Trends ~~in~~ ofHuman-Wildlife ~~Conflict: A Case Study of Conflicting~~~~Kali Tiger Reserve~~in Kali Tiger Reserve Forest, Karnataka, south India

ABSTRACT

Human-wildlife conflict (HWC) is a growing concern, impacting both conservation efforts and livelihoods. This study was conducted to analyse trendsin wildlife conflicts involving agriculture, cattle, and human injuries from 2015-16 to 2022-23 with a focus on the Kali Tiger Reserve in Karnataka, India. The compound annual growth rate (CAGR) method was used to assess the data, revealing critical insights. Agriculture-wildlife conflict showed an overall upward trend with a CAGR of 3.16 per cent. Notably, there was a significant increase in 2016-17, followed by fluctuations in subsequent years. This conflict arises ~~from~~ due to natural habitat fragmentation and deterioration resulting animals encroaching on agricultural fields ~~due to human settlements encroaching on natural habitats~~. Cattle-wildlife conflict exhibited a CAGR of 8.20 per cent, indicating a gradual increase with fluctuating cases from year to year. Tigers and leopards pose a threat to farmers who graze cattle near the forest reserve~~s~~. Innovative solutions are required to balance the ~~coexistence~~ synergyof agriculture production and wildlife management policy. Human injuries due to wildlife displayed fluctuations, with a slight overall decrease (CAGR -0.47%) in the number of cases and an increase of 2.66 per cent in compensation. These incidents occur when people venture into forests for various reasons. Proper regulations and permissions are necessary to minimize such encounters. Overall compensation payments showed a CAGR of 5.83 per cent, reflecting fluctuating growth rates and significant changes in 2022-23. The forest and wildlife conservation ~~department~~ sectors~~determines~~determine compensation based on specific factors for crop loss, cattle deaths, and human injuries. However, conflicts related to human injuries have shown a declining trend. The study suggests relocating rehabilitation efforts away from forest buffer zones and introducing ~~employment programs~~off farm activities for affected communities to reduce their dependence on the forest.

INTRODUCTION

Karnataka, a state in southern India, is truly a natural wonderland graced with some of the most magnificent tropical forests on the Indian sub-continent. This region boasts a remarkable diversity of forest vegetation, encompassing an extensive range of species. Karnataka is well-known for its wide and varied floral diversity and it has a spectrum of forest types, from lush wet evergreen forests to arid dry thorn forests (citation).

Around 60 per cent of Karnataka's forests are nestled in the Western Ghats, a region recognized as one of the world's mega biodiversity hotspots. These Western Ghats are teeming with unique and endemic flora and fauna, making them a crucial conservation area. (Karnataka forest Department, date).

Human-wildlife conflict (HWC) challenges across the world are leading to a decrease in people's tolerance for conservation efforts and are contributing to multiple factors that drive species to extinction. HWC is a significant threat to conservation, livelihoods, and myriad other concerns and should be addressed at a scale equal to its importance. By allocating adequate resources and forming wide-ranging partnerships, we can move towards long-term coexistence that benefits both people and wildlife (Gross *et al.,*2021).The growing human population,deforestation,loss of habitat and decline in their prey species are few major reasons behind the Human wildlife conflict in India.

One of the most difficult problems faced by conservationists today is resolving conflicts between humans and wildlife. The reason for ecological and social variables that lead to conflicts between humans and wildlife is not yet completely understood even after decades of research and large financial investments (Dickman, 2010).The study is aimed to examine patterns of conflict loss and compensation in Kali tiger reserve which is located in the central portion of the Uttara Kannada (North Canara) district of Karnataka state.The Tiger Reserve comprises two important protected areas of the region viz., Dandeli wildlife sanctuary (475.018 Km²) and Anshi National Park (339.866 Km²).Forests of the Tiger Reserve are primarily moist deciduous and semi-evergreen, with excellent patches of evergreen forests in the westernmost parts as well as in deep valleys. Animals found in the Tiger Reserve include Tiger, Leopard, Elephant, Bison, Wild dog, Sambar, ~~Spotted~~spotted deer, Sloth bear, Wild boar, Hanuman langur, Bonnet macaque, varieties of reptiles and birds including all four species of hornbills as its residents etc.

Comment [MK3]: I think citation is not correct it shall be use some tools like Mendley, Endnote or other suitable in your region

Comment [MK4]: the research questions or statment/research gap is not clearly statted. i shall be revised in one paragrahp

Methodology

Location

The study was conducted in Kali tiger reserve of Karnataka, data about crop damage, human death, human injury, cattle death and compensation amount were collected from the Karnataka Forest Department.

Study area map?

Sampling technique and procedure??

Analytical tools and techniques

Compound Annual Growth Rate (CAGR) method is used to analyse the trends in conflict between human and wildlife. The CAGR can be used to calculate the average growth of a single variable over a period of time.

$$CAGR = \left(\left(\frac{EV}{BV} \right) \frac{1}{n} - 1 \right) \times 100$$

Where;

EV = Ending value

BV = Beginning value

n = Number of years

Annual Growth Rates

The percent change from one period to another is calculated from the formula:

$$PR = \frac{V_{PRESENT} - V_{PAST}}{V_{PAST}} \times 100$$

Where,

PR=per cent change

$V_{present}$= present or future value

V_{past}= past or present value

Result and Discussion

Table description?

Table 1: Details of Agriculture – wildlife conflict in Year of 2015-16 to 2022-23

Sl. No.	Year	Crop damage		Annual growth rate	
		No of cases	Amount	No of cases	Amount
1	2015-16	50	136728	-	-
2	2016-17	200	760180	138.63	171.56
3	2017 -I8	55	367525	-129.10	-72.68
4	2018-19	86	685000	44.70	62.26
5	2019-20	40	270906	-76.55	-92.76
6	2020-21	111	874335	102.07	117.17
7	2021-22	101	639974	-9.44	-31.20
8	2022-23	279	1658512	101.61	95.22
CAGR				3.16 NS	14.63 NS

The table 1 presents statistics on agriculture-wildlife conflicts from 2015-16 to 2022- It shows a fluctuating pattern of crop damage incidents and the corresponding annual growth rates. In 2016-17, there was a significant increase in both the number of cases and the amount of damage, with annual growth rates of 138.63% and 171.56%, respectively. The subsequent years saw varying trends, with decreases in 2017-18 and 2019-20 and increases in 2018-19 and 2020-21. However, in 2022-23, there was a substantial rise in both cases and damage, with annual growth rates of 101.61% and 95.22%. The compound annual growth rate (CAGR) for the entire period stands at 3.16% for the number of cases and 14.63% for the damage amount, indicating an overall upward trend in agriculture-wildlife conflicts over the years.

The conflict between agriculture and wildlife stems from wild animals encroaching on agricultural fields in search of food. This issue is exacerbated by the proximity of human settlements to forest buffer zones. As human populations expand and encroach on natural habitats, animals are forced to venture into farmlands, leading to increased instances of wildlife crop damage. Addressing this conflict necessitates a balanced approach that considers both human livelihoods and wildlife conservation, such as implementing mitigation measures, land-use planning, and sustainable coexistence strategies to minimize the impact on both agriculture and the natural world (citation).

Table 2: Details of Cattle – wildlife conflict in Year of 2015-16 to 2022-23

Sl. No.	Year	Cattle Killed		Annual growth rate	
		No of cases	Amount	No of cases	Amount
1	2015-16	61	590095	-	-
2	2016-17	102	995000	51.41	52.25
3	2017 -I8	68	745500	-40.55	-28.87
4	2018-19	64	640000	-6.06	-15.26
5	2019-20	74	719000	14.52	11.64
6	2020-21	167	1501837	81.39	73.66
7	2021-22	141	2410000	-16.92	47.29
8	2022-23	151	3105000	6.85	25.34
CAGR				**8.20 NS**	**19.42****

The data presented in Table 2 shows the details of cattle-wildlife conflict from the year 2015-16 to 2022-23. The number of cases involving cattle killed and the annual growth rate are provided for each year. The annual growth rate indicates the change in the number of cases compared to the previous year. Notably, there is a fluctuating pattern in the number of cases, with a peak in 2021-22, where 141 cases were recorded. The Compound Annual Growth Rate (CAGR) over this period is 8.20%, suggesting a gradual increase in cattle-wildlife conflicts. However, it's important to note that the data also shows significant variations in different years, with both positive and negative growth rates. Overall, while the CAGR suggests a moderate upward trend, the fluctuations in the number of cases from year to year indicate that this issue is influenced by multiple factors and not steadily increasing.

Tigers and leopards often pose a threat to farmers who graze their cattle near forests. These farmers rely on the forest as a source of food for their livestock. However, this practice can lead to unfortunate confrontations with wild animals that see the cattle as prey. As a result, farmers frequently find themselves in a precarious situation, with their livelihoods at risk due to the potential loss of cattle. Balancing the coexistence of agriculture and wildlife in these areas remains a complex challenge, requiring innovative solutions that protect both farmers' interests and the conservation of these magnificent yet endangered species.

Table 3: Details of Human – wildlife conflict in Year of 2015-16 to 2022-23

Sl. No.	Year	Human Injury		Annual growth rate	
		No of cases	Amount	No of cases	Amount
1	2015-16	4	93549	-	-
2	2016-17	0	0	0	0
3	2017 -I8	0	0	0	0
4	2018-19	0	0	0	0
5	2019-20	1	20000	0	0
6	2020-21	3	268240	109.86	259.61
7	2021-22	0	0	0	0
8	2022-23	4	100333	0	0
CAGR				-0.47NS	2.66NS

Over the years from 2015-16 to 2022-23, human-wildlife conflicts with a focus on human injuries have exhibited a fluctuating trend. In 2015-16, there were four cases of human injury with a compensation cost of ₹ 93,549 to the affected individuals. Interestingly, no incidents were reported from 2016-17 to 2018-19, but in 2019-20, there was a resurgence with one case and compensation of ₹ 20,000. A significant increase occurred in 2020-21, with three cases and a compensation amount of ₹ 268,240, showcasing a substantial annual growth rate of 109.86% and 259.61%, respectively. However, in 2021-22, no cases were reported, and in 2022-23, there was another increase with four cases and compensation totalling₹ 1,00,333. The compound annual growth rate (CAGR) for the entire period indicates a slight overall decrease of -0.47% in the number of human injuries, while the CAGR for the number of cases and compensation amount reflects a 2.66% increase, signifying a rise in incidents with notable variations throughout the years. In summary, the data illustrates a fluctuating pattern

Human injuries caused by wildlife often occur when people venture into forests to collect firewood or bring their cattle for grazing. In such situations, encounters with wild animals can result in attacks on humans, leading to injuries. People should stop venturing deep into the forest without approval of the officers to avoid such cases.

Table 4: Overall compensation paid

Sl. No.	Year	Total Compensation paid		Annual growth rate	
		No of cases	Amount	No of cases	Amount
1	2015-16	115	820372	-	-
2	2016-17	302	1755180	96.55	76.06
3	2017 -I8	123	1113025	-89.82	-45.55
4	2018-19	150	1325000	19.85	17.43
5	2019-20	115	1009906	-26.57	-27.16
6	2020-21	281	2644412	89.34	96.26
7	2021-22	242	3049974	-14.94	14.27
8	2022-23	434	4863845	58.41	46.67
CAGR				5.83 NS	17.20**

The table4 provides information on the overall compensation paid over a span of eight years, including the number of cases and the corresponding compensation. It also presents the annual growth rates in both the number of cases and the compensation amount. The data reveals fluctuations in compensation payments, with a substantial increase from 2015-16 to 2016-17, a drastic decrease in 2017-18, and subsequent fluctuations in the following years. The Compound Annual Growth Rate (CAGR) for the compensation payments over the entire period is 5.83%, indicating a moderate overall growth trend. Notably, the annual growth rate for 2022-23 stands out at 58.41%, suggesting a significant increase in compensation compared to the previous year. The fluctuating growth rates and CAGR highlight the volatility and changes in the compensation landscape during the specified period.

The forest department determines compensation amounts for crop loss, cattle deaths, and human injuries. Crop loss compensation is determined by the quantity of crops affected. Cattle death compensation varies between adult cattle and calves, with set prices for each. Human injury compensation is based on the extent and severity of the injuries sustained. Each category of compensation is fixed by the forest department, taking into account specific factors such as the scale of loss, the type of cattle affected, and the nature of human injuries. This approach ensures that the compensation is tailored to the specific circumstances of each case. The figure 1 represents all the components of wildlife components.
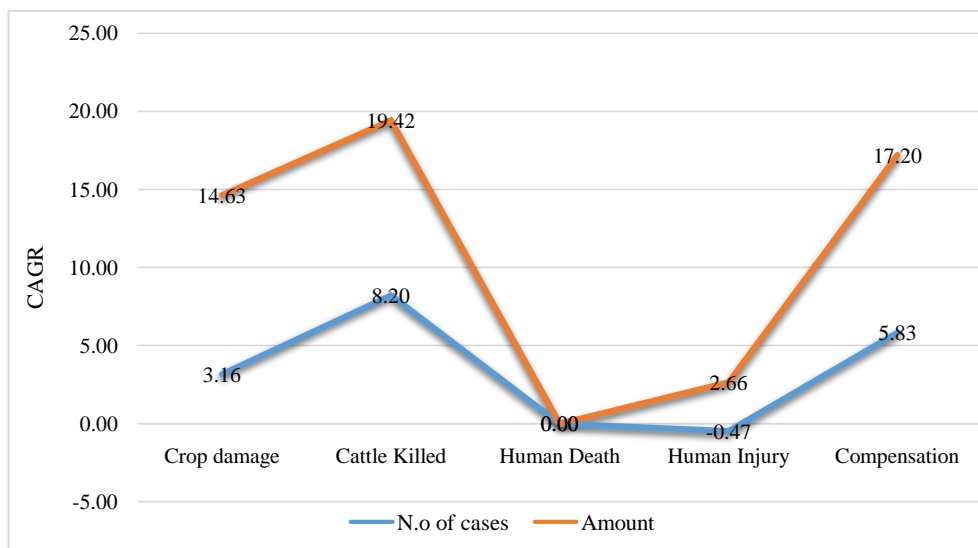
Fig 1: Details of Wildlife conflict details in Year of 2015-16 to 2022-23

CONCLUSION

In the study, the analysis of the compound annual growth rate reveals an upward trend in conflicts involving Agriculture and wildlife (3.16%) and Cattle and wildlife (8.20%). Surprisingly, there is a declining trend in conflicts between humans and wildlife (-0.47%), despite the forest department's efforts to implement rehabilitation programs in and around forested areas. Regrettably, there has been no substantial improvement in mitigating conflicts between wildlife and agriculture, cattle, and humans.

In summary, the government has indeed taken steps to rehabilitate forest-dwelling communities. However, these rehabilitation efforts have been concentrated within the forest's buffer zones, when they should be located further away from the forest. Additionally, the government should introduce employment programs for these rehabilitated communities to reduce their dependence on the forest.

> **Comment [MK9]:** lack of consistent formating needs revision according to the objectives/research questions

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General comments

Formatting consistency should be required

Citation problems (the discussion part totally lack the literature support)

Statement of the problem should be rewritten again

Results (table and graph should be scientifically presented

Conclusion should be writing gain