CAUSE-CONSEQUENCE ANALYSIS OF HUMAN-WILDLIFE CONFLICT IN WAYANAD DISTRICT, KERALA

By

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(2015-17-007)

THESIS

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DECLARATION

I hereby declare that this thesis entitled **"CAUSE CONSEQUENCE ANALYSIS OF HUMAN-WILDLIFE CONFLICT IN WAYANAD DISTRICT, KERALA"** is a bonafide record of research work done by me during the course of research and the thesis has not previously formed the basis for the award to me of any degree, diploma, fellowship or other similar title, of any other University or Society.

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INTRODUCTION

INTRODUCTION

In the present scenario, human-wildlife conflicts are a major concern for the forest managers everywhere in the world. It is a serious management headache for not only the people in the forest fringe areas but also to the wildlife managers, planners, policy makers and government. The rapid rise of these conflicts suggests for critical and continuous evaluation of the subject as the much-followed mitigation strategies are not proving successful in the long run anywhere. For the long-term management, new strategies and approaches are the need of the hour.

Human-wildlife interactions have both positive and negative implications. Positive values of the wildlife resources are physical utility, monetary, recreational, scientific, ecological, existence and historical values (Giles, 1978). Shortage of resources occurring in the fringe areas of the forest will develop adverse impact on humans and wildlife, which is termed as human-wildlife conflict (HWC) (Sillero-Zubiri *et al.*, 2007). Human-wildlife conflicts occur due to significant interaction between humans and wildlife.

Some are of the view that the human-wildlife conflicts have increased as the governments give more priority to the needs of wildlife than the requirements of local people. On the other hand, there are people who find a link between current population explosion and increasing the demand for land resources which ultimately paves the way for conflicts. In many areas, expansion of human population, land conversion, encroachment, developmental activities near the fringe areas and fragmentation of the forest are the primary triggers for human-wildlife conflicts (Romanach *et al.*, 2007; Sharma *et al.*, 2011). Hence there is a need for innovative strategies and good management practices to minimize the conflicts. Many of the innovative strategies, such as electric fencing, natural resource use compensation systems, community-based natural resource management schemes and incentive and insurance programs needs refinement. Introducing innovative ideas to deter wild animals from human settlements is needed to alleviate the interaction. Quantification of damage and giving

compensation to the victims will minimize its severity. Inadequate disbursement of compensation, difficulties in applying and lag in processing are the major complications faced today (Ogra and Badola, 2008). For the improvement of tolerance among the local people awareness programmes could be organised, which was reported to reduce the frequency of conflicts (Gill *et al.*, 2001; Mishra *et al.*, 2003). As wildlife conservation is the major problem faced worldwide, creating co-existence between humans and wildlife is mandatory to improve the situation (Madden, 2004).

Human-wildlife conflicts has two aspects i.e., management and conservation aspect. All the control measures adopted for preventing or reducing the encounter of wild animals in the human dominated landscapes come under the management aspect. In the conservation aspect, priority is given to the needs of both humans and wildlife. The present study was primarily designed to develop a better understanding of the nature of human-wildlife conflicts, its causes, consequences and the various mitigation strategies from the management view point. Both the stakeholders people, as well as wildlife, are suffering from these conflicts and the authorities need to work sincerely to tackle and scale down the conflicts. Resolving human-wildlife conflict is not merely depending upon the wildlife ecology. Awareness of human dimensions is also important. The people in the fringe areas are the worst affected ones, they are losing their hope as a result of these increasing conflicts which for them may be occurring on a daily basis. They are becoming more sensitive and agitated against any human-wildlife conflict as a result. Human-wildlife conflicts were addressed as forest fringe communities issue, but at present due to the human population explosion and developmental activities it is now common in urban landscapes. At present, the Kerala Forest Department provides compensation for crop loss, property damage, human causalities and livestock depredation by wild animals listed in the schedules of Wildlife Protection Act, 1972 like Elephants, Tiger, and Gaur etc. In areas of intense conflicts, the commonly employed preventives are physical barriers such as trenches and

construction of electric fences, which is ineffective in many cases due to the climate and topography and also due to the lack of maintenance.

Human-wildlife conflict is one of the main issues in the Western Ghats. It has gained attention in recent days due to the frequent straying of wild animals in the crop fields and human habitations. During the year 2015-16, 6022 incidents of human-wildlife conflicts were reported in Kerala. Among these, crop damage by wild animals is one of the major problems faced by the marginal farmers in Kerala. Due to the settlements and the expansion of agriculture in the marginal areas, the forests in Kerala are extremely fragmented. This led to crop damage by the wild animals in the agricultural fields adjacent to the forest areas. In addition to these, past activities like the large-scale conversion of forests into monoculture plantations of teak and eucalyptus, shifting cultivation, hydraulic projects and organised encroachments reduced the accessible habitat of wild animals in Kerala (NTCA report, 2011). During the year of 2015-16, the various forest circles in the state had received 6022 applications for compensation and had disbursed Rs. 6.81 crore as compensation to the victims (GOK, 2016). For managing and mitigating the human-wildlife conflicts, scientific data on management and conservation aspects from all the conflict hotspots in the state is essential.

In this background, the present study is undertaken in the Wayanad district to document the human-wildlife conflicts based on the following objectives:

1. To describe the nature, frequency, distribution and intensity of human-wildlife conflicts in Wayanad district, Kerala
2. To understand the causative factors involved in the conflicts
3. To identify and map the hotspots of conflicts
4. To suggest mitigatory measures and enhance human-wildlife coexistence

REVIEW OF LITERATURE

REVIEW OF LITERATURE

In the day to day affairs human wildlife interactions is something that has been in boon due to the various ill-effects caused as a result. It has both positive and negative effects. In the positive impacts, the wildlife provides utility in terms of monetary, ecological, scientific, existence, historic etc. (Giles, 1978). The competition for resources at times of shortage is the prime reason for negative interactions, which is commonly termed as Human-wildlife Conflict (HWC) (Sillero-Zubiri *et al.*, 2007).

Human-Wildlife Conflict (HWC) is fast becoming a serious threat to the survival of many endangered species in the world. The several examples from countries all over the world demonstrate the severity of the conflict and suggest that greater in-depth analysis of the conflict is needed in order to avoid overlooking the problem and undermining the conservation of threatened and potentially endangered species. Human-wildlife conflict is a growing global problem, which is not restricted to particular geographical regions or climatic conditions, but is common to all areas where wildlife and human population coexist and share limited resources. Dense human populations in close vicinity to nature reserves seem to pose the greatest challenges in many countries. Conflicts become more intense where livestock holdings and agriculture are an important part of rural livelihoods. Competition between rural communities and wild animals over natural resources is more intense in developing countries, where local human populations tend to suffer higher costs. Considering the current human population growth rate, increasing demand for resources and the growing demand for access to land, it is clear that human wildlife conflicts will not be eradicated in the near future. For this reason, a better understanding of conflict management options is crucial.

2.1 HUMAN-WILDLIFE CONFLICT

Heberlein (2004) explained human-wildlife conflict as a multi-disciplinary subject which includes both human and wildlife dimensions. As a result, in most of the cases the human dimensions are exaggerated and the situation is publicised with

wider implications. IUCN (2005) had described "*Human-wildlife conflict occurs when the needs and behaviour of wildlife impact negatively on the goals of humans, or when the goals of humans negatively impact the needs of wildlife*". In most of the cases the government with its unscientific and unplanned works tends to exaggerate the situation. The awareness about various aspects of conflicts such as political, social, geographical, cultural, historical, legal and economic dimensions are necessary in problem solving (Madden, 2004). The lack of involvement of different social groups and researchers in the conflict mitigation is necessary, but till now none of this is happening and as a result the conflicts are on hike. The human population expansion, agricultural area expansion, encroachment of forest lands to meet the human demands along with other developmental activities cause for human wildlife conflicts along with forest fragmentation (Romanach *et al.*, 2007, Sharma *et al.*, 2011). Simultaneously the wildlife population is also said to expand (Schulz and Skonhoft, 1996). A concrete measure for mitigation of the conflicts is difficult as the situation does not resemble each other, i.e., in each scenario the situation is different.

2.2 GLOBAL PERSPECTIVE OF HUMAN-WILDLIFE CONFLICTS

2.2.1 Damage to cropping systems

All over the world problems due to human wildlife conflicts are escalating, till now no specific measures have been developed to tackle this which is causing large scale loss and devastation. In 2002, Conover reviewed the issue and discussed about various aspects of human-wildlife conflicts. With reference to marginal farmers the problems of conflicts are mostly combinations of crop damage and complex social dimensions that may be reduced with proper education and awareness (Dublin and Hoare 2004). The creation of awareness in this aspect is a necessity as in most of the times the local residents tend to be misguided for individual favours and political gains. Wildlife laws, attitude of local people, habitat recovery and conservation efforts are the main factors to reduce the human-wildlife conflict in many areas (Mech, 1995; Breitenmoser, 1998; Treves *et al.*, 2002). According to Naughton-Treves *et al.* (2003), lifestyle of city areas attracted local

community, who are in constant contact with wildlife, which may lead to the change in the structure of forest boundary and increased the conflicts. The local communities who were in constant interaction with the wildlife in the past has now tend to immediately rebel against any occurrence of wildlife interactions, the ancestors of these residents who came to these places knew of the wildlife and their behaviour and they were living in harmony with the forests. The younger generations haven't met the circumstances that were met by the older generations and as a result for them this is a greater cause for concern.

Nyhus *et al.* (2003) said that the ultimate reason for human-wildlife conflict is scarcity of resources. Compensation schemes do not limit the intensity of conflicts which is in many parts of the world. Institutional support, quick and accurate quantification of damage, clear guidelines, prompt and unbiased disbursement and sufficient funds are also needed. The compensation schemes do not promote the conservation of wildlife which contradicted the above hypothesis. Competition for resources will be enhanced by the increasing human population, encroachment and fragmentation of the forest habitat which led to conflicts (Romanach *et al.*, 2007). Chen *et al.* (2006) suggested the challenges faced by the traditional nature reserves. Land-use planning with combined approach for the conservation of wildlife was recommended. Peterson *et al.* (2010) characterized many conflict areas by the lack of spatial sampling and modelling and by rectifying these, the efficiency of management, mitigation and conservation of wildlife can be improvised (White and Ward, 2011).

The need for approaches such as conflict mapping will provide a database for the working of managers in conflict mitigation. By various innovative methods the easy mitigation and problem solving can be enabled and such interdisciplinary aspects has to be enabled in the planning. The agricultural techniques and methods in the fringe areas is one of the drivers of conflict, for example rearing the livestock in the immediate fringe areas attracted the carnivores, which is the fundamental cause of conflict in many areas (Naughton-Treves *et al.*, 1998; Landa *et al.*, 1999; Linnell *et al.*, 1999; Naughton-Treves *et al.*, 2000; Stahl and Vandel, 2001; Ogada

et al., 2003; Wydeven *et al.*, 2004). Studies on economic and social impacts associated with crop raiding conducted by Mackenzie and Ahabyone (2012) discussed that because of these continuous and vast devastation by the wildlife are significantly causing reduction in the annual earnings of the communities faced with conflicts, as a result their life is constantly at risk. Allocation of funds to the area of high depredation of crops was recommended, as they have no other means of livelihood. Another study indicated that, attitude towards wildlife is the key factor needed for managing and conserving the wildlife (Jacobs *et al.*, 2012; Manfredo and Dayer, 2004). Human-wildlife conflict is a growing and expanding issue and crop damage by wild animals are one of the major problem worldwide (Dublin and Hoare, 2004; Anthony *et al.*, 2010). Human-elephant conflict led to change in elephant population in the protected areas and the range of elephants is prevalently now available outside the protected areas towards human settlements in and around the protected areas due to the easy availability of edible food (Hoare, 2000). Awareness on the importance of elephant populations in each bio-geographical region is said to have promoted the elephant conservation and management. Nyhus and Sumianto (2000) conducted a study on human-elephant conflict, which was decreased by increasing the support from local people. Improving the existing control measures for mitigation was suggested. As each of the available techniques may not be proving efficient in each of the cases as situation wise planning and employing is necessary to facilitate it. In Africa O'Connell-Rodwell *et al.* (2000), studied about the economic impacts in farmers due to the African elephants in the region. They also examined various control measures used by them in those areas of Africa for conflict mitigation. In some parts, the electric fences were found to be effective in preventing the occurrence of conflicts to some extent. These deterrents will help in improving the relationship between conservationists and communities. A community based study was conducted by Osborn and Parker (2002) for community based suitable methods in deterring elephants from Zimbabwean croplands and they stated that traditional methods were found to be less effective when compared with the individual experimental methods. Integrated and community based approaches were also

suggested to mitigate conflict by Osborn and Parker (2003). Sitati *et al.* (2003) predicted the spatial aspects of human-elephant conflict in Kenya. The effects of Asian elephant on the rural farming economy was studied by Zhang and Wang (2003) and recommended providing sufficient water within the forest by digging artificial ponds. Trenches and immediate sanctioning of compensations to the victims of crop damage were proposed. Fernando *et al.* (2005) described the human elephant conflict perceptions in Sri Lanka. Traditional land-use practices were suggested to mitigate conflict, who shared resources with elephants. Lee and Graham (2006) reviewed the threats faced by elephants and perception of humans on conflict. The study suggested that, human-human conflict in the form of politics is the main cause of conflict. Spraying of capsicum oleoresin was found effective against elephant raiding by Osborn (2002).

The cultivation of chilli plants in the boundaries can be an effective method to keep away the problematic herbivores, as the plant is less palatable (Parker and Osborn, 2006). The cost effectiveness and the viability of these methods need to be carefully observed. Efficacy of wildlife fences was evaluated by Kassilly *et al.* (2008) and reported that, fences are effective control measure for selected problematic species. Kioko *et al.* (2008) assessed the performance of electric fence against the crop raiding elephants in Kenya. Installation of the fence in an area with high elephant density is the main control measure to reduce conflict. Maintenance of effective non-electrified fences was also suggested. High tensile electric fence was proved as an effective control measure for all wild animals than any other traditional methods (Webb *et al.*, 2009).

In Africa, Osei-Owusu and Bakker (2008) implemented a method of chilli-dung brick for deterring elephants in conflict zones. These bricks were burned and the noxious smell as a result of burning irritated the animals. In Indonesia, also this was proven to be effective (Hedges and Gunaryadi, 2009). There are also several methods available which was proven effective in various areas such as the use of spotlights and chilli-fence with noise (Davies *et al.*, 2011), beehive fences in elephant conflicting areas (Vollrath and Douglas-Hamilton, 2002; King *et al.*,

2009), secondary forests near the farms (Rood *et al.*, 2008) etc. Each of these methods have proven to be successful in various parts of the globe, but the effectiveness in Kerala needs to be studied as the attitude of people and the environmental conditions in each of these areas vary to greater extends.

The diet of wild boars in western Europe was studied and in reference to conflicts the plant preference was studied by Schley and Roper (2003). Schley *et al.* (2008) reported that, wild pigs damaged grasslands than annual crops and the seasonal damage was based on the types of crop cultivated. Hunting reduced the conflicts and the need for introducing new harvest models among the local hunting teams were suggested. Amici *et al.* (2012) reported that, crop damage due to wild pig was due to the refuge effect. The improvements in fences and their technology can reduce the conflicts to some extent (Vercauteren *et al.,* 2006). Wang *et al.* (2006) stated that, sambar is a frequent crop-raider in Bhutan. In Africa, less availability of alternate food and high population density of red colobus monkey (*Procolobus kirkii*) triggered this species to coconut plantations (Siex and Struhsaker, 1999). In Asia, primates especially macaques could easily adapt to human habitation and damaged households and the associated cultivation (Hill, 1997; Pienkowski *et al.*, 1998; Twehevo *et al.*, 2005; Marchal and Hill, 2009; Smith *et al.*, 2010).

2.2.2 Livestock predation

The livestock lifting is another aspect of wildlife conflicts which is causing severe shortage in income for the farmers. Woodroffe (2000) studied this and discovered an association between the loss of carnivore population with respect to human density, reported that extinction risk of carnivore population has increased. The carnivore conservation has been dependent upon the dimension of humans and biology of wild animals (Treves and Karanth, 2003). Wam *et al.* (2004) suggested the improvements in traditional fences with electric wires, which protected the cattle from the attack of carnivores in Norway. To prevent wildlife attack, a spatial model for human-carnivore conflict, King (2004) demonstrated the collar technique

which he believed would be effective in combating the increased attacks. The spatial modelling technique was used in mitigation in this method which was specified by Treves *et al.* (2004). Loe and Roskaft (2004) reviewed the human-carnivore conflict after the implementation of the collars which usually cover the neck region where the killing bite was usually given by the carnivores in livestock like sheep.

Wydeven *et al.* (2004) in a radio collar study on the collared carnivores, found that these animals were living among the human population without any intense issue. Wang and Macdonald (2006) in their study in Bhutan categorised leopard, tiger (*Panthera tigris*), Himalayan black bear (*Ursus thibettanus*) and dhole (*Cuon alpinus*) as the main animals causing livestock depredation in Singye Wangchuck National Park. The animals can vary accordingly to each region the carnivores in their hunt can cause livestock depredation. Predators generally consumed the wild species than domestic animals, when the natural prey was available. It fed on livestock as an alternate food, if the availability of natural prey was low. Mitigation of livestock lifting and the conservation strategies of large carnivores in Bhutan were also discussed by Sangay and Vernes (2008).

There were many surveys done on the focus groups to record their experiences. The response was different at each situation with each of the people surveyed, on the nature of attack etc. Dar *et al.* (2009) studied human-carnivore conflict in Machiara National Park, Pakistan and found that the damage caused by leopards was highest than other carnivores. The people started moving away from their past behaviour and started hating these problematic animals which was a greater setback for the conservation objectives. Inskipp and Zimmermann (2009) also observed such phenomenon and found a setback in reporting such conflicts. In some cases, the domestic dogs were found to be effective in detecting the presence of the carnivores. In many of the cases the breakage of tooth and dental diseases are leading these animals in to the human settlements (Patterson *et al.,* 2003).

2.2.3 Human causalities

In Sumatra, Nyhus and Tilson characterized the conflicts happening among human and tiger and reported it to be lower in protected areas and well managed areas. Here the tigers and human population tend to coexist. The abundance of the tiger population was examined and the disturbed areas tend to have less population of tigers and thereby reduced chances of conflicts (Johnson *et al.,* 2006). From this they recommended the identification of the areas to be kept out of bounds for cattle rearing. In this way, the chances of livestock depredation can be reduced and further conflicts can be reduced. It is important to be this way because the changed attitude of people due to increased cases of human tiger conflicts can trigger a negative impact on the tigers.

In most of the studies when the conflicts were studied in case of livestock depredation it was found that the farm owners were dissatisfied with the reporting procedure of conflicts and the compensation that they received was very mere. Thus, in most cases they preferred not to go for the compensation, which even worsened the attitude to conservation (Gusset *et al.,* 2009).

2.2.4 Transmission of diseases to livestock and/or man

Important diseases are known to be transmitted by wildlife to domestic livestock or possibly man (i.e. rabies). On the other hand, scavengers and predators, such as spotted hyenas, jackals, lions and vultures, play a role in the dissemination of pathogens by the opening up and dismembering and dispersal of infected carcasses. That is notably the case for anthrax the spores of which they ingest together with the tissues of the carcasses and then widely disseminate in their faeces (Hugh-Jones and de Vos, 2002).

2.3 INDIAN SCENARIO

The palatability and nutritive value are said to be the reason for the elephants choosing the farmers cultivated cash crops (Sukumar, 1985) and grass was found

to be the staple food for elephants within the forest limits (Baskaran *et al.,* 2010) and at times of elephant raiding the damage becomes greater even if the crops eaten will be less, but the damage due to movements etc. will be lot higher. The competition for food can be a good reason for the increased crop raiding events occurring in the regions (Williams, 2001). With the coming and effective working of project elephant the number of elephant deaths in the country had gone down but the situation with human elephant conflicts remains as such (Bist, 2002). With such conservation efforts, the wildlife conservation is going smoothly, but problems like human wildlife conflicts remain unaddressed. There are many reasons found to be leading to these conflicts which are now at rise such as habitat degradation (Nigam, 2002) which is happening in India at wider scales. The corruption in the economy even add up to this kind of tensions. The conflicts are studied at various parts of the nation, but to the overall conflict mitigation what is added is scares. Chelliah *et al.* (2010) analysed the efficacy of chilli-tobacco rope fence against the crop raiding elephants in south India and it was proved that, chilli-tobacco rope is an effective control measure in low-rainfall seasons. That's the problem when in a country like India it will be ineffective mainly in regions like the Western Ghats and north-eastern regions. In Koundinya Wildlife Sanctuary, the conflicts were reduced due to the decline of elephant population and the translocation of elephants to other habitats increased the conflict (Manakadan *et al.*, 2009). In such cases what we are actually doing is we are removing the problematic animal from the home range to a new location where it will cause for conflicts from the very next day onwards. Gubbi (2012) postulated that human-elephant conflict was high in the places where the human settlements and undisturbed forest areas were confronted.

Considering the case of wild boar, it was studied all over India (Ahmed, 1991; Chauhan and Rajpurohit, 1993; 1996; Chauhan *et al.,* 2009). The problem was available throughout, mostly in weed areas. The population of wild boars were rising and there was nothing that the local people can do against it, which lead to negative attitude of the people towards wild boars, which adversely affected the conservation efforts. Earlier studies showed that, information on human-wild pig

conflict is incomplete in the Indian-sub continent (Tiwari, 1985; Shafi and Khokhar, 1986; Ramachandran *et al.*, 1986; Ahmed, 1991).

Srivastava (2000) in his study reported that in sugarcane cultivated areas Indian crested porcupine (*Hystrix indica)* consumed all the 19 varieties available in the region and was a serious pest in those regions. Degradation and fragmentation was seen as a cause of attack of Indian crested porcupines in this areas by Chakravarthy *et al.* (2006). To introduce a common mitigation, measure the mode of attack was studied in each case, in order to employ this in arecanut and coconut fields, a method of encasing with porcelain pipes was done. The consumption of coconut and arecanut fallen on the ground and debarking was studied. Smearing the adult palms and seedlings with coal tar was advised for effective management (Thyagaraj *et al.,* 2006). Human-macaque conflict and pest behaviour of long-tailed macaques (*Macaca fascicularis*) were studied in Kuala Selangor Nature Park by Hambali *et al.* (2012). In north India, Hanuman Langur (*Presbytis entellus*) and Rhesus Macaque (*Macaca mulatta*) are the two species in close proximity and did disturbance to humans (Ross, 1993).

With the situation in the forest areas and fringes worsens the peoples attitude towards the management worsens (Rao *et al.,* 2002). This is because in all these regions the marginal farmers who are depending on the agriculture for subsistence have a worsened situation. They are downtrodden out of their livelihood levels to poverty. In these cases, the common mitigation method used is relocation of the problematic animals, which is proven to be ineffective in problem solving (Sukumar, 2003). These animals in most of the cases failed to achieve social bonds. There are many cases where these animals started conflicts in these translocated locations.

Marker and Sivamani (2009) highlighted the human-leopard conflict issues in India, its policy and management. Rearing of cattle was the main cause of conflict and it was highest during the dry season. In dry season, especially these animals will converge to some common water bodies to meet their requirements, in such

situation livestock rearing will add to this. Joshi (2010) conducted a study on accidental deaths of leopard due to collision of train in Rajaji National Park, Uttarakhand and reported that, death rate of males was higher than females.

Sharma *et al.* (2011) said that the major reasons for the increase in human population and other developmental activities like urbanization, agricultural expansion which lead to deforestation has led to the increase in conflict incidences. In a study on the efficacy of the translocation programs Athreya *et al.* (2011) described that in all incidents of leopard attacks these leopards were trapped inside the human landscapes and even in these cases there were no incidences of human causalities, only livestock depredation was present.

2.4 KERALA SCENARIO

Crop damage by wild animals in Kerala was surveyed by Veeramani and Jayson (1995) and studies on the human-wildlife conflict in Peppara Wildlife Sanctuary and adjacent areas were carried out by Jayson (1998). In these studies, it was observed that with the coming up of more and more cash crops and reduced farming of traditional crops the conflicts escalated. The coming of outsiders as settlers added to this with their lack of knowledge in forests and wildlife the conflicts became more evident as their attitude to animal attacks were different to tribal native people. Human-wildlife interactions in Wayanad Wildlife Sanctuary were conducted by Easa and Sankar (2001). Here seventy five percent of the households inhibited the land by deforestation. Elephant and wild boar was identified as the primary cause of conflict. Trenches were identified as the most accepted measure to tackle conflict. Growing of more palatable crops near the fields have been a severe cause for the conflict, the animals are more attracted to these cash crops and they tend to show more desire to feed upon these crops. Human-crocodile conflict in Neyyar Wildlife Sanctuary was studied by Jayson and Padmanabhan (2002). Veeramani *et al.* (2004) reported the socio-economic status of cultivators and their interface with wild animals in Marayur Forest Range,

Kerala. In all these areas, a change in cropping pattern was observed in the recent days which can also be seen as a major cause of conflict.

In Kerala, there are reports of wild animals being infected with human diseases like tuberculosis, which can be implied as a result of negative human-wildlife interactions. In Wayanad, Stanton *et al.* (2017) have reported three incidents of tuberculosis in elephants. The anatomical studies revealed the presence of *Mycobacterium tuberculosis* in the three-bull elephant's carcass. This reveals the spilling of these human pathogens into the animals where no such problems were reported yet. In other examples, we can find that due to the lack of predators in the region such diseases are spreading among the herbivores. Otherwise these infected population would have been naturally eliminated from the population by the carnivores. Such instances are also rising.

2.5 PEOPLES PERSPECTIVE

To understand exactly how particular types of human-wildlife conflict impacts on people's lives, we need to understand something of what that situation means to those individuals. Documented studies of wildlife crop raiding activities give some idea of the degree of loss farmers are likely to experience, but few studies have explored in detail exactly what this loss really means to farmers. Even where crop losses appear to be low, particularly for the community as a whole rather than the individual (Hill, 2000; Naughton-Treves, 1996) farmers can still express great concern about such losses, and may register many complaints to local wildlife authority personnel. However, when trying to understand why crop raiding by wildlife is considered to be such a vital issue by farmers it may, in some situations, be necessary to consider the losses experienced by individuals as well as the average losses experienced within different communities.

Recording absolute levels of crop losses by individual farmers or communities will not necessarily adequately explain what those losses really mean to individual farmers. Where individual researchers have probed more deeply it has become apparent that the issue of crop raiding is sometimes conceived as part

of a wider issue that people are concerned about, such as their loss of 'ownership' of wildlife to the State (Naughton-Treves, 1999) and/or lack of control over resources or particular aspects of their lives (Hill, 2000). A further related issue is the fact that many communities appear to tolerate significant levels of crop damage by domestic animals yet are very intolerant of smaller losses to wildlife (Hill, 1997; Naughton-Treves, 1996). Why should this be so? Naughton-Treves demonstrated that in some cases farmers around the Kibale Forest National Park, Uganda, actually experienced greater crop damage by domestic animals than they did from wildlife, yet the farmers' complaints focussed on wildlife activity (Naughton-Treves, 1996). There are many reasons why this might be so, not least the fact that domestic animals are an important asset to local households. Domestic animals can be used for food but, more importantly, they act as a 'savings account'; people gain interest through the birth of young, and the accumulation of animals not only helps people pay for weddings, funerals and school fees, but it also provides a degree of security against seasonal shortfalls in agricultural productivity and other, unforeseen, eventualities. This example illustrates the point that to understand such issues, the whole question of crop raiding and crop losses needs to be considered within the appropriate social and cultural framework, as well as within an ecological and economic context.

There are often local mechanisms for obtaining compensation for crop loss by domestic animals. For example, in Uganda the Village Council impounds the offending animal and the owner required to pay compensation to the person who has suffered crop damage (the level of compensation being determined by the Council). If the animal's owner cannot, or will not, pay, then the animal is sold, compensation is paid to the claimant, and any remaining monies returned to the animal's owner. Interviewees from Nyabyeya Parish, Masindi District, Uganda, claim that the Government is not a good 'neighbour'. It 'owns' all wildlife (the Government is seen to own wildlife because it legislates as to what people can and cannot do in relation to wildlife) yet does not behave like a responsible owner, either by 'controlling' the actions of its wildlife (i.e. preventing wildlife from entering

farming areas) or paying compensation for crop damage caused by that wildlife. Evidence here suggests that when farmers complain about wildlife causing damage to crops the issue is not just about the degree of damage they experience – they are also making a statement about the fact that they consider that by no longer having the legal right to hunt they have (i) lost access to a valuable resource (wild meat) and (ii) have lost the right to adopt a method of controlling crop raiding species that they consider effective (Hill, 2000).

There are various factors that may help identify areas where interventions should focus or which could help explain why crop raiding is such an emotive issue. For instance, whole communities may express great concern about the impact of wildlife on agriculture, yet only a few individuals within that community actually suffer regular or extensive damage to their crops, i.e. people's perception of risk may not necessarily match the actual risk of crop losses to wildlife (Hill, 2000). Additionally, there may be many serious complaints about particular species yet when the situation is investigated systematically it becomes apparent that those species do not necessarily cause the most damage (Naughton-Treves, 1996). Understanding the context in which crop raiding is occurring may help to explain why people complain about particular species, even when those species may not be a major source of crop loss. For example, complaints often focus on elephants and other large bodied animals yet smaller, less dangerous species such as baboons and cane rats may well cause more damage (Hill, 1997; Naughton-Treves, 1996). While it is certainly important to understand the context in which rural people consider crop raiding to be a problem it is also crucial to remember that central to any intervention is the aim to improve livelihood security rather than just stopping crop raiding by wildlife.

It is vital to understand the social context in which crop raiding is occurring, because crop raiding per se may not be the 'real' issue. Instead it may be used by people as a means of expressing their distress or dissatisfaction with a separate or related issue, e.g. the removal of access to particular resources, having to live

alongside animals that are perceived as dangerous to people, such as elephants and buffaloes, or losing their autonomy in certain spheres of life (Hoare, 1995).

By understanding the social context within which these complaints are made we gain a more comprehensive perspective on the issues at stake, facilitating the development of appropriate intervention strategies. Thus, by understanding how people view a particular human-wildlife conflict issue one may be able to explain more fully why people act the way they do, thereby providing valuable insights into locally acceptable and effective control strategies.

2.5.1 Social context

To understand the human dimension to crop raiding by wildlife it is essential to have a good working knowledge of the particular type of conflict within the local cultural, sociodemographic, political and economic context. Data on local land use strategies and tenure systems, gender roles, farming systems, and people's dependence on agriculture for subsistence will supply a social and economic context for understanding the impact of crop damage by wildlife. Information about farmer's responses to wildlife that crop raid, their understanding of and compliance with wildlife laws, and their expectations of any intervention programme are useful when trying to contextualize the importance of human-wildlife conflict issues for rural communities. Knowledge of how people view a particular issue can help explain why those issues can suddenly become conflict issues to be dealt with by outsiders, when previously they were regarded as part of the normal agricultural cycle, eliciting specific and appropriate responses from within the local community. Identifying whether local people are using their apparent concern about crop raiding to express dissatisfaction with changing access to natural resources, government, or local political institutions, for instance, would be crucial for management intervention design (Hill, 2000; Naughton-Treves, 1999).

Local perceptions of damage as well as having detailed information about the nature of the conflict, it is useful to have knowledge of local perceptions of the severity of damage, how and whether people use particular strategies to try to

minimize the levels of crop damage occurring and who actually makes formal complaints about crop raiding by wildlife. Such information will help identify whether crop damage per se is the important issue or whether it is a proxy for another issue. In addition, this information will help to identify target groups for consultation in any intervention program.

2.5.2 Understanding of the law

Depending on the purpose and focus of the investigation, it is advantageous to have information about local people's understanding of national wildlife laws. This with information about their expectations of local wildlife authority personnel and conservation agencies, can help explain why crop raiding is such an emotive issue, even for those members of a community who are at very little risk of losing their crops to wild animals. This is important particularly when thinking about possible intervention strategies – different types of intervention may be appropriate to different sectors of the affected community as a consequence of having different experiences of crop raiding, particularly where not all complainants necessarily experience frequent or extensive crop loss or damage.

For an intervention strategy to be successful it needs to be appropriate in its aims and the manner in which it is implemented. Thus, it is essential that such strategies be developed in consultation with all stakeholders, hence the need to identify appropriate sections of a community or local population, timing of possible labour bottlenecks, people's expectations with respect to responsibility and outcomes, and the presence of traditional risk-sharing strategies by also keeping in mind the national wildlife and forest laws.

2.6 HUMAN WILDLIFE CONFLICT MITIGATION

Human-wildlife conflict situations often have a long history. Past efforts to resolve the conflict may have failed or there may be political issues that exacerbate the situation. No solution will work without site-specific knowledge of what is possible, practical, or acceptable in any particular area. Unfortunately, human-

wildlife conflict situations are often complex so are unlikely to be resolved quickly and cannot be solved solely by technical means. A common problem to date is that most interventions have been planned and implemented by organizations from outside an affected community without clearly defined goals and objectives. The prime objective of any intervention is to identify the project's goals prior to the development of any form of intervention. For instance, is the goal of an intervention to resolve the conflict by just reducing crop loss or might there be other, equally appropriate goals? These other goals may include increasing farmers' tolerance to crop raiding by wildlife by developing ways in which local communities might stand to benefit financially through living alongside wildlife. A further, important consideration is whether mangers are interested in, or able to provide a short or long-term solution to a conflict situation.

The specific goals of any particular intervention scheme are likely to vary depending on the details of the situation concerned, but possible goals for conflict resolution schemes include:

- ✓ Reducing the amount of crop losses to wildlife
- ✓ Improving local people's attitudes towards, and perceptions of, a protected area and its wildlife
- ✓ Helping affected farmers to improve agricultural production
- ✓ Increasing the number of crops being harvested locally, through improved local yields (via improved cultivation & plant husbandry techniques, use of different crop types, improved harvesting and/or storage techniques for example)
- ✓ Reducing levels of poaching

Each of these aims requires different approaches, tools, and budgets, but the ultimate goal of any intervention should be to improve the livelihood security of the farmers concerned. Community involvement once the individual goals have been established and the availability of the necessary resources ascertained, then discussion with the communities can begin. Communities living around protected

areas are different from those in other areas as they often receive a disproportionate amount of interest from the conservation and development authorities. In many such areas, a 'culture of dependency' has developed due to the often-competing motivations of these organizations. This can influence people's expectations with respect to who should take responsibility for developing, implementing and/or maintaining any control scheme, thus it is very important that farmers be involved in the process of developing new solutions from the beginning. Not only does this foster a sense of commitment and involvement amongst them, but it is also vital that they be involved from very early on because they understand how the situation affects them and what kinds of intervention are likely to be acceptable and feasible within the local culture, providing there is adequate representation from the different types of stakeholder involved.

2.7 PARTICIPATORY RURAL APPRAISAL (PRA)

PRA approach is a grouping activity with an aim of obtaining data with better quality than those are normally obtained through questionnaire surveys. PRA is intended to enable local communities to conduct their own analysis and to plan and take action (Chambers, 1992). It is a growing family of approaches, methods, attitudes and behaviours to enable and empower people to share, analyse and enhance their knowledge of life and conditions, and to plan, act, monitor, evaluate and reflect (Chambers, 2004). It is a low-cost method which is a time saving method to analyse wider problem perspectives. PRA places emphasis on empowering local people to assume an active role in analysing their own living conditions, problems and potentials in order to seek for a change of their situation.

2.7.1 Timeline analysis

The timeline with basic events can be used for focussed discussions on problems, social and technological innovations or on community's history of co operations and activities which helped them to solve in past problems successfully. Important events/changes of recent and not so recent origin, having an important bearing on the local community, can be discussed with a group of elderly

community members and their time periods can be identified by the members in that process. This helps in contextualizing any relevant issue through a chain of events and provides a historical perspective to the same.

2.7.2 Problem Tree Method

The Problem Tree method is a planning method based on needs, however it is not a translation of problems into objectives. While going through the process, taking the different steps, there is continuously room for opportunities, new ideas and contributions from the involved parties. One should analyse the capacity and intentions of stakeholders and the wider institutional context, so that relevant and realistic choices can be made on who does what and when. It should be ensured that that all participants get the chance to express the problems they experience and it is important to determine whether the different groups of people perceive the problem in the same way; if not the problem should be reformulated or split. As in PRA related to human-wildlife conflict since the participants are more or less homogenous and location specific the perspective of the problem is usually in the same way.

2.7.3 Vulnerability mapping

A vulnerability map gives the precise location of sites where people, the natural environment or property are at risk due to a potentially catastrophic event that could result in death, injury, pollution or other destruction. Such maps are made in conjunction with information about different types of risks. Vulnerability mapping can allow for improved communication about risks and what is threatened. It allows for better visual presentations and understanding of the risks and vulnerabilities so that decision -makers can see where resources are needed for protection of these areas. The vulnerability maps will allow them to decide on mitigating measures to prevent or reduce loss of life, injury and environmental consequences before a disaster occurs.

MATERIALS AND METHODS

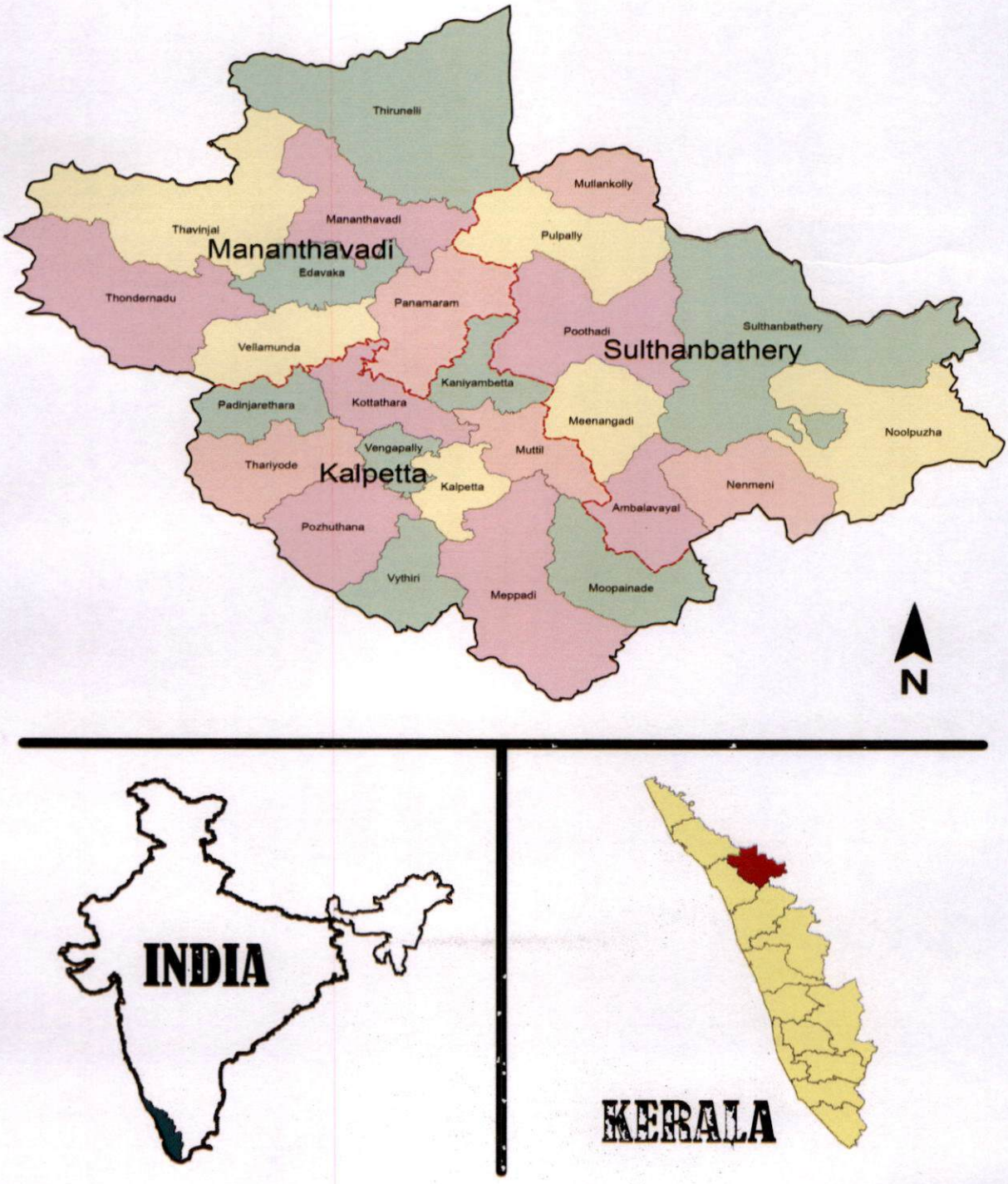
MATERIALS AND METHODS

3.1 STUDY AREA

Wayanad district is a gifted land with natural forest, and wildlife. It is a hilly place and people are engaged in the production of cash crops such as pepper, cardamom, coffee, tea and other rich spices. The district occupies first place in scheduled tribe population and the overall population is the lowest among others in Kerala. The high concentration in the production of cash crops in the district contributes a lot for its economic prosperity. The name Wayanad is derived from the term 'Vayal Nadu' which means the land of paddy fields. The culture of Wayanad district is highly influenced by the indigenous tribal communities.

Wayanad district is located at southern top of the Deccan plateau and about 75 km away from Calicut. The place lies between north latitude $11^0$26'28''and $11^0$58'35''and east longitude $75^0$47'50''and $76^0$26'35''. The district lies at a height of 700 to 2100 M above the sea level on the north-eastern part of Kerala state. It is surrounded by Konkan district of Karnataka in the north, on the east Mysore district of Karnataka and Nilgiri district of Tamil Nadu, on the south Malappuram district and Kozhikode district and Kannur district on the western part. Wayanad forms a part of Nilgiri Biosphere Reserve (NBR) and Project Elephant Reserve No. 7. The area is significant because of the ecological and geographic continuity with other protected areas such as Bandipur Tiger Reserve and Nagerhole National Park of Karnataka in north-eastern portion and Mudumalai Tiger Reserve of Tamil Nadu in south-eastern side offering an ecosystem enriched with wildlife, forming natural corridor for the seasonal migration of long ranging animals within the greater conservation unit. Wayanad district is having a geographical area of 2131 square kms. Out of the total area, 2,090.26 square kms forms the rural and 40.74 square km the urban area. NH - 212 and SH - 29 are the two important roads passing through the important places of the district. Physically Wayanad sits where the Eastern and Western Ghats converges, bringing together both systems in one place.

PLATE:1 STUDY AREA-WAYANAD



Wayanad became a district on first of November, 1980 as the 12th district of Kerala. It is divided for administrative purposes into 3 blocks viz. Vythiri, Mananthavady and Sulthan Bathery and 25 grama panchayaths. The district is mainly a rural economy with the lone municipality, Kalpetta. Majority of the population are agricultural based. The Kabani river drains the whole district with its tributaries, the Panamaram river, the Manathavady river and the Kalindi river. (GOK, 2016)

3.1.1. Population

Wayanad is the least populated district in the state. Total population of the district according to 2011 Census is 8,17,420 persons, with male and female population of 49.14 and 50.86 per cent respectively. It has 31.24 percent of tribal population of the State, which constitutes 18.55 percent of the total population in the district.

Table 1. General Population – Wayanad

(In numbers)

Male	%	Female	%	Total
401684	49.14	415736	50.86	817420

Source:GOI, 2011

The density of population in the district according to 2011 Census is 383 persons per square km. The sex ratio in the district is 1035.

3.1.2. Water sources

Wayanad forms a significant part of the catchment area of Kabani river which flows into Karnataka. Begur and Tholpetty Ranges are drained by Baveli puzha and Panamaram puzha and join the Kabani river. Northern portion of Kurichiat Range is drained by Kannarampuzha and Kurichiat Thodu flowing northward and joining Kabini river. Towards the southeast, Manjal Thodu and other streamlets join Nuguhole river to flow further north east to Karnataka. Southern

portion of the sanctuary is drained by Nulpuzha and Mavinahalla Thodu which combine to form Nuguhole river. Manjal Thodu and other small streams in the sanctuary become dry during peak summer season.

3.1.3. Mountains

Wayanad offers a wide view of hills and forest. Chembra is the highest peak (2,345 M) in the district. The other important mountains are Vellarmala (2,145 M), Banasuramala (2,061 M), Elembilerimala, (1,839 M), Brahamagirimala (1,608 M), Kunnelipadimala (1,607 M), Thariodemala (1,553 M) and Mothumala (1,374 M).

3.1.4. Forest

The forest area in Wayanad district is divided into three regions. They are the North Wayanad and South Wayanad Territorial Divisions and Wayanad Wildlife Division. The total area in the three-forest division constitutes 885.92 square km. According to Champion and Seth classification 1968, the major vegetation types of the district are southern moist missed deciduous forests, west coast semi-evergreen forests and southern dry mixed deciduous forests.

3.1.4.1. Southern Moist Mixed Deciduous Forests

A major portion of the area falls under this category. Moist deciduous forests are interspersed with seasonally waterlogged areas in the depressions known as *vayals* (marshy/wet lands). *Vayals* are dominated by grass and are devoid of tree cover. The moist deciduous forest has a moderate canopy cover (50-70%) during the wet seasons. During the dry season, most of the trees shed leaves and canopy cover is comparatively less (10-20%). Bamboo brakes (*Bambusa arundinacea)* are distributed sporadically all over the habitat. It is also found all along the perennial streams and in the wet areas. The upper canopy consists of *Terminalia tomentosa*, *Terminalia bellirica, Terminalia paniculata, Pterocarpus marsupium, Tectona grandis*, *Grewia tiliaefolia*, *Adina cordifolia*, etc. The middle canopy comprises *Schleichera oleosa*, *Kydia calycina*, *Bridelia retusa*, *Acacia pinnata*, *Butea*

monosperma, *Haldina cordifolia*, *Cinnamomum zeylanicum* etc. Main species of ground flora are *Helicteres isora*, *Lantana camera*, *Eupatorium odoratum*, *Hibiscus furcatus*, *Zizyphus xylocarpus*, *Randia dumetorum*, etc. A few climbers like *Butea parviflora*, *Caesalpinia* sp., *Calycopteris floribunda* are also seen. *Xylia xylocarpa* is conspicuous by its absence. Grasses such as *Cyrtococcum patens*, *Apluda mutica* and *Oplismenus compositus* are thinly distributed with low productivity. Fire occurrence is comparatively less in this type of forests.

3.1.4.2. West Coast Semi-evergreen forest

This type of forest is found mostly in patches at few places. It is a heterogenous mixture of evergreen and deciduous species. The number of species is high but less than pure evergreen. Climbers are heavy and epiphytes abundant. The main species of top canopy *Terminalia bellirica, Olea dioica, Schleichera oleosa, Hydnocarpus pentandra, Aporusa lindleyana, Mallotus philippensis* and *Diospyros* sp. Ground flora consists of *Strobilanthus* sp., *Curcuma* sp., etc. Where the canopy is open *Eupatorium odoratum* is seen spreading.

3.1.4.3. Southern Dry Mixed Deciduous Forests

The dominant tree species are *Shorea roxburghii*, *Anogeissus latifolia*, *Terminalia alata, Terminalia chebula, Pterocarpus marsupium, Gmelina arborea, Schrebera sweitenioides, Diospyros montana, Schleichera oleosa, Grewia tiliaefolia, Dalbergia latifolia, Mitragyna parvifolia, Bauhinia racemosa, Xeromphis uliginosa* and *Tectona grandis*. The saplings of tree species are abundant along the nullahs where ground water is available. Grass species such as *Themeda cymbaria*, *Themeda triandra*, *Cymbopogon flexuosus* and *Imperata cylindrica* grow more than 200 cm in height and form a dominant ground cover. The canopy layer of the trees is broken due to the spatial distribution as well as comparatively low tree density. Canopy cover is less (10-20%) during dry season. Due to its deciduous nature, leaf fall is common even in the month of December and dry spell extends up to pre-monsoon showers beginning in May. The bamboo (*Bambusa arundinacea*) is less frequented compared to moist deciduous forest. In the dry

deciduous forests, the *vayals* are comparatively less and are dominated by tall grass (*Themeda* sp. and *Pennisetum hohenackeri*).

3.1.5. Human habitations and cultivation

An interesting feature of the study area is the large number of settlements where cultivation is practised. A total of 69 enclosures are situated inside the study area. These settlements are confined to the moist deciduous forests and teak plantations. The people occupy almost all the vayals with perennial water sources. A population of more than 25,000 people live in and around the Protected Area. Their main occupation is agriculture. They cultivate cash crops such as coffee, pepper and coconut followed by primary crops *viz.*, paddy, ginger, tapioca and plantains. Electric fencing, provided by the Forest Department protects a few of the settlements. A total of 166 Km. length of electric fencing has been erected in the study area.

Cattles and goats form the major livestock of the people. The people residing inside the sanctuary own a total population of 3500 cattle. These animals are mostly left to feed inside the Sanctuary. Cattle lifting by panther and tiger are also reported (Easa and Sankar, 2001).

3.2. SELECTION OF SAMPLE

Meppadi, Odapallam, Bhoothanam and Thirunelli were selected for the study after detailed discussions with the Forest Department officials and the Principal Agricultural Officer of Wayanad as to identify the vulnerable areas of human- wildlife conflicts. A set of 30 respondents who were facing human-wildlife conflicts were selected from each location by purposive sampling.

3.3. DATA COLLECTION

A detailed interview schedule was prepared to gather information from the sample. For checking the suitability of the schedule in the field it was pre-tested initially. Few households in Peechi, where there were instances of human-wildlife

interactions were selected and pre-testing was done. These target population was selected as they were facing human-wildlife conflicts. This pre-testing was done with an objective to check the suitability of the questions formulated in an actual conflict situation; it was checked for errors before the survey was done on large scale in Wayanad. It was done to check for problems such as misinterpretation of questions, inability to answer a question, sensitive questions, any problem that can occur during the survey, etc. The feedbacks from the respondents were also taken into consideration. With the results of pre-testing the interview schedule was finalised and taken to the actual field. Before the actual survey in the selected areas key respondents were identified and asked for help at each of the locations, their knowledge of the area was utilised not only in interviews but also in organising PRA's. In Wayanad household survey was conducted using this pre-tested structured interview schedule (Appendix No.1) to obtain data of the general characteristics of each household like farming systems, the wildlife damages etc. as well as to understand the respondent's knowledge about forests and forest laws, and their perception, attitude and awareness regarding human-wildlife conflict. In order to meet the objectives and to answer the research problems, the interview schedule was designed under a total of 15 titles. Each of the sections were designed to describe various aspects concerned to the individual, such as:

1. Basic details

This section included factors which were used to analyse the socio-economic status of the individuals such as name, age, sex, education, income, family status, occupation and livelihood.

2. Cropping pattern followed

This section included the details of the farming system the crops, area under farming, the time in which each of them were practiced etc.

3. Land use transformation

Here an account of the changes in the usage of the land holdings during the last 15 years mostly pertaining to the human-wildlife interactions were collected

4. Details of livestock in possession

The details of livestock in possession were collected. The information about depredation occurred in the past were also collected.

5. People's participation

In this section which comprises of two questions, participation of the people in various activities organised by the forest department and their participation in forest management activities were collected. The information on the programs and their participation details were collected.

6. People's attitude

The attitude of the people towards human-wildlife conflicts and wildlife conservation were measured in the study using an arbitrary scale developed for the specific purpose.

a) Attitude towards human-wildlife conflicts

Based on the focus group discussions, review of literature and expert consultation, various statements were selected for being included in the arbitrary scale. Nine statements were included against which respondents were asked their response in a five-point continuum. Strongly agree, agree, neutral, disagree and strongly disagree, with a score of 5,4,3,2 and 1 respectively for positive statements and the scores was reversed for negative statements (Table 2). Individual scores were calculated for respondents based on their preferences in the 5-point continuum.

Depending upon the total scores respondents were categorised into low (9-21), medium (21.01-33) and high (33.1-45). (maximum score was 45 and minimum 9, giving value for the response as 5 for strongly agree to 1 for strongly disagree.)

Table 2. Statements for assessing attitude to human-wildlife conflicts

Sl. No	Statements	Abbreviation
1.	Some loss due to wildlife is to be expected in forest fringe areas and should be tolerated by the local people.	ST 1
2.	Human-wildlife conflict is happening due to encroachment by humans into forests	ST 2
3.	The Forest Department staff generally treat the forest fringe people as encroachers and offenders	ST 3
4.	Forest department should control wildlife using non-lethal methods such as barriers, deterrents and relocation.	ST 4
5.	Tourists coming to see forests/wildlife should pay human wildlife conflict mitigation CESS.	ST 5
6.	Officials and policy makers assigns more value to wildlife over human life and livelihoods	ST 6
7.	In conflict zones, the Forest Department shows sincerity in taking remedial action	ST 7
8.	If Forest Department takes action to upgrade the quality of the forest habitat, the conflict rates will come down.	ST 8
9.	Dearth of accurate data on the carrying capacity of forests is escalating the conflicts	ST 9

b) Attitude towards wildlife conservation

Similarly, nine statements were included against which respondents were asked their response in a five-point continuum to assess the attitude towards wildlife conservation. Strongly agree, agree, neutral, disagree and strongly disagree, with a score of 5,4,3,2 and 1 respectively for positive statements and the scores was reversed for negative statements (Table 2). Individual scores were calculated for

respondents based on their preferences in the 5-point continuum. Depending upon the total scores respondents were categorised into low (9-21), medium (21.01-33) and high (33.1-45). (maximum score was 45 and minimum 9, giving value for the response as 5 for strongly agree to 1 for strongly disagree.)

Table 3. Statements for assessing attitude to wildlife conservation

Sl. No	Statements	Abbreviation
1.	It is important to conserve wildlife	ST 1
2.	Wildlife laws ensure the right of the wildlife to live peacefully	ST 2
3.	People who harm wildlife should be strictly punished	ST 3
4.	Protected areas are too large and should be reduced in size	ST 4
5.	People who traditionally use natural resources in protected areas should be allowed to continue to use them	ST 5
6.	Wildlife should be strictly confined to the protected areas	ST 6
7.	Permission can be given to shoot and kill animals that cause continuous trouble	ST 7
8.	Culling of excess wildlife to keep the population under check is a scientific option.	ST 8
9.	Wildlife conservation laws are biased and do not consider the value of human lives and livelihoods	ST 9

7. Nature, frequency, distribution and intensity of conflicts

Information on various aspects of human-wildlife conflicts on farmers such as damage to cropping systems, damage to livestock components, enterprises discontinued and their dependence with forest resources were collected. The effect of the interaction on the livelihood of the people were also analysed. Questions regarding the animal, time of attack, kind of damage, loss due to wildlife were used to assess the damage on infrastructure by wildlife, crops and livestock components

along any enterprises discontinued if any was put forward for the response. The attack on people was also analysed based on the questions.

Table 4. Damage to cropping systems

Sl.no.	Crops raised	Animal causing damage	Nature of attack	Time of attack (Months)	Stage of crop	Extent of crop loss (%)

Table 5. Enterprises discontinued due to HWC: Y/N, if yes, then

Sl.no.	Enterprise	How long involved	Year of discontinuance	Reason for discontinuance	Loss incurred/year

Table 6. Attack on livestock components

Sl. No.	Name of livestock attacked	Attacking animal	Extent of damage (nos.)	Time of attack (months)	Nature of attack	Financial Loss occurred

Table 7. Attack on family members:

Attacking animal	Death	Injury occurred	Compensation received

8. Causes of human-wildlife conflicts

Questions were made to analyse the causes of human-wildlife conflicts in these regions by method of ranking. Several causes of human-wildlife conflicts were taken from already published articles and was given to the farmers for checking their suitability at those specific locations and to see which were the dominant causes of conflicts. Five sections were included in this such as climate

induced factors, social causes, intra forest factors, human interferences and agronomical factors. Index value of each of the statements were calculated by dividing the score of the statement arranged by the respondents with the potential maximum score, expressed as percentage.

Table 8. The causes of human-wildlife conflict

Sl.no.	Causes	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	Climate induced factors: Increased temperature					
	Drought					
2	Social causes: Poor waste management					
	Increase in ecotourism					
	Damage to forest fences					
	Poor maintenance of forest fences					
3	Intra forest factors: Extinction/ genetic loss					
	Water scarcity inside forests					
	Competition for forage					
4	Human interference Over exploitation of natural resources					
	Invasive alien species					
	Pollution					
	Habitat destruction					
	Quarrying/ sand mining					

	Forest fires					
	Blocking wildlife corridors					
5	Agronomical factors Growing palatable crops near forests					

9. Consequences of human-wildlife conflicts

Questions were made from already published articles about the consequences and were given for ranking based on relevance to their conditions. Farmers were asked about the relevance of these consequences that occurred elsewhere with relevance to Wayanad. Index value of each of the statements were calculated by dividing the score of the statement arranged by the respondents with the potential maximum score, expressed as percentage.

Table 9. The consequences of human-wildlife conflict faced by the respondents in Wayanad.

Sl.no.	Consequences	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	Livelihood affected					
2	Hostility to wildlife					
3	Change in attitude towards conservation					
4	Transmission of diseases					
5	Infrastructural damages					
6	Reduction in ecotourism activities					
7	Human death and injury					
8	Stress from disorganized farm management					
9	Intentional destruction to forests and wildlife					
10	Changed attitude to forest officials					
11	Poor community participation in management activities					

10. Mitigation measures

The effectiveness of various mitigation measures used was assessed from people's response and suitable measures for each locality were identified. People's perception about the mitigation measures employed and the need for modern measures if any was analysed. Ranking was done to analyse the relevance of each measures with respect to the Wayanad scenario. Index value of each of the statements were calculated by dividing the score of the statement arranged by the respondents with the potential maximum score, expressed as percentage.

Plate 2. Electric fencing around the farmlands to avoid crop raiding

Plate 3. Crops and electric fences damaged by elephants

Plate 4. Crop protection using plastic nets against wild boar attacks

Plate 5. Banana fields protected using plastic nets

Table 10. The suitable mitigation measures for human-wildlife conflicts in Wayanad.

Sl.no.	Mitigatory strategies	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1.	Adequate and immediate compensation					
2.	Providing Insurance coverage for crops and livestock					
3.	Traditional barriers for protection					
4.	Intensifying human vigilance					
5.	Watch towers					
6.	Guard animals					
7.	Guarding herds					
8.	Fencing of farmlands					
9.	Curbing livestock grazing in forests					
10.	Deterrents					
11.	Warning systems					
12.	Facilitating access to water for wild animals					
13.	Raising fruit trees for animals					
14.	Conservation education for local people					
15.	Voluntary relocation					
16.	Radio collar/ GPS					

3.4. GIS

At each locations of interview GPS coordinates were taken by using Garmin etrex 30 GPS. These hotspots of conflicts were then marked using pertinent GIS tools. The hotspots are then plotted to mark the areas in Wayanad map.

3.5. PARTICIPATORY RURAL APPRAISAL (PRA)

Along with personal interviews to collect other information regarding the conflicts, detailed PRA was conducted. The exercise was done at each of the four locations. The target group participated in the exercise are people residing in those locations who had some interactions with wildlife and knew about the wildlife conflicts happening in their localities. The group contained people of all age groups, regardless of any particular section. In this exercise, the following tools were employed.

3.5.1. Timeline analysis

It is the historical narration of events, their impact and changes that occurred in the participants life or were known to them. The overall community's attitude and perceptions were taken into consideration. In order to construct a time line, one sits with elderly men and women in a community who slowly try to reconstruct the historical pattern of changes in different variables that have been take place in their locality/community. They may or may not be able to state the precise time/year of such changes but they are generally able to connect such changes with major historical events, whether political, economic or social.

3.5.2. Problem Tree Method

The Problem Tree method is a planning method based on needs. One should analyse the capacity and intentions of stakeholders and the wider institutional context, so that relevant and realistic choices can be made on who does what and when. It should be ensured that that all participants get the chance

Plate. 6. Participatory Rural Appraisal

Plate. 7. Personal interview with the respondents

Plate. 8. Participatory Rural Appraisal- explaining the methodology

Plate. 9. Participatory Rural Appraisal

to express the problems they experience and it is important to determine whether the different groups of people perceive the problem in the same way; if not the problem should be reformulated or split. Here, since the participants are more or less homogenous and location specific, the perspective of the problem was usually in the same way.

3.5.3. Vulnerability mapping

It is a method of mapping which is mainly done in order to analyse the vulnerable areas of some problems, in this situation the human-wildlife conflicts. The vulnerable areas of human-wildlife conflicts are located in the division by the stakeholders. In the district map provided, the stakeholders are made to locate the vulnerable areas as they are more aware of the daily conditions of these regions. The objective of the tool is to clearly identify the susceptible locations and to employ proper mitigation measures. This can be an effective tool before the formulation of the management plans.

3.6. DATA ANALYSIS

3.6.1. Measuring dependent variables

The response of the stakeholders about crop raiding, livestock depredation and the attitude towards wildlife conservation and human-wildlife conflict were measured on a five-point continuum. Strongly agree, Agree, Neutral, Disagree and Strongly disagree with scores 5,4,3,2 and 1 respectively. Based on this individual scoring was done for the attitude of the respondents to each statement in the scale.

3.6.2. Measuring independent variables

3.6.2.1. Age

Age was operationally defined as "the number of years completed at the time of study."

3.6.2.2. Socio-economic status

Socio-economic status was operationalized as "the position a respondent occupies in the community with reference to his/her occupation, landholding, education, house types and social participation." And was mainly classified into two above poverty line (APL) and below poverty line (BPL).

3.6.2.3. Occupation

This variable was operationally defined as "the occupation from which the respondent derives major part of the income".

3.6.2.4. Education

Education indicated the level of formal education of the respondent, which was classified in the following manner

Sl. No.	Category of response
1	Below matriculation
2	Between 10^{th} and graduation
3	Graduation and above

3.6.3. Statistical analysis

Primary quantitative data were subjected to statistical analysis by interpreting the questionnaire responses using computerized means of comparisons and descriptive statistics. The package used for analysis was IBM SPSS software.

RESULTS

RESULTS

The main objective of the study was to portray the nature, frequency, distribution and intensity of human-wildlife conflicts in Wayanad district and to understand the causative factors involved in the conflicts. The study also intended to suggest suitable mitigatory measures to enhance human-wildlife coexistence in Wayanad district. The results of the observations are described below:

4.1. SOCIO-DEMOGRAPHIC CHARACTERS OF RESPONDENTS IN WAYANAD

The study was conducted in the selected areas of Wayanad district, which were regularly facing human-wildlife conflicts. A total of one hundred and twenty (120) respondents were surveyed from Meppadi, Odapallam (Sulthan Bathery), Bhoothanam (Chedleth) and Thirunelli areas of Wayanad district. These areas were selected for detailed data collection after preliminary reconnaissance surveys and focus group discussions. Using a pre-tested interview schedule information were collected about basic socio-economic variables such as age, gender, economic status, education level and size of land holdings of the respondents.

In each of the selected areas, a key respondent was identified and utilising his knowledge about the locality, the interview was done. The interviewed respondents were all facing or have experienced human-wildlife conflicts.

4.1.1. Gender

Gender wise distribution of the respondents are given in Table 11. Out of 120 respondents interviewed 91.67 percent were males and the rest 8.33 percent were females.

Table 11. Gender wise distribution of respondents

Variables	Category	Respondents (%)
Gender	Male	91.67
	Female	8.33

4.1.2. Age

Distribution of the respondents based on age is given in Table 12. Of the total 120 people interviewed, the maximum number of respondents fell under the age class of '36-55 years' (50.83 percent), while the 'above 56 years' age group was represented by 30 percent. This was followed by the 'below 35 years' (19.17 percent) group.

Table 12. Age wise distribution of respondents

Variables	Category	Respondents (%)
Age (years)	Upto 35	19.17
	Between 36-55	50.83
	Above 56	30.00

4.1.3. Occupational status

Occupational status of the respondents is given in Table 13. Of the 120 respondents in Wayanad, majority belonged to self-employed category (78.33 percent) and the rest were wage labourers (21.67 percent).

Table 13. Occupation status of respondents

Variables	Category	Respondents (%)
Occupation	Unemployed	0
	Self-employed	78.33
	Daily wage labours	21.67

4.1.4. Educational status

The educational level of the respondents in Wayanad is provided in Table 14. From Table 7, it can be seen that 66.67 percent of the respondents had education below 10th standard, followed by 22.5 percent having education between 10th and below graduation. Only 10.83 percent were graduates or had education beyond graduation.

Table 14. Educational level of respondents.

Variable	Categories	Respondents (%)
Education level	Below matriculation	66.67
	Between 10th and graduation	22.5
	Graduation and above	10.83

4.1.5. Economic status

The economic status of the respondents is provided in Table 15. Majority of the respondents (93.33 percent) belonged to Above Poverty Line (APL). The rest 6.67 percent of the respondents fell in the Below Poverty Line (BPL).

Table 15: Economic status of respondents in Wayanad

Variable	Categories	Respondents (%)
Economic status	APL (Above Poverty Line)	93.33
	BPL (Below Poverty Line)	6.67

4.1.6. Land holding size

Table 16. Landholding size of respondents

Variable	Land holdings	Respondents (%)
Category	Small (< 1 acre)	30.0
	Medium (1-3 acres)	47.5
	Large (>3 acres)	22.5

From Table 16, it can be seen that majority of the respondents were medium landholders (47.5 percent) with a land holding size between 1-3 acres. Exactly 30 percent were small land holders with area less than 1 acres, followed by large landholders (22.5 percent). In some cases, it was noticed that some of the respondents also cultivated in land taken on lease for a particular time period. Land were mainly taken under lease for paddy cultivation.

4.2. CROPPING PATTERN

By focus group discussions, it was found that the major crops cultivated in the district were coffee, paddy, pepper, banana, coconut, arecanut, ginger and vegetables. The average landholding size of the areas interviewed is 1.97 acres.

4.2.1. Extent of area under cultivation

The extent of cropped area of the respondents is given in the Table 17:

Table 17. Extent of area cropped of interviewed respondents

Sl. No.	Crops	Area (in acres)
1.	Fruits	6.00
2.	Cardamom	33.40
3.	Vegetables	41.95
4.	Tubers	62.03
5.	Ginger	71.35
6.	Banana	105.17
7.	Arecanut	112.40
8.	Coconut	138.18
9.	Paddy	139.60
10.	Pepper	144.95
11.	Coffee	151.60

Crops such as coconut, coffee, pepper, paddy, banana, ginger and arecanut are preferred crops of the respondents (Table 17). Coffee occupies max area (151.6 acres) followed by pepper (144.95 acres) and coconut (138.18 acres).

4.2.2. Proximity to forests

The proximity details of the respondent's farmlands to the forest area is given in Table 18.

Table 18. Proximity of the respondent's farmlands to forests

Sl.no.	Category	Frequency	Percentage
1	Less than 50 m	85	70.83
2	Between 50- 100 m	25	20.83
3	More than 100m	10	8.33

From Table 18, it can be seen that majority of the respondents (70.83 percent) lived 'less than 50m' away from the forests followed by 20.83 per cent of respondents residing at a distance 50-100 m away from the forests.

4.3. LAND USE TRANSFORMATION

Information on the land use transformations that occurred during the last 15 years was collected from the respondents and presented in Table 19.

Table 19. Land use transformation taken place in Wayanad for the past fifteen years.

Time span	Change in pattern occurred	Reason
10-15 yrs. back	• Shift towards high yielding crop varieties which required higher inputs • Crop diversification	• High market demand • Profit oriented farming practices
5-10 yrs. back	• Area under crops such as banana, arecanut increased • Rubber cultivation started • Conversion of lands for uses other than agriculture	• A trend towards cash crops • The settlers introducing cultivation of rubber from the success observed in Central Kerala • Demand from tourism sector • Increasing the profits
Last 5 yrs.	• Decline in farming of tuber crops • Reduced area under cultivation • Reduced sizes of land holdings	• Frequent crop raids by wild animals • Increased cost of cultivation-labour, fertiliser rates… • Decrease in rainfall • Family partitioning

In the interview schedule, information regarding the land use transformation that took place during the last fifteen years were assessed and the probable reasons were sought. The various land use transformations that took place in Wayanad district was assessed. The reasons for these changes was also assessed. The major land use transformations that took place in the past 15 years include shift from traditional farming methods to high yielding varieties, switch over to crops such as banana, rubber, arecanut in vast stretches, land put for uses other than agriculture, and reduction in tuber crops cultivation. The agriculture that is practiced now is more dependent upon the external inputs such as inorganic fertilizers and plant protection chemicals. The main reasons attributed for these include rise in market demand for certain crops, climate change and increased human-wildlife conflicts.

4.4. LIVESTOCK IN POSSESSION

The information regarding the livestock possession of the respondents is presented in Table 20. The farmers reared domestic animals like cow, goat, buffalo and also poultry. The practice varied greatly among the respondents. Some of the respondents did not have any livestock.

Table 20. Details of livestock in possession

Sl. No.	Livestock in possession	Respondents owning	
		Frequency	Percentage (%)
1	Cow	42	35.00
2	Poultry	37	30.83
3	Goat	26	21.67
4	Buffalo	8	6.67
5	Others	2	1.67

The respondents reared animals such as cow, poultry, goat, buffalo etc. The respondents mainly reared cow and poultry. Majority of the respondents did not rear livestock as an income source but did for meeting the household demands, cattle rearing on the other hand was an economic activity.

4.5. PARTICIPATION IN VARIOUS PROGRAM ORGANISED BY FOREST DEPARTMENT IN LAST 2 YEARS

Of the 120 respondents only, 2 percent had participated in any programmes. They participated in a seminar on human-wildlife conflict mitigation in Wayanad Wildlife Sanctuary. Respondents in the vicinity of Wayanad Wildlife Sanctuary had attended such programmes. In South and North Wayanad Forest Divisions the respondents had not attended such programs.

4.6. PARTICIPATION IN JOINT FOREST MANAGEMENT ACTIVITIES

The participation of the respondents to various joint forest management activities were analysed.

Table.21. The participation of the respondents in various joint forest management activities

Dimension of participation	Respondents participation							
	Frequently (No.)	%	Occasionally (No.)	%	Less (No.)	%	Never (No.)	%
Forest watchers	0	0	0	0	0	0	120	100
Fire watchers	4	3.33	0	0	0	0	116	96.67
Protection activities	24	20	36	30	32	26.67	28	23.33
In ecotourism activities	6	5	0	0	14	11.67	100	83.33
Ecotourism: shops and other distribution systems	0	0	0	0	0	0	120	100
Collection of NTFP	7	5.83	4	3.33	0	0	109	90.83
Others	0	0	0	0	0	0	120	100

From Table 21, it can be seen that high level of participation is observed in the protection activities like forest fires etc. Ninety-two respondents had participated in these activities. The tribal population were involved in collection of NTFP (11 respondents). Some of the tribal respondents were also employed as forest fire watchers (6 respondents) during summer seasons. Ecotourism activities were done by six respondents which included providing homestays for the tourists.

4.7. ATTITUDE OF THE RESPONDENTS

The attitude of the respondents to human-wildlife conflicts and wildlife conservation is detailed below.

4.7.1. Attitude to human-wildlife conflicts

The attitude of the respondents towards human-wildlife conflicts is given in Table 22.

Table 22. Attitude of the respondents towards human-wildlife conflicts in Wayanad

Category	Range	Frequency	Percentage (%)
Low	9-21.0	0	0
Medium	21.1-33.0	72	60
High	33.1-45	48	40
Total		120	100

From Table. 22, it was found that the majority of the respondents were positive in attitude towards human-wildlife conflicts. They accepted the facts that human-wildlife cannot be solved in a single day.

The attitude of the respondents towards human-wildlife conflict at Wayanad is presented in Figure 1. It can be seen that a majority (36.67 percent) of the respondents strongly agreed with the statement 'If Forest Department takes action to upgrade the quality of the forest habitat, the conflict rates will come down' (ST 8). They admit to the statement that 'Some loss due to wildlife is to be expected in forest fringe areas and should be tolerated by the local people' (ST 1), (59.17 percent). The statement 'Forest department should control wildlife using non-lethal methods such as barriers, deterrents and relocation' (ST 4) got 41.67 percent respondents support. 'Tourists coming to see forests/wildlife should pay human wildlife conflict mitigation CESS' (ST 5) was also agreed by 38.33 percent. 'Officials and policy makers assigns more value to wildlife over human life and livelihoods' (ST 6) got only 26.67 percent support. For the statement 'In conflict zones, the Forest Department shows sincerity in taking remedial action' (ST 7) a majority (47.5 percent) agreed.

A majority (40 percent) chose to be neutral to the statement 'Dearth of accurate data on the carrying capacity of forests is escalating the conflicts' (ST 9). Thirty seven percent of the respondents agreed to the statement and 22.5 percent of them strongly agreed. So, an agreeance to the statement can be derived from the response.

Two statements 'Human-wildlife conflict is happening due to encroachment by humans into forests' (ST 2) was disagreed by 52.50 percent and the statement 'The Forest Department staff generally treat the forest fringe people as encroachers and offenders' (ST 3) was disagreed by 46.67 percent.

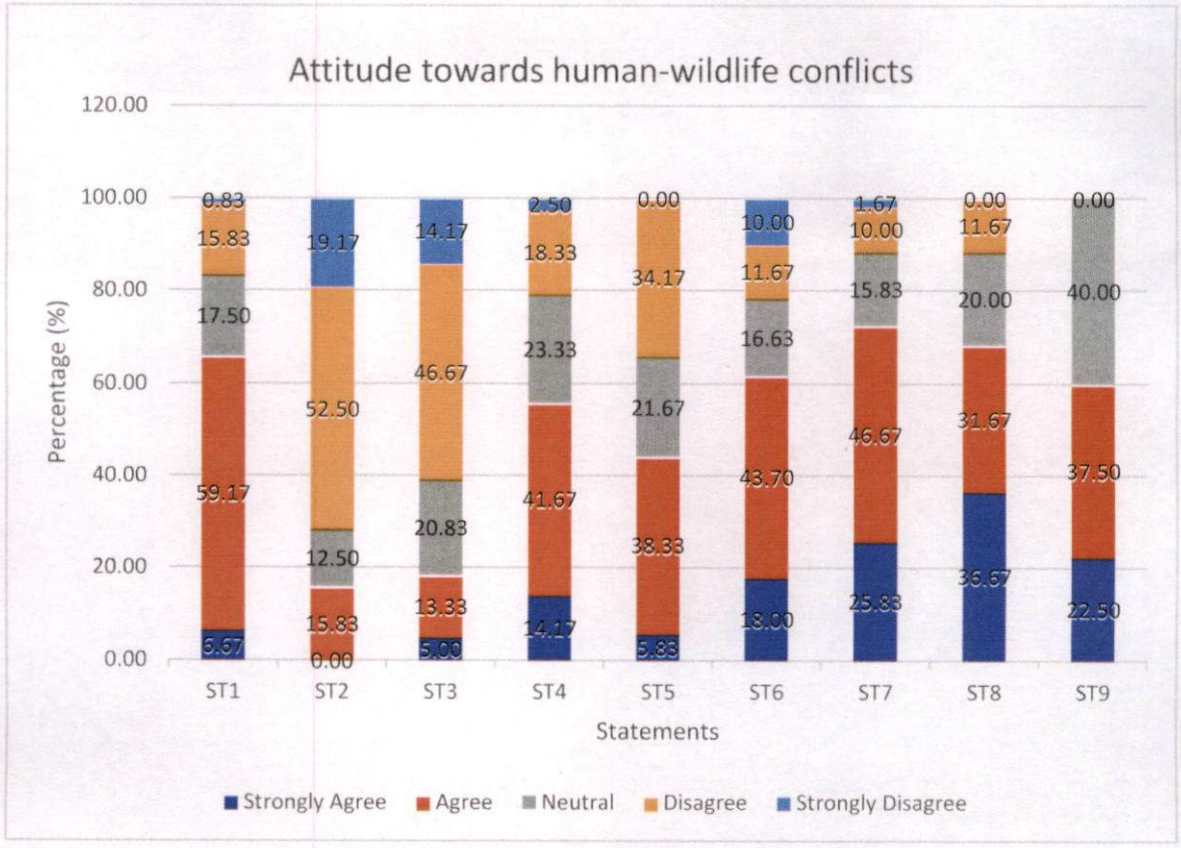


Figure 1. Attitude of the respondents towards human-wildlife conflicts in Wayanad

Table 23. Index values obtained for the statements addressing the respondents attitude towards human-wildlife conflicts.

Sl.No.	Statements	Index value (%)	Ranking
1.	If Forest Department takes action to upgrade the quality of the forest habitat, the conflict rates will come down. (ST 8)	78.67	1
2.	In conflict zones, the Forest Department shows sincerity in taking remedial action (ST 7)	76.83	2
3.	Dearth of accurate data on the carrying capacity of forests is escalating the conflicts (ST 9)	76.50	3
4.	Officials and policy makers assigns more value to wildlife over human life and livelihoods (ST 6)	75.67	4
5.	Some loss due to wildlife is to be expected in forest fringe areas and should be tolerated by the local people. (ST 1)	71.00	5
6.	Forest department should control wildlife using non-lethal methods such as barriers, deterrents and relocation. (ST 4)	69.33	6
7.	Tourists coming to see forests/wildlife should pay human wildlife conflict mitigation CESS. (ST 5)	63.17	7
8.	The Forest Department staff generally treat the forest fringe people as encroachers and offenders (ST 3)	49.00	8
9.	Human-wildlife conflict is happening due to encroachment by humans into forests (ST 2)	45.00	9

From Table 23, it can be observed that the highest rank was obtained for the statement "If Forest Department takes action to upgrade the quality of the forest habitat, the conflict rates will come down." (ST 8) (index value 78.67 percent). In the second position came the statement "In conflict zones, the Forest Department shows sincerity in taking remedial action" (ST 7) (index value 76.83 percent). The statement "Human-wildlife conflict is happening due to encroachment by humans

into forests" (ST 2) and statement "The Forest Department staff generally treat the forest fringe people as encroachers and offenders" (ST3) obtained the least response index.

4.7.2. Attitude to wildlife conservation

The attitude level of the respondents towards wildlife conservation in Wayanad district is given in Table 24.

Table 24. Attitude level of the respondents towards wildlife conservation in Wayanad

Category	Range	Frequency	Percentage (%)
Low	9-21.0	0	0
Medium	21.1-33.0	28	23.33
High	33.1-45	92	76.67
Total		120	100

From Table. 24, it can be seen that the majority of the respondents showed high level of tolerance to human-wildlife conflicts and are positive in their attitude towards wildlife conservation initiatives (high category (76.67 percent) and medium (23.33 percent)).

The attitude of the respondents towards human-wildlife conflict at Wayanad is presented in Figure 2. It can be seen that a majority of the respondents (55 percent) admits that 'It is important to conserve wildlife' (ST 1). The statement 'Wildlife laws ensure the right of the wildlife to live peacefully' (ST 2) was agreed by 79.17 percent. The statement 'People who harm wildlife should be strictly punished' (ST 3) was agreed by 70 percent. A majority (65.83 percent) agreed for the statement 'People who traditionally use natural resources in protected areas should be allowed to continue to use them' (ST 5). The statement 'Permission can be given to shoot and kill animals that cause continuous trouble' (ST 7) was supported by 49.17 percent. For the statement 'Culling of excess wildlife to keep the population under check is a scientific option' (ST 8) majority agreed (43.33

percent) and for the statement 'Wildlife conservation laws are biased and do not consider the value of human lives and livelihoods' (ST 9) 31.67 percent supported.

For the statement 'Wildlife should be strictly confined to the protected areas' (ST 6) the majority was strongly agreed by 42.5 percent.

A majority (45 percent) disagreed to the statement 'Protected areas are too large and should be reduced in size' (ST 4).

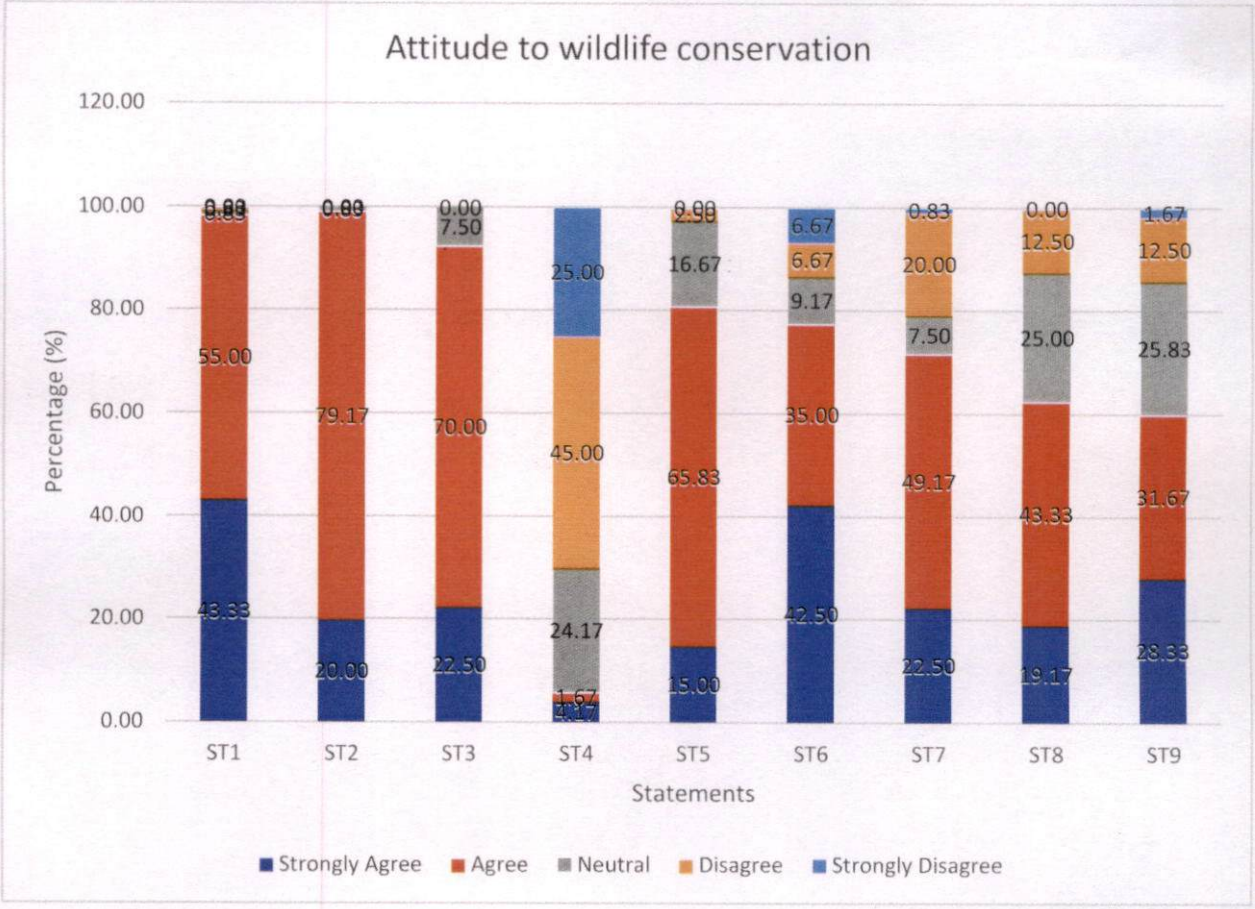


Figure 2. Attitude of the respondents towards wildlife conservation in Wayanad

From Table. 25, it can be observed that the highest rank was obtained for the statement "It is important to conserve wildlife" (index value 88.17 percent). In the second position came statement "Wildlife laws ensure the right of the wildlife to live peacefully" (index value 83.83 percent). The statements "Protected areas are too large and should be reduced in size (ST 4) and "Culling of excess wildlife to

keep the population under check is a scientific option" (ST 8) secured the least ranks.

Table.25. Index values obtained for the statements addressing the respondents attitude towards wildlife conservation.

Sl.No.	Statements	Index value (%)	Ranking
1.	It is important to conserve wildlife (ST 1)	88.17	1
2.	Wildlife laws ensure the right of the wildlife to live peacefully (ST 2)	83.83	2
3.	People who harm wildlife should be strictly punished (ST 3)	83.00	3
4.	Wildlife should be strictly confined to the protected areas (ST 6)	80.00	4
5.	People who traditionally use natural resources in protected areas should be allowed to continue to use them (ST 5)	78.67	5
6.	Wildlife conservation laws are biased and do not consider the value of human lives and livelihoods (ST 9)	75.50	6
7.	Permission can be given to shoot and kill animals that cause continuous trouble (ST 7)	74.50	7
8.	Culling of excess wildlife to keep the population under check is a scientific option. (ST 8)	73.83	8
9.	Protected areas are too large and should be reduced in size (ST 4)	43.00	9

4.8. ASSOCIATION OF SOCIO-DEMOGRAPHIC VARIABLES WITH RESPONDENTS' ATTITUDE TOWARDS HUMAN-WILDLIFE CONFLICT AND WILDLIFE CONSERVATION

Table 26. Association of socio-demographic variables with respondents' attitude towards human-wildlife conflict (Kruskal -Wallis one-way analysis of variance).

Socio-demographic variables	Chi-square value
Age	1.326 ^{ns}
Education status	0.159 ^{ns}

The test results presented in Table 26, reveals that there was no significant association between any of the socio-demographic variables such as age, educational status and attitudes towards human-wildlife conflicts in Wayanad district. The attitude of the respondents is not connected with their age and educational status.

Table 27. Association of socio-demographic variables with respondents' attitude towards wildlife conservation (Kruskal -Wallis one-way analysis of variance).

Socio-demographic variables	Chi-square value
Age	3.221 ^{ns}
Education status	2.715 ^{ns}

The test results presented in Table 27, reveals that there was no significant association between any of the social demographic variables such as age, educational status and attitude towards wildlife conservation in Wayanad district. The attitude of the respondents to wildlife conservation and human-wildlife conflicts are independent of their age and educational status.

4.9. COVERAGE UNDER CROP AND ANIMAL INSURANCE

It was assessed for any programs similar to insuring the crops to various natural calamities were available or not. It was found that no programs were available. The only available benefit from the government against wild animal attacks was the compensation received. The compensation even though available was inadequate for the damages incurred to the farmer.

4.10. MAIN SOURCES OF LIVELIHOOD AND SEASON OF THE ACTIVITY

The sources of livelihood and the season in which they were followed were analysed.

4.10.1. Sources of livelihood

The main sources of livelihood for the respondents in Wayanad are provided in Figure 3. The majority of the respondents in Wayanad are farmers by profession. They farm various crops such as paddy, pepper, coffee, banana, coconut, arecanut, vegetables etc. Ninety-two (92) of the respondents interviewed were farmers in which 52 integrated livestock components to farming system. Wage labour was the next major source of livelihood. They provided the labour required for the large land owners and other farmers.

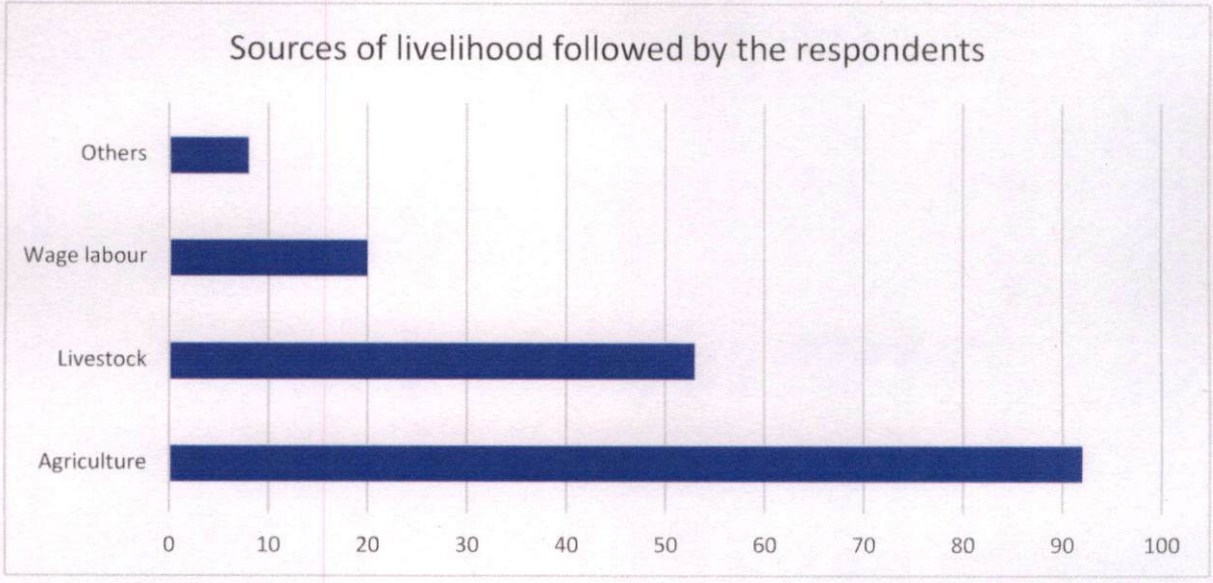


Figure 3. Major sources of livelihood of the respondents in Wayanad.

4.10.2. Season of the activity

The main sources of livelihood and the seasons in which they are practiced are given in Figure.4.

Source of Livelihood	Months practiced											
	Jan.	Feb	Mar.	Apr	May	Jun	July	Aug.	Sep	Oct.	Nov.	Dec.
Agriculture												
Livestock												
Wage Labour												
Forest Products												
Other												

Figure 4. Seasonality of the livelihood sources.

From the Figure 4 it can be seen that activities like agriculture, livestock rearing, wage labour and others (business enterprises, jobs etc.) are practiced year-round. The forest products are collected by tribals during all months of the year except rainy season (June-August).

4.11. NATURE, FREQUENCY, DISTRIBUTION AND INTENSITY OF CONFLICTS

The information obtained from the timeline tool is presented in Table 28. It was done by utilising the experiences and knowledge of the elderly people who participated in PRA exercise.

Table 28. Timeline of human-wildlife conflicts

1980's	• Formation of Wayanad district:1980 • Wayanad wildlife sanctuary: 1985 • More food available inside the forest and hence incidents of human-wildlife conflict were less. Animals were mainly inside the forests and seldom venture out of the forest boundaries. • Poaching, though illegal was present which kept wild animals away from human habitations • Climate was favourable for agriculture. Millets, coffee, tea were the popular crops. • Conservation efforts were gaining gradual momentum after the enactment of Wildlife Protection Act 1972 and the later more pro-conservation laws and policies • People had relatively fewer restrictions to access the forests.
1990's	• The forest based food resource base has declined • Decline in jackal population has an impact on the population of wild boars and other small animals which are crop raiders. • The population of several wild animal species has been increasing. • Gradual shift towards crops such as banana, arecanut as revenue declined in traditional crops • Rampant encroachments and boundary violations started growing
From 2000	• Frequency of crop raiding incidents became more due to declining resource availability in forests

	• Weather has changed, rainfall has decreased considerably, water availability has declined • Farmer debts and suicides are new problems for the district • New weeds have emerged and it added to the lack of resources. These weeds have become a safe ground for wild boars and other small animals • People started growing more palatable crops near the forests
Present day	• Wild animals are a sure sight in crop fields during night mainly • Crop raiding became a common issue • The temperature increased and started facing droughts during summers and annual precipitation decreased • People started becoming more aggressive towards forest department as a result of increased conflicts • Animals are getting more priority than humans and their population have increased

4.11.1. Dependence on forest resources

The dependence of respondents on forest for various resources have reduced in the recent years. Only the elder generation people are involved in any of such activities. Table.29. represents their dependence on forest resources for various purposes.

Table 29. Dependence of the respondents on forest resources

Resources	Purpose of collection	Extent of influence by wildlife conflict on resource utilization							
		Continuing unchanged		Partially reduced		Occasionally practiced		Discontinued	
		Freq	%	Freq	%	Freq	%	Freq	%
Firewood	For household purposes	12	10.00	0	0.00	0	0.00	108	90.00
Water	Irrigation	18	15.00	16	13.33	6	5.00	80	66.67
Honey	For selling in market	6	5.00	0	0.00	2	1.67	112	93.33
Dammar	For selling in market	6	5.00	0	0.00	2	1.67	112	93.33
Medicinal plants	For their own uses	4	3.33	0	0.00	6	5.00	110	91.67
Fodder collection	Meeting the livestock demands	8	6.67	14	11.67	15	12.5	83	69.17
Wild planting materials	Not collected	0	0.00	0	0.00	0	0.00	0	0.00
Green leaf manure	Not collected	0	0.00	0	0.00	0	0.00	0	0.00
Others	Nil	0	0.00	0	0.00	0	0.00	0	0.00

From the Table.29. it can be seen that the respondents are depending on forests for firewood, water, honey, dammar, medicinal plants, fodder. Out of these 40 respondents depend on forests for water, mainly for irrigation purposes. It is unaffected by human-wildlife conflicts for 18 respondents and partially reduced for 16 respondents. Occasionally 6 of the respondents depend on them. Other methods were used by 80 percent of the respondents for meeting the water demand. But they are indirect beneficiaries of forests in their neighbourhood.

Collection of dammar, honey and medicinal plants from forests are done by the tribal respondents, mainly the elder ones in the family are associated with such activities. In the study eight of the respondents collected these products from forests.

Fodder is collected by the respondents for meeting the livestock demand or they graze their livestock in forest boundaries. Fodder collection was continued by 8 respondents and 14 of them partially reduced this activity because of increased human-wildlife conflicts. Occasionally 15 of the respondents collect fodder from forests and 83 of them are not involved in fodder collection.

Green leaf manure and wild planting materials were not collected by any of the respondents interviewed. No other activities for which they depend on forest resources are reported.

4.11.2. Damage by wild animals

The respondents were enquired about the animals effecting damages and the kind of damages caused. The questions were drafted to collect information regarding animals responsible for damages, the time of attacks, extent of attacks etc. The information regarding the damage causing animals are provided in the Table. 30.

Table 30. The damage causing animals and the damages caused by them.

Sl. No	Animals involved	Damage caused	Problem area
1	Elephant	Extensive damage to cropping systems-Banana, paddy, jackfruit etc mainly affected	Meppadi, Chedleth, Sulthan Battery, Thirunelli
2	Wild boar	Extensive damage to cropping systems- all tuber crops, vegetables, paddy etc mainly affected	Meppadi, Chedleth, Sulthan Battery, Thirunelli
3	Bonnet Macaque	Damage to crops- coconut, arecanut, coffee, pepper, banana, vegetables… Nuisance	Meppadi, Chedleth, Sulthan Battery, Thirunelli
4	Leopard	Livestock damage: death (goat and calves)	Thirunelli, Sulthan Bathery, Chedleth
5	Giant squirrel	Damage to crops- coconut, arecanut, banana, vegetables	Meppadi, Chedleth, Sulthan Battery, Thirunelli
6	Spotted deer	Damage to crops- mainly in paddy where they attack in groups	Sulthan Battery, Thirunelli
7	Tiger	Livestock damage: death (goat and calves) and injuries	Sulthan Battery, Thirunelli
8	Peafowl	Damage to crops	Chedleth, Thirunelli
9	Porcupine	Damage to crops	Sulthan Bathery, Meppadi

The respondents reported that the attacks/crop raiding were more frequent in the rainy season and also when the jackfruits, mangoes etc ripen. During the ripening period, the presence of elephants was more frequent. The attacks were common during the months August to September when it is the harvest season of banana. In coffee plantations, during the month of March to May at times of its harvest the attacks usually occur. Majority responded that there were attacks occur all the year around, which is creating huge income loss for small farmers. The problematic animals found in the study area of Wayanad district were analysed (Figure 5) and the respondents said that the majority of the conflicts in the districts were caused by elephants and wild boars (55 percent). Following comes the damages induced by Bonnet Macaques (15 percent).

Leopard was the main animal causing livestock depredation. The livestock depredation caused by large carnivores are rare and the respondents reported that only few incidents occurred during the last year.

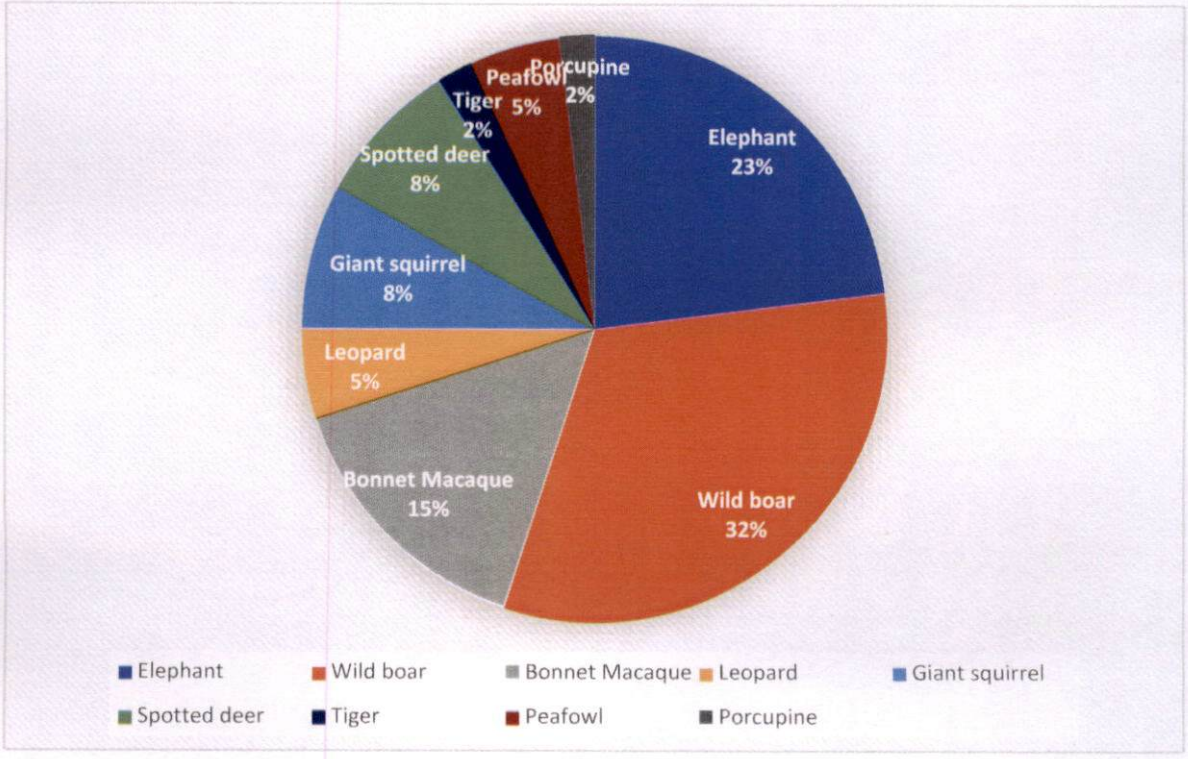


Figure 5. Problematic animals of Wayanad district

4.11.3. Hotspots of human-wildlife conflict in Wayanad

From the respondents, the hotspots of conflicts within the district were identified (Plate 4 & 5). Using the PRA tool vulnerability mapping the hotspots were identified (plate 6 & 7). The respondents from the four study locations, namely Meppadi, Sulthan Bathery, Chedleth and Thirunelli identified Thirunelli (Pulimunda, Naikatti and Anapara), Tholpetty, Pulpally (Pathiri, Bhoothanam and Irulam), Sulthan Bathery (Odapallam, Kallumukku and Kalloor), Muthanga , Meppadi (Kadachikunnu, Attamala and Anapara), Noolpuzha and Kalpetta (Kalpetta and Sughandheri) as intense conflict zones. They further say that conflict zones can be identified everywhere in Wayanad right from Thamarassey and Lakkidi areas.

Plate.10. Vulnerability mapping exercise in Meppadi

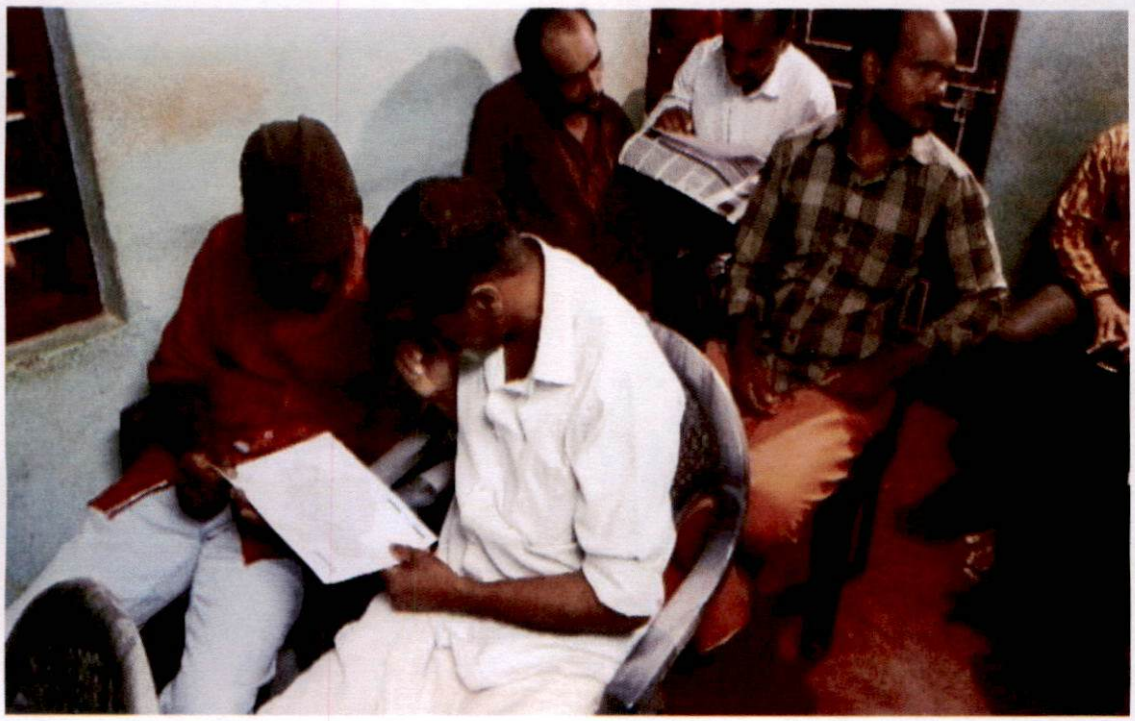


Plate 11. Vulnerability mapping exercise in Sulthan Bathery

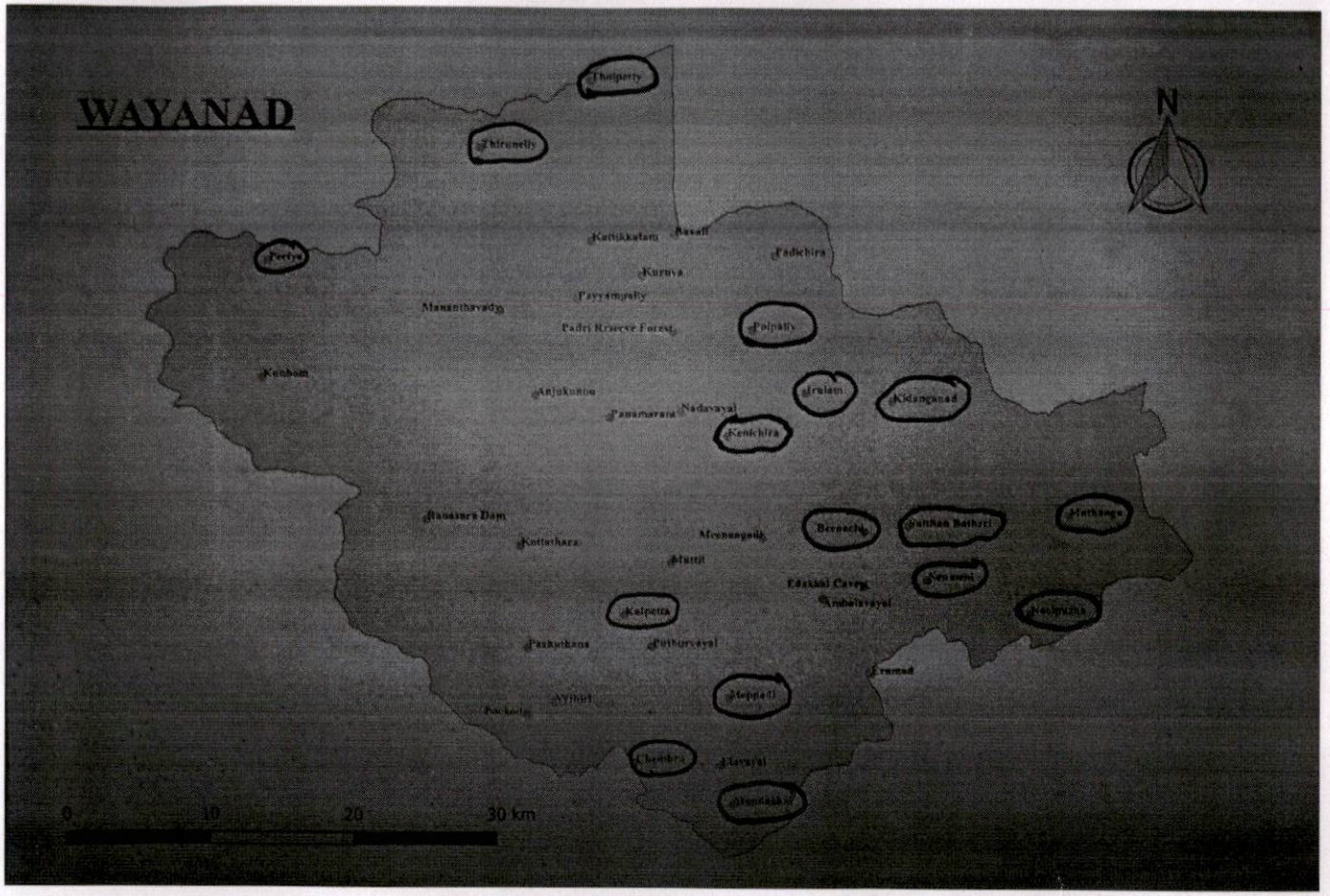


Plate 12. Identified hotspots after vulnerability mapping conducted in Odapallam (Sulthan Bathery) in Wayanad district.

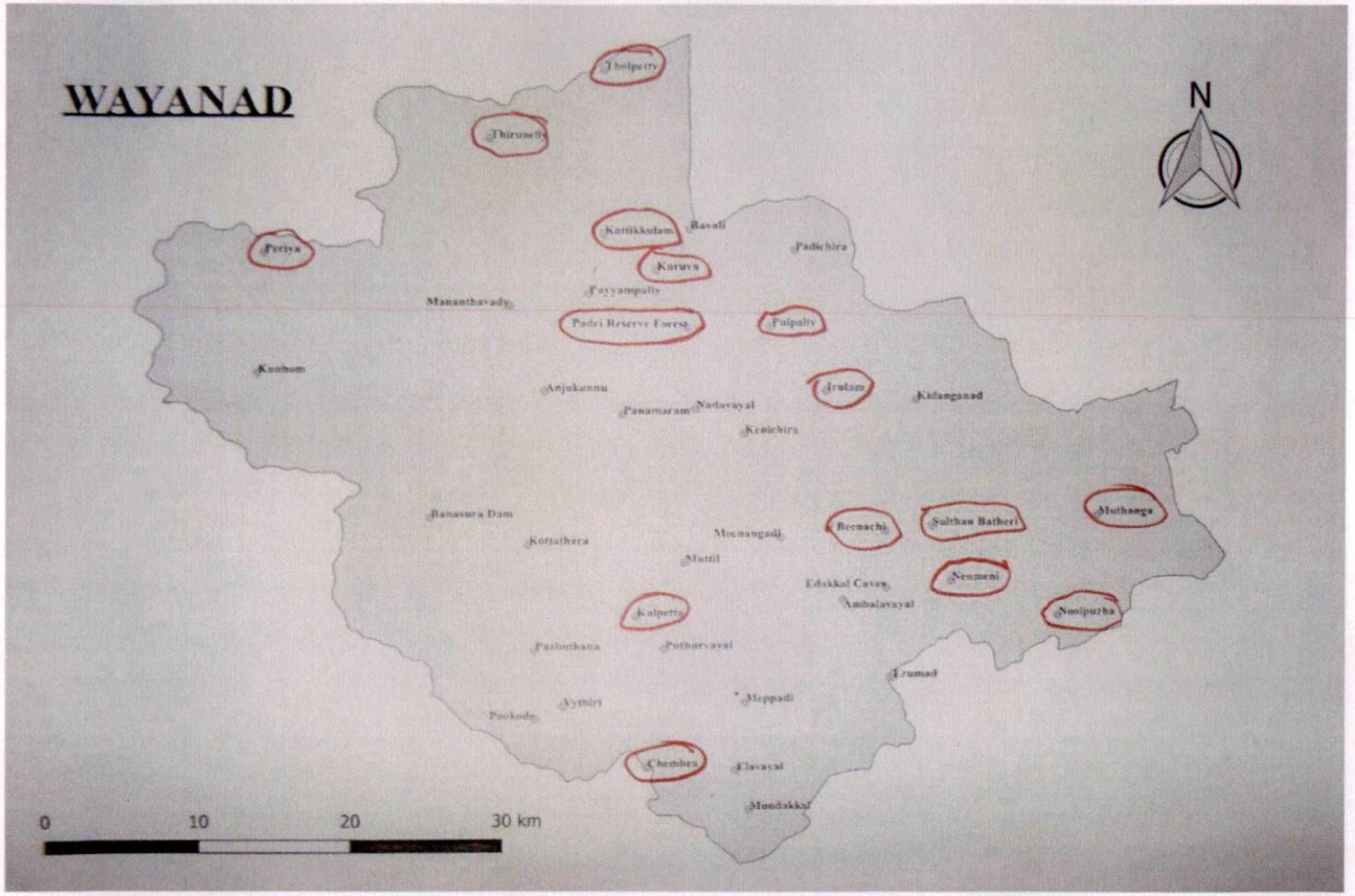


Plate.13. Identified hotspots after vulnerability mapping conducted at Thirunelli in Wayanad district.

4.12. CAUSES OF HUMAN-WILDLIFE CONFLICT

The opinion regarding the causes of human-wildlife conflicts in all the study locations from Wayanad was collected from the respondents. The information regarding causes of conflicts were collected both during the interviews and also during the PRA. A tool in PRA, Problem Tree method was employed to analyse the causes of conflicts in the different locations in Wayanad.

Table 31. Perceived causes of human-wildlife conflict at each of the study locations in Wayanad.

Sl.no.	Causes	Meppadi	Sulthan Bathery	Chedleth	Thirunelli
1	Increased temperature inside forests	99.33	98.00	80.67	92.00
2	Drought	98.67	98.00	97.33	99.33
3	Poor waste management	37.33	24.00	26.67	26.00
4	Increase in ecotourism	34.67	24.67	55.33	44.67
5	Damage to forest fences	40.00	68.67	65.33	66.67
6	Poor management of forest fences	38.00	66.67	88.67	69.33
7	Extinction/ genetic loss	80.00	66.00	58.00	55.33
8	Water scarcity inside forests	94.67	96.00	96.67	98.00
9	Competition for forage	58.67	54.67	64.67	64.67
10	Over exploitation of natural resources	70.00	56.00	42.67	54.67
11	Invasive alien species	69.33	45.33	51.33	54.67
12	Pollution	42.00	20.00	28.00	26.67
13	Habitat destruction	70.00	56.67	60.67	72.67
14	Quarrying/ sand mining	50.00	22.00	20.00	27.33
15	Forest fires	83.33	60.67	89.33	78.67
16	Blocking of wildlife corridors	78.00	33.33	80.00	63.33
17	Growing palatable crops near forests	22.00	97.33	98.67	97.33

A cumulative of the responses from each of the locations revealed the major causes of human-wildlife conflict in the district (Table.32). They responded that, the increased temperature was the major trigger of human-wildlife conflicts (index value 92.5) followed by water scarcity inside the forests (index value 92.33), Growing palatable crops near forests (index value 89.67). Drought in the forests (index value 83.67) and forest fires (index value 77.83) were also mentioned as important influencing factors.

Table 32. The most severe causes triggering human-wildlife conflicts in Wayanad district.

Sl.No	Causes	Index value (%)	Ranking
1.	Increased temperature inside forests	92.50	1
2.	Water scarcity inside forests	92.33	2
3.	Growing palatable crops near forests	89.67	3
4.	Drought	83.67	4
5.	Forest fires	77.83	5
6.	Competition for forage	67.17	6
7.	Extinction/ genetic loss	66.17	7
8.	Poor management of forest fences	66.00	8
9.	Habitat destruction	65.67	9
10.	Blocking of wildlife corridors	63.67	10
11.	Damage to electric fences	60.17	11
12.	Invasive alien species	59.67	12
13.	Over exploitation of natural resources	55.83	13
14.	Increase in ecotourism	39.83	14
15.	Quarrying/ sand mining	29.83	15
16.	Pollution	29.17	16
17.	Poor waste management	28.50	17

4.13. CONSEQUENCES OF HUMAN-WILDLIFE CONFLICTS

The perception regarding the consequences faced by the respondents in. the four study locations across the district was collected (Table.33). It can be seen that one of the major consequences due to human-wildlife conflicts among the respondents was the stress they undergo from disorganised farm management and disruption in their livelihoods getting affected.

Table 33. Perceived consequences of human-wildlife conflicts across the district

Sl.no.	Consequences	Meppadi	Sulthan Bathery	Chedleth	Thirunelli
1	Livelihood affected	97.33	98.67	98.67	98.67
2	Hostility to wildlife	80.00	93.33	83.33	84.00
3	Change in attitude towards conservation	67.33	86.00	81.33	80.67
4	Transmission of diseases	22.67	20.67	20.00	20.00
5	Infrastructural damages	32.00	28.67	37.33	34.00
6	Reduction in ecotourism activities	36.67	20.67	24.67	22.67
7	Human death and injury	28.67	76.00	56.67	67.33
8	Stress from disorganised farm management	85.33	90.00	96.67	94.67
9	Intentional destruction to forests and wildlife	56.67	40.00	38.67	35.33
10	Changed attitude towards forest officials	60.67	86.00	75.33	76.67
11	Poor community participation in management activities	63.33	43.33	38.67	47.33

The respondents remarked that the major consequences of human-wildlife conflicts in Wayanad (Table. 34) include (in the decreasing order of severity) stress from disorganised farm management (index value 91.67), livelihood getting affected (index value 87.50), hostility to wildlife (index value 85.17), change in attitude towards conservation (index value 78.83) and changed attitude towards forest officials (index value 75.83).

Table 34. The consequences of human-wildlife conflict in Wayanad district.

Sl.No	Consequences	Index value (%)	Ranking
1.	Stress from disorganised farm management	91.67	1
2.	Livelihood affected	87.50	2
3.	Hostility to wildlife	85.17	3
4.	Change in attitude towards conservation	78.83	4
5.	Changed attitude towards forest officials	75.83	5
6.	Human death and injury	56.17	6
7.	Poor community participation in management activities	48.17	7
8.	Intentional destruction to forests and wildlife	41.83	8
9.	Infrastructural damages	33.67	9
10.	Transmission of diseases	28.17	10
11.	Reduction in ecotourism activities	26.17	11

4.14. MITIGATION MEASURES

The perception of the respondents regarding the most suitable mitigation measures to be adopted in their area was collected during the interview and during the PRA exercises is outlined in (Table. 35). Majority of the respondents favoured raising fruit trees inside the forests and facilitating access to water inside the forests as the best suitable measures.

Table 35. Best suitable mitigation measure (as perceived by the respondents) for reducing human-wildlife conflict in the conflict zones

Sl.no.	Mitigation measures	Meppadi	Sulthan Bathery	Chedleth	Thirunelli
1	Adequate and immediate compensation	63.33	57.33	89.33	75.33
2	Providing insurance coverage for crops and livestock	72.00	67.33	95.33	85.33
3	Traditional barriers for protection	66.67	36.67	59.33	51.33
4	Intensifying human vigilance	45.33	42.00	74.67	56.67
5	Watch towers	31.33	34.00	46.00	38.67
6	Guard animals	29.33	30.00	37.33	42.00
7	Guarding herds	36.67	28.67	26.67	37.33
8	Fencing of farmlands	83.33	96.00	96.00	96.67
9	Curbing livestock grazing in forests	65.33	53.33	70.67	62.67
10	Deterrents	56.00	43.33	45.33	44.00
11	Warning systems	49.33	61.33	79.33	69.33
12	Facilitating access to water for wild animals	87.33	90.00	93.33	92.67
13	Raising fruit trees for animals	96.67	88.67	93.33	93.33
14	Conservation education for local people	69.33	54.00	66.00	63.33
15	Voluntary relocation	43.33	32.00	57.33	46.67
16	Radio collar/ gps	58.00	33.33	55.33	50.00

The mitigation measures were ranked based on the index values (Table. 36). Respondents were of the opinion that raising more fruit trees inside the forests and thereby improving the food resource base inside the forests is the best way to mitigate human-wildlife conflict (index value 93). Facilitating access to water for wild animals (index value 92.83), erecting electric fencing around farmlands in the forest fringe areas (index value 88.00), providing insurance coverage for crops and livestock (index value 80.00) and extending adequate and immediate compensation

(index value 71.83) are the major five measures suggested by them. Following these came the measures such as construction of more barriers to keep the animals away from farmlands (index value 69.83), implementing warning systems for making people aware of animal presence (index value 64.83). Educating the people about the need for conservation came eighth (index value 63.17) and curbing livestock grazing in forests came ninth (index value 63.00).

Table 36. The opinion regarding the best methods for mitigating human-wildlife conflict in Wayanad district.

Sl.No	Mitigation measures	Index value (%)	Ranking
1.	Raising fruit trees for animals	93.00	1
2.	Facilitating access to water for wild animals	92.83	2
3.	Fencing of farmlands	88.00	3
4.	Providing insurance coverage for crops and livestock	80.00	4
5.	Adequate and immediate compensation	71.83	5
6.	Traditional barriers for protection	69.83	6
7.	Warning systems	64.83	7
8.	Conservation education for local people	63.17	8
9.	Curbing livestock grazing in forests	63.00	9
10.	Intensifying human vigilance	54.67	10
11.	Radio collar/ GPS	48.83	11
12.	Deterrents	47.33	12
13.	Voluntary relocation	43.83	13
14.	Watch towers	39.00	14
15.	Guard animals	34.67	15
16.	Guarding herds	32.50	16

4.15. ROLE OF VARIOUS STAKEHOLDERS IN CONFLICT MITIGATION

The role of different stakeholders such as farmers, the local self-government institutions (LSGI's), government departments, non-governmental organisations (NGO's) and research institutions like agricultural universities were analysed from the view point of the respondents. Table 37 lists the response on the likely roles of various stakeholders in conflict mitigation and ensuring co-existence.

Table 37. Possible role of different stakeholders in conflict mitigation

Sl. No	Stakeholders	Their role
1.	Farmers	✓ Keep guard animals ✓ Intensify human vigilance ✓ Reducing cultivation of more palatable crops favoured by wild animals ✓ Help forest department in maintenance of barriers such as trenches, electric fences etc. ✓ Avoid grazing inside forests ✓ Keep wild animals inside forests by use of deterrents such as crackers, repellents etc.
2.	Local self-government institutions	✓ Provisions for barrier making in programs like MNREGA ✓ Ensure water for wildlife inside forests ✓ Planting more species like fodder grass, fruit trees in fringes which can keep animals in borders and fringes away from fields ✓ Controlling mining and quarrying ✓ Play an intermediator role between famers and government
3.	Governments	✓ Provide adequate and immediate compensation

		✓ Programs like crop insurance against wildlife damages ✓ More funds for erecting or establishing barriers like trenches, electric fences ✓ Stone wall enclosures around forests ✓ Programs to plant more indigenous fruit plants in forests ✓ Adequate compensation at times of relocation ✓ Discourage monoculture plantations of teak eucalyptus etc. ✓ Subsidise solar power fencing ✓ More staffs in management of conflicts
4.	Non-governmental organisations	✓ Conduct awareness campaigns for farmers on human-wildlife coexistence ✓ Study the situation and provide mitigation measures ✓ Provide guidance to Local self-government institutions and farmers in conflict mitigation ✓ Popularise measures like deterrents among farmers
5.	Research institutions	✓ Study feasibility of programs such as reintroduction of jackals and such species which have gone extirpation ✓ More technologies to keep wild animals away from crop fields ✓ More eco-friendly measures like eco-friendly deterrents

(source: PRA)

Plate.14. Identification of the roles of various stakeholders in human-wildlife conflict mitigation

Based on the interaction with the respondents the roles of various stakeholders in conflict mitigation were identified. According to the respondents the farmers can take up the maintenance of the barriers like electric fences, animal proof trenches in their neighbourhood and can also reduce the cultivation of palatable crops which are favoured by the wild animals. They say that the local self-government institutions can make provisions for construction of barriers like trenches, stone walls in programs like MNREGA and ensure water for wildlife inside forests. The main interventions they expect from the government includes providing adequate and immediate compensation for conflict affected farmers, implement programs like crop insurance against wildlife damages similar to the ones given for natural calamities, programs to plant more indigenous fruit plants in forests and discourage monoculture plantations of teak eucalyptus etc in the forest land. The NGO's can play an important role in creating awareness campaigns for farmers on the importance of human-wildlife coexistence and provide guidance to local self-government institutions and farmers in conflict mitigation. The research

institutions like Agricultural universities can develop animal deterrents or early warning systems based on modern technologies for conflict mitigation. They may also study the feasibility of reintroduction of jackals and such small carnivorous species which have declined in population or no longer available in the localities.

DISCUSSION

DISCUSSION

Human-wildlife conflicts are becoming a serious management paradox for all the stakeholders. In this scenario, the present study aimed to provide information on the nature, frequency, distribution, causes and consequences of the conflicts that is happening in Wayanad district from the view point of selected respondents residing in the conflict hotspots of this district. The results of the findings are discussed below.

5.1. SOCIO-DEMOGRAPHIC PROFILE

Though the female population in Wayanad is greater than males (GOK, 2016), response from females were limited. The majority of the respondents were males (Table. 11) as the males naturally took the lead to lord over all family matters including responding to the queries. As a result, options to generate response from the female population was thus limited which explains the low proportion of female respondents in the present survey. Moreover, the females have also displayed a shyness towards the interview and they preferred the male members in the family to respond to the interview.

Majority of the respondents were also above 36 years of age (Table. 12). One of the main reason is that the respondents in the lower age groups were away for either job or for pursuing education. Regarding vocations, the respondents in the Wayanad is gradually shifting from agriculture. Only the people in the higher age groups of a family are engaged or are continuing in agriculture. As far as education is concerned, the majority of the respondents have stopped education below tenth standard (Table. 14). Only in the recent years the education in the district has improved and as a result most of the elder people are having education upto matric level only. In most of the cases the schools are located far away and the family responsibilities mostly kept them at home for providing family labour. Incidentally, this district is having the least literacy rate in the state (89 percent). In the recent years the literacy rates in Wayanad (compared to 2001 census) are improving due to various programs (GOK, 2016).

Guillerme *et al.* (2011) found that 85 percent of the rural population of Wayanad depends on agriculture for livelihood and income. Majority of the respondents in Wayanad are agriculturalists and naturally self-employed (Table. 13). In this study too, it was observed that even when the respondents were small land holders, they were practicing agriculture in large areas of land by taking fields on lease. Easa and Sankar (2001) had also reported that the main occupation of the non-tribal groups in Wayanad is agriculture and the tribals depend mainly on daily wages. The land holding of the district is the highest in Kerala (0.44 ha). The proportion of total cultivators to the workers is 17.61 percent over Kerala's 5.84 percent, clearly showing the greater extent of people practicing agriculture (Jose and Padmanabhan, 2016).

The majority of the respondents belonged to the Above Poverty Line category (Table. 15). They were now getting adequate income from agriculture they follow. In the state, implementation of various plans such as land reforms, spread of education and health care, and also interventions by Kudumbasree, poverty have declined. In Wayanad also the population in Below Poverty Line has declined (GOK, 2016) thanks to the various upliftment programs by the government which provides them more opportunities in life.

In Wayanad, 89.04 percent of the population are having land below 1 ha area (Jose and Padmanabhan, 2016). In this study too, majority of the respondents (Table 16) were found to be having a land holding size between 1 acre and 3 acres (47.5 percent). The respondents mainly cultivate crops such as coconut, coffee, pepper, paddy, banana, ginger and arecanut (Table 17). The total area under farming are integrated with different crops like coconut, coffee, pepper, arecanut etc., except for paddy and ginger. They utilise the available land appropriately to integrate these crops in the available land.

The activities for livelihood followed and the season in which it is followed was also assessed. Activities like agriculture, livestock rearing, wage labour, other enterprises like business is followed year-round (Figure 4). During the rainy season,

the collection of forest products by the members of the tribal population is limited. The collection of forest products is done mainly by the older members of the tribal groups. The collection of forest products is no longer continued in the way it used to be. Many factors like shift to other occupations, fear of wild animals etc have caused the decline in the collection of forest products. The agriculture in the district is mainly practiced around two seasons Punja (December to May) and Nanja (June to November), and is mainly rain-fed (Nagabhatla *et al.,* 2015).

5.2. CROPS AND CROPPING PATTERN

Guillerme *et al.* (2011) had observed that found 85 percent of the rural population depends on agriculture for livelihood. Wayanad being a high-altitude region favours the growth of coffee and tea, by providing the favourable conditions for growth. Respondents in the conflict areas of the district cultivate coffee in combination with other species such as coconut, arecanut, jackfruit etc. Easa and Sankar (2001) too had reported that cultivation is a major source of income for the people of Wayanad. The major crops are paddy, ginger, millet, pepper, coffee, plantain, coconut, arecanut, vegetables, tapioca, jack tree, etc. which is in accordance with the observations of the study. In the recent past, there has been a greater boom in the banana cultivation in the district as the people cultivating the crop have increased. Ginger is practiced in the paddy fields during the off seasons and majority of the people who practice paddy cultivate ginger also.

However, of late the district had the highest percentage departure from normal rainfall in Kerala. The actual rainfall received in the district was 1073.8 mm to the normal rainfall of 2632.1 mm. This has directly affected the cropping system in the district as it is mainly dependent upon the rainfall received. The district has shown a decline in the area as well as the production of crops like rice, coconut, arecanut, ginger, cardamom (GOK, 2016). The agricultural scenario is declining and the government is trying to rejuvenate it with programs such as Revival package for pepper in Wayanad.

Majority of the respondents were living in close proximity (Table 18) to forests (less than 50 m from the boundaries). As a result, the chances of interaction of these respondents with wild animals are naturally high. Their crops and the livestock they rear can possibly attract several wild animals to their fields. The GOK (2016) found that there is 0.50 lakh L/ day collection of milk and the procurement of dairy has increased in the district from 486.9 lakh L/ year to 542.39 lakh L/ year. This clearly indicates a rise in livestock practices in the district even though occasionally faced with instances of livestock depredation. Availability of water is also another major factor that will attract the wild animals to these households and farmlands.

5.3. LAND USE TRANSFORMATION

The present study also noticed a definite shift in the farming practices in the study areas at Wayanad. The respondents here informed that they had long shifted to cash crops and had abandoned traditional crops that they had long practiced. Paddy and tuber crops cultivation was abandoned by many and had switched to other crops to avoid instances of crop raiding by wild animals. The respondents have reported the continuous threat from wild animals as a definite cause to shift /decrease cultivation. Some people even abandoned the cultivation of coffee, pepper, ginger and plantain because of increased crop raiding. Several respondents had opined that the attack increased mainly because of the fragmentations of the forest and disturbances to the movement corridors.

According to the respondents, paddy was the chief wet crop and the staple food, which the indigenous communities consumed along with farm millets. Later came crops such as coffee (in 1830), tea (in 1892), cardamom, pepper and rubber were introduced into the region and popularised by Britishers (Nair, 1911). The Christian migrants who came after independence (Kjosavik and Shanmugaratnam, 2007) popularised crops such as banana, ginger, arecanut and tapioca (Varghese, 2002). Pepper and vanilla came later. In the 1990's the traditional varieties of paddy were displaced by high yielding ones which required application of high quantity

of fertilisers and pesticides. By 2005, the only region remaining under paddy cultivation was those which were not feasible for any other crops due to poor drainage and flooding during monsoons. When the area under paddy decreased from 30,482 ha in 1982-83 to 8995 ha in 2011-12, the area increased for banana (468 ha -12,359 ha), arecanut (3852- 12,181 ha) (Jose and Padmanabhan, 2016). Moreover, there are also cases of high-level political lobbying for commercial conversion of paddy fields for tourism and real-estate development (Anonymous, 2012). The Kerala Conservation of Paddy Land and Wetland Act of 2008 protects the remaining paddy farmers and the paddy cultivated areas from transformations. The main driver of the land use change is product diversification or market oriented new cropping practices as a response towards variability in environmental conditions such as rainfall, boom in tourism industry and capital investment from emigrant community members (Nagabhatla *et al.,* 2015).

5.4. LIVESTOCK IN POSSESSION

FAO (2009) said that the effect of human-wildlife conflict has serious effect in Asia because the people have greater dependence on livestock as a source of income and livelihood strategy. Being an agricultural community, the people in Wayanad were engaged in all types of farming activities including livestock rearing. Common domestic animals such as cow, buffalo, goat, and poultry were reared by the majority of the respondents (Table 20). Due to increased human-wildlife conflicts, the livestock rearing is facing difficulties. In this study, instances of livestock depredation by wild animals are reported. The livestock depredation has not only caused the respondents financial losses but also the mental agony due to the loss of their livestock. These animals might be reared by them with greater emotional attachments, as a result their loss causes deep agony.

5.5. FORESTRY EXTENSION ACTIVITIES

The response in the study areas to details of participation in forestry extension programmes organised by the forest department was a mixed one. While a few of the respondents showed interest in attending, some said that they were

unaware of any such programs. A few reported that the forest department did not organise any such training programs at all. Among the respondents who had previously participated, some of them stopped attending such programs as they deemed it not useful for mitigating human-wildlife conflicts. The lack of participation can also be due to the unawareness among people of such programs. The chances are also that such programs are not given necessary publicity among the respondents and as a result they do not involve in such activities.

The attitude of the people towards forest department could be moulded in the wrong direction due to their lack of participation in department conducted training programs. These training programs can help in improving the tolerance level of the people and promote human-wildlife coexistence.

Over the years the participation of the respondents in various joint forest management activities has also declined (Table 21). People no longer depend on forest resources for livelihood. Even among the tribal population such a trend is being observed. The present study found that respondents only participate actively in forest protection activities. No other income generating activities like NTFP collection are practiced by the respondents.

The major reason for the lack of participation in these activities is due to the alternate employment opportunities such as wage labour in other sectors like farming, construction, etc. The tribal population who were taking part in activities such as non-timber forest products collection no longer continues it. They are mainly engaged as wage labour which is highly remunerative when compared to collection of forest products. They get payment every day and do not have to spend days in forests for earning money. Most of the people in the present generation are wage labours and they have works year-round. The fear of attacks by wild animals is also preventing them from continuing forest based activities.

5.6. ATTITUDES

5.6.1. Attitude to human-wildlife conflicts

The respondents in the study area generally were not in rebellion on account of the human-wildlife conflicts occurring in the district (Table.22) which is a positive oppurtunity. On the contrary, the feeling among the respondents was that they understood the fact that being in a forest fringe area, they will be interacting with the wildlife in their daily life. This attitude in fact is a positive sign and also an opportunity for the policy makers and planners to achieve conservation goals.

On the action side, majority of the respondents expected the Forest Department to take effective measures to upgrade the quality of the forest habitat, which they feel will bring down the conflict rates (Figure.1). The respondents believed that the shortage of resources in their natural habitats is pushing the wild animals to the farmlands. Proper habitat enrichment programs, they believe, can reduce the conflicts. The respondents say that before a decade there were less conflict incidents. They argue that as a result of establishments of plantations of teak and eucalyptus and other unscientific works done in the past, the forest quality or forest health has declined. At the same time, the respondents expect more cooperation from the forest department at times of crop raiding or livestock depredation. They also complain about the uncertainty and procedural delays in receiving the compensation, which explains the reason why these statements did generate negative response. Compensation can only help in avoiding the resentment of the farmers who incurred damages (Sukumar, 2016). To what extent these programs can be effective in Wayanad scenario needs to be studied more intensely.

However, the respondents agree to the fact that the forest department is understaffed to respond effectively to each and every conflict situations. As wildlife induced damages are already causing reduction in earnings, the respondents sometimes will not tolerate even a small delay in the response on the part of the official machinery. The respondents were also accepting the fact that some loss

due to wildlife is to be expected in forest fringe areas and they were ready to tolerate such losses (Figure.1). As they were residing in forest fringe areas they have been experiencing these throughout their life time. Meanwhile, the respondents expect the forest department to control the conflict by employing non-lethal methods such as barriers, deterrents and relocation programs. This attitude further cements their concern for protecting their livelihood and also conserving the wildlife. They, however, are of the definite view that the wildlife should be protected within the boundaries of the protected areas itself without allowing them a chance to enter their farmlands. In many areas of Wayanad, the respondents also accused the tourists of influencing the behaviour of the wild animals. As the tourists try to feed these animals, this effect a change in the behaviour of the animals. In such a circumstance, the respondents demanded that the tourists must pay a wildlife conflict mitigation CESS. This money could be utilised for implementing various conflict mitigation activities such as construction and maintenance of the electric fences, trenches, creating rescue shelters etc. The respondents believe that in conflicts, the official machinery tends to overlook the loss suffered in terms of human livelihoods and property and are more concerned about the safety of the wildlife. They demand equal attention to the loss suffered by the humans. However, the respondents in general were supportive of the several mitigation options exercised by the forest department and other government agencies. They also agreed that the forest department is working effectively within their limitations to facilitate a safe life for the people in Wayanad. This is justified by their agreement to the statement that in conflict zones, the Forest Department shows sincerity in taking remedial action.

The respondents were lacking any scientific knowledge on the influence of wild animal population dynamics in human-wildlife conflicts. It could be observed from the neutral responses when they were asked about the carrying capacity of the forests and whether it was causing conflicts. For them carrying capacity is a term that is provided to them by some conservationists and the lobbies which try to intensify the conflicts for their personal gains by mobilising people.

The respondents opposed the view that encroachments cause conflicts. Instead they believe that due to strict imposition of the forest laws encroachments aren't happening and hence this is not a cause now-a-days. Moreover, the respondents believe that the forest department do not treat the forest fringe people as encroachers and offenders. On the other hand, they said that the forest department and the local people are working hand-in-hand to reduce the conflicts. The department is also working to garner more people's participation in various activities, they said.

5.6.2. Attitude to wildlife conservation

The attitude of the respondents was highly in favour of wildlife conservation (Table.24).

Respondents however (Figure.2), strongly demanded that wildlife should be strictly confined to the boundaries of the protected areas. This showed their demand for more protection of their farmlands from the wildlife attacks. They advocate for the need for separate living spaces for the animals and humans to live peacefully, for which effective conflict mitigation is necessary.

The respondent's agreement to the statements that it is important to conserve wildlife, wildlife laws ensure the right of the wildlife to live peacefully and people who harm wildlife should be strictly punished, shows their positive attitude towards wildlife conservation. Meanwhile, they are also not advocating for rapid culling of all the problematic animals near the fields. They also agreed to the statements 'permission can be given to shoot and kill animals that cause continuous trouble', 'culling of excess wildlife to keep the population under check is a scientific option' and 'wildlife conservation laws are biased and do not consider the value of human lives and livelihoods'. Ironically, these negative responses could be explained as a reflection of the intense distress they experience on account of the sustained threats from wildlife attacks on their livelihoods and property.

The respondents are not of the opinion that the size of the protected areas should be reduced. They argued that even with the present forest size, they are facing wildlife attacks and size reduction can only escalate the conflicts. So, they are not voting for the option to reduce the size of the protected areas. The respondents accorded high priority for wildlife conservation and for actions to ensure their peaceful existence (Table 13), which once again signifies their pro-conservation mentality despite being under threat.

Heberlein (2012) has observed that the tolerance of the people towards various species is necessary for formulating necessary management strategy. In the present scenario, when the people displayed an open attitude towards human-wildlife conflicts and positive inclination to wildlife conservation, conflict management is easier. Gunaryadi and Hedges (2017) found that when the local communities were incorporated for conflict mitigation, it was effective in reducing the conflicts.

5.7. ASSOCIATION OF SOCIO-DEMOGRAPHIC VARIABLES WITH RESPONDENTS' ATTITUDE TOWARDS HUMAN-WILDLIFE CONFLICT AND WILDLIFE CONSERVATION

There was no significant difference between any of the social demographic variables such as age, educational status to attitude towards human-wildlife conflicts and wildlife conservation in Wayanad district (Table.26 and 27), which indicates that the attitude of the population is not affected by any of these factors. Being in a forested district like Wayanad, the respondents are frequently interacting with the forests and wildlife which have made them accept the intrinsic values and made them more conservationists in attitude. Despite threat pressures, they are pro-conservationists which is advantageous while formulating mitigation programs. Kansky *et al.* (2016) says that when the people are much aware of the situation and they exhibit a positive tolerance towards conflicts, considering the benefits, the management of the prevailing condition become easier and less tense. The tolerance level of the people is an important factor which determine the management of the

situation, suitable strategies for effective management cannot be employed only when the people tend to cooperate with it.

5.8. NATURE, FREQUENCY, DISTRIBUTION AND INTENSITY OF CONFLICTS

5.8.1. Dependence on forest resources

The respondents interviewed depended once on forests for firewood, water, honey, dammar, medicinal plants and fodder collection (Table 29). All of these activities are now discontinued by the majority of the respondents. Water is the only item for which dependence was found to be high. They mainly use it for irrigating their farmlands. Firewood collection is discontinued by the majority of the respondents because of the fact that collection is illegal and also that most of them are possessing cooking gas (LPG) connection. As a result, their energy demand for cooking are met from this. For occasional burning the firewood is met from the homesteads. This has led to decline in dependence on forests.

The collection of honey, dammar, medicinal plants and fodder are only continued by a small fraction of the respondents. It is done by the members of the tribal population in the areas. But in recent years even these people no longer engage in such activities. They get year-round occupation in the village and towns as wage labourers, in which they are daily paid after a day's work. This made them to slowly turn away from going inside forests for collection of non-timber forest products or get involved in forest based activities. Wage labour is providing them adequate money for a decent livelihood. They no longer have to spent days in forests for NTFP collection in fear of wild animals, if they go as wage labour. As a result, there has been a shift from their traditional jobs to wage labour.

5.8.2. Damage by wild animals

Crop damage is a severe problem in most of the settlements. The major conflict causing animals reported by the respondents in all the study areas are

elephant *(Elephas maximus)*, wild boar (*Sus scrofa)*, bonnet macaque (*Macaca radiata*), leopard (*Panthera pardus*), giant squirrel (*Ratufa indica)*, spotted dear (*Axis axis*), tiger (*Pantheratigris*), peafowl (*Pavo cristatus)* and porcupine (*Hystrix indica*) (Table 30). The respondents identified elephant and wild boar as the main problematic animals. Easa and Sankar (2001) in their study in Wayanad also observed elephant and wild boar to be the main problematic animals causing damage. In the last 10 years, the respondents say that there has been an increase in damage caused by the elephants. Even the people living away from the fringes reported of elephants causing damages. The present study too observed a similar response from the people as the damage by the animals have only increased in the recent years. They have discussed that even though most of them are aware of the compensation provisions, only a smaller proportion of the affected parties avail the facility mainly because of the procedural complexity. Analysis of the data in Wayanad indicates that elephants were involved in about 75% of the crop raiding and paddy was the most affected crop. The crop raiding was higher in rainy seasons especially in the reproductive phase of the crops. Crop-raiding more frequently occurs from late evening to early morning according to Sitati e*t al.* (2003) and Venkataraman *et al.* (2005). Settlements surrounded by moist deciduous forests and those with teak plantations were more prone to crop raiding. This is similar to the response that was collected during the present study.

Sukumar (1983) listed the factors inducing the conflicts as those related to movement pattern, availability of water and food, reduction, fragmentation and degradation of habitat, and the difference in the palatability and nutritive value of crops compared to the natural food species. Sitati *et al.* (2003) reported elephants to be more dangerous in herbivores as they cause human deaths and injuries more than by any other herbivores. Parker *et al.* (2007) added to this the fear factor that is induced in the minds of the residents by elephants. Throughout the interviews the respondents described of this fear which prevent them even from going out in night, riding motorcycles in evening and nights. The fear of attack from animals is

limiting the activities of the people, as a result the activities which they have done in the past is limited due to greater danger of animal attack.

In many situations the damages by animals like squirrels, rats and such animals are underestimated and so often the damages are left unnoticed (Harich *et al.,* 2013). The damages by these animals also needs to be considered as they are underestimated. These damages are not addressed during any mitigation programs. In the present study, the respondents also complained about the widespread attacks of giant squirrels.

5.8.3. Hotspots of human-wildlife conflict in Wayanad

The respondents identified Thirunelli (Pulimunda, Naikatti and Anapara), Tholpetty, Pulpally, Pathiri, Bhoothanam and Irulam), SulthanBathery (Odapallam, Kallumukku and Kalloor), Muthanga, Meppadi (Kadachikunnu, Attamala and Anapara), Noolpuzha and Kalpetta (Kalpetta, Lakkidi and Sughandheri) as the most intense conflict areas. Most of these areas are in close proximity to the forest areas and due to the continuous nature of habitat the animals are frequently causing damages. In the parts that are sharing borders with Karnataka and Tamil Nadu, the animal density is higher. In the summer months, the animals from the neighbouring states are found to migrate to these areas looking for resources like food and water. The animal movements in these areas tend to change the actual available animal population in the bordering regions. These characters are the main reason for which these specific locations are attributed as areas of intense human-wildlife conflicts. Wayanad is coming under the elephant corridor connecting Karnataka and Tamil Nadu with Kerala, as a result the animal density in the district is high and hence places of intense conflicts are numerous.

Chen *et al.* (2016) reports that the identification of the hotspots of human-wildlife conflicts can enable a greater success in the mitigation of conflicts. In the management of the conflicts when the regions are prioritised, the identification of conflicts will help in effective management. These intensely affected regions in

Wayanad identified by the respondents of this study must be considered for more direct intervention and action by policy makers and planners.

5.9. CAUSES OF HUMAN-WILDLIFE CONFLICT

The major causes of human-wildlife conflict in the decreasing order of severity and importance are increase in temperature, water scarcity inside the forests, growing palatable crops near forests, drought, forest fires (Table. 32). The respondents were of the opinion that the increased temperature and decrease in the annual rainfall have caused droughts in the recent periods and this has triggered conflicts. In Wayanad a decrease of rainfall from 2632.1 mm normal to 1073.8 mm was observed (GOK, 2016). A similar trend was observed in temperature also, the summers were hotter compared to the past. This has led to animal migration from drier tracts to the farmlands where food and water is available. Wayanad being a tri-junction, is the favourite migratory point during summer season when wild animals from the nearby areas such as Bandhipur, Nagerhole and Mudhumalai protected areas migrate to resulting in increased the competition for resources. This too has increased events of human-wildlife conflicts in the fringe areas of Wayanad, especially involving elephant herds. Nyhus *et al.* (2003) said that the ultimate reason for human-wildlife conflict is scarcity of resources. People also say that due to the cruel treatments in neighbouring states these wild animals coming from outside are more violent in nature in interactions, even though evidence supporting this view are largely unavailable.

Desai and Baskaran (1996) has said that the population occupancy of the habitats is directly dependent upon the water availability and the movement pattern of elephants was in accordance to that. The respondents also reported that animal population in the majority of conflict instances arrive in the farmers' fields for water resulting in trampling of crop and set in motion a range of conflicts. Sukumar (1985) and Sivaganesan (1991) had found a shift in the use of habitat in association with water and food availability. Easa and Sankar (2001) too had observed a seasonal pattern of distribution in elephants influenced by food and water availability. Of

late, Wayanad is facing severe rainfall deficit which is influencing its macroclimate. Marker and Sivamani (2009) observed that in dry season, the animals will converge to some common water bodies to meet their requirements, in such situation livestock which depend on such water bodies will face danger of depredation and ultimately will cause conflicts.

The respondents also mentioned that growing palatable crops in the fringe also as an important cause of conflicts. In forests with plantations of teak and eucalyptus, paddy and banana are a rich source of diet for the wild herbivores. These fields also are a source of water. So, the crop raiding animals tend to remain near to the crop lands so as to feed on these crops resulting in human-wildlife conflicts. Sukumar (1985) had mentioned that the high nutrient value and digestibility coupled with less toxins as the possible reasons for preference for paddy. Palatability of paddy was also high compared to the matured grasses in second wet season. Historical changes in the landscapes had caused habitat fragmentation in Wayanad and this is a primary factor of conflicts (Easa and Sankar, 2001; Nigam, 2002). However, at this instance, respondents did not point habitat fragmentation as a primary cause of human-wildlife conflict perhaps due to a general lack of awareness on such matters. However, since its importance is significant, the forest department must create awareness on this among the local populace so as to garner their support in stopping further habitat fragmentation and thus mitigate further conflicts.

Mukherjee (2016) in her study in human-wildlife conflicts said the forest fire not only causes negative interaction between humans and animal but also destruction of natural habitat of species and loss of biodiversity. The recent forest fires in Wayanad had caused severe habitat damage and biodiversity loss. Frequent forest fires which occurs in the district during the summers was pointed out to be one of the five main reasons for the human-wildlife conflicts. In Wayanad district alone an area of 417.83 ha of forests were damaged by forest fires (Anonymous, 2017). The fires lead to shortage in resources and as a result the animals are forced to migrate elsewhere including farmlands, for resources. The damage to the

farmlands differ between species and the damage elephants can inflict is devastating for the individual farmer (Parker *et al.,* 2007; Osei-Owusu and Bakker 2008). In Assam, Kushwaha and Hazarika (2004) in their study on habitat degradation found it to be immediately causing direct human-wildlife conflict. In Wayanad, people are less engaged in activities such as forest products collection and the forest areas are well protected from encroachments.

5.10. CONSEQUENCES OF HUMAN-WILDLIFE CONFLICTS

The major five consequences of increased conflicts (in the decreasing order of severity) are stress from disorganised farm management, followed by livelihood affected, hostility to wildlife, change in attitude towards conservation and changed attitude towards forest officials (Table 34). In Wayanad, the respondents of this study are people who are in constant interaction with the animals. In majority of the conflict situations, the farmer is left with major damages to farmlands and to livestock in a small scale. Depending on the frequency and severity of such farm losses, their mental agonies and distress varies. Hence, they were of the view that stress from disorganised farm management is a major consequence, and that too, a long one, that they face from these human-wildlife conflicts.

The next immediate consequence is disruption in livelihood opportunities and financial disruption. Crop raiding, which includes crop trampling, causes shortage of farm produce for marketing or stress/injury to livestock which is a source of income during the off seasons. In some way or the other, their livelihood is getting affected and can be short or long term in nature. Crop damage which is the major impact of conflicts, can lead to loss of food security for a subsistence agriculture practiced family, which cannot pay for any measures for protecting their farm lands. Naughton-Treves (1997) found it to be a severe consequence of human-wildlife conflicts. The situation can drive the family into poverty and have greater impacts on life. Sekhar (1998) reports that damage to livestock can be a cause of the decline in the annual income of the family, which is mainly happening to the people in the developing nations where people practice such methods for

subsistence. Lamarque *et al.* (2009) observes that crop damages not only affect the farmers feed but also the income and has impacts on health, nutrition, education and ultimately, development.

Hostility to wildlife and change in attitude towards forest officials and conservation goals is another consequence of conflicts which is going to occur in the near future. The people due to their tolerance for wildlife which is linked with their awareness on conservation issues are not violently responding, but successful mitigation measures need to be urgently taken in order to address their concerns.

Presently instances of deliberate destruction of forests and wildlife as a retaliatory strategy is not practiced by the victims. At the same time, community participation in forest management activities, especially forest protection activities are high. They are very much aware of the need of the forests and wildlife and the benefits they derive from them. It can be safely argued that living closely with the forests have induced such a behaviour. Gureja *et al.* (2002) in their study on human-elephant conflicts in Assam observed people moving away from their traditions of worshipping elephants and poisoning and electrocuting them in their desperate attempts to protect themselves and their livelihood. Fortunately, no such occurrences are observed in any of the study areas in Wayanad, which might be due to the effective functioning of the forest department and the good relationship of people with forests and forest department staff. The people in Wayanad have shown greater levels of tolerance in conflict situations.

In Wayanad, human deaths as a result of human wildlife conflicts were less and as a result the respondents did not view it as a major consequence. A few isolated events have happened in Wayanad, mainly in night and some occurred to alcoholics venturing out of bounds. Lamarque *et al.* (2009) reported human deaths to be a major setback, not in national or any such higher level but to a community or a family. Losing a family member, to the greatest level the bread winner to a poor family can mean the difference between a secure life and destitution where day to day survival becomes life's priority or the loss of the mother to a child, who

has to take her place doing family matters and the opportunity of education for that child is lost. In such times, this will be some consequences of greater damage to that family.

5.11. MITIGATION MEASURES

The five best mitigation measures suggested by the respondents (in decreasing order of priority) were improving the food resources inside the forests, facilitating access to water for wild animals, fencing of farmlands, providing insurance coverage for crops and livestock and adequate and immediate compensation (Table 36).

The respondents were of the opinion that the basic cause of the increased human-wildlife conflicts is the reduced food availability. As already mentioned, they were of the view that area under monoculture plantations of teak and eucalyptus have interfered with the regeneration of the natural vegetation cover which has resulted in the declined food availability. This needs to be scientifically proven. The invasion of weeds, especially *Lantana camara* and now, *Senna spectabilis* in the area also decrease the natural vegetation cover of the area. The lack of resources has forced these animals which have remained inside the forests a decade ago to the fringes and to the farmlands. The respondents who were basically farming community say it to be the root cause and they say it is a natural change in behaviour. If the forest department can somehow increase the food availability in the forests by some methods of farming they say these conflicts can be reduced to some extent. It is to be admitted that this is knee-jerk reaction from the victims and could not be admitted as introduction of plants into a forest ecosystem can result in disastrous consequences. The main problematic animals in Wayanad were elephant and wild boar. Among this, the wild boars were residing in the fringes and is causing severe crop raiding issues. So, this is one reason of the respondents suggested habitat improvement also as a mitigation strategy.

Water is another main reason driving animals into the villages and farmlands where water is available in plenty for various purposes such as irrigation

etc. The respondents are happy that the forest department is refilling the ponds and other water bodies during summer in Wayanad. Zhang and Wang (2003) had recommended providing sufficient water within the forest by digging artificial ponds. Fencing around farms was the third best mitigation measure according to the respondents. They say if each farm is fenced then the chances of animals getting into the farms will be decreased. If this measure is done then what will be the condition of an animal which gets trapped inside these fences is a matter of concern. This need to be looked on to before suggesting any of such measures.

Providing insurance coverage for crops and livestock and disbursing adequate and immediate compensation were suggested by the respondents. In the present scenario, the people have to invest much time for receiving a small amount as compensation. They say enabling this will help in making a positive impact in the people's attitude and ultimately there will be more tolerance to human-wildlife conflicts. This was not as such a mitigation measure but can improve human tolerance. Vitterso *et al.* (1998) in their work in Norway on livestock depredation observed that people at times of conflicts may even require double the amount as compensation in order to tolerate wildlife particularly if they have strong attachment to their livestock. At such points, a hiked compensation and its timely disbursal can improve their tolerance to conflicts. The present study also observes a similar condition when the people won't tolerate a small compensation in return for their livestock loss from the government. The respondents who were primarily farmers responded that if some insurance schemes are available against wildlife damages like the ones that they receive at times of environmental calamities then it would assist them to cope with the loss in income.

Many of the respondents agreed to the idea of having guard animals to alert themselves of the presence of the wild animals in their vicinity. This can not only help in evading animals during the attacks but also reduce the human injuries, as most of them happen when people go out unaware of the presence of wild animals in the neighbourhood. Rigg *et al.* (2011) found use of guard animals to be helpful

in reducing human-wildlife conflicts. In case of carnivores, these guard animals can help in reducing the occurrence of human injuries and deaths due to the attacks.

Attitude towards wildlife is a key factor for managing and conserving the wildlife (Jacobs *et al.*, 2012; Manfredo and Dayer, 2004). Awareness on the importance of elephant populations in each bio-geographical region is said to have promoted the elephant conservation and management in Africa (Hoare, 2000). Creating more awareness among the people in Wayanad is necessary to create a sense of coexistence. Public awareness and compensation for losses could reduce conflict to a greater extent and can contribute to ensure coexistence of people (Pant *et al.*, 2016).

The respondents argued for the feasibility studies of modern technologies like unmanned drones in conflict mitigation. In Africa, Hann *et al.* (2017) found drones suitable for moving the animals from the farmlands without direct interaction. This was conducted for a year and was found economically feasible. In India, such technologies can be taken for field testing. Incorporating the use of modern technologies can help in reducing the injuries to humans that happen now during evading actions, wild animals capturing programs etc. Many such promising technologies for reducing the impact on wildlife and humans are available. These include devices for improving the communication among the individuals of the wild animal presence which can reduce the crop raiding by localising people for guarding in this area (Graham *et al.,* 2012). Karanth *et al.* (2014) have said use of a photographic database of tigers that enables the identification and relocation of the conflict causing animals, if necessary, at times of conflicts. McManus *et al.* (2015) have advocated for the need for examination of the benefits and costs of lethal and non-lethal measures employed in controlling problematic animals. There have been many suggestions like gathering information on problematic animals (Silwal *et al.,* 2016) and improved techniques that can help in reducing livestock losses (Rust, 2016). The techniques need to be standardised for the local conditions and studied of their feasibility. When the area for cultivation, nature protection and harvesting of natural resources are getting contested, there is greater urgency for

new conceptual methods and novel methods (Fisher, 2016). Interestingly, Redpath *et al.* (2015) argued that many of the so-called conflicts between humans and wildlife are mainly occurring due to the conflict in ideas for conservation and other human activities. The situation is getting politicised.

5.12. ROLE OF VARIOUS STAKEHOLDERS IN CONFLICT MITIGATION

The role of different stakeholders such as farmers, the local self-government institutions (LSGI's), governments, non-governmental organisations (NGO's) and research institutions like agricultural universities are discussed below (Table 37).

5.12.1. Role of farmers

The farmers can get involved in management activities concerning their farmlands. They can make use of available local techniques such as deterrents, guarding etc. to keep the wild animals off their farmlands but without inviting the penal provisions of WPA 1972. They can organise themselves into some cooperatives and employ night watch in the forest fringes toward off the animals. They can keep guard animals to get alerted at times of animal presence. As long as the fringe communities cultivate energy rich and more nutrient crops the wild animals will be attracted to the farmlands (Sukumar, 2016). So, a change in crops and cropping practices could be experimented. The farmers can provide a solution to the much costly problem of maintenance of fences and other barriers, at a time when the forest department is lacking in staffs for day to day activities. The farmers should also avoid the practice of leaving their livestock to freely graze or browse inside the forest areas.

They can employ various deterrents available to keep animals away from farmlands which are legal and do not harm the wild animals. Many deterrents were tested successfully in various parts of the world like:

- Implementation of chilli- dung brick for dettering elephants in conflict zones of Africa (Osei-Owusu and Bakker, 2008). It was proved effective in Indonesia also (Hedges and Gunaryadi, 2009).
- The use of combination of spotlights and chilli fence with noise was found to be effective in Asia and Africa (Davies *et al.*, 2011).
- Cultivation of chilli plants in the boundaries was found effective in keeping the problematic herbivores away, as the plant is less palatable (Parker and Osborn, 2006).
- Secondary forests near the farms (Rood *et al.*, 2008).
- Use of beehive fences in elephant conflict areas (Vollrath and Douglas-Hamilton, 2002; King *et al.*, 2009)

Such measures need field trials for knowing about their viability, such initiatives can be taken up by the farmers to find out a possible measure to mitigate conflicts in their locality.

In some cases, the domestic dogs were found to be effective in detecting the presence of the carnivores. In many of the cases the breakage of tooth and dental diseases are leading these animals in to the human settlements (Patterson *et al.*, 2003). For these animals who are looking for easy prey the guard animals can help in reducing instances of livestock depredation. These methods can be efficiently worked out by the farmers.

5.12.2. Role of local self-government institutions (LSGI's)

In conflict mitigation, the LSGI's can play a significant role by reducing the gap and becoming a link between the government and farmers. They can act as a mediator among the government schemes and various plans and people, by publicising it among the local population. They can localise labour from programs like MNREGA, who can help in making and maintenance of trenches and other barriers. They can ensure water for wildlife inside forests by assisting the forest department in filling the natural ponds and other water holding structures which

will enable enough water inside the forests, that the animals need not go to farmlands for it. Planting more indigenous species which could be taken as food by the wild herbivores in fringes which can keep animals in borders and fringes away from fields and other such programs can be taken up by the LSGI's which will be assisted by the department. But in reality, this can attract more animal presence in the fringes. This option may not be suitable for implementation even though the respondents argue for it. These organisations can control mining and quarrying, if happening in their areas which can be a long-term cause of human-wildlife conflicts. The disturbances from these activities can damage the habitat and also be a source of nuisance for the animals in the region. This may be a causative factor of human-wildlife conflicts in the areas adjoining the mining sites.

In Wayanad Wildlife sanctuary now a new initiative is planned to make the conflict mitigation more feasible. The elected representatives of the region are taken into core areas of the forests. This is done to create awareness among them about the misconceptions regarding the wildlife conflicts and to incorporate them into mitigation programs (Anonymous, 2017). These programs will enable support of these elected representatives at times of conflicts in managing the local population, who will respond positively to these representatives. The representatives of the forest fringe communities and the local youths must also be taken into the forest areas and briefed about forest and wildlife ecology so as to elicit their informed support.

5.12.3. Role of government

The governments at higher levels such as state governments can do a lot in making conflict mitigation a greater success. At many times, the farmers don't go to the forest department for compensation as there is greater time delay and the compensation provided is much below the actual loss that the farmer has incurred. So, providing adequate and immediate compensation can be a major step in conflict mitigation, which will change the attitude of the people towards human-wildlife conflicts. The government can provide a better solution to the problem of lack of

funds in many of the measures such as trench making, fences etc. Staff strength for the understaffed localities must be immediately addressed. A program like crop insurance against wildlife damages similar to other natural calamities can be initiated which can aid the farmers from the damages. Creation of stone wall enclosures around forests is one of the demands of the respondents. At times of relocation from more conflict prone areas, the compensation that they receive for relocation is not so much, with which they can start a new life there. At many places of solar power fencing, due to lack of proper maintenance they are not be working properly. In such situation enabling the maintenance by the local residents can rule out the chances of lack of proper maintenance. If fencing could be subsidised the farmers will get proper protection against the attacks. If government can provide assistance in such matters it will be greatly helpful for combating the conflicts according to respondent's perspective.

5.12.4. Role of Non-governmental organisations (NGO's)

The non-governmental organisations can play various roles, which are left out by other stakeholders. The NGO's can be more people friendly when compared to the forest department or any other such body. They can organise and conduct awareness campaigns for farmers, about their role in conflict mitigation, forest and wildlife ecology etc. They can study the situation and provide mitigation measures, which will be more situation specific. They can provide guidance to Local self-government institutions and farmers in conflict mitigation and familiarise people with various new methods such as new deterrents, management measures etc.

5.12.5. Role of research institutes

These institutes can provide the managers with scientific data on conflict mitigation and management including new deterrents, new barriers, new cropping pattern, wildlife population dynamics, impact of invasive alien species, forest meteorology etc. which can reduce the conflicts. They can study feasibility of such programs and others such as reintroduction of jackals and such predatory species which have long gone extirpation, which is much suggested by the respondents.

They can experiment with new technologies to keep wild animals away from crop fields, which are eco-friendlier.

Management at the end is a process of facilitating and mediating the balance between wildlife persistence and stakeholder tolerance (Decker *et al.,* 2012). In the present scenario, the effective management of human-wildlife conflicts in Wayanad can be achieved only by managing the interaction between the various stakeholders and the wildlife. The cooperation and support of all the involved stakeholders is essential for managing the crisis.

SUMMARY

SUMMARY

In the present scenario, human-wildlife conflict is an important topic of discussion. It is occurring in a day to day basis all over the world. Wherever there are conflicts it results in financial losses to the native population and sometimes may cause injuries or death in the community. As a result, the tolerance of the people towards human-wildlife conflicts are declining. The declining tolerance and the negative attitude that is developing in the victims makes it difficult to manage and resolve conflicts. There are several factors resulting in the human-wildlife conflicts such as animal behaviour, human behaviour, locality, culture, the resources in the locality etc. So, there is a need for scientific research to analyse and find possible mitigation measures for this rising problem.

Wayanad district in Kerala have recently become the hotspot of human-wildlife conflicts. In this context, the present study was undertaken to document the human-wildlife conflicts in the Wayanad district based on the specific objectives to understand the nature, frequency and distribution of human-wildlife conflict, to identify the causative factors involved in these conflicts and to find the possible mitigatory measures to enhance human-wildlife coexistence in Wayanad district. For this, a total of 120 respondents from the identified locations (Meppadi, Sulthan Bathery- Odapallam, Chedleth- Bhoothanam and Thirunelli) were subjected to questionnaire survey and selected Participatory Rural Appraisal (PRA) tools to study the above-mentioned objectives.

The salient findings are summarized below.

- The major source of livelihood for the respondents was agriculture.
- The major crops cultivated by the respondents are coffee, pepper, paddy, coconut, arecanut, banana, ginger and vegetables.
- They integrated livestock components with agriculture.
- Most of the respondents lived in close proximity (less than 50 m) to the field.

- Due to increased human-wildlife conflicts the area under agriculture is declining.
- The respondent is discontinuing the collection of forest products and their dependence on forests for livelihood is declining due to wildlife conflicts and increased demand for wage labour in the district.
- The socio-economic variables such as age, gender, educational status and economic status of the respondents did not significantly influence their attitude towards human wildlife conflicts.
- The respondents displayed a positive attitude towards wildlife conservation and human-wildlife conflicts. They knew it was important to conserve wildlife and approved strict punishments for people harming them. They opposed the idea of reducing the size of protected areas and culling excess wildlife.
- The respondents were generally tolerant in the face of increasing human-wildlife conflicts. They were accepting the losses due to wildlife attacks and believed in the forest department's working in conflict mitigation.
- As per the respondents, in the last ten years the climate of the district has changed, water became scarce and due to these the farming practices have changed.
- There has been a change in the land use system of Wayanad due to institutional factors such as higher labour wages, higher cost of production, lack of market demand, socio-demographic factors (migration, land leasing…), the unrestricted land use transformation favouring public policies in the past etc.
- Elephants and wild boars were identified the major conflict creating animals in the district.
- Crop raiding was the main type of human-wildlife conflict observed in the district. The increase in temperature and water scarcity was pointed out as the major reasons for conflicts by the victims.
- The conflict hotspots identified from vulnerability mapping were Thirunelli (Pulimunda, Naikatti and Anapara), Tholpetty, Pulpally (Pathiri,

Bhoothanam and Irulam), Sulthan Bathery (Odapallam, Kallumukku and Kalloor), Muthanga, Meppadi (Kadachikunnu, Attamala and Anapara), Noolpuzha and Kalpetta (Kalpetta and Sughandheri).

- The respondents attributed the rise in the temperature and decrease in water availability in the forests to be causing conflicts. Farming activities in the forest fringe attracts the wild animals to farmlands.
- These conflicts were leading to stress from disorganised farm management and ultimately the livelihood of the victims was getting affected.
- The main mitigation strategies suggested were to raise fruit trees for animals inside the forests, facilitate access to water for animals and to provide fencing around farmlands.
- The identification of various stakeholders from multidisciplinary fields can associate in conflict mitigation and working in close association can enable efficient conflict mitigation and creating human-wildlife coexistence.
- According to the respondents, if the farmers can take up the maintenance of electric fences, trenches etc. in their neighbourhood and can also reduce the cultivation of more palatable crops which are favoured by the animals the conflicts can be effectively managed.
- The Local self-government institutions can make provisions for barrier making in programs like MNREGA, ensure water for wildlife inside forests and plant more species like fodder grass, fruit trees etc.
- The government may take steps to provide adequate and immediate compensation for conflict affected farmers
- The government may also implement programs like crop insurance against wildlife damages similar to the ones provided in the case of natural calamities
- The government may discourage new monoculture plantations of teak eucalyptus etc. in forest areas.
- The NGO's can work to improve the awareness of local people regarding the importance of human-wildlife coexistence and can provide guidance to Local self-government institutions and farmers in conflict mitigation.

- The research institutions like Agricultural universities can take up location specific studies to understand the causes of conflicts and develop appropriate mitigation strategies incorporating modern technologies
- Researchers may also conduct a feasibility study for the reintroduction of suitable predatory species which are no longer found in the neighbourhood that once helped to check the over population of wild boars.

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CAUSE-CONSEQUENCE ANALYSIS OF HUMAN-WILDLIFE CONFLICT IN WAYANAD DISTRICT, KERALA

BY

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ABSTRACT OF THE THESIS

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ABSTRACT

Human-wildlife conflicts is now a paradox for foresters and policy makers across the globe. In Kerala, interaction between humans and wildlife is affecting many lives and livelihoods. The damage caused by these interactions are drastic, it can vary from crop loss in a small area to human deaths. For the people living near the protected areas crop losses and livestock losses due to raiding by wildlife are a serious social and ecological concern as this can create an anti-wildlife lobby in the long run. So, understanding the social dimensions of such conflicts is also important to frame effective mitigation strategies. The study titled "Cause-consequence analysis of human-wildlife conflict in Wayanad district, Kerala" conducted during 2015-2017 tried to discern the nature, frequency, distribution and intensity of human-wildlife conflicts in Wayanad district and to understand the causative factors involved in the conflicts. The study was also intended to suggest suitable mitigatory measures to enhance human-wildlife coexistence in Wayanad district. A total of 120 households were interviewed from four locations in Wayanad namely Meppadi, Odapallam (SulthanBathery), Bhoothanam (Chedleth) and Thirunelli. Detailed interviews using pre-tested questionnaire was conducted and Participatory Rural Appraisal (PRA) tools like timeline, problem tree and vulnerability mapping was employed at each location for collecting additional information. Crop raiding was found to be the major type of conflict occurring in the district. Over the past years there occurred a shift in the farming practices with banana becoming a popular crop at the expense of the traditional crops. Most of the respondents lived in the close proximity and practiced agriculture and also occasionally integrated livestock in their farms. More palatable crops in the forest fringes along with domestic animals and plentiful water attracted the wildlife to the farmlands. Plantations of teak, eucalyptus etc, together with the invasive alien weed species has smothered the natural vegetation thereby reduced the natural food resources triggering animal migration. Reduced rainfall, droughts and forest fires that the district now increasingly experience has further reduced the availability of resources for the wildlife. These were found to be the major causes leading to conflicts. People were well aware of the forest laws and the attitude of the farmers to wildlife was positive. They believed in coexistence and conservation to be unavoidable for human existence. Enrichment of the habitat and fencing around the

farmlands were favoured as the best mitigation measure. People did support the compensation schemes and insurances, provided they were adequate and immediate. The study outlines the possible role of various stakeholders such as farmers, Non-Governmental Organisations, Research institutions, Local self-governmental institutions and governments in improving the conflict mitigation process.

APPENDIX

Appendix No:1 (Interview schedule)

College of Forestry, Kerala Agri. University, Thrissur

CAUSE- CONSEQUENCE ANALYSIS OF HUMAN- WILDLIFE CONFLICT IN WAYANAD

Interviewer Name:

1. Basic details (Household Particulars)

A. Date:	B. Village:		C. Latitude: Longitude:
D. **Name**	E. Household members Male: Female: Children: Total:		
F. How long have been living in this village:			G. Occupation
H. Age	I. Gender	J. Annual income	H. Economic status APL/BPL/OTHERS

2. Cropping pattern followed/ Land utilization details

Sl.no	Crop	Extent (acres)	Duration (Months)	Time of		Proximity to forests (Km)
				Planting	Harvesting	

3. Land use transformation

Time span	Change in pattern occurred	Reason
10-15 yrs. back		
5-10 yrs. back		
Last 5 yrs.		

4. Details of livestock in possession

Sl.no.	Name of animals/ birds	Quantity (nos.)	How long engaged in this enterprise (years)	Annual income from livestock

.5. Participation in training program by forest department in last 2 years.

Sl.no.	Name of the program	Duration of the program	Location	Purpose of the program

6. Participation in joint forest management activities:

Dimension of participation	Frequently participated	Occasionally	Less participating	Never participated
Forest watchers				
Fire watchers				
Protection activities				
In ecotourism activities				
Ecotourism: shops and other distribution systems				
Collection of NTFP				
Others				

7. Attitudes to human wildlife conflict

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Some loss due to wildlife is to be expected in forest fringe areas and should be tolerated by the local people.					
Human-wildlife conflict is happening due to encroachment by humans into forests					
The FD staff generally treat the forest fringe people as encroachers and offenders					
Forest department should control wildlife using non-lethal methods such as barriers, deterrents and relocation.					
Tourists coming to see forests/wildlife should pay human wildlife conflict mitigation CESS.					
Officials and policy makers assigns more value to wildlife over human life and livelihoods					
In conflict zones, the FD shows sincerity in taking remedial action					
If FD takes action to upgrade the quality of the forest habitat, the conflict rates will come down.					
Dearth of accurate data on the carrying capacity of forests is escalating the conflicts					

8. Attitudes to wildlife conservation

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
It is important to conserve wildlife					
Wildlife laws ensure the right of the wildlife to live peacefully					
People who harm wildlife should be strictly punished					
Protected areas are too large and should be reduced in size					
People who traditionally use natural resources in protected areas should be allowed to continue to use them					
Wildlife should be strictly confined to the protected areas					
Permission can be given to shoot and kill animals that cause continuous trouble					
Culling of excess wildlife to keep the population under check is a scientific option.					
Wildlife conservation laws are biased and do not consider the value of human lives and livelihoods					

9. Coverage under crop and animal insurance

	No: insured / area covered	Amount insured (Rs.)	Coverage (Years)	Compensation received (if any)
Crop				
Animal/ birds				

10. Main sources of livelihood and season of the activity

Source of Livelihood	Months practiced											
	Jan.	Feb	Mar.	Apr	May	Jun	July	Aug.	Sep	Oct.	Nov.	Dec.
Agriculture												
Livestock												
Wage Labor												
Forest Products												
Other												

11. Nature frequency, distribution and intensity of conflicts

11.1. Dependence on forest resources

Resources	Purpose of collection	Extent of influence by wildlife conflict on resource utilization			
		Continuing unchanged	Partially reduced	Occasionally practiced	Discontinued
Firewood					
Water					
Honey					
Dammar					
Medicinal plants					
Fodder collection					
Wild planting materials					
Green leaf manure					
Others					

11.2. Damage to cropping systems

Sl.no.	Crops raised	Animal causing damage	Nature of attack	Stage of crop	Months of attack	Extent of crop loss (%)

11.3. Enterprises discontinued due to HWC: Y/N, if yes, then

Sl.no.	Enterprise	How long involved	Year of discontinuance	Reason for discontinuance	Loss incurred/year

11.4. Attack on livestock components

Sl. No.	Name of livestock attacked	Attacking animal	Extent of damage (nos.)	Time of attack (months)	Nature of attack	Financial Loss occurred

11.5. Attack on family members:

Attacking animal	Death	Injury occurred	Compensation received

12. Perceived extent of human- wildlife conflict in farming systems:

Impact of conflict	Crop loss	Loss of domestic animal	Area abandoned	Property damage	Damage to social infrastructure	Closure of enterprises
Physical loss						
% of loss						
Financial loss/ year						
No. of man-days lost						

Total financial loss occurred:

13. Causes of HWC

Sl.no.	Causes	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	Climate induced factors: Increased temperature					
	Drought					
2	Social causes: Poor waste management					
	Increase in ecotourism					
	Damage to forest fences					
	Poor maintenance of forest fences					
3	Intra forest factors: Extinction/ genetic loss					
	Water scarcity inside forests					
	Competition for forage					
4	Human interference Over exploitation of natural resources					
	Invasive alien species					
	Pollution					
	Habitat destruction					
	Quarrying/ sand mining					
	Forest fires					
	Blocking wildlife corridors					
5	Agronomical factors Growing palatable crops near forests					

14. Consequences of HWC:

Sl.no.	Consequences	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	Livelihood affected					
2	Hostility to wildlife					
3	Change in attitude towards conservation					
4	Transmission of diseases					
5	Infrastructural damages					
6	Reduction in ecotourism activities					
7	Human death and injury					
8	Stress from disorganized farm management					
9	Intentional destruction to forests and wildlife					
10	Changed attitude to forest officials					
11	Poor community participation in management activities					

15. Mitigation measures

15.1. Participatory Mitigation measures

Sl.no.	Mitigatory strategies	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
17.	Adequate and immediate compensation					
18.	Providing Insurance coverage for crops and livestock					
19.	Traditional barriers for protection					
20.	Intensifying human vigilance					
21.	Watch towers					
22.	Guard animals					
23.	Guarding herds					
24.	Fencing of farmlands					
25.	Curbing livestock grazing in forests					
26.	Deterrents					
27.	Warning systems					
28.	Facilitating access to water for wild animals					
29.	Raising fruit trees for animals					
30.	Conservation education for local people					
31.	Voluntary relocation					
32.	Radio collar/ GPS					

15.2. Perceived roles of different stakeholders

Suggested component	Role of farmer	Role of LSGI's.	Role of Govt.	Role of NGO's
Changes in cropping pattern				
Changes in the microclimate of the forest				
Adequate and immediate compensation				
Providing Insurance coverage				
Traditional barriers				
Intensifying human vigilance				
Watch towers				
Guard animals				
Guarding herds				
Effectiveness of fencing				
Curbing livestock grazing in forests				
Deterrents				
Warning systems				
Facilitating access to water for wild animals				
Raising fruit trees for animals				
Voluntary relocation				
Radio collar/ GPS				