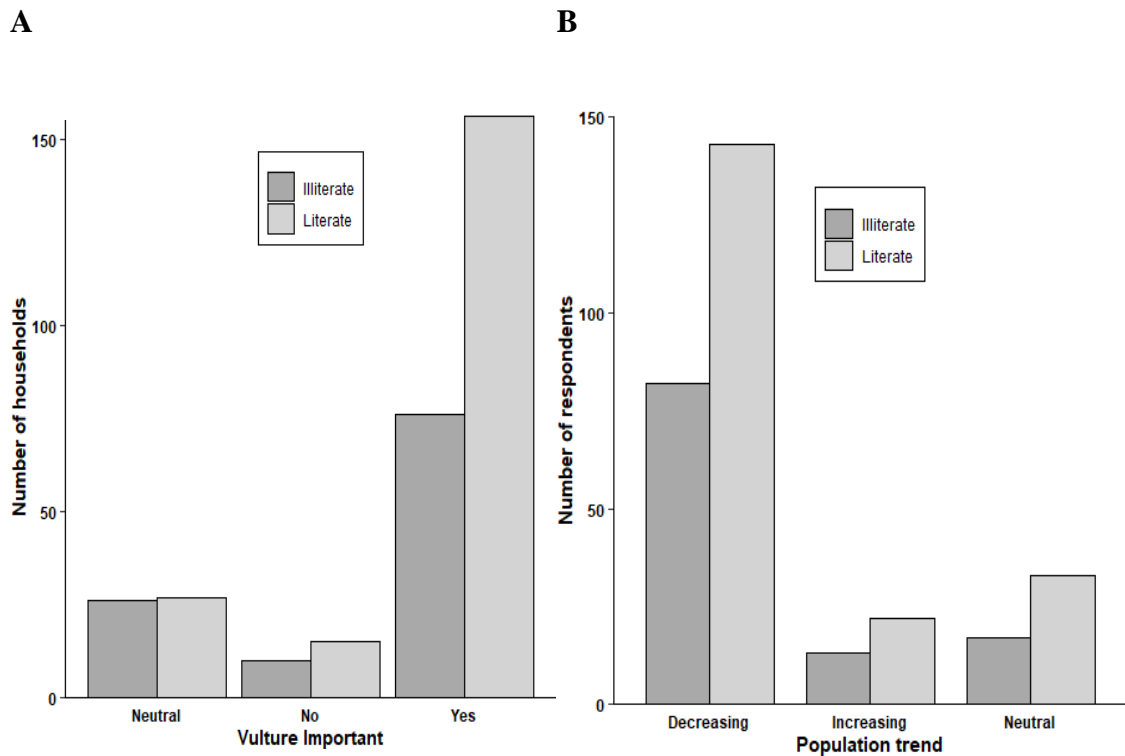


Figure 4: Number of respondents view regarding (A) Vulture important; and (B) Population trend of vulture in Vulture Safe Feeding Site, Gaidahawa, Rupandehi in 2022.

4.8 People attitude towards VSFS

In total nearly half of respondents (41%, n=148) had positive attitudes, other (45%, n=139) were indifferent towards VSFS and (14%, n=23) had negative attitudes. Out of total farmer respondents (n=226), few (6%, n=19) farmer were found to have negative attitude towards VSFS, especially respondents near VSFS. We observed that local people perceptions towards VSFS varied with distance from VSFS ($\chi^2= 37.346$, $df = 2$, $p < 0.001$).

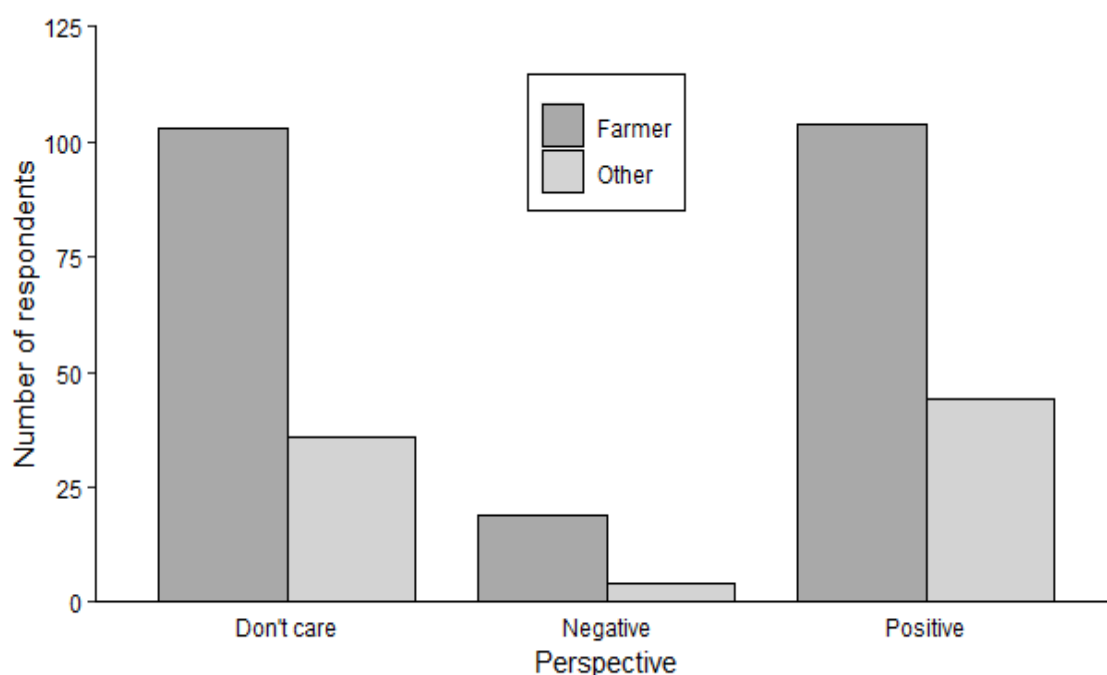


Figure 5: Number of farmers and others respondents' perspective towards Vulture Safe Feeding Site, Gaidahawa, Rupandehi in 2022.

4.9 Threats

Near VSFS, Gaidahawa, more than half of respondents (64%) mentioned that food scarcity was the major threats to vulture followed by habitat loss (7%), unintentional poisoning (1%), natural disaster (0.6%) and 27% were unaware of any threats to vulture. Only 5% of respondents (VSFS staff, member and agro vet) were aware of Non-Steroidal Anti-Inflammatory Drugs (NSAID) diclofenac threats on vulture.

Two, Agro-vet and veterinary shops were visited to find out the availability of Non-Steroidal Anti-Inflammatory Drugs drug near the VSFS, Gaidahawa. Both owner were aware of ban on diclofenac drug and alternative safe Meloxicam drug. Meloxicam drug were found in both shops. NSAIDs drugs available near VSFS, Gaidahawa are Meloxicam (vial-100 ml, Rs-450), Tolfenamic acid (vial-100 ml, Rs-350) and Flunixin (vial-15 ml, Rs-125). However, Meloxicam drug was comparatively expensive than other NSAID drug available.

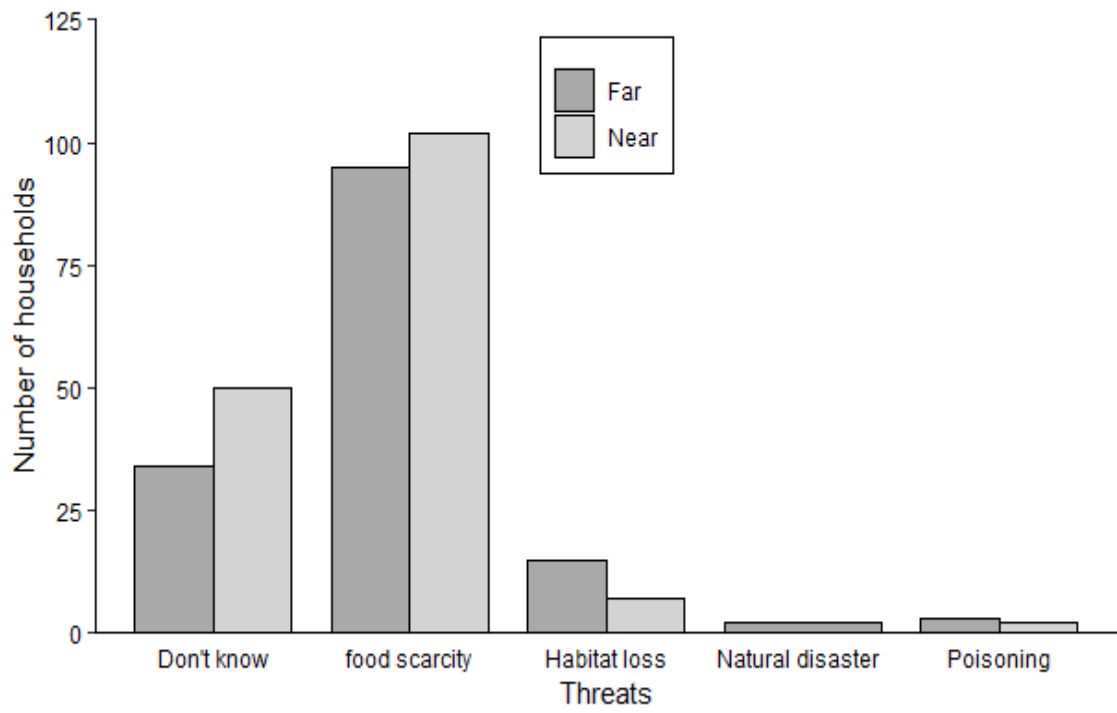


Figure 6: According to Respondents, different threats to vulture in Vulture Safe Feeding Site, Gaidahawa, Rupandehi in 2022.

5. DISCUSSION

This study confirmed the uses of Vulture Safe Feeding Sites of Gaidahawa by five vulture species, namely, White-rumped vulture, Himalayan vulture, Egyptian vulture, Cinereous vulture and Slender-billed vulture. Among these the White-rumped vulture and Slender-billed vulture are Critically Endangered, Cinereous vulture and Egyptian vulture are Endangered and Himalayan vulture is Near Threatened (DNPWC 2015, Birdlife International 2021a, 2021b, 2021d, 2021e, 2021g). Previously, seven species of vultures were observed during October 2009-September 2010 (Dhakal 2016). The fewer species was probably due to shorter study period or due to the breeding season of vultures. Vultures abundance was slightly higher during winter than autumn, this might be due to higher availability of livestock carcass in the winter season (Mateo-Tomás et al. 2012), and migration of Himalayan vulture from high altitude to low land of Nepal (Subedi 2014). In this study period, a regular supply of carcasses were found. During each carcass feeding, competition was also observed among vulture, crow, dog, grey mongoose, and eagle. Although crows were most frequently observed using carrion, their lower food requirements minimize their impact on competition. While dogs were observed occasionally snatching food and limiting the foods for vulture, it might increase more competition for food. Higher diversity value was found during winter than in autumn, it shows that vulture species were relatively evenly distributed during winter than autumn.

There is strong relationship between vultures and livestock, as vultures distribution and sustainability were determined by livestock husbandry practices in nearby area (Mateo-Tomás et al. 2012). Near VSFS of Gaidahawa, buffalo was most farmed livestock, followed by goat, cow, pig and sheep, respectively. Among the total respondents only few were willing to provide their old and unproductive cattle to VSFS, it was due to lack of transportation facility to bring the old and unproductive cattle from farm to VSFS. In Cow Rescue Centre of VSFS, Gaidahawa, 18 old and unproductive cow were counted. These cow were the primary source of food for vulture (Bhusal 2018), however decreasing trend were observed in number of cattle farmed household in neighbor village. Local thought that cow farmed was loss business at present, as a result they were replaced by buffalo farmed. This trends showed that in near future there might be difficult to get old cows in Cow Rescue

Centre of VSFS. Majority of respondents buried their livestock carcass immediately after their death, probably due to fear of foul smell and diseases from carcass, as a result this affect vulture food availability (Dupont et al. 2012).

If people realize that vultures are important scavengers, they may start to conserve the vultures (Cortés-Avizanda et al. 2018). Almost all respondents were aware of vulture importance mainly for environmental sanitation. This vulture importance knowledge most likely resulted through formal schooling and awareness programs organized by different institutions in different time intervals. People agreed that the vulture population is in decreasing trend and food scarcity was the major cause of it, it might be due to immediate carcass disposal mechanism (Dupont et al. 2012, Dhakal et al. 2022). Vulture safe feeding sites work with local communities (Bhusal 2018), however, local people living near VSFS were found to have comparatively high negative perspective towards VSFS. Negative perspective had direct effect on vulture survival, as local perceptions, interests and knowledge are critical for long-term conservation of endangered species (Cortés-Avizanda et al. 2018). Conflict were observed between VSFS and respondents, it was due to crop damage done by cow of Cow Rescue Center, of VSFS. It was the major cause for respondent's negative perspective towards VSFS. Local people were also unhappy about poor management of carcass dumping sites, foul smell and fear of diseases from carcass. Only the respondents, such as staff, member of VSFS, had positive attitude towards VSFS, it may be due to job and fund they received from VSFS. Majority of local respondent's believed that food scarcity was the major threats of vulture followed by habitat loss, poisoning and natural disaster, respectively, in VSFS, all these were results of local respondents behavior such as burying carcass, deforestation, unintentional poisoning, etc. (Dhakal et al. 2022). In spite of food scarcity, power line collision and electrocution are also the increasing threats to the vulture species (Hamal et al. 2023). In the study area people don't use diclofenac near VSFS, however, some drugs NSAID "flunixin" was found in the veterinary shop of nearby VSFS. It is found to be toxic to vultures (Jimenez-Lopez et al. 2021). Meloxicam were comparatively expensive to other drugs, which may discourage people to buy it. Thus study suggests that immediate proper management VSFS and effective plan to encourage local to provide old and unproductive cattle, are required in VSFS of Gaidahawa, Rupandehi district.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

Out of nine species recorded in Nepal, VSFS of Gaidahawa supports the five species of vultures. They are relatively higher in richness and evenness during winter than in autumn. Competition occurs between vultures and other scavengers and dog are found to have maximum effect and occasionally limiting the food for vulture. Nearly half of the respondents have positive attitude towards VSFS. But the negative attitudes among the farmers are increasing due to poor management of VSFS. Only few respondents are willing to provide old cattle in VSFS, it suggests that in near future there may be scarcity of carcass availability for vulture. Thus immediate and effective planning and programs are needed to encourage people, to provide old cattle and to change negative attitudes towards VSFS, in Gaidahawa Vulture Safe Feeding Sites.

6.2 Recommendations

Some recommendation that needed to be done for VSFS management are as follow:

- Management of transportation facility to carry the old livestock from farm to VSFS must be done.
- Local people must be encouraged to provide their old livestock to VSFS by providing few incentive money for old livestock.
- Carcass dumping sites should be made far from residential area and main highway road.
- To reduce the crop damage caused by cattle of Cow Rescue Center of VSFS, well-managed shed should be made and fencing should be done around Cow Rescue Center.

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PHOTOPLATES

Photo plates 1: Cow Rescue Center, staff and competitors in Vulture Safe Feeding Site.



Cow Rescue Center



Cattle in Cow Rescue Center



Staff of VSFS



Skinned carcass of cow



Dog feeding at VSFS



Grey Mongoose at VSFS

Photo plates 2: Different species of vultures at Vulture safe feeding site and interviewed near it.



Cinereous vulture and Himalayan vulture



Vultures at VSFS



Vultures basking



Egyptian vulture



Agro-vet near VSFS



Interviewed near VSFS

APPENDIX 1

Questionnaire format

Questionnaire used to survey 310 households from the near VDC of Vulture Safe Feeding Site.

Section I Demographic and socio-economic condition of the respondents

Name:

Age:

Gender: Male () Female ()

Religion:

Hindu () Muslim () Buddhist () Christian ()

Education status:

Illiterate () literate () secondary () Intermediate () University ()

Occupation:

Farmer () Teacher () Social worker () Government employer () Business ()

Section II Willingness to provide old livestock to VSFS

1. Do you have livestock?

Yes () No ()

2. If yes. What are their types and number?

Cow () Buffalo () Pig () Goat ()

3. What do you do if your livestock get sick?

Do treatment () Left without treatment to die ()

4. If your livestock get sick what do you use, veterinary drug/homemade medicine?

Yes () No ()

5. Do you know about veterinary drug diclofenac and its negative impact on vulture?

Yes () No ()

6. Will you keep your livestock until it gets old or sell after some years?

Keep () Sell ()

7. What do you do with your old and unproductive livestock?

Left to die at home () Give to VSFS ()

8. How do you manage your livestock carcass?
Buried () Throw at jungle () Give to VSFS ()
9. In past, did you use to give your old and unproductive livestock to VSFS?
Yes () No ()
10. In past, did you use to farm cow?
Yes () No ()
11. When did you left to farm cow and why?
3yrs ago () 5yrs ago () 7yrs ago () 10yrs ago ()
12. Can you recognize the vulture among these picture? (I will show picture of vulture with other bird)
Yes () No ()
13. Which of the vulture you see the most in your area?
Himalayan vulture () Griffon vulture ()
Bearded vulture () Cinereous vulture ()
Red-headed vulture () Slender-billed vulture ()
White-rumped vulture () Egyptian vulture ()
Indian vulture ()

Section III People perception towards vulture and Jatayu restaurant

14. Do you think vulture are important for us and environment?
Yes () No () Neutral ()
15. What do you think of vulture population trend at present?
Increasing () Decreasing () Neutral ()
16. Do you think vulture conservation is necessary?
Yes () No ()
17. Do you know about Jatayu restaurant/VSFS?
Yes () No ()
18. Have you ever visited Jatayu restaurant?
Yes () No ()
19. What perspective do you have towards Jatayu restaurant/VSFS?
Negative () Positive () Neutral ()
20. Do you think Jatayu restaurant are effective in vulture conservation in your locality?
Yes () No ()