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Human Animal Conflict in State of Maharashtra using Data Analytics

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Abstract: ***Maharashtra, a land rich in its biodiversity, well known for its wildlife. Maharashtra stands 3rd in terms of Human-Animal Conflict behind Uttarakhand and Karnataka. Human–Animal conflict refers to the interaction between wildlife and people leading to a resultant negative impact on people, their resources, wild animals and their habitat. The paper discusses a 2year study(1st Jan-2019 to 1st Jan 2021) carried out on human-animal interactions in Maharashtra -focusing on various factors involved under Human-animal conflict, and its current situations in the state. The Paper further focuses on use of advanced computer technologies, and techniques like Data Analytics & Statistical Analysis to study the actual current situation of Human-Animal Conflict in Maharashtra.***
Keywords: Maharashtra, Human Animal Conflict, Data Analytics, Computer, Wildlife, Statistical Analysis.

I. INTRODUCTION

A. *Human -Animal Conflict*

A hot trending topic in present India. The term Human Animal conflict is defined as -A breach to the imaginary wall of peace between the two entities of nature -the Wildlife and Human life. It gets a meaning when unknowingly one of them breaches the wall and enters the others territory, and that's when they confront each other resulting either a peaceful coexistence or the most dangerous confrontation leading to the inevitable fight. Human Wildlife Conflict (HWC) is emerging as a significant wildlife management issue. The conflict results in severe impacts on communities in the form of crop depredation, property damage, loss of livestock, human injury and human killing. Although a lot of studies have been done worldwide but such studies are limited in India. Recent study on how wildlife thrives in the Coconut-Cashewnut plantations of Sindhudurg District of Maharashtra is a perfect example of how wildlife has adapted itself to the ever changing ecosystem patterns due to constant climatic change and degradation in forest land. It explains well how the wildlife thrives in Human dominated agropastoral ecosystems and how it impacts the daily lifecycle of both. Human animal conflicts is classified in 3 categories depending on its domain of impact. It includes either human based conflict, livestock-based conflicts and Crop Degradations. This paper and the overall project focus on HWC (Human wildlife conflict) in State of Maharashtra. Maharashtra stands 3rd in the list behind Uttarakhand and Karnataka based on the counts of the actual cases of human animal conflicts occurring in a brief annual period. Over 20000 cases are recorded every year in Maharashtra. Maharashtra has 36 defined districts of which no district is practically conflict free. Focusing on Maharashtra for the following study itself is a challenge. Dealing with HWC is the most significant issue. In this era of Technology, Computer technology can be efficiently used to deal the problem, using the Data analytics and corresponding predictor methods we can deal with HWC. Thus to deal with the HWC an interface design idea is proposed which covers how Data analytics can be used in Data mitigation and Processing method to deal with the actual counts of conflict cases, its degree of impact, necessary measures to curb them, educate people on the same, keep records of actual cases, compensations costs and status of help along with effective distribution of it ; which would surely play an important role to reduce the conflicts.

B. *Discussions*

Human-wildlife conflict is fast becoming a critical threat to the survival of many endangered species, like wild buffalo, elephants, tiger, lion, leopard etc. such conflicts affect not only its population but also has broadened environmental impacts on ecosystem equilibrium and biodiversity conservation. Studying Human Animal Conflict has many factors to take in consideration while study. It depends directly or indirectly on these factors like Geography of the Area , Species variance in that area, Percentage of forest land cover , a specific species dominance e.g (Tiger dominates the North Eastern Maharashtra landscape.), climatic change and corresponding impact on the environment, natural prey base factor that affects the larger predators, degree of human interference in that specific area, human settlements in surrounding forested land, lifestyle of human communities living in that area reasons and frequency of attacks and many more direct and indirect factors.

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If human population increases, development expands, and affects the climatic changes, it directly depends upon the degree of human animal conflict e.g.(Leopards along the fringes of SGNP, Mumbai have adapted themselves to the ever growing and fast developing Mumbai city resulting in forest cover shrinkage and encroachment inside the buffer zone of National park driving them indirectly in human settlements and increased conflicts).While you study the conflicts ,processing them and analysing is also a great task to accomplish. Maintaining the human-animal conflict records include maintaining actual counts of cases, total area affected under the conflict, quantity of crops and total crop revenue affected after crop raiding's, compensation calculation for each and every case, further mapping of possible regions and predicting future conflicts.

II. METHODOLOGY

The following study about human animal conflicts in Maharashtra and corresponding data collection started in 2019. This study was planned currently for State of Maharashtra. Collection of data in form of different cases and its details registered through length and breadth of Maharashtra started in June 2019, via various leading newspapers like Sakal ,Lokmat, Maharashtra Times ,Loksatta , Kesari, and many local papers of each district. Along with newspapers, various web news portals and blogs like Business Standard, the Box, Hindustan Times, WIRE etc were used for data collection.

A preliminary survey for studying the basic geography and biodiversity around Pune district was also carried out which covered primarily the Southern Pune region of grasslands and a simultaneous human- grassland biodiversity interactions for prime predators like wolf and hyena was primarily studied. This Survey covered the villages of Jejuri, Morgan, Purandar , Saswad, Supe , in Purandar Taluka, and Bhor Taluka and adjoining surrounding regions. While the habitat and wildlife study in Junnar and Shirur in Northern Pune was carried out with help of different resources. The rest of the Maharashtra was covered in this project, based on pre-study of Indian wildlife and Wildlife of Maharashtra, Geographical aspect of Maharashtra, historic and present conditions of human-animal conflict and its factors and other various collected data. The total project included 2yr year study. The data collection started from 1st Jan 2019 to 1st Jan 2021 (period of 24 months /2Years).

Maharashtra was divided in predefined 6 divisions –

1) Pune Division
2) Konkan Division
3) Nashik Division
4) Aurangabad division
5) Nagpur Division
6) Amravati Division

These 6 divisions were studied individually, and a detailed report about each of its human-animal conflicts was maintained. Maharashtra has total 36 defined districts of which 33 were under study, while rest three (Mumbai and Mumbai suburb -combined as one Mumbai)&(Beed and Osmanabad were excluded due to no firm data knowledge about them.) Further the districts were separately studied. Classifications of districts included clustering of similar districts based on parameters like - similar climatic, geographic conditions, similarity in biodiversity, the dominant species responsible for conflict and rich active corridor paths for free wildlife locomotion was done. The human-animal conflicts were grouped in 2 categories based on domain of impact which were

These 2 categories were further divided based on types of conflicts and loss occurred –

a) Direct human involvement-
- Human deaths
- Human injuries

b) Indirect human involvement-
- Livestock deaths
- Livestock injuries
- Crop raiding and destruction

The collected data was again distributed based on the species, types of conflicts, individual involvement of each of them and many more similar factors which was statistically analysed further to calculate the results. Depending on various species , their respective hotspots were individually studied like e.g. the districts of Ahmednagar ,Solapur & Pune were focused on for wolf, Sangli ,Konkan for mugger-crocodile and northern Maharashtra for sloth bear.

Analysis this collected data was done using computer techniques of Data Analytics and Data Visualization, including Geographical Range Mapping and Graph plotting.

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A. *Dealing the HWC using Computer Engineering*

Human-animal conflict as explained has transformed in a serious issue, and dealing with it using orthodox techniques is proving insufficient. What about dealing HWC using Engineering? Rather a computer engineering. While selecting this topic, a thought was put forth for designing an interactive website which aims in educating, creating awareness, user enquiry for new case reporting, explaining the conditions and actual situations about human-animal conflicts using data analytics, data visualizations, range mapping and user-friendly simple website finally helping them to handle the conflict.

B. *Algorithms Proposed*

Implementation of this project requires a strong backend built up which includes Data analytics. Data analytics calculates the results based on of collecting, processing, clustering, statistical analysis and presentation of data.

The Algorithms proposed were

1) *Clustering:* Clustering of data in homogenous sets would help in distributing of data systematically. Clustering would help in sorting and clustering of similar regions of common conflict and would help in identifying the similarity in conflict pattern.
2) *Apriori-Algorithm:* Apriori algorithm is a frequent set mining algorithm along with association rule learning. Apriori algorithm with our context can be used for finding frequent species set of the species involved in human-animal conflict for two or more zones, or at districts which predicts the types of conflicts would be faced by that region and surroundings.
3) *Linear-Regression:* Regression mapping is a learning algorithm based on **supervised learning**. It performs a **regression task**. Regression models a target prediction value based on independent variables. It is can mostly be used for plotting out the yearly and monthly linear nonlinear graphic growth of human animal conflicts based on a specific species, region, or type of conflicts.

III. PROPOSED COMPUTER BASED SYSTEM TO DEAL WITH HWC

A. *System Architecture*

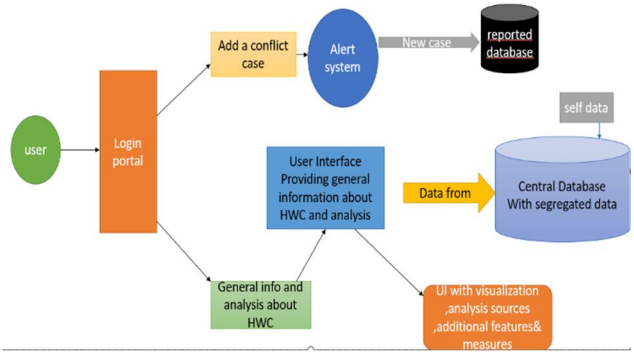

Fig1. System Architecture of proposed system

1) *Login Portal:* User friendly Login portal design- containing user login fields.
2) *Information Portal:* Portal supporting the overall information about human-animal conflicts, wildlife of Maharashtra, types, and reasons of conflict UI providing Information- once you enter information portal- you get a choice of information types including general information, types, gallery-for photos, guidelines for prevention and avoiding conflicts etc.. It is a user selectable module where he/she can select the what to read.
3) *Visualization UI-Data Analysis Module:* This module holds all the analysis part done on the internal collected database, which gives the actual realization of what happens in human-animal conflict. It features, all necessary types of analysis. visualization part holds the range mapping, conflict mapping visual GUIs.
4) *Enquiry System:* Enquiry system deals with recording of new input, i.e external user enquiries , fresh new reporting of HWC cases, and quick helping system with necessary primary solution. Further information collecting, loss estimation would be calculated and provided. It also contains one more feature on a successful enquiry the user gets back the notification of successful registration and instant suggestion of primary advice to deal with the present situation.
5) *Central Database:* The central database contains the total collected data, on which the analysis is carried out and displayed. It contains all the detail records and losses occurred in the brief defined project period.
6) *Reported Database:* This database would store newly added cases by external users who logged in for help and enquiry. Monthly analysis of this new collected data would be done and displayed to the users.

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B. Activity Flow of the Model to be Built

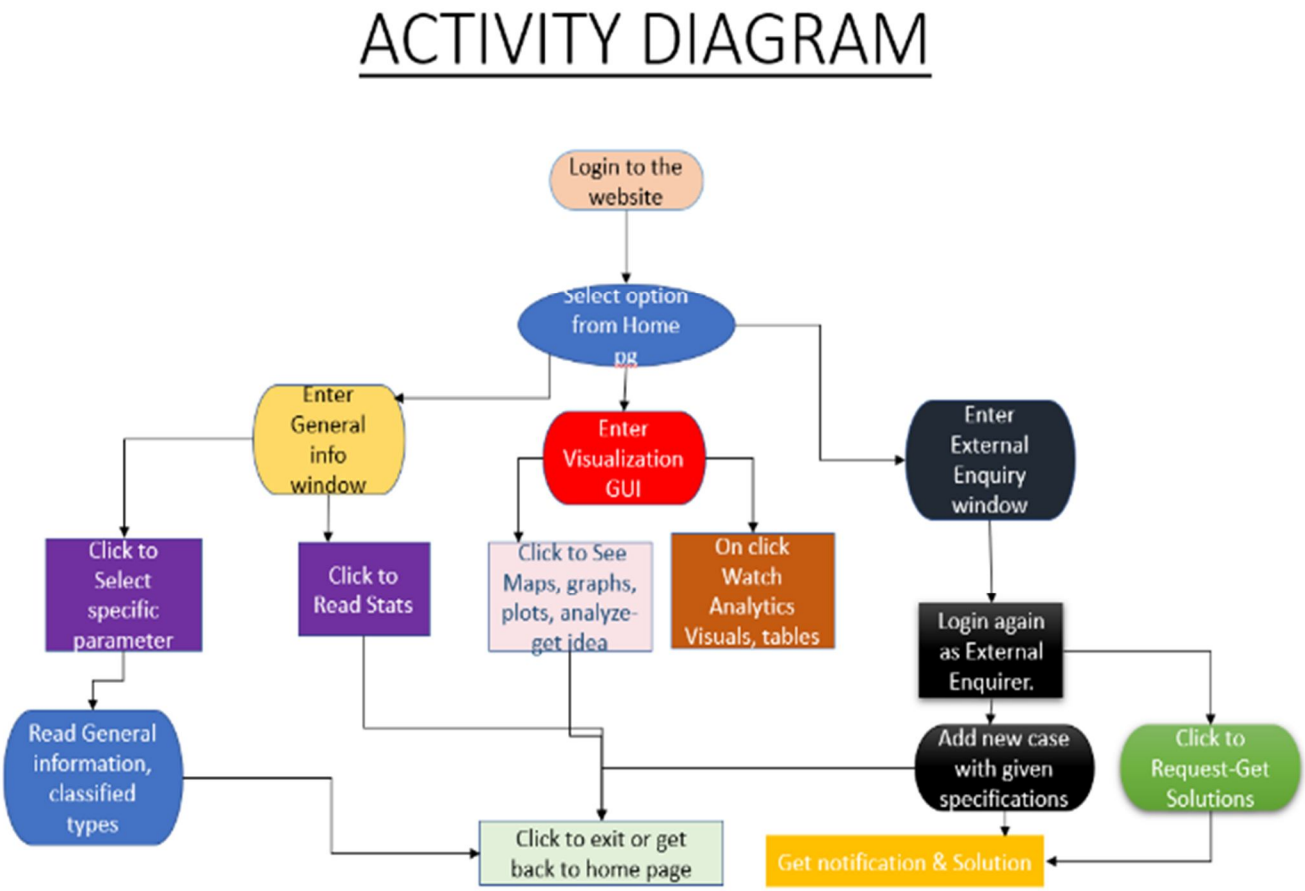

Fig2. Activity flow of the system

The System

1) User logs in the system.
2) User can select whichever module he/she wants to open and read.
3) User can directly enter the enquiry portal for adding a new case/ his grievance or ask for help
4) User can select the analytics portal where he/she can refer to the analysed data or read the information regarding HWC in Maharashtra.
5) If user adds a new case, in help/enquiry portal he/she gets the notification of successful registration.

IV. OBSERVATIONS, RESULTS & CONCLUSION

A. Observations

The Total data collected for this project comprised of 665 prominent recorded cases all across Maharashtra.
33 of the 36 districts were covered with at least 1 case recorded per district. The total time period of the data collection was from 1st Jan 2019 -1st Jan 2021 (a small brief period of 24 months / 2years). Highest cases hail from Pune (138) with Latur records the least number (1). 3 districts (Mumbai and Mumbai suburb combined under one Mumbai) & (Osmanabad and Beed were excluded due to, no firm data about current cases, or no firm dimensions about them were known).The two-year data was annually divided in 2 parts 2019- with 201 cases and 2020 with 463 cases of Human-animal conflicts in Maharashtra.

B. Geographical Study and Forest cover of Maharashtra in Brief

Maharashtra was divided in 5 zones for ease of study.
Geography of a region is an equally important aspect to understand while studying HWC for a region as the geographical impact and variations are directly proportional to the wildlife diversity of a region.

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These zones are classified as – North Zone, South Zone, East Zone, West Zone and Central Zone.

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Srno	Zone	Geography	Forest type	Districts
1	North	Hilly & heavily forested area	Semi & dry deciduous Northeast has dense tropical semideciduous and bamboo forests	Nagpur Dhule, Nandurbar, Amravati, Gondia, Chandrapur, Bhandara, Gadchiroli, Akola, Buldhana, Washim, Yavatmal, Vardha Jalgaon
2	West	Supreme Influence of Sahyadri's on Geography of this region	Dry deciduous, thorny scrubs and grasslands Coastal strips support mangrove forests	Mumbai, Pune, Nashik, Nagar, Thane, Palghar, Raigad
3	East	Combined geography of moderate hilly regions and flat agricultural land	Dry deciduous forests and agricultural region	Nanded, Latur, Hingoli, Usmanaba-d(not included in our study)
4	South	Moderate to High undulations of Sahyadri & agricultural influence	Dense Semi-wet forests influence of Sahyadri's and coastal strips	Satara, Kolhapur, Sangli, Solapur, Sindhudurg,Ratnagiri
5	Central	Flat plains of Marathwada one of the drier regions Pure agricultural landscapes	Thorny scrub vegetation, drier region,agro-pastoral landscapes	Jalna, Parbhani, Aurangabad, beed(not included in study)

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C. Identification of Species Involved in Conflicts.

Based on a brief study of the probability of occurrence ,25 Active wildlife species were identified, involved either directly or indirectly in the conflict with high, moderate or lower damage index rate as classified.

They included 5 of the Order Carnivora, 16 Herbivores, & 2 Omnivores species, and one human oriented conflict. The Categories for the species were decided based on the degree of severity of conflict and frequency of their involvement.

They include the following: -

Sr no	Species	Category	Type of conflict involved in
1	Tiger (Panthera tigris tigris)	1	Human and Livestock based
2	Leopard (Panthera pardus fusca)	1	Human and Livestock based
3	Indian Wolf (Canis lupus pallipes)	1	Human and Livestock based
4	Elephant (Elephas maximus indicus)	1	High crop raiding
5	Indian Gaur (Bos gaurus)	1	High crop raiding
6	Sloth bear (Melarsus ursinus)	2	Human and Livestock based
7	Wild boar (Sus scrofa)	2	High crop raiding
8	Chinkara (Gazella bennetti)	2	High crop raiding
9	Blackbuck (Antilope cervicapra)	2	High crop raiding
10	Neelgai (Boselaphus tragocamelus)	2	High crop raiding
11	Spotted deer (Axis axis)	3	Crop Raiding &Straying
12	Sambar (Cervus unicolor)	3	Straying
13	Barking deer (Muntiacus muntjak)	3	Straying
14	Hanuman Langur (Semnopithecus. L)	3	Crop raiding & property damage
15	Rhesus Macaque (Macaca mulatta)	3	Property damage, human based
16	Bonnet Macaque (Macaca radiata)	3	Property damage, human based
17	Small Indian Civet (Viverricula indica)	3	Straying
18	Palm civet (Paradoxurus hemphroditus)	3	Crop Raiding
19	Black-naped Hare (Lepus nigricollis)	3	Crop Raiding
20	Indian Porcupine (Hystrix indica)	3	Crop Raiding & Straying
21	Striped Hyena(Hyena hyena)	3	Straying & human based
22	Golden Jackal (Canis aureus)	3	Straying & human based
23	Jungle Cat (Felis chaus)	3	Straying
24	Indian Pangolin	3	Straying, theft (human oriented)

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D. Reptilians

1 species from the class Reptilia was also included in our study, it involves the Mugger crocodile which has been observed active along the rivers of Konkan strip and Southern Maharashtra prominently in districts of Sangli, Satara and Kolhapur. The reason behind including Mugger crocodile in our list is due to some of the fiercest conflicts with humans. Humans have either lost their lives or leading to a lifetime irreparable loss. Cattle lifting by crocodiles, grazing over the banks of river, are not rare.

Sr no	Species	Category	Type of conflict involved in
1	Mugger-Crocodile	2	Human and livestock

E. District wise classification of HWC

Dominant species of each district was derived based on the number of cases occurred involving that species / Total number of cases occurred in that district. A percentage was calculated for decision making. Leopard ranks 1st dominating 18 of the 33 districts followed by Tiger dominating 8 other districts. Other dominant species included Elephant (Kolhapur), Crocodile(Sangli), 2species of macaques(Parbhani), Wild boar (Washim & Jalna) while two districts(Akola &Nanded) showed no individual species dominating others, thus were grouped under 'Mixed Dominance'

All these cases range from a period of (1st Jan 2019-1st Jan 2021) (All of them are taken from our collected data of total 665 cases.)

Sr no	District	Number of cases	Dominating Species
1	Mumbai	17	Leopard
2	Pune	139	Leopard
3	Nagpur	14	Tiger
4	Ahmednagar	47	Leopard
5	Nashik	60	Leopard
6	Solapur	13	Leopard
7	Kolhapur	33	Elephant
8	Satara	25	Leopard
9	Sangli	20	Crocodile
10	Thane	8	Leopard
11	Raigad	8	Leopard
12	Ratnagiri	20	Leopard
13	Sindhudurg	29	Leopard
14	Palghar	3	Leopard
15	Dhule	10	Leopard
16	Nandurbar	10	Leopard
17	Jalgaon	7	Leopard
18	Jalna	7	Wild boar
19	Parbhani	8	Bonnet Macaque
20	Nanded	8	Mixed dominance
21	Aurangabad	6	Leopard
22	Hingoli	7	Tiger
23	Latur	1	Leopard
24	Amravati	17	Leopard
25	Akola	9	Mixed dominance
26	Washim	5	Wild boar
27	Buldhana	10	Leopard
28	Yavatmal	17	Tiger
29	Vardha	12	Tiger
30	Chandrapur	53	Tiger
31	Bhandara	10	Tiger
32	Gondia	20	Tiger
33	Gadchiroli	12	Tiger
Total	33	665	Leopard(18)

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F. Number of Cases Associated with Each Species

As stated before 24 active species have been recorded and 1 unidentified species which was described as some leopardlike creature. (A hyena is mistaken usually for a leopard if both of them share the same area and a frequently spotted.) thus due lack of form evidence it was kept as a unique special case marked with (*). 6 cases of such unidentified species were also counted. For ease, here the 2 macaque (bonnet and rhesus) species have been grouped together and counted. Percentage calculated explains how 51.35% cases are credited to the Leopard
Followed by the Tiger (10.69%).

Sr no	Species	No of cases each species is involved in	Percentage of contribution in HWC Maharashtra (%)
1	Tiger	71	10.6927
2	Leopard	341	51.3554
3	Indian Wolf	16	2.409
4	Elephant	21	3.162
5	Indian Gaur	18	2.706
6	Sloth Bear	15	2.26
7	Wild Boar	39	2.26
8	Blackbuck	14	2.108
9	Neelgai	13	1.957
10	Chinkara	8	1.204
11	Spotted deer	12	1.80
12	Sambar	1	0.15
13	Barking deer	4	0.60
14	Mugger-Crocodile	17	2.56
15	Bonnet &Rhesus macaque	9(6+3)	1.355
16	Palm civet	7	1.054
17	Small Indian civet	1	0.15
18	Hanuman langur	13	1.957
19	Indian porcupine	4	0.60
20	Golden jackal	12	1.80
21	Striped Hyena	8	1.204
22	Jungle cat	4	0.60
23	Indian pangolin	11	1.656
*	Leopard-like	6	0.903
Total	23	665	100

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G. G. Other Factors in Human Animal Conflicts-

1) *Human Dependency and Interference in Nature:* The Factor of Human dependency on Nature either directly or indirectly and the degree of interference is one of the prime reasons for triggering Human-animal conflict. In North-eastern Maharashtra where most of the communities are nomadic of forest originated live at the fringes of dense forests either on farming or simply depend upon the forest products for earning a living have to enter the tiger prone areas daily. Here they have a frequent interaction with wildlife which sometimes prove dangerous or even fatal. The livestock owned by these people are frequently left loose in the forests nearby for grazing which results in Tigers and leopards attacking the easy option of prey leading to livestock related conflicts. Similar conditions have been observed in Western Maharashtra where Tigers are replaced by the wolves, due to dominating grasslands ecosystems.
2) *Agropastoral landscapes a Unique Ecosystem:* Rapid Urbanizations and directing more and more forest land to the agricultural sector have resulted in Wildlife shifting and adapting itself as per the new human oriented Agropastoral landscapes. The semi agricultural areas (agricultural land on fringes of a forests) or the established agricultural land both support a wide variety of wildlife. As observed these conditions have rooted up in Western, Central and Southern Maharashtra. The districts in Konkan Division and Southern Maharashtra of Kolhapur, Satara Sangli,& Solapur and Pune, Nashik, Ahmednagar in Western part of the state highlight such modern Human-animal conflict conditions. Naturally farmers coming in contact with these species tend to face some or the other type of interaction leading to the conflict. E.g Some notable examples include - Leopards adapting themselves to the sugarcane fields in tehsils of Junnar, Ambegaon, Shirur (Northern Pune) , Karad (Satara) & Gadhinglaj, Kaagal, Chandgad, Ajara (Kolhapur) are now locally dependent on these agricultural lands for shelter & food. One more example is the Palm civet (locally known as 'Kandechor' in South Konkan)which is a common dweller of Sahyadri's is widespread in Konkan belt primarily known for its crop raiding nature. In Southern Maharashtra (Konkan Strip) Cashewnut-Beetlenut plantations in Sindhudurg and Ratnagiri districts support a wide variety of wildlife sheltering them. The plantations of jackfruit, mango, palm, beetlenut, coconut serve as a mini forest for them. 10 species of mammals have been identified across Maharashtra who regularly use the agropastoral and plantation landscapes, depending on the crops as a food source. This dependency of the wildlife may affect the agriculture directly (crop raiding) or resources nearby (hunting of livestock in adjacent villages). Thus, Agropastoral landscapes play a very important role in Human -animal conflicts and conserving them is inevitable.

V. RESULTS

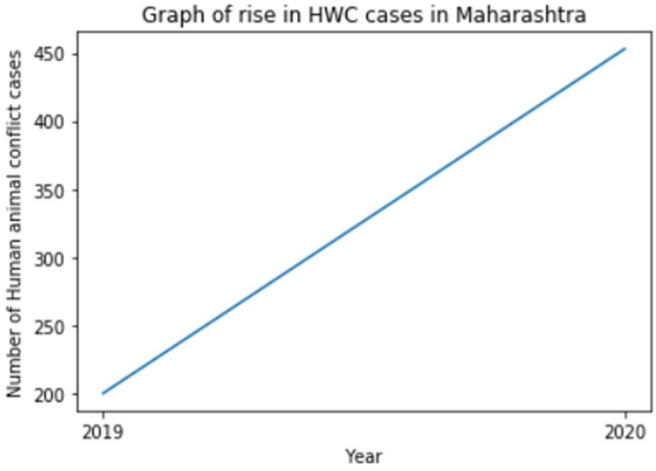
From a brief 2-year study, 665 cases were recorded.

The results were grouped based on their category. All the analysis results calculated below are based on observations on these 665 cases

A. Analysis Based Results

Here are some of our Analytics based results.

1) *Rise in Number of Cases Recorded:* A Linear growth was observed in the number of HWC cases in Maharashtra in a span of 2 years. 2019 saw 201 cases while 2020 recorded 454 cases.



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B. What percentage Each Type of Conflict Measures?

The most frequently recorded cases belonged to livestock injuries, followed by human injuries and crop raiding. While livestock deaths are measurable, the cases of humans losing their life in such conflicts is not very frequent. It differed according to the region, Central and Southern Maharashtra had more numbers of crop raiding cases, whereas Western and Northern state had more numbers of attacks on humans and livestock.

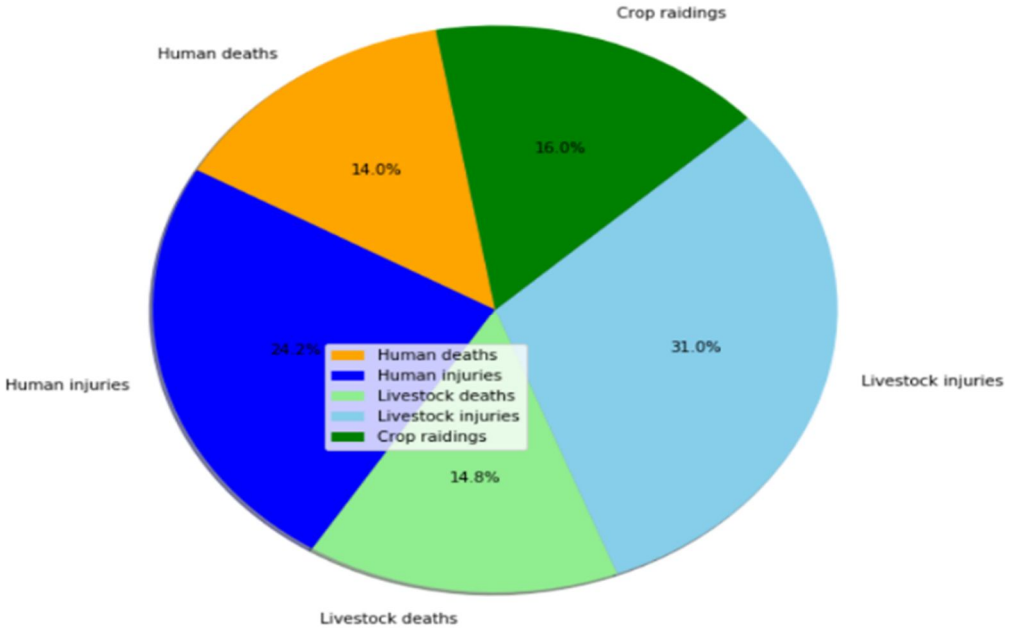

Fig.3 -Percentage measure of each category of conflict

C. Crop Raiding

A Total of 66 cases were recorded in our dataset, but further studying we know that 100s of the cases are recorded under this category every year hence many go unnoticed. 11 active species were identified which contributed to this cause- they comprise of 7 larger mammals and 2 small bodied mammals. 2 more species have been identified and included despite of having no recorded cases but knowing about their general behaviour and background of crop raiding. They include the Asian palm civet (Viverricula indica) raiding crops over the Southern Konkan districts & Black naped hare (Lepus. nigricollis) which is omnipresent.

Though this analysis is based on our collected data some counts differ. E.g 9258 cases of crop raiding by elephants have been recorded from Southern Maharashtra.

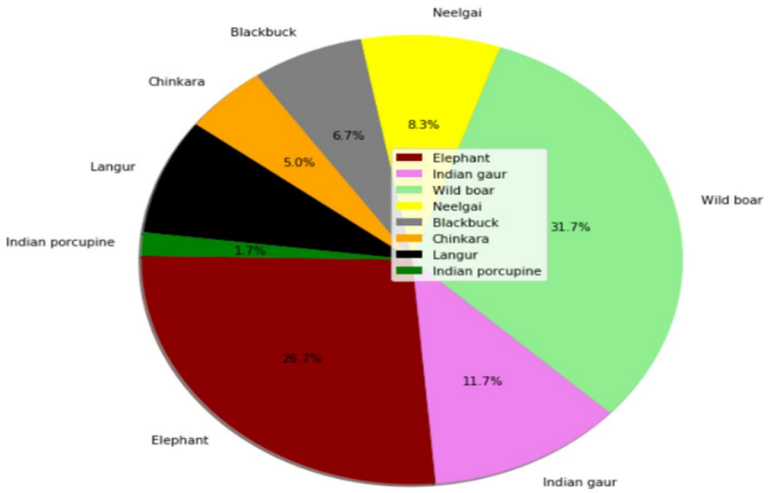

Fig 4 crop raiding percentage

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D. Human deaths and Injuries

Statistical counts show-2019 counted 19 human deaths and 54 human injuries while 2020 saw 54 human deaths and 114 human injuries, most of which were caused by two species Tiger and the Leopard while wolf played a smaller role in this count. Some other cases of Elephants, Indian Gaur, Sloth bears & Crocodiles attacking and killing humans have also been added to the count.

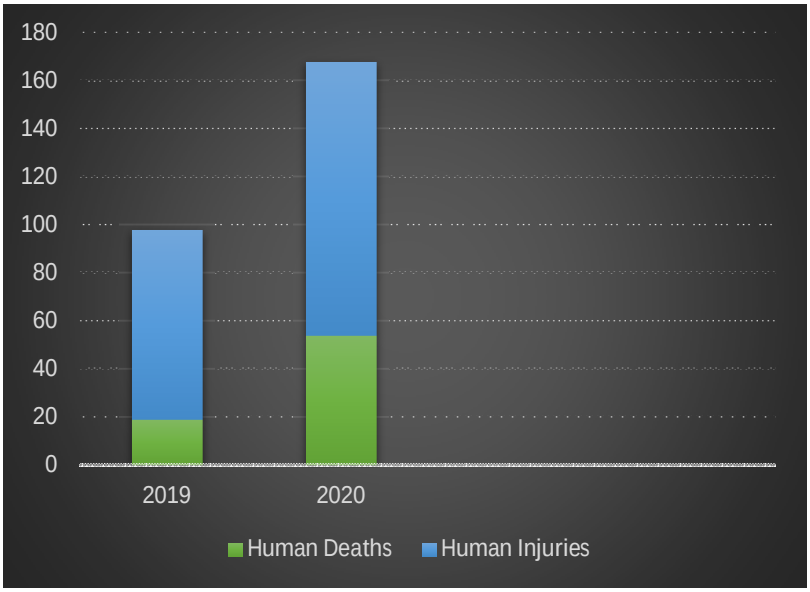

Fig 5- Yearly Graph of human related cases

E. Livestock Death and Injuries

31% of the total cases recorded belong to this category. Livestock injuries count 14.8% of the total cases -together they count(45.8%) which nearly equals 50%. 3 species have been identified which are involved in livestock related conflicts – The Tiger, Leopard and Wolf. Leopard tops the list covering the southern western and central Maharashtra except for the tiger responsible for 80% of the livestock hunting and cattle lifting in North Eastern Maharashtra. Wolf ranks 3rd with most of the wolf involved cases coming from western Maharashtra under this category.

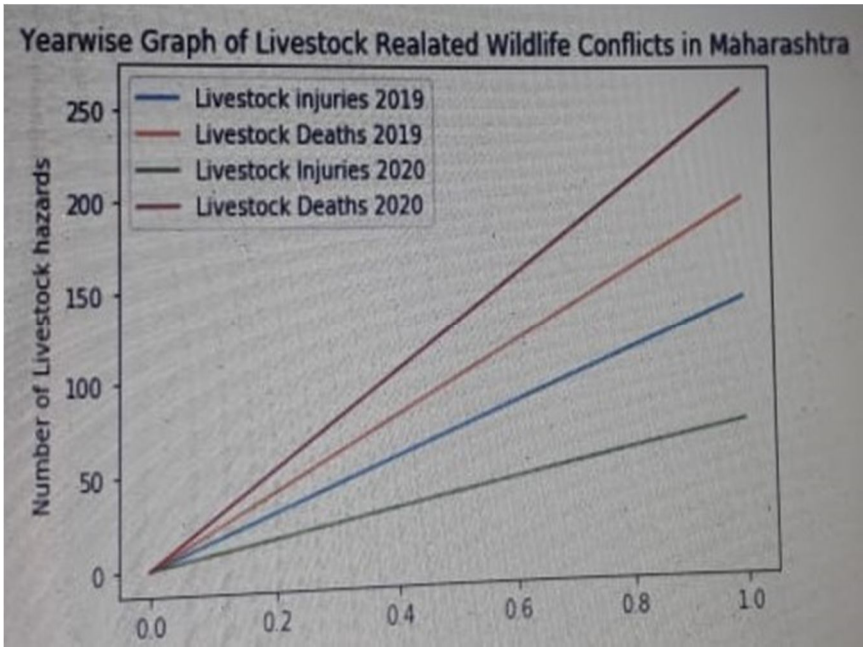

Fig 6 -Annual analysis of livestock related conflicts

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F. Range Mapping

Range mapping includes mapping and plotting of real time points, ranges & identifying hotspots of conflicts for each species. Ranges were mapped separately for 8 prime species (Tiger, Leopard, Elephant, Wolf, Indian Gaur , Crocodile & Sloth bear ,Wild boar) while other prominent species like Neelgai, Blackbuck, Jackal & Wild boar(though included)were omnipresent with multiple range points ,and areas to map. e.g., Wild boar is practically present in all 36 districts of Maharashtra along with blackbucks having a scattered population making it difficult to identify their exact range, except for some well-known points. Here are some range mapping results.

Sr no	Species	Identified range points and hotspots	Area covered by the range points (in Sq. km)	No of Districts The range is spread through
1	Tiger	23	45320.1	15
2	Leopard	500+	191119	36
3	Indian Wolf	80	29381.4	16
4	Elephant	11	4967.1	2
5	Indian Gaur	57	63478	23
6	Mugger-Crocodile	31	1311.44	11
7	Sloth bear	109	47677	24
8	Wild boar	500+	204555	36
	Total	1311 approx.	58389	36

The total area covered by the range mapping points measures approx. 583809.13 Sq.km. Its because many of the species have overlapping ranges which are separately calculated and then summed up.

The mapped area has approximate measurements due to the resource nomadic behaviour and changing territorial patterns observed in many species, thus the mapped area gives just an idea of the framework of wildlife web spun in Maharashtra state. Though the areas covered by a specific species is large enough their populations are highly scattered within their range and no major congestion is found at one spot for any of the above species. It was observed that leopard and Wild boar had most widespread impact-zone defining more than 500 different range points all across the Maharashtra state, while Tiger has 23 range plots most of them covering the North-eastern and Northern Maharashtra. The smaller mammalian species from Primates, Civets and Cervids and Canids were widespread, with no proper demark able specific range. Apart from well-defined forested areas and hilly terrain smaller mammalian species were observed close to the human settlements and Agricultural landscapes depending directly or indirectly on humans or human resources for survival.

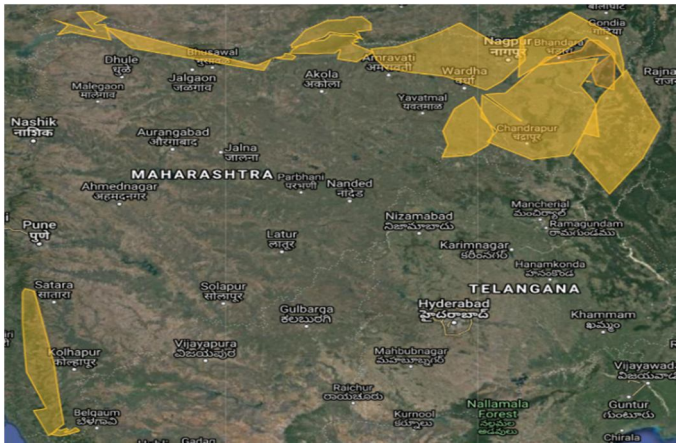

Fig 7. Probable range mapped for Tiger in Maharashtra (Range mapping results)

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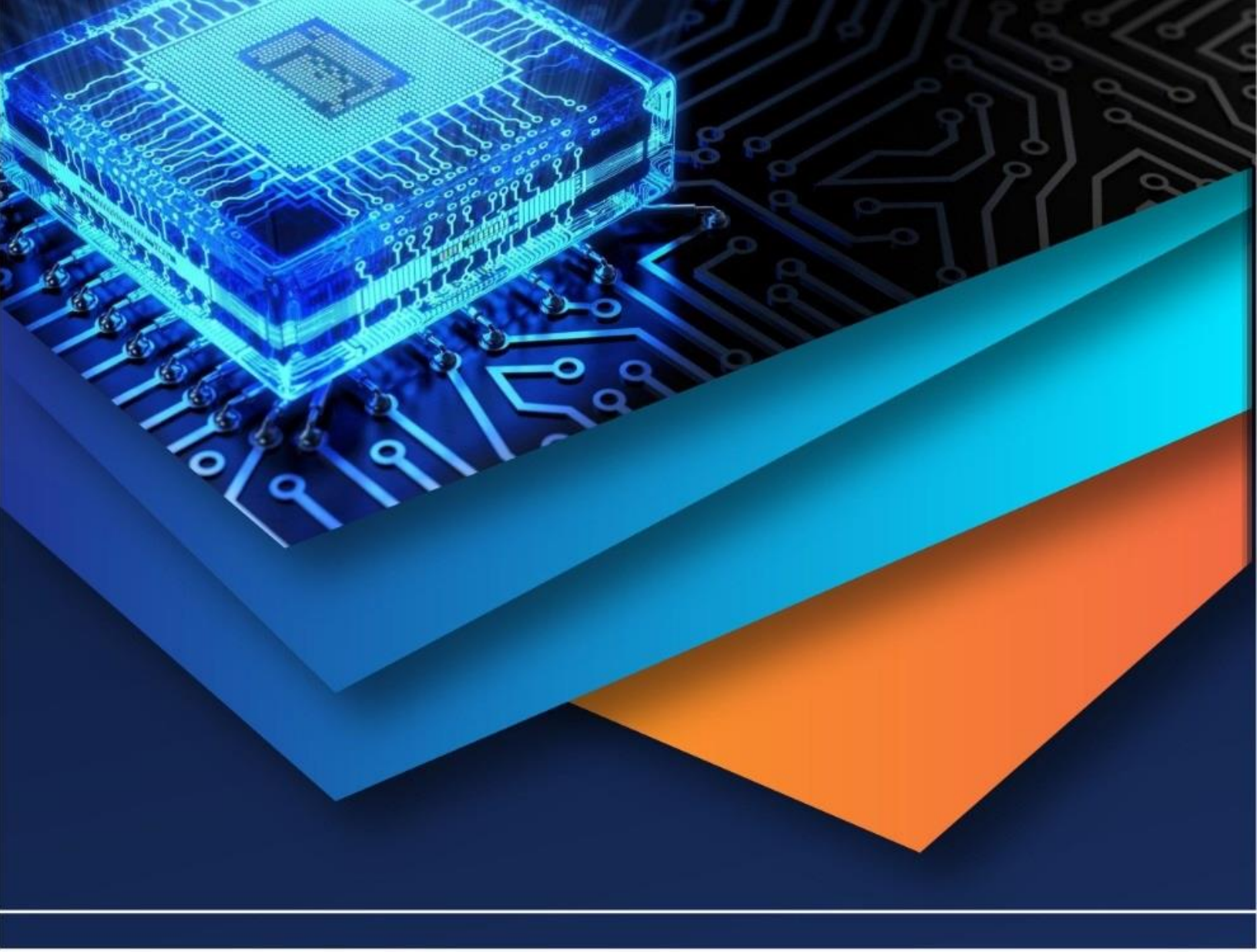

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