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### Maintaining the biodiversity and wilderness areas amid the COVID-19 crisis and further

DrShakeelaBanu C<sup>1</sup>, Dr. Roopashree R<sup>\*2</sup>, Dr. Neeraj Jain<sup>3</sup>, Manali Gupta<sup>4</sup>, Ashish Kaushal<sup>5</sup>, Mustafa Jawad Kadham<sup>6</sup>

<sup>1</sup>Faculty of Management Studies, CMS Business School, Jain(Deemed to be University), Bangalore, , Email Id: [dr.shakeelabanu@cms.ac.in](mailto:dr.shakeelabanu@cms.ac.in)

<sup>\*2</sup>Assistant Professor, Department of Chemistry and Biochemistry, JAIN (Deemed to be University), Bangalore, Karnataka, India, Email Id- [r.roopashree@jainuniversity.ac.in](mailto:r.roopashree@jainuniversity.ac.in), Orcid Id-0000-0002-0382-6321

<sup>3</sup>Professor, Department of Science, Maharishi University of Information Technology, Uttar Pradesh, India, Email Id: [neeraj.jain@muit.in](mailto:neeraj.jain@muit.in), Orcid Id- 0009-0002-6961-4441

<sup>4</sup>Assistant Professor, Department of Computer Science Engineering (CSBS), Noida Institute of Engineering & Technology, Greater Noida, Uttar Pradesh, India, Email Id: [manali.gupta@niet.co.in](mailto:manali.gupta@niet.co.in), Orcid Id- 0000-0001-6876-817X

<sup>5</sup>Jindal Global Business School, O P Jindal Global University, Sonapat, Haryana, Email: [ashishkiitdelhi@gmail.com](mailto:ashishkiitdelhi@gmail.com)

<sup>6</sup>College of Medical Techniques, Al-Farahidi University, Baghdad, Iraq. Email Id: [Mustafa.jawad@uofarahidi.edu.iq](mailto:Mustafa.jawad@uofarahidi.edu.iq)  
<https://orcid.org/0000-0002-8569-1458>

Corresponding author (\*): [dr.shakeelabanu@cms.ac.in](mailto:dr.shakeelabanu@cms.ac.in)

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#### Abstract

The COVID-19 outbreak has had a major negative effect on conservation efforts for protected species. To halt the COVID-19 pandemic was secured. A study of the pandemic's effects on conservation was conducted in an office setting since there weren't enough researchers to do fieldwork. This study's objective was to determine how the pandemic influenced the security of animals in enclosed spaces in 2020. Zero lockdowns, whole lockdowns, and limited lockdown were the three time periods that researchers split 2020 into. Data on crime, animal protection, and tourist performance were all gathered in the same manner, and each point's data was then assigned to a central location to be combined and evaluated. Run various types of tests to see whether the data variables remained normal. The research found that (i) there were the same amount of law enforcement rangers in 2020 and (ii) local wildlife poaching rose under complete lockdown, by means of a reach your peak in the parched period for illicit fishing, mining, and hunting. (iii) the number of tourists who visited and the money generate from both regional and international tourism dropped during both the whole and limited lockdowns, and (iv) the number of domestic tourists who visited in 2020 continued to decline. The results of this analysis suggest that the COVID-19 pandemic will undoubtedly have detrimental impacts on animal conservation, and those effects will only become worse as the epidemic spreads. According to the report, collaboration with conservation organizations and financial reserves aided the Parks and Species Management Authority's (PSMA) 2020 efforts to protect species. To ensure that conservation has safety nets, funding sources must be diversified and financial reserves must be built up.

Keywords- Biodiversity, Wildlife, COVID-19, Poachers, Conservation.

#### 1. Introduction

The widespread epidemic of coronavirus illness 2019 (COVID-19) has created a global disaster causing destruction (Sharma *et al.*, 2022). A novel strain of a pre-existing coronavirus causes the contagious sickness known as COVID-19, which first appeared in December 2019 and has since extended to more than 210 countries worldwide. The report analyzes

the Corona virus's effects on ecotourism industry, rural-dependent people, and conservation, especially in protected regions. Communities implement efficient techniques and tactics to mitigate the consequences of unpredicted catastrophes like COVID-19 and to change certain rules to benefit local populations and protected areas (Cherkaoui *et al.*, 2020).

The established developing countries, the tourist industry are a crucial source of income for foreign currency, employment, tax revenue, protection of the natural world and the environment, and cultural preservation. Agribusiness, manufacturing, and construction are just a few industries severely affected by the epidemic. At its highest point in 2020, COVID-19 caused a significant worldwide economic crisis. The rate of employment increased to 6.5%, the number of people living in severe deficiency climbed to 9.4% worldwide, and the global economy experienced a loss of 3.36% during this period (Afrin and Shammi, 2023). The COVID-19 epidemic affects every receives and culture fisheries value chain step. These effects are particularly noticeable among small-scale fishermen since few jobs are available, and they need more access to basic financial services and safety. The COVID-19 pandemic's consequences have affected every aspect of human civilization but disproportionately devastated the world's economically and socially vulnerable populations. The value of higher education is widely acknowledged since the kind, vision, purpose, goals, and quality of higher education that any nation offers is essential to its overall expansion, whether developing or developing (Sarkar *et al.*, 2021). Stochastic distress, the COVID-19 pandemic simultaneously affects people, homes, businesses, and institutions worldwide. Ecotourism involves recreation based on natural resources and has multiple connections to climate change, including the likelihood of direct effects due to possible environmental degradation, car trails, and polluting tourist and local behavior (Spenceley *et al.*, 2021). They discovered that the drought, erratic irrigation supplies, and climate change contributed to the agricultural corporation's difficulty filling employment. Most nations are experiencing lockdowns, a lack of hospital beds, and shop inventories are being depleted quicker than the COVID-19 update prevented global travel. The main focus was on increasing temperatures and pastoral water management crisis in smaller-holder farmers' adaptation and mitigation to typical weather change, which decorated the need for numerous stakeholders and integrated development plans (IDPs), which include great resource use plans for a municipality and their stakeholders in such duties (Chebby *et al.*, 2021). The meta-analysis of the research outlines the many ways that COVID-19 has affected society groups and natural systems (Malio *at al.*, 2023). The relationship between the natural environment, human civilization, and the Component humanity-environment subsystem (CHES), all enduring sub-components, has been shown and clarified using a conceptual model. The study (elkhwesky *et al.*, 2022) addressed possibilities for sharing information on the impact of the COVID-19 epidemic on protected area tourists from all over the world to increase protected area tourism's resilience as a regenerative conservation strategy. The research (Purcell *et al.*, 2021) evaluated and comprehended the effects of the COVID-19 epidemic on socio-economic activities, tourist sector revenue, alternative sources of money utilized by adjacent local populations to survive, and its implications for biodiversity conservation. The paper (Kaur., 2020) increased resilience and sustainability in the face of complexity and catastrophic events while also improving the human being. (McNeely, 2021) determined the analysis of 48 papers on sustainable hospitality practices located in the Web of Science (WoS) and Scopus databases. The publications covered the years from 2020 to 2021 during the COVID-19 pandemic and made noteworthy advancements. The study of sustainable practices in the hotel sector will progress in 2020 and 2021. Sustainable practices in hospitality have some conceptual and practical similar characteristics.

The study (Rondeau *et al.*, 2020) accelerated the sector's transition to sustainable T&T, secured by conscious consumption and more governmental oversight. The author (Nhamo *et al.*, 2020) COVID-19 generated business issues and visualized the new experience economy measures as a framework supporting an economical lifestyle that the essay offers to encourage a frugal way of life. The efficient COVID-19 solution is required for the problem that addresses social and economic Development, climate change, and biodiversity and offers the chance to significantly alter the structure and operation of the global economy (king *et al.*, 2021). The pandemic's many shocks to the economy of rural and coastal families in biodiversity nations, which are geographically and sector connected, are its most striking aspect. Opportunities and challenges (Sohn *et al.*, 2021) in several areas of research and policy were investigated. Despite the COVID-19 outbreak, area 2 nations must concentrate on the Development of sustainable agricultural practices as well as regulations that would reduce hunger. The biodiversity and wilderness regions are intact despite the COVID-19 outbreak, and moving forward with this goal (Dubey *et al.*, 2022).

In this paper following segments: the methodology of the study is presented in section 2, the result of the paper is presented in section 3, and the conclusion of the paper is presented in section 4.

## 2. Methodology

### Study Design

This research explores the 65 gazette protected areas located on state territory and under the authority. The government institution in Area 1 has a national mission to protect wildlife. There are fifteen national parks, eighteen safari areas, fifteen recreational parks, nine sanctuaries, ten botanic gardens, and eighteen botanical reserves among Area 1's gazette protected areas. These areas are divided into a total of six categories. The protected area network in Area 1 is projected to encompass an area of 7.4 million hectares, equivalent to around 18.9% of the country's entire landmass. For the sake of this investigation, we split the year 2020 into three distinct time intervals from the first of the year to the end of March, there was 'zero lockdown,' while from the 30th of March through the first of July, there was a 'whole lockdown,' and from the second of July until the 31st of December, there was 'limited lockdown'.

### Data collection

Using a standard reporting format, data on the resources available for law enforcement, the effort and results of law enforcement, instances of prohibited conduct, and tourist arrivals were obtained from the stations every month. Human and material resources were required to protect wildlife to complete activities like ranger deployments, incursion response, and wildlife crime reporting. Depending on how long a ranger stays in the field, the number of casual patrols is the number of times they leave and return on the same day. Each ranger spent a certain number of nights on patrol in the wilderness, represented by the number associated with extended patrol days. Data on illegal conservation efforts include counts of intrusions, people arrested, and cases decided in wildlife tribunals. Details on dog fatalities, snare removal, the recovery of kapenta and inshore illegal fish, and the removal of motor vehicles, bicycle boats, canoes, and fishing boats.

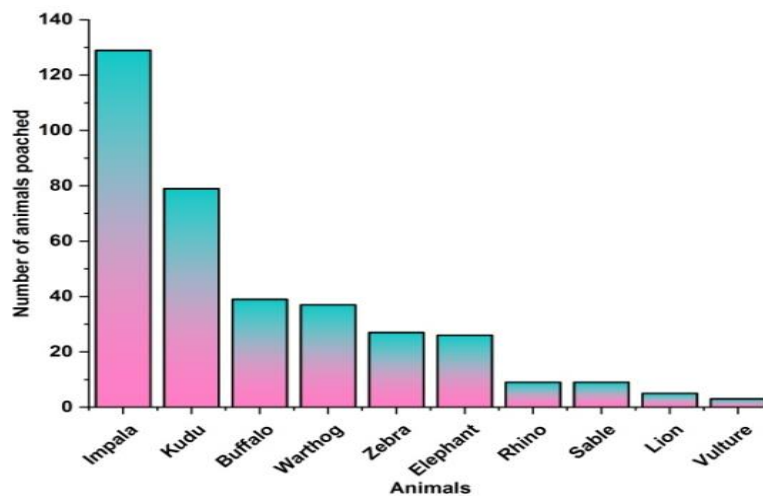
### Data Analysis

To assess the condition, there could be differences between the three lockdown states—zero lockdown, whole lockdown, and limited lockdown. We evaluated visitor performance, resource allocation, unlawful conduct, and law enforcement action. It includes descriptive statistics, graphical displays, and statistical analysis findings. A Microsoft Excel Version spreadsheet was used to compile and organize the data. To ascertain whether there was a typical distribution of

criminal activity and the resources available for wildlife protection. The Shapiro–Wilk test's significance is calibrated at  $p = 0.05$ , a relatively small number. Using data on prohibited activity over the three research periods, ANOVA, and law enforcement resources, we investigated how the COVID–19 lockout affected wildlife protection. To specifically examine the resource preservation status in 2019, the ANOVA research incorporates Fisher Least Significant Difference (LSD) post hoc analysis. For each statistical analysis, IBM SPSS Version software was employed (Table 1).

**Table 1:** Numerical values of animals poached

Animals	Number of animals poached
Impala	129
Kudu	79
Buffalo	39
Warthog	37
Zebra	27
Elephant	26
Rhino	9
Sable	9
Lion	5
Vulture	3



**Figure 1:** List of animals killed unlawfully

### 3. Result

#### Resources at law enforcement's collection

In 2020, the rangers 1,430 would be accessible for law enforcement work, according to studies in this field. This number represented around 91.5 percent of the demand, which was ideal. When there were zero lockdowns, there was a complete lockdown, and there was a limited lockdown, the proportion of valid rangers available to assist law enforcement was 71.9%, 86.5%, and 79.7%. In the year 2020, activities associated with law enforcement were responsible for the allocation and use of a total of 267349 liters of diesel and 99967 liters of gasoline. The procedure used 49.2% and 51.8% of the total fuels in the spending plan. During the "zero lockdown," "whole lockdown," and "limited lockdown" periods, diesel was distributed at 45.5%, 49.6%, and 45.8%, respectively, while gasoline was distributed at 43.4%, 51.1%, and 49.8% during the same times.

An analysis of the resource allocation data revealed that, except for fuel allocation during the limited lockdown period ( $p=0.021$ ), the data were consistent with the normalcy assumptions. An analysis of variance (ANOVA) was used to examine how resources were distributed throughout the categories. The number of rangers on hand to safeguard animals mostly stayed the same. ANOVA analysis revealed a statistically significant difference between the whole sample of real rangers and each of their component categories. The actual number of rangers present varied significantly, with "no" and "limited" lockdowns having a mean difference of 95 and "whole" and "limited," respectively, having a mean diversity of 120. Whether there was a limited or total lockdown, the number of rangers available to protect the resources did not differ substantially ( $p = 0.238$ ).

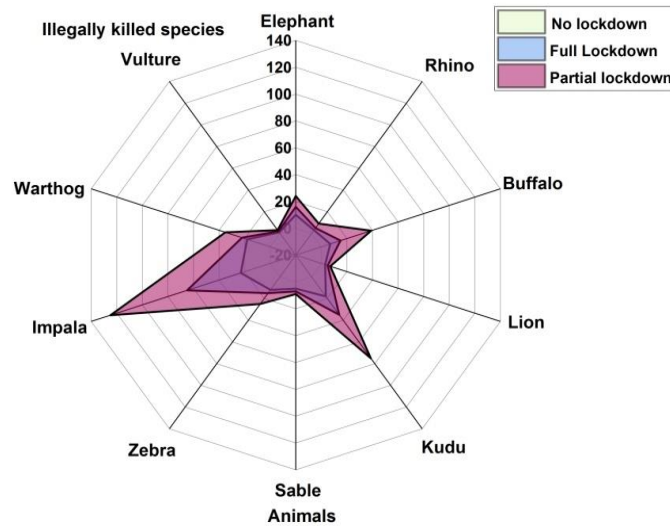
Depending analyzing the outcomes of an analysis of variance (ANOVA) using, there were discernible differences between the day-to-day law enforcement activities carried out during the "zero lockdown" and "limited lockdown" periods. A total of 193 person-days and 383 man-nights of "whole lockdown" also "limited lockdown" mean differences were discovered by further LSD post hoc testing. However, there was no discernible difference between the 'no' lockdown and the 'whole' lockdown ( $p = 0.085$ ). The analysis result for the extra-long patrol night shifts was also recorded. Using a significance level of 0.012 in favor of the first condition and a mean diversity of 835 man-nights, According to the LSD position hoc test, there were significant differences between the "limited" lockdown and "no" lockdown conditions. At 779 man-nights ( $p = 0.845$ ), the mean difference between "no" and "whole lockdown" decided to be significant.

### Illegal wildlife exploitation

A significant number of plains diversion types were misplaced due to poaching in (Figure 1), Poached high-value animals like elephants ( $F,9 = 0.571, p = 604$ ) and rhinoceros ( $F,9 = 0.001, p = 1$ ). The data with a significant variation across research periods concerned lion poaching ( $F, 9 = 6.675, p = 0.081$ ). As a result of cyanide poisoning, four of the 28 poached elephants found in a region near parks and a wildlife estate died. One of the vultures died from poisoning. One elephant died of poison on the park's assets during the limited lockdown. During the dry months, there was a significant increase in illicit wildlife harvesting. High-value animals such as elephants and Rhinoceros did not face the same challenges. In 2020 (Table 2), many plains game was harvested illegally. With just 28 elephants stolen unlawfully in 2020 compared to 53 in 2019, the number of high-value animals was low. In 2020 7 rhinoceroses were poached, compared to 26 in 2019 (6 and 20) (Figure 2).

**Table 2:** Values of killed species

Animals	Illegally killed species		
	Zero lockdown	Whole lockdown	Limited lockdown
Elephant	10	16	24
Rhino	3	5	9
Buffalo	7	15	39
Lion	3	5	7
Kudu	18	35	75
Sable	5	7	9
Zebra	12	15	25
Impala	23	65	125
Warthog	18	22	35
Vulture	1	2	3



**Figure 2:** Illegally killed animal species per lockout

**Table 3:** Summary of other law enforcement

Variable	Limited Lock down Mean Monthly	Total	Zero Lock down Mean Monthly	Total	Whole Lock down Mean Monthly	Total	Total of annual
Inshore Fish Recovered (kgs)	10 333	61 988	3 512	10 535	6 899	20 694	93 215
Kapenta Fish recovered (kgs)	382	2290	114	342	162	486	3116
Court Cases Finalized	34	199	23	66	38	112	374
Canoes impounded	86	508	82	245	121	358	1 111
Armed Contacts	3	12	2	4	3	8	22
Length of fishnets recovered (m)	73 271	43 9626	64 489	19 3465	72 214	216641	84 9730

**Table 3** shows that the illicit activity increased during the complete and limited lockdown. As the number of persons imprisoned for wildlife poaching decreased (**Figure 3A**), the number of detained illegal miners and fishermen increased (**Figure 3B and 3C**) from the 'Zero lockdown to limited lock down' periods. Throughout the lockdown time (**Figure 3D**), the most bicycles were detained for being utilized to conduct wildlife offenses.

**Table: 4** Values of lockdown period actions

<b>A</b>	Zero lockdown	Whole lockdown	Limited lockdown
(i) Mean of arrested local poachers	170	129	74
(ii) arrested local poachers	220	270	120

<b>B</b>	Zero lockdown	Whole lockdown	Limited lockdown
(i) Mean of people arrested illegal	31	100	96

mining			
(i) People arrested	60	120	110
illegal mining			

C	Zero lockdown	Whole lockdown	Limited lockdown
(i) Mean of local fish poachers arrested	258	368	340
(ii) Local fish poachers arrested	280	435	430

D	Zero lockdown	Whole lockdown	Limited lockdown
(i) Mean of bicycle impounded	15	39	15
(ii) Bicycle impounded	19	52	20

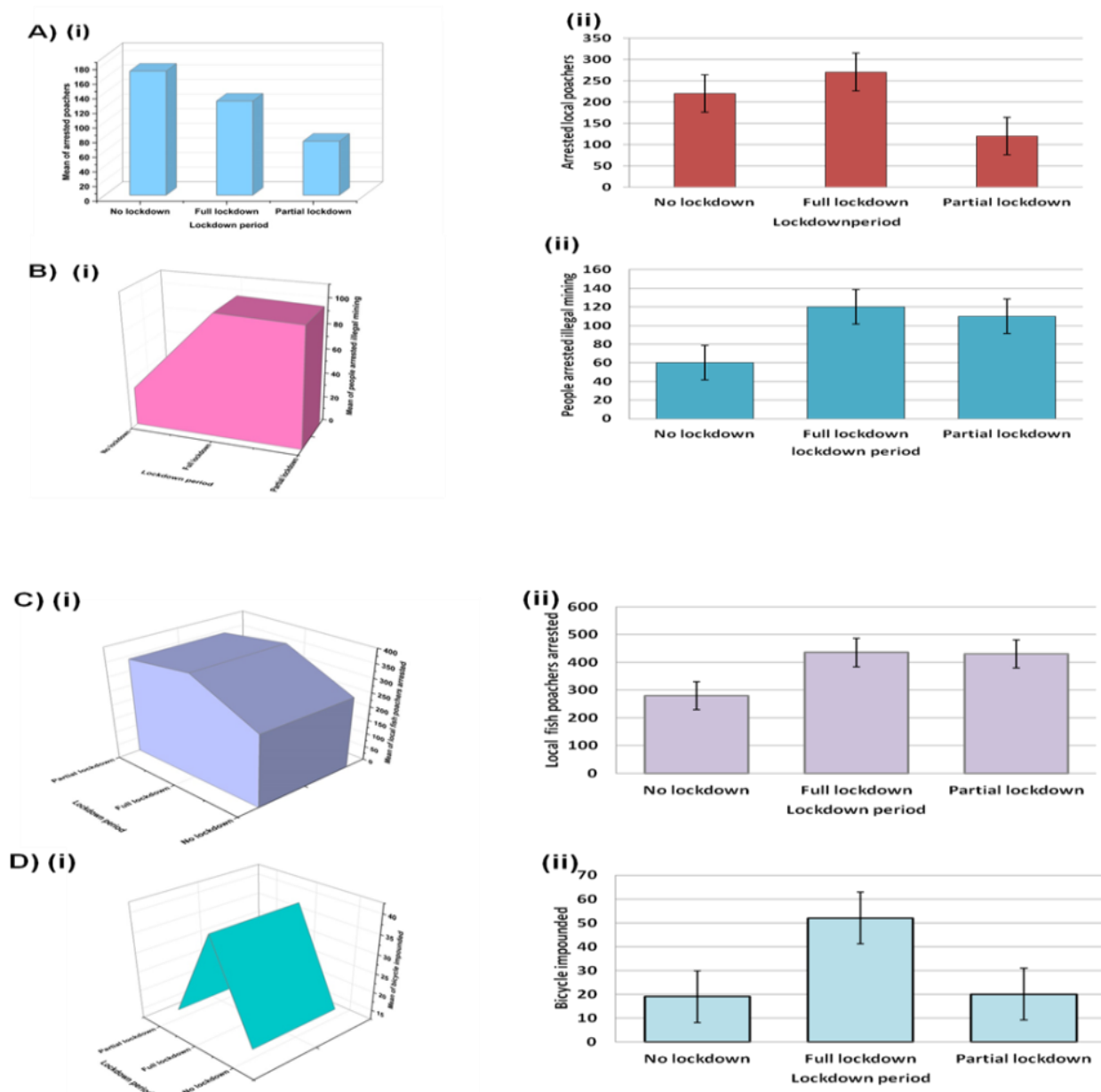


Figure 3: Activity of lockdown period

The quantity of local poachers apprehended did not exhibit statistical significance shown in **(Figure 3A)**. A Zero lockdown and a Limited lockdown, however, differ greatly from one another. According to statistics, there are often a lot of individuals behind bars for illicit mining. Both 'no and whole' lockdown and 'zero and limited' lockdown had a statistically significant difference ( $p = 0.025$  and  $p = 0.017$ , respectively), ( $F, 9 = 2.670, p = 0.123$ ). The number of poachers caught for illegal fishing remained constant **(Table 4)**. With a mean difference of ( $p = 0.003$ ) between "zero" and "whole" lockdown as well as ( $p = 0.001$ ) between limited and whole, there were statistically significant numbers of bicycles seized ( $F,9 = 12.034, p = 0.003$ ).

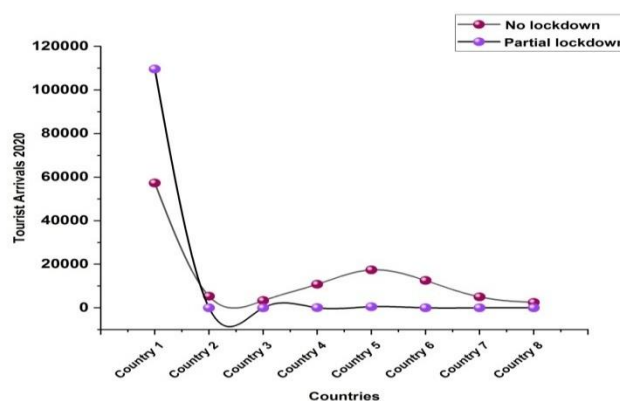
### Results from Tourism

The arrival trends for the first quarter before the COVID-19 epidemic were anticipated. Most tourists were from inside the country, and then came visitors from various countries **(Figure 4)**. One hundred eighty-five internal visitors entered the building during the lockdown, but zero external customers from the local or global market entered. The mean domestic tourist arrivals varied considerably throughout the course of the three periods, according to the Welch robust test for equality of means. There was no statistically significant difference between the time before and during the brief lockdown, according to the LSD post hoc test ( $p=0.919$ ).

Nonetheless, there was a discernible difference in the quantity of designated domestic visitor arrivals throughout the two periods of "whole" lockdown and limited lockdown. During 2020, there was a 60% variation in the arrivals from the other source markets compared to the expected total sales of US\$20,126 600. Domestic tourism contributed 35% of the total tourist earnings (\$8 024 239), while tourism in other countries and regions made 65% (\$024239) of the money. Reduced tourist income resulted from the decline in visitor **(Table 5)**.

**Table 5:**List of arrival tourist

Countries	Tourist Arrivals 2020	
	Zero lockdown	Limited lockdown
Country 1	57295	109597
Country 2	5345	15
Country 3	3325	2
Country 4	10856	72
Country 5	17445	528
Country 6	12553	15
Country 7	5045	20
Country 8	2498	1



**Figure 4:** Tourist Arrivals



**Figure 4** shows the total number of visitors that entered the parks and wildlife estates in the region before, during, and after the limited lockdown. During the whole lockdown, only 185 domestic visitors were documented, and none from the other source's markets.

#### 4. Conclusion

The corona virus's geographic spread has wreaked havoc on local and national economies, resulting in a catastrophic economic and humanitarian catastrophe. One of the issues with conservation has always been illegal animal resource collection. According to several studies, loss of livelihood brought on by disruptions like political unrest and economic collapse, such as collapse, is often associated with illegal hunting. During the most recent crises, communities experienced severe unemployment, income loss, and food shortages. Academics have acknowledged that undeveloped communities are susceptible to the global pandemic (Mojau and Nanuru 2022). The social welfare in the neighborhood is significantly impacted negatively by such an influence (Hassan *et al.*, 2022). The quality of life for locals, the effectiveness of managing numerous protected areas, and the financial health of these places have all been severely harmed by the current pandemic (safitri *et al.*, 2022). Inadequate policy instruments, along with insufficient resource management, are only a handful of the other variables that might lead to security holes and criminal exploitation tendencies (Singh *et al.*, 2021). Threats to biodiversity have intensified as a result of the COVID-19 pandemic-induced economic crisis, including poaching, wildlife trafficking, and logging (Yadav, 2020).

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