

**ROLE OF ZOO IN WILDLIFE MANAGEMENT AND CONSERVATION
EDUCATION IN CENTRAL ZOO, LALITPUR, NEPAL**



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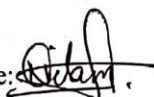
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DECLARATION

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
AAZP	Arignar Anna Zoological Park
ACAP	Annapurna Conservation Area Project
BNP	Bardia National Park
CNP	Chitwan National Park
CR	Critically Endangered
CZ	Central Zoo
EN	Endangered
F. Y	Fiscal year
FOZ	Friends of the Zoo
GCAP	Gaurishankar Conservation Area Project
INGOs	International Non- governmental organization
IUCN	International Union for Conservation of Nature
KMTNC	King Mahendra Trust for Nature Conservation
LC	Least Concern
NGOs	Non-governmental organization
NP	National Park
NT	Near Threatened
NTNC	National Trust for Nature Conservation
SSP	Species Survival Plans
SWR	Suklaphanta Wildlife Reserve
TZ	Thiruvananthapuram Zoo
VU	Vulnerable

ABSTRACT

The study was conducted at Central Zoo, Kathmandu with an aim to explore the role of Central Zoo in wildlife management and conservation education. The specific objectives were to know the status and identify the management challenges of animals in zoo, to evaluate the conservation education among visitors, and to identify the roles played by Central Zoo in conservation education. Key informant interview, questionnaire survey, literature review for comparison and regular field visit were done to meet the objectives. Among 400 questionnaire survey, 12 were incomplete so neglecting those only 388 questionnaire surveys were analyzed using different statistical methods. Comparison of enclosure and diet of only charismatic mammals with other zoos were done to evaluate the overall status of zoo. Central zoo gives shelter to 118 species. The result revealed that the overall status of zoo was not sufficient for management and conservation of animals. The enclosure/ cage size does not meet the standard size. The diet given for animals were similar to standard diet given for captive animals. Central Zoo mainly focused to FOZ (Friends of Zoo) members for conservation education while other visitors are unknown about the conservation programs. Among the respondents, 59.79% were unaware about the conservation programs and 40.20% were aware that zoo conducts conservation programs. In the context of conservation education programs conducted by CZ, result interpret highly significant difference ($\chi^2=35.64$, $df=1$, $p< 0.002$) between FOZ and non-FOZ. Visitors seems to be satisfied to the conservation programs conducted by central zoo. Zoo conducts various programs for FOZ members providing knowledge of different species, their status, their importance and aware them to protect animals. It conducts various awareness programs and celebrates all important international days such as World Environment Day, World Tiger Day, World Red Panda Day, World Pangolin Day etc. This study suggests that present condition of zoo needs to be improved and try to meet the international standard level. Rapid construction and renovation work of enclosure should be done and also should focused in visitor facilities. Not only FOZ members they should also organize special programs for other visitors and encourage them in conservation through their programs.

1. INTRODUCTION

1.1. Background

In situ and ex situ are the two major approaches for the conservation of the wildlife. In situ is define as on-site conservation in nature and ex situ as off-site, unnatural or captive conservation (Braverman 2014). In situ conservation is conserving the ecosystems and their natural habitats and maintaining their viable population of species in their natural habitats. For example: National Parks (NP), Conservation areas (CA), Protected Areas (PA) etc. Ex situ conservation is conserving biodiversity outside their natural habitats. Examples: gene banks, seed banks, botanical gardens, zoos etc.

Zoo, with the cheerful crowd of the visitors enjoying the animal display carry different responsibility as well. It is the attractive places of entertainment, which nowadays emphasize in wildlife conservation, conservation education programs, captive breeding and research (Carr and Cohen 2011). Along with the dealing with the public, labor, financial issues, external and internal politics zoo manager also face daily challenges of animal management (Kawata 2008). There is vast difference between old traditional zoos and modern zoo. Nowadays in modern zoos concern about the animal welfare. To meet the welfare needs of captive animal zoos and aquariums in the world are changing from traditional barren exhibit designs to naturalistic designs where captive animal gets natural type of habitat (Davey 2006). To avoid the risk of conflict between the animals (EAZA 2008) and to reduce the unusual behavior of animals (Veasey 2006) standard zoo enclosure according to the species need to be constructed. In regular management of any zoo, food is most important component (Sikander et al. 2015). In case of captivity it is often difficult for the keepers to managed food as in natural condition The zoo and aquarium community has to struggle with lots of challenges and responsibility of managing ex situ population with goal of maximizing term population sustainability. They have certain plans and programs to maximize genetic and demographic health and work towards long term sustainability (Wilson et. al. 2019)

Conservation education also play very important role in conserving biodiversity. Effective conservation education is essential for promoting conservation policy, creating knowledgeable citizen, changing people's concepts towards more sustainable future (Jacobson et al. 2015). For

many people, zoo has become beautiful experience of wild animal as well as their first intimate with animals. It provides environmental education and conservation education to large number of people. Through conservation education, zoo can help to reduce the negative effects of the animal trade on some species (Tribe and Booth 2003).

Outreach and partnership programs with local people providing the knowledge about the biodiversity, its importance, status and ways to conserve it are very effective. Through the field based conservation programs both the participants and the scientist are benefited. Participants learn what scientists do, how and why they do whereas Scientists can also learn how local relate to the species and habitat (Brewer 2002). Conservation education develops lifelong knowledge and skills for conservation action. It affects the awareness, attitudes and behaviors of people towards natural resources. Ex situ conservation has more important role in conservation as it protects the endangered species from being extinct (Pritchard et al. 2012).

Annually more than 700 million people visit zoos and aquariums worldwide and are thus getting environmental education (Gusset and Dick 2011). According to (Smith and Broad 2007) there are three notable trends in zoo that is first is zoo give greater emphasis on their role in conservation and education. Second is encouraging visitors to undertake conservation action through it conservation education. And lastly, the third trend is the advert and proliferation of new immersion style naturalistic exhibits in which the visitors enter the habitat of the animal.

Central Zoo is only zoo of Nepal which not only provides shelter for animal but also conducts different conservation education programs. It spread awareness of the conservation of biodiversity, by providing information about species and their natural habitats. CZ specially focused to the students as they are the future hand for nature conservation.

1.2. Significance of the study

Central Zoo is the only place in Kathmandu where we can observe and understand various species of wildlife in captivity. Zoo is one of the best examples of the ex-situ conservation providing the conservation education to the people. It plays crucial role in conservation of animals, improve animal health and welfare creating natural habitat and providing food

according to their dietary requirement. Zoo encourages research and provides entertainment as well. It conducts various programs under wildlife conservation in order to educate people about the biodiversity and its importance to us. Zoo encourages Friends of the Zoo (FOZ) membership, which is mainly focused to the students. There is no any such research conducted on topic challenges management of zoo and impact of conservation education in CZ.

The study signifies role of Central Zoo in wildlife management and conservation education. It helps to evaluate the status and diversity of species in CZ. It also explores the challenges faced by CZ in wildlife management which eventually helps in mitigating them. It helps to evaluate the effectiveness of conservation education among the visitors.

1.3. Objectives of the study

The general objective of the study was to explore role of Central Zoo in wildlife management and conservation education. Following were the specific objectives of the study:

- i. To know status and identify the management challenges of animals in zoo.
- ii. To evaluate the conservation education among visitors.
- iii. To identify the roles played by Central Zoo in conservation education.

1.4. Limitation of the study

As there was very limited such survey carried in the topic management challenges of animals and conservation education in CZ. This study could not take any references from Nepal and could not compare current result with previous one. As the study was dependent on questionnaire survey and interviews it was difficult to extract exact information. It was difficult doing questionnaire with old age people as they only speak their native language. In this study management challenges of only charismatic mammals are discussed.

2. LITERATURE REVIEW

2.1. Challenges of management of zoo

The study carried by Sekar et al. (2008) in Arignar Anna Zoological Park (AAZP) found that the presence of zoo visitors significantly influences the behavior of captive bison and also affects their welfare. They show more frequent resting when visitors were absent than they were present. They show significantly more moving behavior and aggressive behavior.

Concern to the welfare of captive animal is very important aspect where zoo exhibits play very important role. The study to investigate the relationship between exhibits naturalism, animal visibility and visitor interest was carried out by Davey (2006) in Chinese zoo, Beijing, China. Visitors interest in both naturalistic and barren exhibit designs was observe. The study showed that the visitor behavior at both exhibit designs was similar. The visitor interest is not compromised when animals become less visible at naturalistic exhibits. The study suggests barren exhibits can be transform to naturalistic exhibits without effecting visitor needs.

Animal spent most of their time in foraging habit. But in case of captive animal foraging behavior is totally restricted. So the zoo animal shows large amount of spare time. Feeding enrichment is one of the ways to increase activities of captive animal which is big challenge for zoo manager. The study carried by Koene (1999) show that most of the animal in captivity are passive due to easy food availability. The study was mainly focused on giraffe which show that they spend most of the time (49%) in feeding which was less than in nature. They spent more time in abnormal behavior that is tongue playing (25%).

Association of Zoo and Aquariums (AZA) cooperatively manage Species Survival Plan (SSP) program to maximize the genetic and demographic health and work toward long term population sustainability. To develop the SSP sustainability database AZA collaborated with hundreds of members of the zoo and aquarium community. After summarizing all 356 SSP programs the paper report 5 broad types of critical need. The first was additional space, 168 of 356 (47.2%) reported space as being necessary to achieve and maintain sustainability which was followed by husbandry (46.3%), Population import for genetic or demographic purpose (44.7%), Breeding and transfer recommendation fulfillment (33.17%) and lastly only 8.7% was for development and implementation of reproductive technologies (Wilson et al. 2019)

In contrast, zoo rescue the animals and forced to collect unwanted animals from public or other authorities. Receiving such animals is great burden and challenge for zoo. Zoos usually have limited space, limited budget. Animals that are donated by public may not be healthy and contaminated from different diseases. Accepting all the donated animals in zoo is big challenges for zoo (Cuaron 2005).

2.2. Role of zoo

Patrick et al. (2007) examined the mission statement of 136 zoos in the United States found that 13 mission statements has mentioned theme education and 118 mission statements mentioned about the theme conservation whereas 44 mission statements mentioned education in direct relation to conservation.

Carr and Cohen (2011) conducted the study on the image on the websites of 54 zoos spread across the UK (10), USA (24), New Zealand (3), Australia (7) Canada (6), South Africa (2), China (1) and Singapore (1). The result shows that zoo as an advertisement focused mainly as the place of entertainment. To the image carrying message of education and conservation also was connected with entertainment.

Endangered Species Act (ESA) have recovery plan for every listed species. There were 38 recovery plans that described 486 recovery actions for which zoos were responsible party. The conservation activities were categorized into 11 keywords. It includes Assurance population (36.1% of keyword), research (27.4%), population augmentation (23.5%) followed by population monitoring and assessments (12.4%) mitigating threats (1.7%), restoring habitat (0.9%), managing and planning (8.3%), education and outreach (7.5%), husbandry knowledge and veterinary care (7.1%), fundraising (4.5%). Compared to the conservation actions described in recovery plans North American zoos and aquariums reported different percentage of actions carried. They are mainly focused on research (25.2%) monitoring assessment (17.6%), population augmentation (16.0%) followed by managing assurance (12.7%), fundraising (11.3%), education and outreach (5.2%) and other keyword less than 3% (Castaldo et al. 2018)

Questionnaire survey was conducted at three Indian zoos, Arignar Anna Zoological Park (AAZP), Thiruvananthapuram zoo (TZ) and Shri Chamarajendra Zoological Garden by (Mallapur et al. 2008). The result shows that 64% of zoo visitors from all three zoos said that

zoo could help to protect wild animals. 20% of visitors from AAZP and 29% of visitors from TZ stated that main goal of zoo is to protect endangered species. The study suggests, zoo as the excellent learning environment to convey the message of conservation and education.

Zoo conducts various conservation programs for student. The programs are very much effective to the students. They get lots of knowledge and become much more aware in wildlife conservation. In the survey of students of elementary school (4th grade) and Middle school (7th grade) carried by Gianelloni et al. (2012) found that education given by zoo is much more informative than the education given in the schools. It was found that in the elementary school student's marks of posttest was 13% higher than pretest which was considered to be highly statistically significant ($t=8.27$, $p<.001$). Similarly, in middle school students 15% higher on posttest than in pretest which is highly statistically significant ($t=14.63$, $p<.001$).

The role of zoo has been changing from places of entertaining to education as the key role. Questionnaire survey was done in the Wellington zoo. The result shows that 79% of visitors prefer zoo as a place of education, 73% as a place of relaxation, 55 % as a place for conservation of animal, 46% as a place where visitors can see the animals entertaining them, 37% as a place of research. In the survey visitors perceived that zoo most important role was education, conservation and breeding animals (Mason 2007).

The study conducted on how people perceive role of today zoos shows very surprising result. 74.1% of respondent perceive conservation as the most important role of zoo followed by research role (49.1%) and education role (41.7%). surprisingly respondent perceive entertainment as least important role of zoo. Only 13.9% of respondent perceive entertainment as role of zoo (Reade and Waran 1996).

Tribe and Booth (2003) compiled the current literature review, interviews of zoo management in Australia and the United Kingdom, and ongoing survey of zoo managers, zoo staff, and zoo visitors. Zoo is not just the collection of captive wild animals for displaying to the public. World Zoo Conservation Strategy encourages zoos to support conservation both in situ and ex situ conservation approaches. In situ activities of zoo include endangered species rescue, habitat protection and restoration, reintroduction and supplementation while ex situ activities include the genetic management and captive breeding of threatened species, education and research.

Research Gap: There was very limited such survey carried on CZ of Nepal. No any articles were published on management challenge of animals in CZ, role of CZ in conservation education or evaluation of conservation education among the visitors. Hence, this is the first work in the field impact of conservation education of central zoo.

3. METHODOLOGY

3.1. Study area

Central Zoo (CZ) located at Jawalakhel, Lalitpur which is five kilometers (km) away from the main city Kathmandu. Geographically, it is located at 27.6731849°N and 85.3109334°E. It comprises of total six hectors of area. The CZ was established by late Prime Minister Juddha Shamsheer Jung Bahadur Rana in 1932 as his private property. With the political changes in 1950, the ownership of the private zoo came under the Government of Nepal (GON) and remained under the management of various government departments for many years. In December 1995, on the auspicious occasion of the Golden Jubilee Birthday celebration of Late King Birendra Bir Bikram Shah Dev, the GON formally entrusted overall management responsibility of the CZ to the National Trust for Nature Conservation (NTNC) for 30 years (NTNC-Central Zoo 2018).

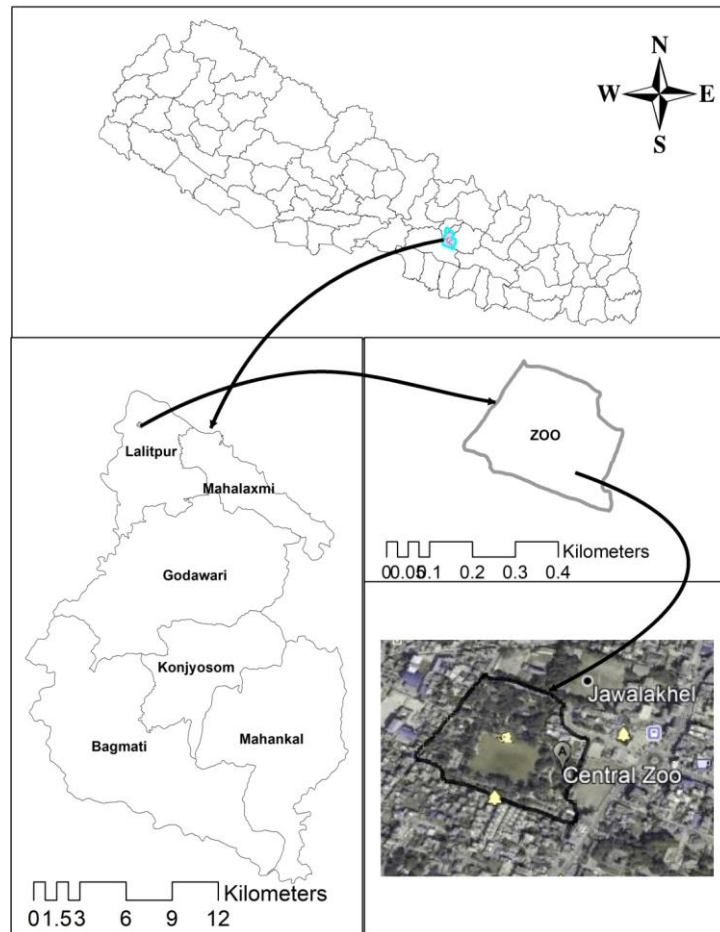


Figure 1: Map showing the Central Zoo in Lalitpur, Nepal.

3.1.1. Environment of the study area

CZ lie about 2 km away from the main city center 'Mangal Bajar' in Lalitpur district. On the Southern side, the big highway called a 'Ring Road' lie which is 2 km away. It links Lalitpur district and Kathmandu valley. CZ is located at center area where there is easy access to transportation from all over the valley. It is surrounded by heavy settlements.

On the left side of the main gate there is ticket counter. On the right side there is information and research center. Straight to the entrance gate of CZ there is three fountain and the statue of the sister in-law of late Prime Minister Judha Shumsher Jung Bahadur Rana named "Karana Kumari". Just behind the statue there is big pond whose area is about 2500 meter square where visitor enjoy boating. On the right of the statue there is small children park with different playing equipment such as slides, swings, funny temple, merry-go-round for children. There is big ground as picnic spot inside zoo.

3.1.2. Climatic condition of study area

Lalitpur district experiences a sub-tropical type of climate. The climate is mild and generally warm and temperate. The temperature varies according to season. Summers are very hot and winters are cold. Summer lasts from March to mid-June. Monsoon season lasts from mid- June to September. Winter lasts from December to February. In summer, there is much more rain than in winters. The average annual temperature is 17.8° C. The maximum temperature is on average 23.3° C and minimum around 9.8° C. The average annual rainfall is 1430 mm (Climate-Data.org)

3.1.3. Culture and practices

Newars are the dominant ethnic group of Jawalekhel, Lalitpur who have rich cultural and religious values. Jawalakhel is famous for the festival Rato Machhendra Nath Jatra which is also called Bunga Dyah Jatra. It last for a month. It is one of the greatest religious events in the city and the longest chariot festival celebrated in the country. The preparation of Jatra begins from Pulchok and the chariot is complete, the image of 'Bunga Dyah' from the temple is installed in it and the chariot is pulled by many people to different area of Lalitpur. Finally, after a month long procession chariot rich to Jawalakhel where the festival is concluded with the ceremony of 'Bhoto Jatra', the display of the Bhoto, a traditional Nepalese vest. Thousands of people visit Jawalakhel to enjoy Jatra. During that festival CZ is the most crowded as

maximum people visit zoo to have their lunch inside. That is also called 'Jawala Bhuwe' by Newari people where they eat their food inside CZ. Throughout the month of festival CZ is crowded with lots of people.

Inside CZ, there are three temples. In the temple 'Shri Harishankar Narayan Mandir' inside the zoo where some groups of Newar people visit every year to do their rituals show that CZ also have religious value.

One of the World heritage site Krishna Mandir is also located at Patan, Lalitpur. It is also religiously rich site. Many people from Nepal as well as from other country visit there for different purposes. This also makes CZ famous among different people as it is also located at Patan.

3.2. Methods of data collection

3.2.1. Questionnaire survey

Structured questionnaire survey was done to collect the data. Related questionnaire was prepared for the visitors to meet the objective 2 (Appendix III). Questionnaire was done on different time of day, on weekdays or weekends as number of visitor is very high in holidays. People with different age group including children, adults and old age were surveyed.

Questionnaire survey with visitors was done for fifteen days. Survey was done from 12 AM to 4 PM. Among the 400 questionnaire 12 questionnaires were not use for analysis as they were incomplete. Only 388 questionnaires were used for further analysis.

3.2.2. Key informant interview

Face to face interview was conducted with the staffs of CZ in order to meet the objective 1 and 3. The official information about the zoo management and conservation education were collected with the zoo officers Mr. Ganesh Koirala and Mrs. Lina Chalise. Challenges of central zoo related to foods, space, diseases, funding, and security of the animals were explored. Interview was also focused on the role of central zoo towards conservation, types of the programs they conduct, status of involvement of school, government and private sectors towards the conservation education.

3.3.3. Field Survey

Regular field survey was done. Unobtrusive observation was done in order to observe the unusual behavior of the visitors towards the animal. Any kind of unusual incident was recorded with photographs. Also direct observation was done while feeding animals.

3.3.4. Secondary data

The secondary data was collected from the different published articles, journals and comparison of total area, enclosure size, diet was done in order to evaluate status of central zoo.

3.3. Data analysis

Collected data was entered into Excel and the simple data analysis such as graph and pie chart was done using Excel and other statistical calculation was done using software PAST 3.25. To analyze if there's any relationship between tested variables the Pearson's Chi square test was used which is used to analyze the visitor's perception data (Balakrishna et al. 2013). For questions related to ranking the people perception Likert scale method was used.

4. RESULTS

4.1. Status and management challenges of mammal in Central Zoo

Altogether there was 1064 individual of 118 different species at CZ which includes 34 mammal species (266 individuals), 53 bird species (708 individual), 10 reptile species (34 individuals), and 21 fish species (56 individual) (Figure 2). Among 34 mammal species, 9 species were under protected list of NPWC Act 1973. Species of birds were highest followed by mammals. Most of the animals excluding primates were inactive and do not show any kind of interesting activities. Either they were just sitting, sleeping or eating. Only primates sometimes showed different activities like playing and jumping. There was no any record of animal escaping from zoo and records of visitor's injury from animal recorded in last few years.

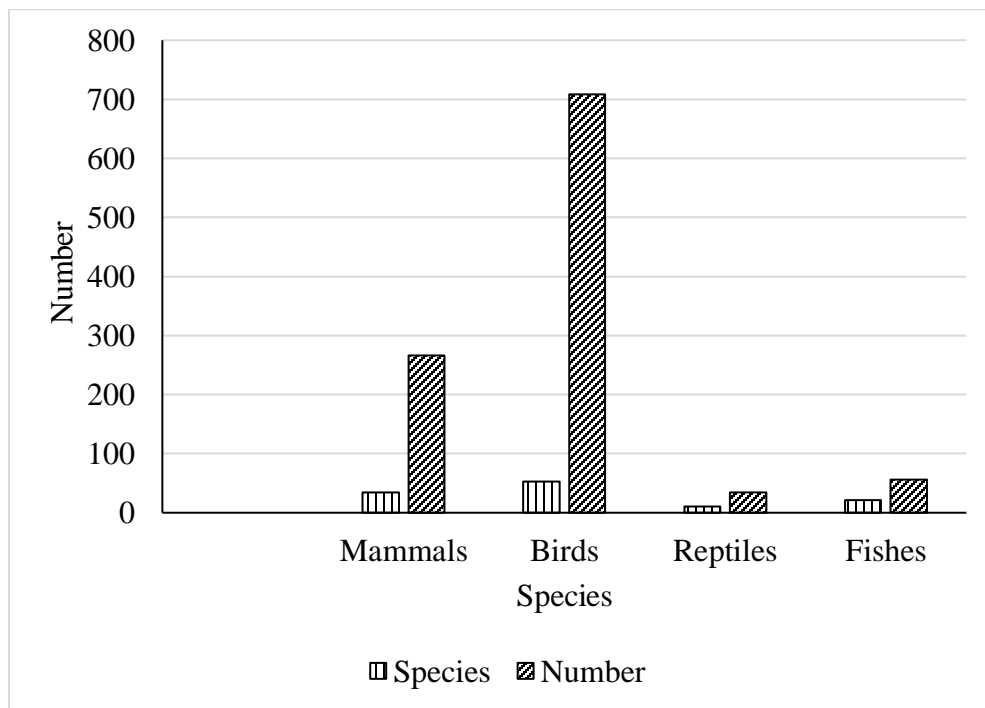


Figure 2: Number of species and individuals in Central Zoo.

Among 34 species of mammal, 6 species were endangered species and 7 were vulnerable species. (Figure 3). Among the captive mammals 85% (n= 29) were native and 15% (n= 5) were exotic (Figure 4).

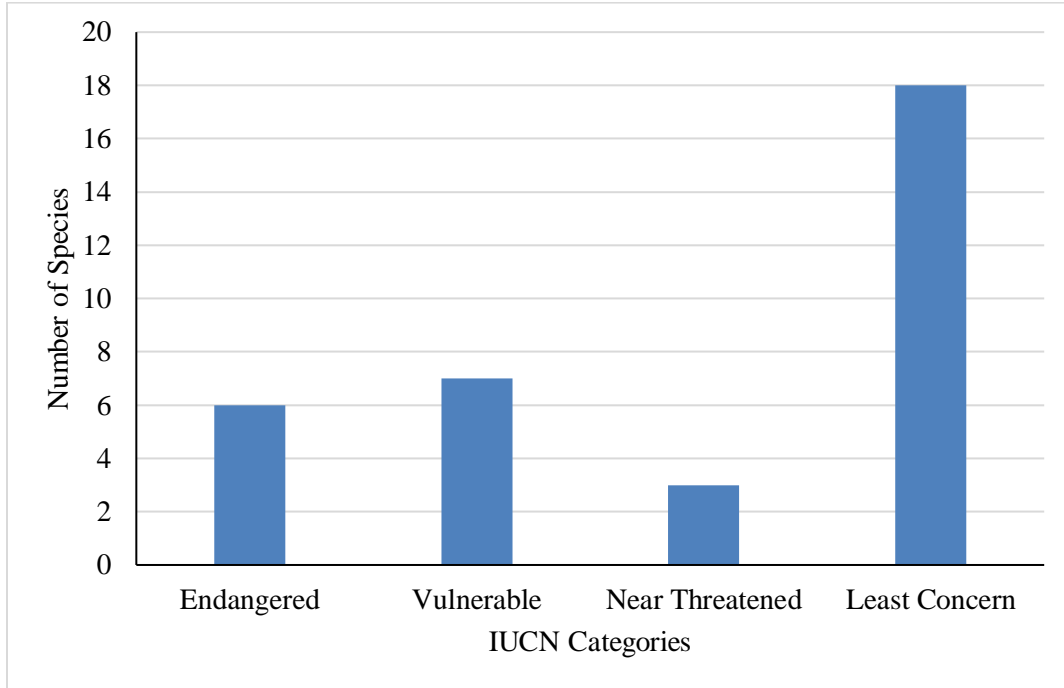


Figure 3: Status of mammal species according to IUCN Red List 2018.

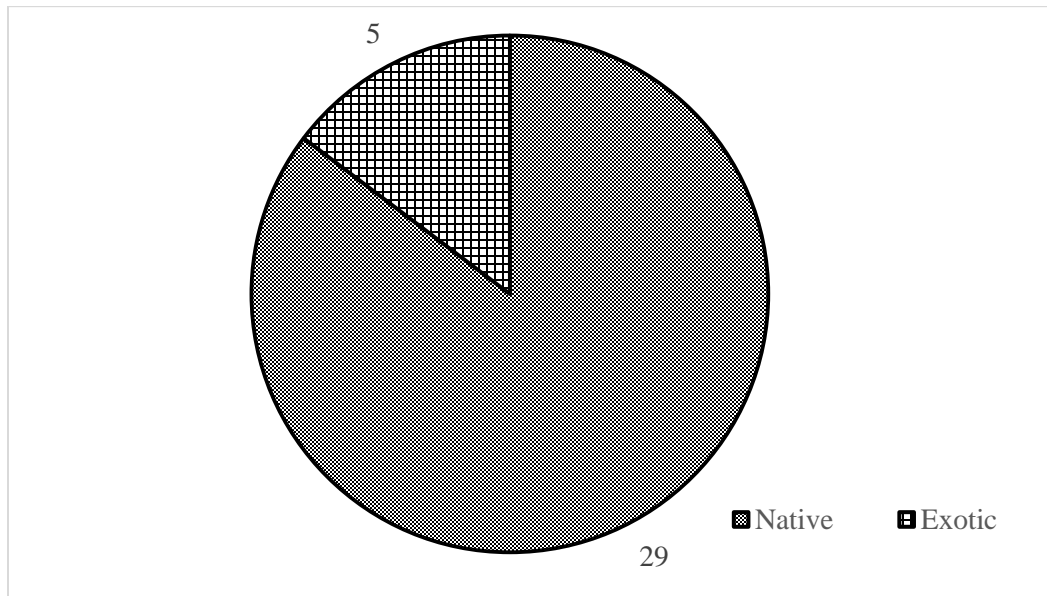


Figure 4: Native and exotic mammal species in Central Zoo.

Management challenges of central zoo

Zoo being an ex-situ conservation approach has lots of responsibility. It is the place for entertainment, conservation, research and education. Visitors have lots of expectation as they pay their money to visit zoo. Being the self-dependent organization it has to earn money by them self to meet all the expectation of visitors. Animal management outside their natural habitat is itself the great challenge for zoo. Concerns to the animal welfare are very important task of zoo. Zoo has struggled with the challenges and responsibility of managing ex situ population with goal of maximizing long term population sustainability (Wilson et al. 2019). Budget were allocated for different activities to solved the challenges (Figure 5). Challenges of zoo management were categorized into three major themes:

4.1.1 Animal management

4.1.2. Animal collection

4.1.3. Conservation Education

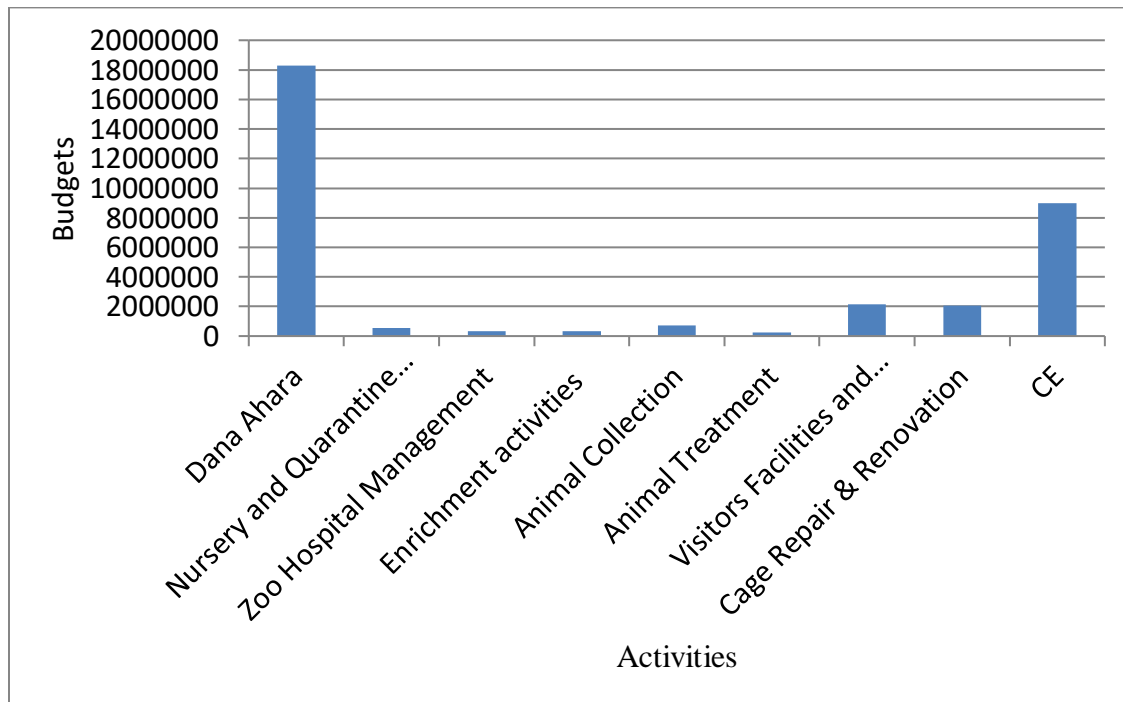


Figure 5: Budget allocated for different activities of CZ.

4.1.1 Animal management

Theme animal management includes area, shelter, food, disturbance, hygiene, diseases, facilities to visitors and also in situ conservation. Proper enclosure and nutritional foods to the captured animal is very important aspect for zoo.

Area

The total area of CZ was only six hectares. The area for zoo was comparatively very less than zoo of other countries. Area of Arignar Anna Zoological Park (AAZP) was 602 hectares (1490 acres) (Masterplan of AAZP, 2013-2023) and Indira Gandhi Zoological Park, India was 625 acres of land respectively. Similarly, area of Taipei Zoo, China is 165 hectares (Tsaour et al. 2007). Since total area is small it was difficult to manage enclosures/ cages of the animal. There was no sufficient space to add more species and individuals. In comparison to the total space, the space allocated to each specific species is sufficient (Personal communication with Ganesh Koirala, zoo staff)

Shelter

Due to small area of CZ the cages constructed for all animals were small. The shelter was congested and floor was dry and barren. The exhibit was monotonous and had no naturalistic features. Very few trees were planted. Presence of shed was insufficient. Animal had to suffer hard in hot sunny day as well as in rainy day. Overall condition is not satisfactory (Photographs appendix II). According to the requirement regular cage repair and renovation is carried in CZ. More than NRs. 20,50,000 (US\$ 17,804.25) is allocated for the repair and renovation of cages (Figure 5)

Cage type and various factors related to the complexity of enclosures were observed. The presence of utensils for food, bath pool, presence of sheds, tress, wooden log, kinds of substrate for some of the charismatic mammals were observed and tabulated in table 1.

Table 1: Checklist of Enclosure and cages of CZ.

S N	Species	Cage type	Presen ce of utensil of food	Availab ility of water bath	Kind of substrate	Prese nce of Shed	Presen ce of trees	Prese nce of tree log
1.	Primates	Open	Yes	No	Muddy	Yes	No	Yes
2.	Small ungulates	Closed	Yes	No	Muddy	Yes	Yes	No
3.	One-horned Rhinoceros	Open	Yes	Yes	Muddy	Yes	No	No
4.	Hippopotamus	Closed	Yes	Yes	Cemented	Yes	No	No
5.	Asian Elephant	Open	Yes	Yes	Muddy	Yes	Yes	No
6.	Himalayan/ Sloth Bear	Open		Yes	Muddy	Yes	No	Yes
7.	Royal Bengal Tiger	Open	No	Yes	Muddy	Yes	Yes	No
8.	Leopard	Closed	No	No	Muddy	Yes	No	Yes

Enclosure size: The enclosure size of the selected mammals was compared with the enclosure/ cage size of Lahore Zoo of Pakistan, AAZP of India and Central Zoo Authority (CZA) of India. The enclosure size varied for each species and is tabulated in table 2. The enclosure size of all selected species was insufficient except the enclosure/ cage size of Royal Bengal Tiger.

Table 2: Enclosure/cage size of CZ with comparison to Lahore zoo, AAZP, CZA of India.

SN	Species	Enclosure/cage size of CZ (Sq. m)	Enclosure/cage size of Lahore zoo (Sq. m)	Enclosure/cage size of AAZP (Sq. m)	Standard zoo enclosure by CZA of India (Per pair) (Sq. m)	Status
1	Primates	92.90	645.19	900-2000	500	Insufficient
2	Four-horned Antelope, Spotted Deer, Sambar Deer, Black Buck, Barking deer, Blue Bull, Blue Sheep, Himalayan Goral	538.83	111.48-371.61	1000-3500	1500	Insufficient
3	One horned Rhinoceros	1161.28	3624.79	6139.5	2000	Insufficient
4	Hippopotamus	334.45	3624.79	3949.55	1000	Insufficient
5	Asian Elephant	139.35	3624.79	87477.59	5000	Insufficient
6	Himalayan/Sloth Bear	176.51	320.32	1000-2000	1000	Insufficient
7	Royal Bengal Tiger	1282.06	379.88	7408.65	1000	Sufficient
9	Leopard	120.77	152.91	263.32	500	Insufficient

Source: Personal interaction with Senior Curator and Hussain et al. (2015), Master plan of AAZP (2013-2023), Guidelines by CZA (2012).

Food

Zoo tries to offer not only nutritionally sound diet but also one which replicate essential characteristics of natural diet. There was no laboratory test of the nutritional diet in CZ but they make sure that the foods they buy are fresh and healthy. Regular feeding according to the diet with written time table was practiced. Amount of each food was in hand written form. In case of primate's foods were sometime hidden in the grasses so that they get busy in finding the food.

Mainly concentrated food was given to the animals. For ungulates, according to the requirement of animal, concentrated food was prepared which was the mixture of maize, gram, soyabean, chokkar, sattu, shakkar, salt and minerals. Fruits and vegetables like banana, apple, cabbage, carrots, green seasonal grass and straw was also given. Diet was similar for all ungulates only the amount varied with species size and nature. The major diet for carnivores was buff meat. The diet of primates includes gram, peanuts, and fruits (Table 3). CZ allocated maximum budget NRs. 18300000 (US\$ 158,935.50) for food of animals (Figure 5).

The diet or food was given to the ungulates twice a day, to primates 6-7 times per day, large mammals like Rhinoceros, Hippopotamus, Elephant were fed for 5 times per day and the carnivores were fed just once a day.

Table 3: Diet provided to the animals in CZ with comparison to Lahore zoo and South Asian standards.

S N	Species	Diet provided at CZ	Diet provided at Lahore zoo	South Asian Standards	Status
1.	Primates	0.2gm of peanuts Fruits and vegetables Eggs and bread	1-2 kg of fruits, 2-3 chapatti	2-3 kg fruits 2-3 chapatti Sugarcane	Sufficient
2.	Ungulates	2-6kg concentrated food 1-2 kg straw Additional seasonal grass	5-10 kg fodder, 200-500 gm 200-350 gm Daal channa	2-3 kg concentrated food 3-5 kg green fodder, fruits and vegetables Mineral and iodine	Sufficient
3.	One horned Rhinoceros	7.5kg concentrated food with salt and mineral 5kg straw 7.5 kg fruit and vegetable. Additional seasonal grass	Data Deficient		
4.	Hippopotamus	7 kg concentrated food 2 kg straw 18 kg fruits and vegetables Seasonal grass	20-30 kg fruits, 120-160 kg fodder	5-7 kg concentrated food 50-100 kg green grass Vegetables and fruits	Sufficient
5.	Asian Elephant	5.5 kg concentrated	20-30 kg fruits 3-10 chapatti	3 kg sugarcane, 100 kg fodder, 10 kg Jaggery (gur),	Sufficient

		food with salt and minerals	150-250kg fodder	10 kg fruits, 10 kg flour, 1/2 kg salt	
		10 kg straw	1-5 gm Parched		
		12 kg fruits and vegetables	grams 2-5 kg javi, 1-5 kg		
		Seasonal grass	oats		
		1.5 kg fruits and vegetables	6-7 kg fruits	250 gm chapatti of gram flour, 2 liters of milk, 500 gm rice, fruits and breads.	
6.	Himalayan/Sloth Bear	1 kg bread, 1 egg	1.5-2 kg chapatti		Sufficient
		1.5 liters milk			
7.	Royal Bengal Tiger	6.5 kg buff meat per individual	Data deficient		
8.	Leopard	4.5 kg buffalo meat per individual	4-5 kg beef 3 half kg of milk	4-5 beef or mutton 1/2 liters of milk	Sufficient

Source: Personal interaction with Senior Curator and Sikander et al. (2015)

Facilities provided by CZ to visitors

The entrance fee collected from visitors is the main source of income in zoo (Table 6). Hence, the authority has both responsibilities of management of zoo animals and manage the facilities of the visitors. A total of 74 staffs involve for the zoo management (Table 5). It allocated NRs 21,30,000 (US\$ 18,499.05) budget for visitor facilities and infrastructure development. Different facilities that has been provided by CZ to visitors is shown in table 4. From the personal interaction with the visitors of the zoo found that the visitors were not fully satisfied with the facilities such as drinking water, toilets, benches during rainy season provided by CZ.

Table 4: List of facilities provided by CZ.

Zoo facilities	Quantity
Lake	1
Boating – Rafting	1
- Paddle boat	7
- Duck boat	2
Toilet	3
Fountain	3
Children Park	1
Temple	3
Statue	2
Drinking water	2
Picnic spot	2
Information and research center	3
Animal hospital	1
Fish aquarium	1
FOZ membership center	1

Table 5: Key Employees of CZ.

Employees	Number
Project Manager	1
Curator	1
Administrative officer	1
Account officer	1
Conservation officer	1
Assistants	21
Veterinary doctor	1
Zoo keeper	24
Helper/ Guard	23

Table 6: Ticket fee for visitors.

Categories	Price (NRs)
Adult (Nepali)	150
Student (Nepali)	90
Children (From 4-12 yrs)	50
Adult (Foreigner)	750
Children (from 4- 12 yrs)	375
<u>Filming</u>	
Video and documentary filming	15,000
Feature filming	25,000
<u>Fishing</u>	
Nepali and Foreigner	1000
FOZ members	500
<u>FOZ membership fee</u>	
Nepali student	200
Nepali Family (4 members)	600

Disturbance

CZ is located in the heart of highly populated urban area. At the time of the establishment of CZ the city was not urbanized but with increasing urbanization CZ is facing the great challenge in animal management. Most of the animals kept in zoo are rescued and carried from their natural habitat, hence they obviously felt disturbed when they are kept in the enclosure. The crowd of the peoples, houses, vehicles and the stalls all around the CZ and the high flow of visitors in weekday, holidays and festivals also disturbed animals.

Hygiene/Disease

Zoo animals are in close enclosure and are not exposed to outer environment hence there is less probability of being infected by any kinds of diseases. They were always given a special care. CZ takes serious care in hygiene of cages. They use kohrsoline and vircone spray for ensuring the disinfection of the surfaces. They also use lime dust around to avoid bad smell. CZ practices de-worming to all species in every six months. They do vaccination to the species only when they are suspected to any diseases. They used to vaccinate all species few years back but now vaccination is opportunistic. Animals are vaccinated according to their requirement. When any species are rescued from wild, first they are kept in quarantine where they are given a special care. No one is allowed to go and see animals except the expert. Well-skilled separate keepers are responsible for caretaking of those species. They observed the animals then go to further vaccination programs only if needed.

Facilitate in situ conservation

CZ does not have any written policies for direct in-situ conservation. It indirectly contributes to in situ conservation through conservation education. But occasionally zoo conducts some programs such as translocation. It has translocated wild water buffalo to CNP and Black buck to Suklaphanta NP. Through its conservation education programs, it aware public about the importance of biodiversity. They conducted regular conservation programs at buffer zone area of Shivapuri Nagarjun NP to educate and aware the public.

4.1.2. Animal collection

The main source of animal collection in CZ was rescue, national priorities and zoo priorities. Most of the animals in Central Zoo were rescued from different part of country. During the

process of illegal wildlife trade many species were rescued by central investigation bureau (CIB) and Nepal police who were ultimately brought to zoo. Different species like Mona monkey, Vervet monkey, Patas monkey, ringed tailed lemur were rescued from illegal wildlife trades. Those species which are injured or orphan which cannot survive in the natural habitat again, the CZ provide the shelter for them where they get special cure and can survive. National priorities species such as Dhaphe is mostly liked and demanded by public hence CZ planned to collect those species to zoo. Zoo priorities includes those species which are especially unpaired. The target of animal collection will be for making species paired for mating and breeding. This year CZ plans to collect Swamp deer, Sambar deer, Blue bull, Blue sheep, Goral, Assamese monkey, Gharial, Dhaphe, Monal, and Aquarium fishes. The main objective for collection of these species is to make pair of unpaired species.

Zoo has skilled well equipped manpower with veterinary doctor for animal collection. There were two ambulances for transportation of animal from different parts of country. Many exotic species used to be gifted from different countries before but nowadays these things are very less in practice. Animal collection is big challenge for zoo.

4.1.3. Conservation education

Being an ex situ conservation approaches, conservation education is the most important part of zoo. It is one of the biggest challenges for zoo to educate, aware and attract public towards wildlife conservation. Zoo had been conducting various programs for educating and to aware public. CZ specially focused on school students. It has special facilities of FOZ membership. Altogether there were 138 schools being member of FOZ. CZ have big responsibility of bonding these all schools into one single group and making them part of programs. It also conducted program of student exchange from different country. CZ allocated budget of NRs. 8995400 (US\$ 78,125.05) in conservation education.

4.2. Conservation education among visitors

Altogether data of 388 respondents was used for analysis. Among them 47.93 % (n= 186) were male and 52.06% (n= 202) were female. Respondents were maximum of school level students 66.23% (n=257) including FOZ members (n=120). The highest number of respondents were from age group 18-59 (n=190) followed by age group below 18 (n=175). Respondents were also analyzed on the basis of locations.

Table 7: Detail of the respondents.

Categories	Frequency	Percentage	
Gender			
Male	186	47.93	
Female	202	52.06	
Education			
Uneducated	27	6.95	
School level	257	66.23	FOZ=120, 30.92%
Bachelor	66	17.01	
Above	38	9.79	
Age			
>18	175	45.103	
18-59	190	48.96	
<59	23	5.92	
Location			
Inside valley	287	73.96	
Outside valley	89	22.93	
Foreigner	12	3.09	

From the analysis of questionnaire survey, 85% (n=329) has visited zoo before and 15% (n=59) was visiting zoo for the first time. Maximum visitors 49.22% visit zoo in every 2/3 year and 31.44% visit zoo once in 6 months to 1 year (Figure 6).

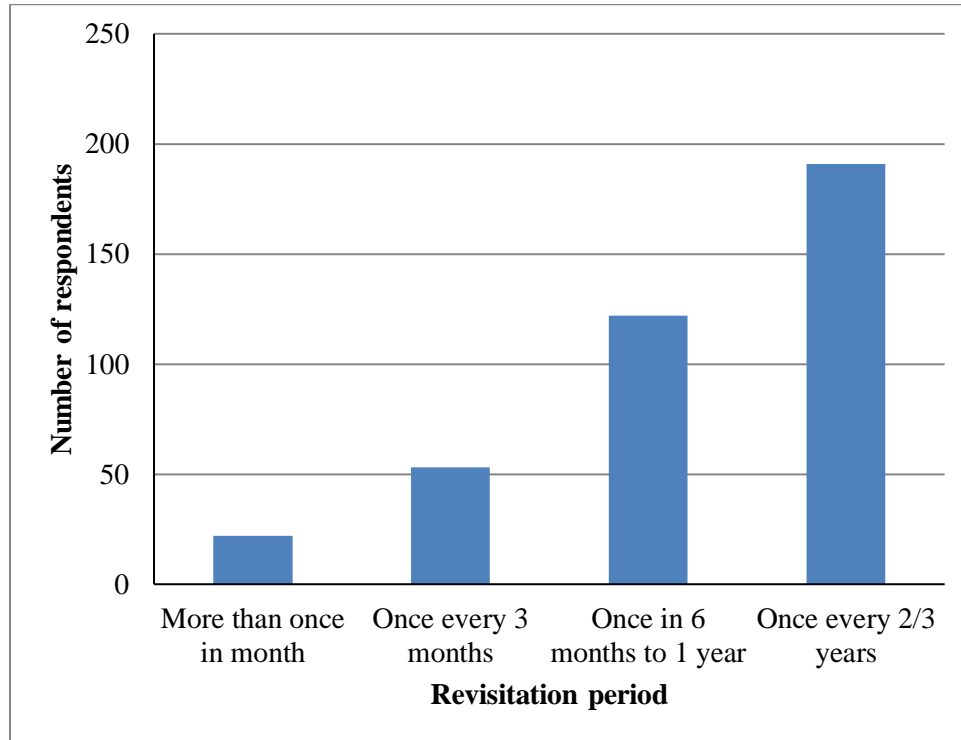


Figure 6: Re-visitation period of visitors.

There is significant difference between visitors from inside valley and outside the valley ($\chi^2=29.33$, $df=3$, $p<0.001$).

Analyzing the response of FOZ, it was found that highest reason to visit zoo was for opportunity to feed animals, 2nd rank was to educate themselves about the endangered species, 3rd rank was given to close encounter with wild animal and 4th and 5th was given to know about endangered species and for my enjoyment respectively. The responses of non FOZ visitors shows that 1st rank is close encounter with wild animal, 2nd to know about the endangered species, 3rd rank was given for my/children enjoyment, 4th and 5th was to educate themselves or children about endangered species and for opportunity to feed animals (Table 8, Figure 7). There is significant difference between FOZ and non FOZ visitor's responses in influences to visit zoo ($\chi^2=80.608$, $df=4$, $p=0.0001$).

Table 8: Response from FOZ and non FOZ visitor

	FOZ (rank)	Non FOZ (rank)
A	348 (4)	895 (2)
B	309 (5)	856 (3)
C	366 (2)	817 (4)
D	365 (3)	899 (1)
E	412 (1)	553 (5)

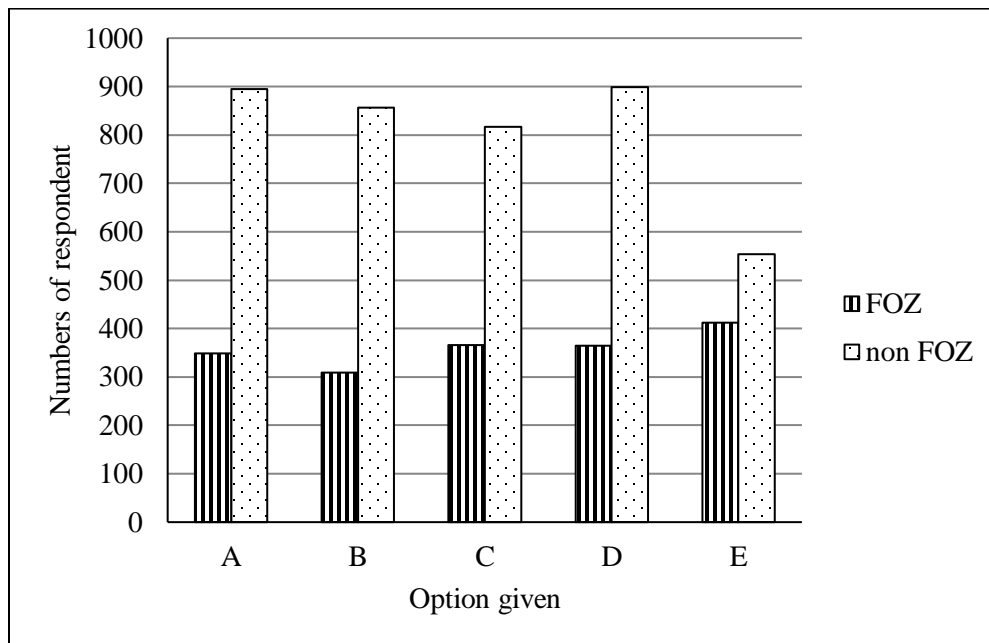


Figure 7: Influence of FOZ and non FOZ visitors to visit zoo.

Option A represent to know about endangered, option B represent for my/children enjoyment, option C represent to educate themselves/ my children about endangered species, option D represent close encounters with wild animals, and option E represent for the opportunity feed animals

Visitors ranked the option into top priorities that zoo should focused. The first priorities that zoo should give according to visitors is caring for animals, 2nd is educating the public about conservation issues such as threatened species, 3rd is to providing opportunities for visitors to see wild animals, 4th is to breed endangered animal to the zoo and 5th is to providing fun day out for the public/ picnic spot (Figure 8).

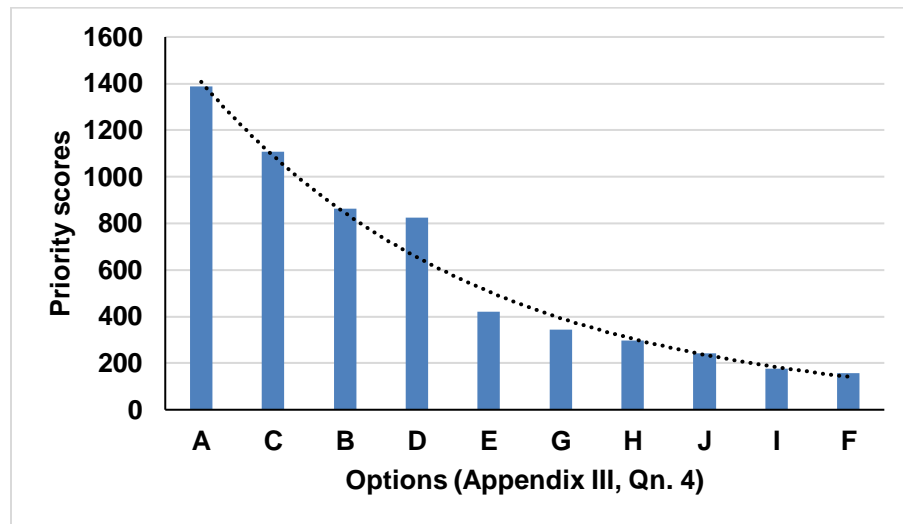


Figure 8: Top ten priorities zoo should give according to visitors.

Option A represent caring for animal in the zoo, option B represent providing opportunities for visitors to see wild animals, option C represent educating the public about conservation issues such as threatened species, option D represent breeding endangered animals in the zoo, option E represent providing a fun day out for the public/picnic spot, option F represent reintroducing endangered animals into the wild that were bred in zoo, option G represent carrying out and supporting conservation projects outside of the zoo to conserve wild animals, option H represent providing expert training for keeper/staff/conservationists, option I represent donations to conservation organizations/ project, and option J represent scientific research.

In the study, 69.32% (n= 269) were involved in some kinds of conservation project and 30.67% (n= 119) were not involved in any kinds of conservation projects or groups. There were no significant differences in involvement in any conservation project between male and female ($\chi^2= 0.023$, df =1, p= 0.877). Participation of both male and female into conservation project was similar. Analysis of respondent shows that 61.34% (n= 238) of visitors were aware that zoo contribute to conservation and 38.65% (n=150) were unaware. The visitors include 30.92% (n=120) FOZ members among which 21.90% were aware that zoo contribute to conservation and 9.02% answered they were not aware that zoo contribute to conservation. Interpretation of result show there was no significant difference ($\chi^2= 3.711$, df=1, p=0.054) between FOZ and non FOZ visitors about zoo contribute to conservation. Among all the respondents, 59.79% (n=232) does not know about the different conservation programs conducted by CZ and 40.20% (n=156) know about the conservation programs conducted by the CZ (Figure 8). There was significant difference ($\chi^2=35.64$, df=1, p< 0.002) between FOZ and non FOZ visitors in context of conservation programs conducted by CZ. In the question relating to the satisfaction of the visitors towards the conservation programs carried out by CZ, 37.62% (n=146) are neutral 31.18% (n=121) are satisfied 21.64% (n=84) are very satisfied and 9.53% (n=37) are unsatisfied. Among the 30% of FOZ members 8.50% (n=33) are very satisfied, 14.43% (n=56) are satisfied, 6.70% (n= 26) are neutral and only 1.28% (n=5) answered they are unsatisfied (Figure 9).

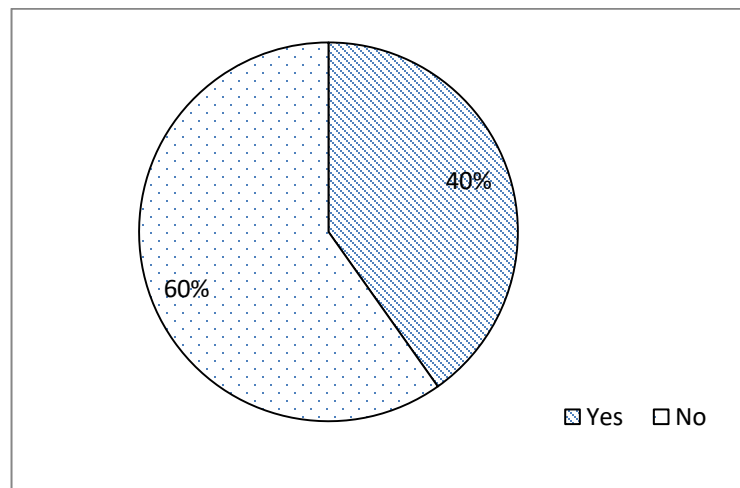


Figure 9: Percentage of respondents who were aware about conservation programs to be conducted.

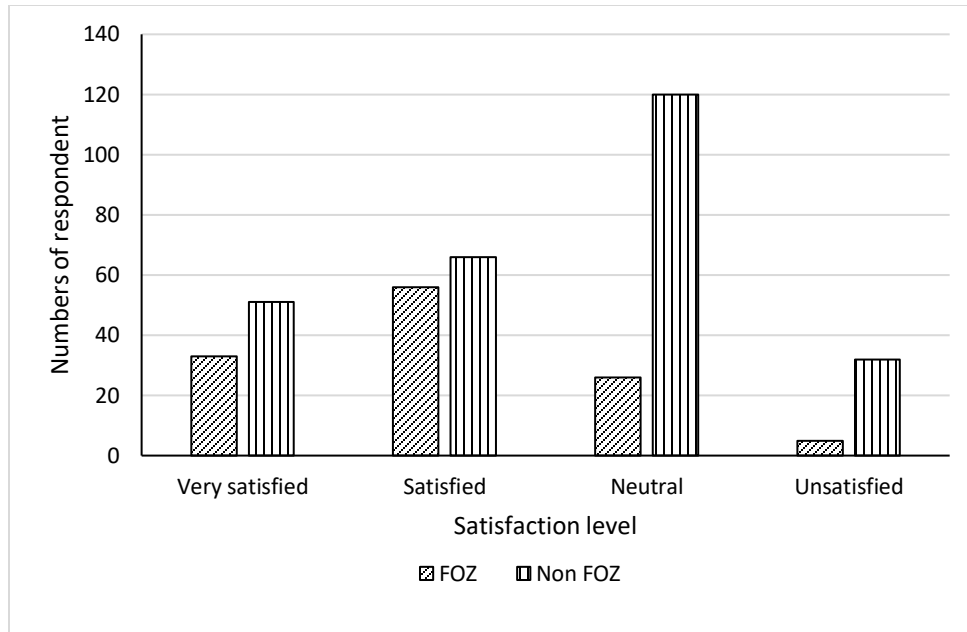


Figure 10: Satisfaction of FOZ and non FOZ members towards the conservation programs.

Analysis of the question, relating to difference between priorities of visitors and priorities given by CZ showed that 32.73% (n= 127) answered Yes and 29.12% (n=144) answered No to the question and 37.88% (n=147) answered don't know. Most of the visitors answered that zoo should work on needs of both the animals as well as visitors equally (Figure 11)

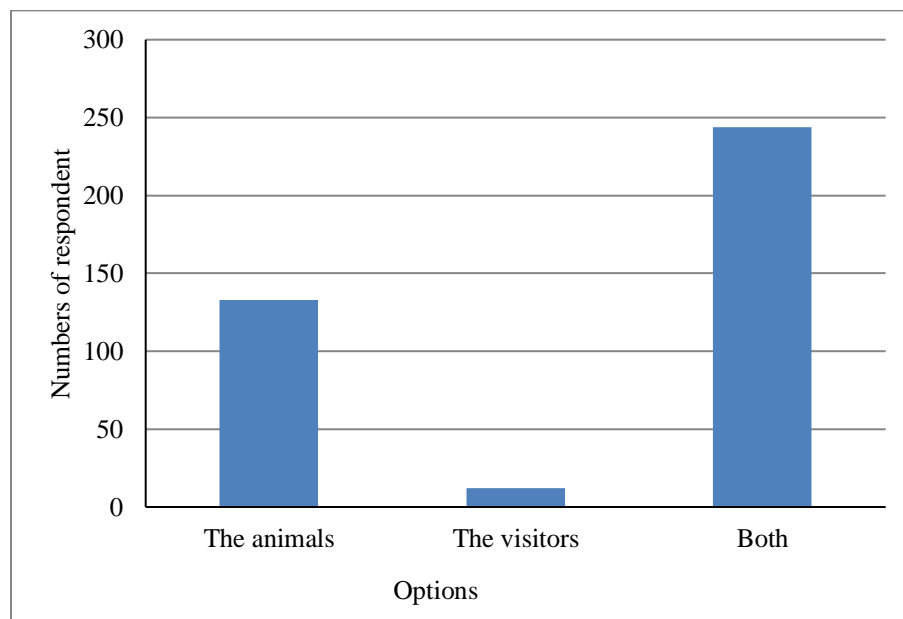


Figure 11: Priorities should be given by zoo according to visitors.

Very low number of visitors answered they read signboards regularly. Only 12% in total surveyed visitors always read the signboards and 28% never read it.

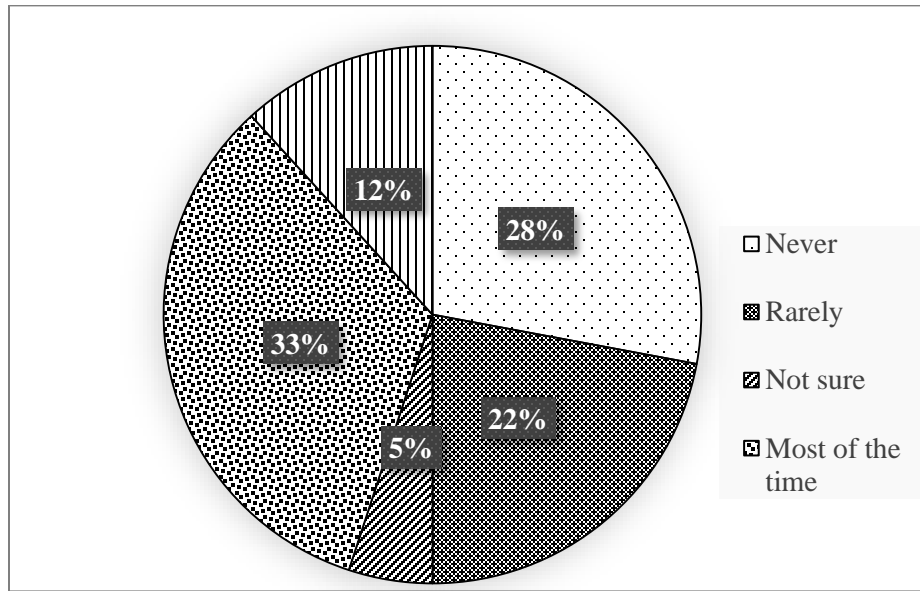


Figure 12: Percentage of visitors who read the signboards.

Among the total surveyed respondents, 56% feel that zoo will gain importance as more species become endangered. Only 3% of surveyed visitors said zoo will eventually will banned.

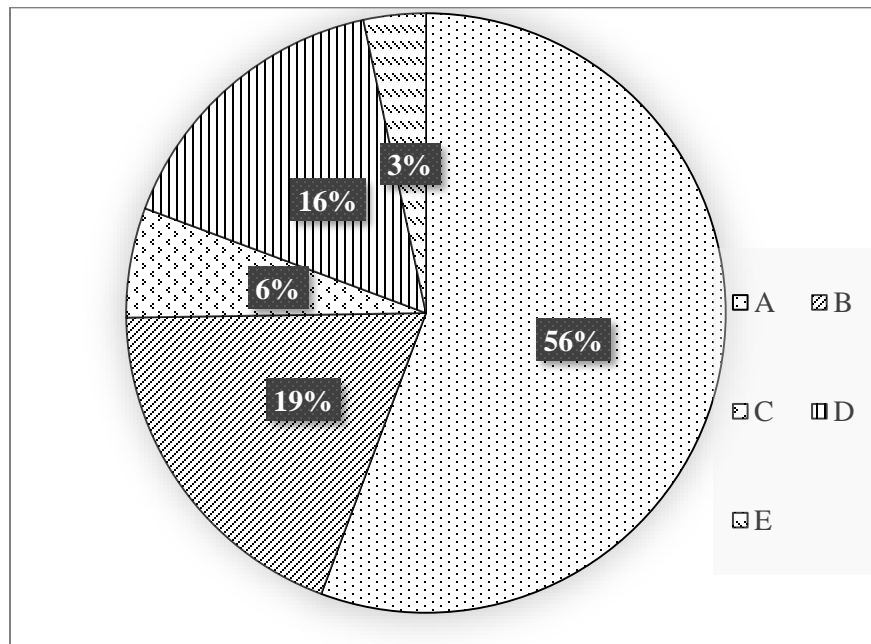


Figure 13: Visitors prediction on the future of CZ.

Option A represent they will gain importance as more species become endangered, option B represent they will continue as they are, option C represent they will release all animals into wild, option D represent they will start focusing more on the needs of visitors, option E represent they will eventually be banned.

4.3. Role of Central Zoo in conservation education

The role of Central Zoo is not only to care animals but also to provide knowledge of biodiversity, its importance and aware people for the conservation. It not only displays animal for entertainment but also give knowledge to the people. CZ conduct various programs to aware public specially students. CZ provides FOZ membership cards. A total of one hundred eightythree schools are registered as the members of FOZ including thirtyeight government schools. Every year CZ provides free membership of FOZ to five government schools and five schools located inside the buffer zone of Shivapuri Nagarjun NP. It conducts different programs for FOZ members. CZ celebrates all the important days related to biodiversity.

- World Environment Day
- Global Tiger Day
- World Elephant Day
- World Wetland Day
- World Rhino Day
- World Panda Day
- World Earth Day
- World Wildlife Week
- Global Pangolin Day
- International Vulture Awareness Day etc.

They organized different competition on hot topic relating to biodiversity. Following are the interactive learning competition conducted by CZ.

- Essay competition
- Drawing competition
- Quiz competition
- Poem competition

- Mosaic competition
- Sports for conservation

They also conduct various programs/ campaigns/ trainings to educate student so that they get familiar with the problems and the way of protecting biodiversity. Following are the programs conducted by CZ.

- Animal feeding programs
- Climate change awareness programs
- Solid waste management programs
- Day with vet
- Bird watching programs.
- Night guided tour
- Educational tour to different NP and museum.
- Conference

CZ also organized student exchange program where students from Nepal visit zoo of different countries and vice versa where they shared their knowledge of different biodiversity, present issues, and measures of conserving it.

5. DISCUSSION

5.1. Status and management challenges of Mammal in Central Zoo

The area of CZ was only six hectares which was comparatively very less than zoos of other countries but CZ of Nepal gives shelter to only 118 species with total 1064 individuals. But the AAZP with area of 602 hectares provided shelter to 2,553 species of flora and fauna. The total number of species was also comparatively low than other countries. The enclosures for all species were small and traditional. In the survey done by Wilson et al. (2019) suggested additional space as the first critical needs for species survival plans. The floor was barren and dry. There was no any grasses or bushes inside the cage of ungulates which prefer to live in grassland. This might be because of wrong timing of study period. The reconditioning and reconstruction of the cages was going on during study period. As animal welfare is an important aspect naturalistic exhibit for animal is very essential but naturalistic exhibit may affect the visitors as they pay money for viewing animal. In case of naturalistic exhibit animal might hide themselves or may not be easily seen. The study done by Davey (2006) suggested that visitor needs and interest can also be fulfilled at naturalistic exhibit as visitor interest are not compromised in both type of exhibit. The study conducted by Tan et al. (2013) concluded that the activities and the behavior showed by bear was affected by the size and complexity of the enclosure. Result interpreted that only the size of enclosure of Royal Bengal Tiger in CZ is appropriate with comparison to international zoos. There was presence of all the requirements inside enclosure such as ample shades, water pool in tiger enclosure. Pitsko (2003) also concluded that enclosure for tiger should be large with natural substrate and vegetation, water pool and ample shade.

Food is another big challenge for zoo manager as diet is the vital requirement of all living beings. CZ provides concentrated food for herbivores animal with some additional diets. Diet is main aspect for animal behavior. In the study most of the animals of CZ seems to be inactive except primates. Animal spend their most of time foraging in wild but in case of captive foraging behavior is restricted hence animal look inactive or show some unusual behavior (Koene 1999). But in case of primates, though the enclosure size is not appropriate they are active and showed different types of behavior such as playing, foraging, jumping. This type of active behavior might be because in CZ primates were feed for 5-6 times a day and food are

scattered and sometimes hide so that monkeys spend their time for finding food. Hennessy et al. (2014) recommended that cage size does not have a noticeable impact on habitual kinds of abnormal behavior in rhesus monkeys. Vaccination to the animal is only opportunistic i.e. only when required because the cost for vaccination is very high as animal needs to be darted for vaccination and also when normal animals are pre-vaccinated then species lose their self-defense ability.

5.2. Conservation education

Number of school students was highest respondent in questionnaire survey. This might be because zoo is the first priority of school student as it provides entertainment as well as education about wildlife and their habitat. This might also be due to the FOZ membership which was mainly focused to the school students. Total 183 schools are engaged with zoo with thousands of student being member of FOZ. Also during the survey period, it was world environment week celebration going on hence number of student were high. The result shows that highest percentage of visitors were from inside valley. Visitors from outside valley and from other countries were comparatively low. Central zoo was located inside valley hence many visitors were from inside valley and people from outside valley may not give first priority to visit zoo rather they might prefer some cultural, traditional or world heritage sites.

From the analysis of study, we found that more than half 85% of people revisited zoo it suggested that CZ is being successful in some way to attract visitors through their different activities on regular basis. The major four theme of zoo are entertainment, research, conservation and education. The survey result showed that visitors ranked education to the higher priorities than enjoyment. The concept of zoo among visitors is being slowly changing from entertainment to education and conservation. The similar result has been found by Reade and Waran (1996) where the visitors has ranked conservation as role of zoo to top category and entertainment to least important category. This showed that zoo played very important role in changing people perception towards captive animals. Among the visitors there was significant difference between the response showed by FOZ and non FOZ visitors. FOZ ranked entertainment to the last while other visitor ranked it to 3rd position and FOZ ranked feeding animal to 1st position while other visitors ranked it to last. This might be because CZ conducted animal feeding program only to FOZ member while other visitors are strictly prohibited to feed

any animal inside zoo. Feeding programs for FOZ member is also most prioritized programs by CZ

CZ allocated large amount of budget about NRs. 8995400 (US\$ 78,125.05) for conservation education but still large number of public were unaware about the conservation programs conducted by CZ. Among the surveyed visitors 59.79% were unaware about the conservation programs conducted by CZ. This is the big challenge for CZ. This might be because of lack of advertisement. Also perception of the visitors towards conservation education might be different from concept of CZ. CZ has kept signboards outside the cages of each species, two display board where information of all species of CZ were displayed, well computerized information and research center has been established with the main aim of educating the visitors. Only 12% of visitors always read signboards while other visitors do not care about the boards or only read it sometimes The reason for more number of visitors to be unaware about the conservation education programs might be because conservation education programs are not in their priorities or might be because they feel only the special classes where expert explain and share information in one closed room as the conservation education.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1. Conclusions

This study had tried to analyzed the challenges in management of animals in CZ, and role of CZ in conservation education among visitors. With the regular visit to CZ, interviews with the zoo staff and the questionnaire survey with the visitors, the condition of CZ and conservation education among the visitors were evaluated. Based on the regular direct observation and interviews, this study found that there are various challenges faced by CZ in managing the animals. The most challenging is area of CZ and diet given to the animals. For the proper management of the animals in CZ increase in the total area of zoo is required. Only with the increase in the total area, management of the proper cages for the individual species is possible.

Zoo has been conducting the various programs for educating and to aware public. They specially focus on the school students and FOZ members but other visitors are being neglected. Half of the visitors surveyed who are not FOZ member are not aware about any kinds of conservation programs conducted by the CZ. Hence, more programs focusing to all types of visitors with some sorts of advertisements are required.

6.2. Recommendations

On the basis of this study for the improvement of CZ following recommendation are suggested. These recommendations are mainly focused from the complains of visitors while doing questionnaire survey.

6.2.1. Recommendations for improvement of CZ

CZ needs to improve and try to meet the standard international level. Traditional barren exhibits should be now changed into naturalistic exhibits so that animal feels homely and could spend their time on foraging and show some usual behavior rather than unusual behavior.

- Rapid reconstruction and renovation work should be done.
- More new species should be added. Exotic species like Lion, Kangaroo should also be included.
- Regular cleanliness of cages as well and surrounding should be done to minimize the animal smell. Pond inside zoo is also in bad condition due to eutrophication. Regular cleanliness should be conducted.

- Strict plastic checking should be done and not only plastic bag any product with plastic should be strictly banned.
- Facility of restaurant inside CZ should be provided.
- Zoo keepers for each animal section should be added and they should be more active to give information about those animals as many visitors are not educated and cannot read the signboards.
- Special facilities for disable visitors should be taken given.

6.2.2. Recommendations for conservation education

The study shows that the conservation education is limited only to school students who are FOZ members. Unlike them most of other visitors are even unknown about CZ contributing in conservation of animals and conduct conservation programs. Therefore, CZ should also focus on non FOZ visitors. Weekly programs with some advertisement should be done. Also providing pamphlets to visitors giving some information about CZ, captive animals, their importance in nature could help in educating non FOZ visitors. Education awareness programs should be added and should be more generalized among the public. Not only inside valley but education programs should be also extended to other parts of country.

6.2.3. Recommendations for researchers

Challenges management of only few species is discussed in this study. Researcher can conduct further research on challenges in management of animals in CZ in detail as all species are equally important.

6.2.4. Recommendations for new zoo

The area of the new zoo should be increased than the old one and the enclosure/cage size of each species should be larger and should meet the international standard enclosure size. The diet provided to the captive animal should be well planned with nutritional test. More species of exotic animals can be added to attract the visitors. View tower at the center can be constructed so that visitors can observe all the species from top.

7. REFERENCES

- Balakrishnan, N., Voinov, V., and Nikulin, M.S. 2013. Chi-squared goodness of fit tests with applications. Academic Press.
- Bonal, B.S., Sharma, S.C., Patnaik, S.K., Gupta, B.K., Dogra, A.S., Bharucha, E., et.al, 2012. Guidelines on minimum dimensions of enclosures for housing exotic animals of different species.
- Braverman, I. 2014. Conservation without nature: the trouble with in situ versus ex situ conservation. *Geoforum*, **51**, 47-57.
- Brewer, C. 2002. Outreach and partnership programs for conservation education where endangered species conservation and research occur. *Conservation Biology* **16**(1): 4-6.
- Carr, N., and Cohen, S. 2011. The public face of zoos: images of entertainment, education and conservation. *Anthrozoos*, **24**(2): 175-189.
- Che-Castaldo, J.P., Grow, S.A., and Faust, L.J. 2018. Evaluating the Contribution of North American Zoos and Aquariums to Endangered Species Recovery. *Scientific reports* **8**(1): 9789.
- Cuaron, A.D. 2005. Further role of zoos in conservation: Monitoring wildlife use and the dilemma of receiving donated and confiscated animals. *Zoo Biology*: **24**(2): 115-124.
- Davey, G. 2006. Relationships between exhibit naturalism, animal visibility and visitor interest in a Chinese Zoo. *Applied Animal Behaviour Science* **96**(1-2): 93-102.
- EAZA 2008. Minimum Standards for the Accommodation and Care of Animals in Zoos and Aquaria. <https://www.eaza.net/assets/Uploads/Standards-and-policies/Standards-for-the-Accommodation-and-Care-of-Animals-2014.pdf> . accessed on 27 September, 2014
- Gianelloni, M., Lipsey, R., and Prather, J. 2012. School at the zoo. A report submitted to Jefferson country public schools.
- Gusset, M., and Dick, G. 2011. The global reach of zoos and aquariums in visitor numbers and conservation expenditures. *Zoo Biology* **30**(5): 566-569.

- Hennessy, M.B., McCowan, B., Jiang, J., and Capitanio, J.P. 2014. Depressive-like behavioral response of adult male rhesus monkeys during routine animal husbandry procedure. *Frontiers in behavioral neuroscience*, **8**, 309.
- <https://en.climate-data.org/asia/nepal/central-development-region/patan-50567/>
- Hussain, Z., Ali, Z., Nemat, A., Ahmad, S., Sikander, S.K., and Saleem, K. 2015. Enclosure size of animals of Lahore zoological garden in comparison of international norms. *Primates*, **6**, 20.
- Jacobson, S.K., McDuff, M.D., and Monroe, M.C. 2015. Conservation education and outreach techniques. Oxford University Press.
- Kawata, K. 2008. Zoo animal feeding: a natural history viewpoint. *Der Zoologische Garten* **78**(1): 17-42.
- Koene, P. 1999. When feeding is just eating: How do farm and zoo animals use their spare time. *Regulation of Feed Intake*. New York: CABI, 13-20.
- Mallapur, A., Waran, N., and Sinha, A. 2008. The captive audience: The educative influence of zoos on their visitors in India. *International zoo yearbook* **42**(1): 214-224.
- Mason, P. 2007. Roles of the modern zoo: conflicting or complementary? *Tourism Review International* **11**(3): 251-263.
- Patrick, P.G., Matthews, C.E., Ayers, D.F., and Tunnicliffe, S.D. 2007. Conservation and education: Prominent themes in zoo mission statements. *The Journal of Environmental Education* **38**(3): 53-60.
- Pitsko, L.E. 2003. Wild tigers in captivity: A study of the effects of the captive environment on tiger behavior (Doctoral dissertation, Virginia Tech).
- Pritchard, D.J., Fa, J.E., Oldfield, S., and Harrop, S.R. 2012. Bring the captive closer to the wild: redefining the role of ex situ conservation. *Oryx* **46**(1): 18-23.
- Reade, L.S., and Waran, N.K. 1996. The modern zoo: How do people perceive zoo animals? *Applied animal behavior science* **47**(1-2): 109-118.
- Reddy, T., Kalyani, A., Manimozhi, A., and Thirumurugan, R. 2013. Master plan of Arignar Anna Zoological Park, Tamil Nadu forest department, Vanular, Chennai.

- Sekar, M., Rajagopal, T., and Archunan, G. 2008. Influence of zoo visitor presence on the behavior of captive Indian gaur (*Bos gaurus gaurus*) in a zoological park. *Journal of Applied Animal Welfare Science* **11**(4): 352-357.
- Sikander, S.K., Ali, Z., Nemat, A., Ahmad, S., Hussain, Z., Saleem, K. et al. 2015. Diet provision for zoo animals in captive conditions of Lahore Zoo, Pakistan. *Journal of animal and plant sciences*, **25**(3), 493-499.
- Smith, L., and Broad, S. 2007. Do zoo visitors attend to conservation messages? A case study of an elephant exhibit. *Tourism Review International* **11**(3): 225-235.
- Tan, H.M., Ong, S.M., Langat, G., Bahaman, A.R., Sharma, R.S.K., and Sumita, S. 2013. The influence of enclosure design on diurnal activity and stereotypic behaviour in captive Malayan Sun bears (*Helarctos malayanus*). *Research in veterinary science*, **94**(2), 228-239.
- Tribe, A., and Booth, R. 2003. Assessing the role of zoos in wildlife conservation. *Human Dimensions of Wildlife* **8**(1): 65-74.
- Tsaur, S.H., Chiu, Y.T., and Wang, C.H. 2007. The visitor's behavioral consequences of experiential marketing: An empirical study on Taipei Zoo. *Journal of Travel and Tourism Marketing* **21**(1): 47-64.
- Veasey, J. 2006. Concepts in the care and welfare of captive elephants. *International Zoo Yearbook*, **40**(1), 63-79.
- Wilson, L., Dorsey, C., and Moore, D. 2019. Challenges and solutions: An analysis of community-reported needs of AZA collaboratively managed animal populations. *Zoo biology* **38**(1): 45-

APPENDICES

Appendix I: List of animals

Table 9: List of mammals in CZ

S.N	Common Name	Scientific Name	Order	Family	IUCN status	NPWC status	Origin	Total
1	Asian Elephant	<i>Elephas maximus</i>	Proboscidea	Elephantidae	EN	Protected	Native	1
2	Assamese Macaque	<i>Macaca assamensis</i>	Primates	Cercopithecidae	NT	Protected	Native	1
3	Barking Deer	<i>Muntiacus vaginalis</i>	Cetartiodactyla	Cervidae	LC		Native	18
4	Black Buck	<i>Antilope cervicapra</i>	Cetartiodactyla	Bovidae	NT	Protected	Native	2
5	Blue Bull	<i>Boselaphus tragacamelus</i>	Cetartiodactyla	Bovidae	LC		Native	1
6	Blue Sheep	<i>Pseudois nayaur</i>	Cetartiodactyla	Bovidae	LC		Native	1
7	Common Langur	<i>Semnopithecus entellus</i>	Primates	Cercopithecidae	LC		Native	5
8	Leopard	<i>Panthera pardus</i>	Carnivora	Felidae	VU		Native	3

9	Common Palm Civet	<i>Paradoxurus hermaphrodites</i>	Carnivora	Viverridae	LC		Native	2
10	Four horned Antelope	<i>Tetracerus quadricornis</i>	Artiodactyla	Bovidae		Protected	Native	1
11	Guinea Pig	<i>Cavia porcellus</i>	Rodentia	Caviidae	LC		Exotic	46
12	Himalayan Black Bear	<i>Ursus thibetamus</i>	Carnivora	Ursidae	VU		Native	4
13	Himalayan Goral	<i>Naemorhedus goral</i>	Cetartiodactyla	Bovidae	NT		Native	1
14	Himalayan Palm Civet	<i>Paguma larvata</i>	Carnivora	Viverridae	LC		Native	4
16	Jackal	<i>Canis aureus</i>	Carnivora	Canidae	LC		Native	13
17	Jungle Cat	<i>Felis chaus</i>	Carnivora	Felidae	LC		Native	4
18	Large Indian Civet	<i>Viverra zibetha</i>	Carnivora	Viverridae	LC		Native	5
19	Leopard Cat	<i>Prionilurus bengalensis</i>	Carnivora	Felidae	LC		Native	6
20	One-horned Rhinoceros	<i>Rhinoceros unicornis</i>	Perissodactyla	Rhinocerotidae	VU	Protected	Native	3
21	Indian Crested Porcupine	<i>Hystrix indica</i>	Rodentia	Hystricidae	LC		Native	16

22	Rabbit	<i>Oryctolagus cuniculus</i>	Lagomorpha	Leporidae	LC		Native	20
23	Red Panda	<i>Ailurus fulgens</i>	Carnivora	Ailuridae	EN	Protected	Native	2

24	Royal Bengal Tiger	<i>Panthera tigris tigris</i>	Carnivora	Felidae	EN	Protected	Native	4
25	Rhesus Macaque	<i>Macaca mulatta</i>	Primates	Cercopithecidae	LC		Native	8
26	Ring-tailed Lemur	<i>Lemus catta</i>	Primates	Lemuridae	EN		Exotic	2
27	Sambar Deer	<i>Rusa unicolor</i>	Cetartiodactyla	Cervidae	VU		Native	1
28	Siamang	<i>Symphalangus syndactylus</i>	Primates	Hylobatidae	EN		Exotic	2
29	Sloth Bear	<i>Melursus ursinus</i>	Carnivora	Ursidae	VU		Native	4
30	Spotted Deer	<i>Axis axis</i>	Cetartiodactyla	Cervidae	LC		Native	25
31	Five striped palm Squirrel	<i>Funambulus pennantii</i>	Rodentia	Sciuridae	LC		Native	2
32	White Mice	<i>Mus musculus</i>	Rodentia	Muridae	LC		Exotic	50
33	Wild Boar	<i>Sus scrofa</i>	Cetartiodactyla	Suidae	LC		Native	3
34	Wild water Buffalo	<i>Bubalus arnee</i>	Cetartiodactyla	Bovidae	EN	Protected	Native	5

Table 10: List of Birds in CZ

SN.	Common Name	Scientific Name	Order	Family	IUCN status	NPWP status	Origin	Total
1	African ostrich	<i>Struthio camelus</i>	Struthioniformes	Struthionidae	LC		Exotic	2
2	African Grey Parrot	<i>Psittacus erithacus</i>	Psittaciformes	Psittacidae	EN		Exotic	1
3	Alexandrine Parakeet	<i>Psittacula eupatria</i>	Psittaciformes	Psittacidae	NT		Native	11
4	Bar headed Goose	<i>Anser indicus</i>	Anseriformes	Anatidae	LC		Native	1
5	Barn Owl	<i>Tyto alba</i>	Strigiformes	Tytonidae	LC		Native	4
6	Black crowned Night Heron	<i>Nycticorax nycticorax</i>	Pelecaniformes	Ardeidae	LC		Native	1
7	Black headed Ibis	<i>Threskiornis melanocephalus</i>	Pelecaniformes	Threskiornithidae	NT		Native	4
8	Black Headed Munia	<i>Lonchura malacca</i>	Passeriformes	Estrildidae	LC		Native	8
9	Black masked Lovebird	<i>Agapornis personatus</i>	Psittaciformes	Psittacidae	LC		Exotic	4
10	Black Kite	<i>Milvus migrans</i>	Accipitriformes	Accipitridae	LC		Native	16

11	Brown Fish Owl	<i>Ketupa zeylonensis</i>	Strigiformes	Strigidae	LC		Native	4
12	Budgerigar	<i>Mlopsittacus undulatus</i>	Psittaciformes	Psittacidae	LC		Exotic	93
13	Cockatiel	<i>Nymphicus hollandicus</i>	Psittaciformes	Cacatuidae	LC		Exotic	29
14	Common Peafowl	<i>Pavo cristatus</i>	Galliformes	Phasianidae	LC		Native	6
15	Common Shelduck	<i>Tadorna tadorna</i>	Anseriformes	Anatidae	LC		Native	1
16	Common Quail	<i>Coturnix coturnix</i>	Galliformes	Phasianidae	LC		Exotic	5
17	Crimson horned Pheasant	<i>Tragopan satyra</i>	Galliformes	Phasianidae	NT	Protected	Native	2
18	Emerald Dove	<i>Chalcophaps indica</i>	Columbiformes	Columbidae	LC		Native	2
19	Enu	<i>Dromaius novaehollandiae</i>	Struthioniformes	Casuariidae	LC		Exotic	14
20	Eurasian Collared dove	<i>Streptopelia decaocto</i>	Columbiformes	Columbidae	LC		Native	2
21	Eurasian Eagle Owl	<i>Bubo bubo</i>	Strigiformes	Strigidae	LC		Native	5
22	Fantail pigeon	<i>Columba livia domestica</i>	Columbiformes	Columbidae	LC		Native	21
23	Golden Pheasant	<i>Chrysolophus pictus</i>	Galliformes	Phasianidae	LC		Exotic	22

24	Grey Heron	<i>Ardea cinerea</i>	Pelecaniformes	Ardeidae	LC		Native	1
25	Grey Goose	<i>Anser anser</i>	Anseriformes	Anatidae	LC		Native	49
26	Himalayan Griffon Vulture	<i>Gyps himalayensis</i>	Accipitriformes	Accipitridae	NT		Native	5
27	Indian Silverbill	<i>Lonchura malabarica</i>	Passeriformes	Estrildidae	LC		Native	3
28	Java Sparrow	<i>Lonchura oryzivora</i>	Passeriformes	Estrildidae	VU		Exotic	11
29	Kalij Pheasant	<i>Lophura leucomelanos</i>	Galliformes	Phasianidae	LC		Native	15
30	Lady Amherst's Pheasant	<i>Chrysolophus amherstiae</i>	Galliformes	Phasianidae	LC		Exotic	16
31	Lesser Adjutant	<i>Leptoptilos javanicus</i>	Ciconiiformes	Ciconiidae	VU		Native	1
33	Peach faced love bird	<i>Agapornis roseicollis</i>	Psittaciformes	Psittacidae	LC		Exotic	11

34	Peregrine Falcon	<i>Falco peregrinus</i>	Falconiformes	Falconidae	LC		Native	2
35	Salmon crested Cockatoo	<i>Cacatua moluccensis</i>	Psittaciformes	Cacatuidae	VU		Exotic	1
36	Red breasted Parakeet	<i>Psittacula alexandri</i>	Psittaciformes	Psittacidae	NT		Native	3
37	Red Collared Dove	<i>Streptopelia tranquebarica</i>	Columbiformes	Columbidae	LC		Native	3
38	Reeves's Pheasant	<i>Syrnaticus reevesii</i>	Galliformes	Phasianidae	VU		Exotic	2
39	Ring necked Pheasant	<i>Phasianus colchicus</i>	Galliformes	Phasianidae	LC		Exotic	3
40	Rose ringe Parakeet	<i>Psittacula krameri</i>	Psittaciformes	Psittacidae	LC		Native	29
41	Ruddy Shelduck	<i>Tadorna ferruginea</i>	Anseriformes	Anatidae	LC		Native	3
42	Sarus Crane	<i>Antigone antigone</i>	Gruiformes	Gruidae	VU	Protected	Native	3
43	Scaly breasted Munia	<i>Lonchura punctulata</i>	Passeriformes	Estrildidae	LC		Native	188
44	Silver Pheasant	<i>Lonchura nycthemera</i>	Galliformes	Phasianidae	LC		Exotic	15

45	Sulpher crested Coackatoo	<i>Cacatua galerita</i>	Psittaciformes	Cacatuidae	LC		Exotic	5
46	Senegal Parrot	<i>Poicephalus senegalus</i>	Psittaciformes	Psittacidae	LC		Exotic	16
47	Speckled Pigeon	<i>Columba guinea</i>	Columbiformes	Columbidae	LC		Exotic	17
48	Turkey Bird	<i>Meleagris gallopavo</i>	Galliformes	Phasianidae	LC		Exotic	2
49	White Cockatoo	<i>Cacatua goffiniana</i>	Psittaciformes	Cacatuidae	NT		Exotic	2
51	White Stork	<i>Ciconia ciconia</i>	Ciconiidae	Ciconia	LC	Protected	Native	1
52	Blue & yellow Macaw	<i>Ara ararauna</i>	Psittaciformes	Psittacidae	LC		Exotic	11
53	Zebra Finch	<i>Taeniopygia guttata</i>	Passeriformes	Estrildidae	LC		Exotic	30

Table 11: List of Reptiles in CZ

S.N	Common Name	Scientific Name	Order	Family	IUCN status	NPWC Status	Origin	Total
1	Asiatic Rock Python	<i>Python molurus</i>	Squamata	Pythonidae	NT	Protected	Native	4
2	Chinese Aligator	<i>Alligator sinensis</i>	Crocodylia	Alligatoridae	CR		Exotic	1
3	Cobra	<i>Naja naja</i>	Squamata	Elapidae	LC		Native	1
4	Gharial Crocodile	<i>Gavialis gangeticus</i>	Crocodylia	Gavialidae	CR	Protected	Native	1
5	Common Indian Monitor	<i>Varanus bengelensis</i>	Squamata	Varanidae	LC		Native	1
6	Indian Roofed Turtle	<i>Kachuga tecta</i>	Testudines	Geoemydidae	LC		Native	5
7	Red-eared Slider (Turtle)	<i>Trachemys scripta elegans</i>	Testudines	Emydidae	LC		Exotic	13
8	Black Pond Turtle	<i>Geoclemys hamiltonii</i>	Testudines	Geoemydidae	VU		Native	4
9	Tricarinate Hill Turtle	<i>Melanochalys tricarinata</i>	Testudines	Geoemydidae	VU		Native	1
10	Elongated Tortoise	<i>Indotestudo elongata</i>	Testudines	Testudinidae	EN		Native	3

Table 12: List of Fishes in CZ

S.N	Common Name	Scientific Name	Order	Family	IUCN status	NPWC status	Origin	Total
1	Black Tiger Shark	<i>Pangasius sutchi</i>	Siluriformes	Pangasiidae	EN		Exotic	10
2	Silver Shark	<i>Balantiocheilos melanopterus</i>	Cupriniformes	Cyprinidae	EN		Exotic	6
3	Koi & Manila Carp	<i>Cyprinus carpio</i>	Cupriniformes	Cyprinidae	VU		Exotic	3
4	Golden Mahseer	<i>Tor putitora</i>	Cupriniformes	Cyprinidae	EN		Native	5
5	Oskar	<i>Astronotus ocellatus</i>	Cichliformes	Cichlidae			Exotic	3
6	Red Parrot fish	<i>Scarus xanthopleura</i>	Perciformes	Labridae	LC		Exotic	4
7	Sucker Mouth	<i>Hypostomus sps</i>	Siluriformes	Loricariidae	LC		Exotic	2

8	Tinfoil Barb	<i>Barbus Schwanenfeld</i>	Cupriniformes	Cyprinidae	LC		Exotic	5
9	Arowana Silver	<i>Osteoglossum bicirrhosum</i>	Osteoglossiformes	Osteoglossidae			Exotic	1
10	Redheaded Cichlid	<i>Vieja synspila</i>	Perciformes	Cichlidae	DD		Exotic	1
11	Oaxaca Cichlid	<i>Vieja Zonatus</i>	Perciformes	Cichlidae			Exotic	1
12	Silver Cichlid	<i>Vieja argentea</i>	Perciformes	Cichlidae			Exotic	2
13	Coatzacoalcos Cichlid	<i>Paratheraps Coatzacoalcos</i>					Exotic	1
14	Tailbar Cichlid	<i>Paratheraps hartwegi</i>	Perciformes	Cichlidae			Exotic	1
15	Amatitlan Cichlid	<i>Paratheraps guttulatus</i>	Cichliformes	Cichlidae			Exotic	2
16	Black Diamond Cichlid	<i>Paratilapia polleni</i>	Perciformes	Cichlidae	VU		Exotic	1

17	Jack Dempsey	<i>Cichlasoma Octofasciatum</i>	Perciformes	Cichlidae			Exotic	1
18	Clown Loach	<i>Chromobotia macracanthus</i>	Cypriniformes	Botiidae			Exotic	1
19	Featherfin Squeaker	<i>Synodontis eupterus</i>	Siluriformes	Mochokidae	LC		Exotic	3
20	Pantano Cichlid	<i>Cichlasoma pearsei</i>	Perciformes	Cichlidae			Exotic	2
21	Alligator Gar	<i>Atractosteus spatula</i>	Lepisosteiformes	Lepisosteidae			Exotic	1

Appendix II: Photographs



Photographs 1: Barren exhibit and poor condition of shelter of zoo animals.



Photographs 2: Food of captive animal in CZ



Photographs 3: Students taking part in the art and mosaic competition organized by CZ on topic relating biodiversity conservation.



Photographs 4: FOZ students at Shivapuri Nagarjun NP to learn about biodiversity.



Photograph 5: Student exchange program. CZ giving presentation on biodiversity of Nepal for student of different country.



Photograph 6: Student participating in the friendly sustainable zoo structure competition organized by CZ.



Photograph 7: Questionnaire survey done with the visitors including students.



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Photograph 8: Plastic checking in gate



Photograph 9: Crowd at CZ in holiday



Photograph 10: Visitors feeding animals



Photograph 11: Visitors teasing animals

Appendix III: Questionnaires for visitors

QUESTIONS FOR THE VISITORS

Personal details:

Age:

Gender:

Location:

Education:

- i. None
- ii. School level
- iii. +2 level
- iv. Bachelor
- v. Above

Occupation:

1. Have you visited Central zoo before?

- i. Yes
- ii. No

2. How often do you visit zoos?

- i. Very regularly (more than once a month)
- ii. Often (once every 3 months)
- iii. Sometimes (once in 6 months than a year)
- iv. Not very often (once every 2/3 years)

3. Rank the following from 1-5 (1 being highest reason, 5 being lowest), What influence you to visit zoo?

- A. To know about endangered species.
- B. For my/ children's enjoyment.
- C. To educate themselves/my children about endangered species
- D. Close encounters with wild animals
- E. For the opportunity to see/feed animals

4. In your personal opinion what do you think the top 5 priorities of a zoo should be, please rate the following (1 being the highest priority):

- A. Caring for animals in the zoo.
- B. Providing opportunities for visitors to see wild animals.
- C. Educating the public about conservation issues such as threatened species.

- D. Breeding endangered animals in the zoo.
 - E. Providing a fun day out for the public/ picnic spot.
 - F. Reintroducing endangered animals into the wild that were bred in zoo.
 - G. Carrying out and supporting conservation projects outside of the zoo to conserve wild animals.
 - H. Providing expert training for keepers/staff/conservationists
 - I. Donations to conservation organizations/project
 - J. Scientific Research
5. Are you involved in any conservation projects or groups?
 - i. Yes
 - ii. No
 6. Are you aware of how zoo contribute to conservation? If yes, please list up different ways in which zoos help to conserve animals.
 - i. Yes
 - ii. No
 7. Are you aware that zoo conducts conservation programs?
 - i. Yes
 - ii. No
 8. Are there any particular species that you wish should be kept in zoo?
 - i. Yes
 - ii. No
 9. How satisfied are you with conservation work carried out by zoos?
 - i. Very satisfied
 - ii. Satisfied
 - iii. Neutral
 - iv. Unsatisfied
 10. Do you think there is a difference between the priorities which YOU think zoo should have, and the priorities which zoos actually hold themselves?
 - i. Yes
 - ii. No
 - iii. Don't know
 11. Should those who work in the zoo mostly consider the needs of the animals or the needs of the visitors?
 - i. The animals
 - ii. The visitors
 - iii. They're equal
 12. When you visit the zoo, do you try and listen to keeper talks about that particular animal?
 - i. Never
 - ii. Rarely
 - iii. Not sure
 - iv. Most of the time
 - v. Always
 13. What do you think the future holds for zoos?
 - i. They'll gain importance as more species become endangered.

- ii. They'll continue as they are.
- iii. They'll release all animals into the wild.
- iv. They'll start focusing more on the needs of visitors.
- v. They'll eventually be banned.
- vi. Other

14. Would you be prepared to donate money towards animal conservation projects?

- i. I would
- ii. I would not
- iii. I'm not sure