CAUSE-CONSEQUENCE ANALYSIS OF HUMAN-WILDLIFE CONFLICT AT NEMMARA FOREST DIVISION, KERALA

BY

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(2013-17-108)

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DECLARATION

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INTRODUCTION

INTRODUCTION

Human-wildlife conflict (HWC) has been in existence for as long as humans and wild animals have shared the same landscapes and resources. The depiction of the Egyptian God of Evil, Sobek with a crocodile head is no coincidence. Forensic evidences of the "Taung skull" discovered in South Africa in 1924, belonged to a child who was killed by an eagle two million years ago (Berger and Clarke, 1995; Berger, 2006). Human-wildlife conflict occurs when wildlife requirements encroach on those of human populations, with costs both to residents and wild animals (IUCN, 2005). Human-wildlife conflict is a combination of various factors such as cultural, historical, geographic, social, economic, biological and political factors of a locality. The causes of HWC include habitat factors such as impact of human activities and natural factors, human factors including the requirements of human development, migration of peoples for reasons of security or food safety, attitudes and perceptions and also natural characteristics of wildlife (Lamarque *et al.,* 2009). Human-wildlife conflict is fast becoming a serious threat to the survival of many endangered species in the world as well as to the people living along with them. Considering the current human population growth rate, increasing demand for resources and access to land, it is clear that human-wildlife conflicts will be of prime importance in the near future.

The sheer number of human-wildlife conflict cases from countries all over the world demonstrate the severity of the conflict. Today, managing human–wildlife conflict is one of the greatest challenges in India. Across the world, it is generally accepted that conflict erodes public support and builds animosity against wildlife conservation (Madhusudan, 2003; Naughton-Treves and Treves, 2005; Ogra and Badola, 2008). Further, debates on conflict are now increasingly becoming more public and political. Similarly, chronic conflict has an increased impact on wildlife and their habitat (Woodroffe *et al.*, 2005; Gubbi, 2010). It may affect wildlife at the species, population and individual levels through processes of extinction, range contraction, population suppression and behavioural changes (Woodroffe *et al.*, 2005). Protected areas and the presence of wild animal populations inflict costs on local communities developing in them negative and anti-conservation attitudes which in case worsen the management strategies.

The people who are living in and around the forest areas are losing their traditional tolerance levels fast and are becoming more sensitive and agitated against any human-wildlife conflict. At present the Kerala Forest Department provides compensation for crop loss,

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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 some areas where Human-Wildlife conflict is profound physical barriers are provided such as trenches and solar fencing these efforts even though are found to be effective becomes ineffective due to lack of proper maintenance and monitoring.

Studies on the human-wildlife conflicts are far and few in Kerala. Jayson and Christopher (2008) based on their study on Human-Elephant conflict of Peppara Wildlife sanctuary in Kerala opinioned that cash crops which are more nutritive, attracts elephants and other potential animals resulting in crop raiding. They suggest that low water availability inside the forests is also a cause for wild animals intruding into human habitation. Iqbal (2011) in his study on human-wildlife conflict in selected Forest Divisions of Kerala stated that the increased crop damage in territorial forest areas is due to the vast areas of cultivation of palatable and nutritious crops where as in protected forests only limited agricultural activities is done by the tribal people resulting in lower conflict rates. The scientific study regarding human-wildlife conflict from the people's point of view would further strengthen wildlife management and conflict mitigation.

The state forest department is facing immense pressure to resolve such conflict issues favouring both people as well as wildlife. Cases of human-wildlife conflict are slowly emerging as a major concern for the state forest department in the Nemmara forest division. The instances of increasing competition for space and food between humans and the various species of wildlife have come into media focus at Nemmara. But more than the larger mammals, large scale predation of field crops by peacocks, giant squirrels and wild boar has already strained the relationships between the department and the forest fringe farming communities. Through this study, it is expected to provide baseline data on the underlying causes behind the current and likely conflicts which will help to suggest effective mitigatory mechanisms to resolve the crisis. This data will further help to develop forest management strategies that will balance human aspirations and forest protection in Nemmara forest division. There are only a few studies in Kerala that analyses Human-wildlife conflicts with focus on awareness and attitude levels of the people and on land use change and land cover change pattern.

The study focuses on Human-wildlife conflict of Nemmara Forest Division, Palakkad and the objectives are given below;

1. To portray the nature and distribution of human-wildlife conflicts in Nemmara Forest Division, Palakkad

2. To analyse factors of land use change and land cover change pattern.

3. To assess the awareness and attitude of the forest fringe people, including the victims of human-wildlife conflicts about the forest and related biodiversity laws and rules.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

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. Conflict between humans and wildlife is one of the most widespread and intractable issues facing conservation biologists today. Human animal conflict addresses a huge diversity of situations and species, from grain-eating rodents to man-eating tigers (Pimentel *et al.,* 2005; Barlow, 2009). 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.

Human-wildlife conflict occurs when wildlife requirements encroach on those of human populations, with costs both to residents and wild animals (IUCN, 2005). Human-wildlife conflict is a combination of various factors such as cultural, historical, geographic, social, economic, biological and political factors of a locality. Human-wildlife conflict has been in existence for as long as humans have existed and wild animals and people have shared the same landscapes and resources. Human-wildlife conflict has far reaching environmental impacts. Species most exposed to conflict are also shown to be more prone to extinction (Ogada *et al.*, 2003) because of injury and death caused due to humans these can be either accidental, such as road traffic and railway accidents, capture in snares set for other species or from falling into farm wells, or intentional, caused by retaliatory shooting, poison or capture. Such human-induced mortality affects not only the population viability of some of the most endangered species, but also has broader environmental impacts on ecosystem equilibrium and biodiversity preservation. Human-wildlife conflicts also undermine human welfare, health and safety, and have economic and social costs. Nuisance encounters with small animals, exposure to zoonotic

diseases, physical injury or even death caused by large predators attacks have high financial costs for individuals and society in the form of medical treatments to cure and prevent infections transmitted from animals through human contact (Ministry of water, land and air protection, 2003), Humans can be economically affected through destruction and damage to property and infrastructure (e.g. agricultural crops, orchards, grain stores, water installation, fencing, pipes), livestock depredation, transmission of domestic animal diseases, such as foot and mouth. Negative social impacts include missed school and work, additional labour costs, loss of sleep, fear, restriction of travel or loss of pets (Hoar, 1992; Human-Elephant Conflict Working Group, HECWG). Conflict between man and animals is an important factor which determines the relationship between protected area officials and the local communities living near such areas (Studsrod and Wegge, 1995; Hill, 1998).

2.1. TYPOLOGY OF HUMAN-WILDLIFE CONFLICT

2.1.1. Human Deaths and Injuries

Human deaths and injuries, although less common than crop damage, are the most severe manifestations of human-wildlife conflict and are universally regarded as intolerable.

An assessment of the scale of human deaths caused by wildlife species in Africa at the end of the seventies, concluded that hippopotamus was responsible for more deaths than any other large animal in Africa. Large mammalian carnivores are also responsible for numerous fatal attacks on human. Mega herbivores like elephants and hippos are also involved in human deaths every year, albeit more rarely. With very few exceptions neither species deliberately target people and in most cases deaths occur as accidents under the following circumstances: (i) defence of crops against raiding animals – usually at night; (ii) accidental contact with an animal at close quarters notably on paths near water at night; (iii) encounter with an injured animal whose normal sense of caution is impaired.

In Mozambique, Africa, over a period of 18 months between 2001 and 2002, lions killed 70 people in Cabo Delgado province. Most of these were people out at night protecting their crops from elephant (FAO, 2005). In Tanzania, home to the world's largest lion population, lions' attacks are widespread. Between 1990 and 2004, lions killed at least 563 people and injured more than 308; the problem has increased dramatically over the past 15 years, with the majority of cases occurring in the southern part of the country (Packer *et al.*, 2005).

2.1.2. Destruction of Crops

Crop damage is the most prevalent form of Human-Wildlife Conflict across the globe. The occurrence and frequency of crop raiding is dependent upon a multitude of conditions such as the availability, variability and type of food sources in the natural ecosystem, the level of human activity on a farm and the type and maturation time of crops as compared to natural food sources. A wide variety of vertebrate pests come into conflict with farming activities including birds, rodents, primates, antelopes, buffalos, bush pigs, and elephants. The agricultural productions most raided are those which grow close to the rivers or lakes like rice, vegetables and other crops grown on the river banks during the drop in the water level.

Nyhus *et al.* (2000) determined the distribution, impact and conservation implications of elephant crop-raiding in 13 villages that border Way Kambas national park in Southern Sumathra and found out that availability of water, food and cover to be the three main factors which influenced the movement of elephants. The damage due to elephants also differed significantly by month for both annual as well as perennial crops. Elephants entered village fields and damaged crops year-round but damage to all crops were found to be low during months of September and October 1997 coinciding with the beginning of a major El Nino Southern Oscillation drought as very few farmers cultivated crops during this period.

2.1.3 Livestock Depredation

Another adverse effect of hum is the killing of domestic animals by wildlife. The number and type of domestic animals killed by wildlife varies, depending on the species, time of year, and availability of natural preys. In areas where pastoralism remains the livelihood and main asset of many people, predation on livestock becomes an issue. At a national level the losses are hardly significant but to the individual stock owner, they can be devastating. To a small-scale stock owner, losses to predation can mean the difference between economic independence and dire poverty.

Large carnivores are the principal culprits as shown by Patterson *et al.* (2004) who analyzed attacks on livestock over a four-year period on two neighboring arid-land ranches adjoining Tsavo East National Park, Kenya. A total of 312 attacks claiming 433 head of stock were examined: lions were responsible for 85.9% of the attacks while hyenas and cheetahs were the other culprits. Lions and hyenas attacked mainly cattle and did so at night, whereas cheetahs almost exclusively took smaller sheep and goats. However other smaller carnivores

species are responsible for livestock depredation. Nevertheless, mammalian carnivores are not the only group involved. Ogada and Ogada (2004), documented the species of wildlife responsible for killing livestock in the AWF Samburu Heartland and reported that such deaths were due to: lions (35% of reported deaths), leopard (35%), hyena (18%), baboon (4%), elephants (3%), buffalo (2%), wild dog (2%) and cheetah (1%).

In Alberta, Canada, over a period of 14 years (1982-1996) wolves caused 2,806 deaths among domestic animals, mainly cattle and to a lesser extent dogs, horses, sheep, chickens, bison, goats, geese and turkeys. In Idaho, Montana and Wyoming (USA), during a similar time period (1987-2001) wolves killed 728 animals, mainly sheep and cattle (Musiani *et al.,* 2003).

2.1.4. 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).

2.1.5. Others

Primates like macaques and baboons raid gardens and food in lodges and camping areas and can be an immense nuisance in small urban settlements if left unchecked. Elephants can damage infrastructures like ponds or tracks in national parks (Alfa, Gambari Imorou *et al.,* 2004) but also outside. In Namibia, for example, the main problem caused by elephants in the arid north-west is damage to water installations whereas, in the rest of the country, it is damage to crops (Government of Namibia, 2007).

2.2 CAUSES AND DRIVING FORCES OF HUMAN-WILDLIFE CONFLICT

2.2.1 Human Population Growth

Demographic and social changes place more people in direct contact with wildlife: as human populations grow, settlements expand into and around protected areas (IUCN, 2003), as well as in urban and sub-urban areas. In Africa, human population growth has led to encroachment into wildlife habitats, constriction of species into marginal habitat patches and direct competition with local communities (Siex *et al.*1999), In the State of British Colombia,

Canada, conflicts are not restricted to nature reserves or rural areas but often occur in urban conglomerates as well. In the last few years, human population growth is correlated proportionally with the number of encounters and serious incidents with cougar *(Puma concolor)*, black bears (*Ursus maritimus*) and grizzly bears (*Ursus arctos*) (Ministry of water, land and air protection, 2003).

2.2.2 Land Use Transformation

This driving force is very much associated with the previous one, as the transformation of forests, savannah and other ecosystems into agrarian areas or urban agglomerates is a consequence of the increasing demand for land, food production, energy and raw materials. In Kenya, in many areas with abundant wildlife, such as Samburu, Trans-Mara, Taita and Kwale, conflict is intensified by land use fragmentation and the development of small-scale farming. In fact, state and trust ranches have been subdivided and sold as smallholdings and cultivated with commercial horticultural crops (Keneya Wildlife Service 1996). In the state of Gujarat, on the periphery of Gir National park and Sanctuary, intense and escalating conflicts with Asian lions (*Panthera leo persica*) and leopards (*Panthera pardus*) are due to the rapid and extensive change in land use associated with the conversion of groundnut (*Arachis hypogea*) and great millet (*Pennisetum typhoides*) fields into sugarcane (*Saccharum offinarum*) and mango (*Mangifera indica*) cultivation. These crops create favorable habitats for predators and play a major role in influencing the natural distribution and abundance of wildlife communities (Vijayan and Pati, 2002).

2.2.3 Species Habitat Loss, Degradation and Fragmentation

Species habitat loss, degradation and fragmentation are also interconnected with population growth and land use change. Again, this is a further aspect of the issues discussed above. In Sumatra, the alteration of forest areas into agriculture and grazing land has restricted the Sumatran tiger's (*Panthera tigris sumatrae*) home range to a patch of few forest. Currently only a few individuals remain on the island (Nyphus and Tilson, 2004).

2.2.4 Growing ecotourism projects and increasing access to nature reserves

Recreational activities and growing public interest in charismatic species, such as large carnivores and endangered species, have increased the human presence in protected areas and raised concern about capacities to manage and regulate public access and large-scale use of

protected areas. Associated with the four global trends is a fifth cluster connected to alteration of natural food and water availability.

2.2.5 Increasing livestock populations and competitive exclusion of wild herbivores

Growing densities in livestock populations can create an overlap of diets and forage competition with wild herbivores, resulting in overgrazing and decline or local extinction in wild herbivore populations (Mishra *et al.*, 2003), In India domestic cattle often out number wild ungulates within protected areas often reaching densities up to 1,500/km2 and it has been ascertained that livestock graze in 73% of wildlife sanctuaries and 39% of protected areas (Mishra, 1997). Under these circumstances, livestock becomes an important source of prey for predators.

2.2.6 Abundance and distribution of wild prey

Many authors recognize that when native prey is abundant, wild predators consume it in preference to livestock and that impoverishment of prey populations is one of the major causes of carnivores shifting their diets to livestock. Clearly, this is due to the ease of capture and limited escape abilities of livestock (Mishra, 1997; Mishra *et.al.,* 2003; Butler, 2000). In Venezuela in Hato Pinero commercial cattle ranch, the correlation between alteration of prey availability and local livestock depredation is evident by the fact that the highest depredation rates have been recorded in areas where prey abundance and diversity are relatively low (Polisar *et al.,* 2003).

2.2.7 Increasing wildlife population as a result of conservation programs

Beyond the ongoing problems of HWC, new questions have emerged. In recent years, the successful recovery of declining or near extinct species populations (Fall and Jackson, 2002) through wildlife management and protection from over exploitation (Messmer, 2000) has also lead to new conflicts. Effective protection and habitat management within the Gir National Park and Sanctuary in the Indian state of Gujarat doubled the Asian lion (*Panthera leo persica*) population between 1970 and 1993. The social organization, habitat and prey requirements of the species were difficult to accommodate within the human-defined home range, and resulted in many lions straying out of the reserve into local villages (Vijayan and Pati, 2002). In the ranches of North America, European settlement almost exterminated wolves. Recent recovery programmes, however have contributed to the recolonization by wolves of their original home range, including rural areas; and in the process have increased the potential

for conflict, especially where domestic livestock is a major economic activity (Musiani *et al.*, 2003)

2.2.8 Climatic Factors

Although not often mentioned, for a reason that they cannot be controlled, the climatic trends are an important cause of HWC. Seasonal changes in rainfall are directly correlated with predation intensity in most of the cases. In Tsavo National Parks, (Patterson *et al.*, 2004), quantifies a positive relationship between monthly rainfall and attacks, demonstrating that in this region lions are more likely to attack livestock during seasonal rains. During drought periods, ungulates spend most of their time near a limited number of water sources and thus they are easily found and killed; when rain fills seasonal pools, lions disperse into their habitat, change their diets, and prey on easier targets. However, contrary to the Kenya Tsavo case, wild predators are more likely to attract attention and attack domestic animals in the dry season months, when the vegetative cover does not facilitate the hunting strategies of lions and leopard that are based on surprise (Butler, 2000).

2.3 PEOPLES PERSPECTIVE

To understand exactly how particular types of human-wildlife conflict impact 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 and 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, 1998; Naughton and Treves, 1996). 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 focused 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 money is 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.

2.3.1 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.

2.4 HUMAN WILDLIFE CONFLICT MITIGATION

There are several approaches to managing human wildlife conflicts. Prevention strategies endeavor to prevent the conflict occurring in the first place and take action towards addressing its root causes, protection strategies are to be implemented when the conflict is certainly to happen or has already occurred, while mitigation strategies attempt to reduce the level of impact and lessen the problem. The main difference between the options is the moment when the measure is implemented.

By definition a management technique is only cost-effective if the cost of implementing the technique is less than the value of the damage that is being done, taking into account the fact that a short period of active management may have a continued effect, protecting the crop or the herd over a longer period afterwards.

2.4.1. Human Management

2.4.1.1. Community Awareness

Awareness can be carried out in the community at different levels, for instance in schools or in adult education arenas such as farmer field schools. It is actually believed that educating children, coupled with awareness raising among adults through the traditional authority of chiefs and headmen, would be highly cost effective. Practical manuals targeting specifically local communities like the "Human Wildlife Conflict manual" (WWF SARPO, 2005), "Protecting crops from damage by elephants - A farmer's manual" and "Community-based Problem Animal Control – Livelihood security for people living in elephant range – Training manual realized by (Elephant Pepper Development Trust, 2006), are very useful tools to raise awareness on HWC at the local level.

2.4.1.2 Behavioral Changes

A few basic rules can be provided to decrease the risk of lion attacks like: (i) wearing bush colored clothes when carrying out activities in the field; (ii) check for the direction of the wind when approaching a risky area; (iii) increase one's silhouette by wearing a backpack or heavy clothing to appear larger; (iv) avoid movements at night; (v) take small children off the ground when travelling with them (Quigley and Herrero, 2005). Similar studies were also found to be successful in Sundarbans, India.

2.4.2 Compensations

The payment of compensation in the event of loss is usually confined to a specific class of loss, for example livestock killed by predators or elephants or human deaths. The schemes are often funded by a conservation organisation, although government schemes also exist. All are designed to increase the damage tolerance level among the affected communities and prevent them taking direct action themselves, which would have usually involved hunting down and killing the elephants, lions or other species involved (Muruthi, 2005).

2.4.3 Community Based Natural Resources Management (CBNRM)

In Africa, CBNRM was established in 1998 through the conservancy program in the Caprivi region where the eco-tourism industry and hunting concessions are potentially valuable for developing a local economy based on wildlife related revenues. The aim was to entail a system of returning benefits to rural communities in order to motivate them to protect wildlife outside protected areas and to discourage poaching (O'Connell-Rodwell *et al.*, 2000).

2.4.4 Voluntary Relocation

Where alternative land and incentives are available, voluntary relocation of local communities to areas offering better access to natural resources and socio-economic opportunities can be an adequate solution to managing HWC (Madhusudan, 2003). In fact, resettlement schemes aiming to prevent the overlap of wildlife and people, can be successful in the long run if some essential assumptions are met: (i) the villagers should gain substantial benefits, such as better access to resources; (ii) they should be relocated to an area where the risk of losing property is lower and (iii) they should not face any political, social and cultural opposition (Treves and Karanth, 2003).

2.4.5 Intensifying human vigilance also guard animals

Vigilance is an important component of crop or livestock protection and HWC management. The fear for man normally prevents the animals from committing damage. In Kibale National Park, Uganda, elephants were found to wait at the forest edge until farmers left the fields before they would enter (Naughton-Treves, 1998), suggesting an aversion to human presence. Elephants around Kakum Conservation Area, Ghana and Nagarhole National Park, India appear to avoid farms where people are present.

2.4.6 Fencing

If they are properly designed, constructed and maintained, fences can be almost completely effective in preventing conflict between people and wild animals. Several types of fences are used throughout the world for various purposes. Diverse types of fences have been successfully used to protect crops against a wide variety of mammals including elephants. On the other hand, for primates, squirrels etc. classical wire fencing is ineffective.

Finally, fences can be erected around protected areas. Indeed, as a result of increasing human wildlife conflicts and in the absence of greater involvement in and direct benefit from conservation, communities seem to be increasingly opting for "separation" rather than "integration" of culture and nature in the landscape. Most people support the creation of "fenced in" wildlife sanctuaries where they can benefit, yet be separated, from wildlife, so that they can practise other land uses such as pastoralism and agriculture. However, despite being a good way to managing HWC, fencing is not a panacea; it has also a few ecological and economic disadvantages and is never 100% efficient.

Plant hedges of various spiny cacti (e.g. *Caesalpinia decapetala, Euphorbia* sp., *Opuntia* sp., *Agave* sp.) have the positive aspects of being a low cost solution effective with both carnivores and ungulates. Although less permanent, fences made of dead thorny branches are erected as kraals for cattle but also against elephants like in the Malian Gourma where they represent 32% of the protective measure implemented against 28% for moats (Maïga, 1999). Trenches, covered or not, have been found to keep elephants from cultivated areas with considerable success. Stone walls have been used to exclude buffalo from invading cultivated areas in the AWF Virunga Heartland (Muruthi, 2005). Large, sharp rocks act as a very effective elephant barrier (Hanks, 2006).

Electric fencing can be considered as a more sophisticated and efficient solution: (i) it is more durable, due to the reduced physical pressure from animals; (ii) it deters a wider range of species and (iii) it is more aesthetically appealing. However, the cost of installation is higher compared to the simple fences and the maintenance implies a need for constant insulation (Hoare, 1992).

2.4.7 Crop or Herd Management

Human-wildlife conflicts can be reduced, perhaps in some cases totally prevented, by implementing changes to the resource/production that causes the conflict. This can be achievable by altering the resource itself, the way it is managed or making changes to the surrounding landscape so that the problem-causing animal be more vulnerable to predation, easier to spot by people and dogs, and generally less at ease in the area (Muruthi, 2005).

Little research exists on wildlife preferences for particular crops, but there are a few crops that are less palatable to wildlife and notably that elephants appear not to eat. Alternative crops such as ginger and chilli have been encouraged around Kakum National Park (Ghana) and several farmers who were considered to be in high-conflict areas have shifted from cultivating food crops to growing cash crops. As well as the inevitable cocoa farm, they cultivated ginger to sell at the local markets (Hanks, 2006). A landscape approach to reducing human wildlife conflicts might therefore involve growing crops in large communal fields with straight edges, fences or thorny or spiny hedges, and also removing nearby cover and habitat for wildlife (Muruthi, 2005).

2.4.8 Problem Animal management

2.4.8.1 Deterrent Methods

Deterrent methods aim at repelling the animals from the targeted resource. They can be grouped into several categories according to the sense they regard: hearing, sight, smell, taste, touch. Deterrent techniques may have some success. For instance, the deterrent created by chilli impregnated twine, and by burning balls of elephant dung containing chillies, has had some success in Zimbabwe (Osborn and Parker, 2002;2006). Additionally, though widely used, deterrent techniques face a common problem because animals soon learn that they pose no real threat and then ignore them. Modern or traditional methods face the same problem of habituation and become less effective over time (Muruthi, 2005). It is thus recommended that a combination of techniques be employed in order to minimize the risk of wildlife becoming used to any single method.

2.4.8.2 Translocations

Translocation consists of moving a certain number of animals from a problematic zone to a new site. In spite of the risk of exporting the problem to another site, it may be a practical and politically correct approach in some cases and where there is the availability of a suitable habitat with territorial vacancies.

In some situations, translocation can be a pre-emptive action before HWC occurs. For instance, the presence of a lion in cattle ranching area or large crocodiles in water bodies in human dominated landscapes is often detected before the animals have caused a problem. These potential problem-causing animals could then be removed and translocated before they take livestock or people. This technique has been employed for elephants and carnivores.

Elephant Elephant translocation, formerly unsuccessful, improved significantly at the beginning of the 1990s when it was shown that only family groups or solitary males should be moved (Coetsee, 1996). More than 1,000 elephants had been translocated successfully to 58 reserves in South Africa up to 2004; 141 individuals were translocated in Kenya between 1996 and 2002 with a mortality rate of 9.2% (Omondi *et al.,* 2002).

2.4.9. Environmental Management

2.4.9.1. Increase Alternate Crops, Preys or Water Points

The use of diversionary tactics, i.e. providing an alternate source of food or water, in an attempt to lessen competition with people for crops or water sources is a less commonly used approach. The successful use of diversionary fields to reduce crop damage which has been

reported in USA and in Europe (Conover, 2002), does not seems very pertinent in other parts of the world. On the other hand, the improvement of the habitat in the protected areas and their buffer zones could retain wildlife longer and so decrease the intensity of crop-raiding.

The most promising solutions appear therefore to be: (i) for wild carnivores, the protection of prey that they depend on; (ii) for both herbivores and carnivores, the provision of alternative water sources to reducing conflict with people.

2.4.9.2. Land Use Planning

Land use planning is a fundamental human-wildlife conflict management strategy which offers possibly the best chance of overall and long-term success. Indeed, unlike protection and mitigation methods, it tackles the root of the problem. It is therefore a preventive approach the goal of which is to create landscapes where people and wildlife can co-exist and have as little negative impact on each other as possible in order to alleviate human-wildlife conflict. Land-use planning is typically a long-term process that requires government support, often legislative and/or policy changes, and can be extremely expensive to implement. Land-use plans are therefore rarely implemented at large-scale. On the other hand, the local level can be very useful to develop and implement land-use plans efficient to reduce losses to wildlife (Muruthi, 2005).

2.4.9.3. Zoning Around Protected Areas

Zoning has been widely used in biodiversity conservation and for the creation of national parks, natural reserves and other protected areas. It refers to any form of geographically differentiated land management where different forms of potentially conflicting land use are given priority in different areas. If a zoning approach is chosen, it is vital to scale management zones to the size of the biological process that they are designed to manage. For instance, for carnivore zones, it must be thought in terms of bigger land areas than for any other terrestrial species group (Linnell *et al.,* 2005).

Zoning includes differences in: (i) degrees of protection; (ii) thresholds for initiation of control actions; (iii) hunting regimes; (iv) implementation of compensation and (v) economic incentives to mitigate conflicts. Thus, regarding HWC mitigation, the advantages of zoning are obviously multiple: (i) it concentrates the resources for costly conflict reduction and intensive conservation measures into limited areas; (ii) when responses depend on where conflicts occur, it provides for simplified management procedures which can be initiated

without time-consuming investigation; (iii) it provides predictability for people, so that they can make long-term plans and economic investments knowing to what extent wildlife will be part of their future; (iv) it may allow people to become accustomed to the presence of wild animals, and thereby reduce fear levels.

However, there are a number of sociological, political and ethical disadvantages to zoning that must be considered (Linnell *et al.,* 2005). For instance, a disadvantage of zoning is that it may decrease the tolerance carrying capacity of people towards wildlife, notably among people left outside the area where wildlife damages are compensated.

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 amount 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.

2.5 CASE STUDIES FROM INDIA

Kumar (2012) in his study of human-wildlife conflict in a degraded habitat of lower Chambal valley states that the problem of inadequate food and fodder with degraded habitats is posing stress on wildlife to move toward crop land. On the other hand, protected forest cover also provided a safe shelter to wildlife resulting in crop raiding. The raiding of crop fields is posing stress on farmers to change their cropping sites or to avoid most preferred crops for raiding by wild animals. As a result of that, people of the region are avoiding bean crops (gram, pigeon-pea etc). People of the region are also not well aware about modern deterrence techniques. By organizing people in similar interest groups and helping those by training and funding will help to control the encroachment of crop land by wildlife.

In the proximity of Gir National Park and Sanctuary, the Asian lion (*Panthera leo*) and leopard (*Panthera pardus*) use the extensive plantations of sugarcane and mango to find shelter

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and water and to hunt prey such as buffaloes, cows, pigs and dogs. Several lions are reported to have strayed outside the park boundary and into plantations for more than a week, while leopards have chosen it as permanent habitat and even breed in cultivated fields boarding the edge of the park (Vijayan and Pati, 2002).

In Kibber Wildlife Sanctuary, Himachal Pradesh, (Mishra, 1997) noted that 18% of livestock holdings were killed by snow leopard (*Uncia uncia*) and wolf (*Canis lupus*) for an estimated total value of US $128 per household per annum and it imparts a very significant economic impact given per annual cash incomes of $200 to $400. Villagers claimed predation rates increased after sanctuary establishment, while surveys indicated dramatic increases in livestock numbers accompanying changes in animal husbandry systems (Mishra, 2000). In Karnataka, the overall annual loss due to large tigers and leopards depredation around the Bhadra Tiger Reserve, is reported to be approximately 12% of the total family livestock holding. In addition, elephant damage to crops accounted for an average loss of 14% of the total annual production (Madhusudan, 2003).

Studies on the human-wildlife conflicts are far and few in Kerala. Jayson and Christopher (2008) based on their study on Human-Elephant conflict of Peppara Wildlife sanctuary in Kerala opinioned that cash crops which are more nutritive, attracts elephants and other potential animals resulting in crop raiding. They suggest that low water availability inside the forests is also a cause for wild animals intruding into human habitation. Iqbal (2011) in his study on human wildlife conflict in selected Forest Divisions of Kerala stated that the increased crop damage in territorial forest areas is due to the vast areas of cultivation of palatable and nutritious crops where as in protected forests only limited agricultural activities is done by the tribal people resulting in lower conflict rates.

The woman farming groups of Palakkad, Thrissur and Kasaragod districts have reported about increasing rate of destruction of produces by wild animals like monkeys, wild boar, peacocks, squirrels etc. as a major problem for their farming attempts (CGSAFED and KSWC, 2012).

2.6 FOREST TYPES AT NEMMARA FOREST DIVISION

The geographical area of the Division is 34,885.90 ha, but actual wooded area is considerably less. Plantations of teak softwood etc. were raised in 3667.571 ha. The extent of leased out areas for private parties and other agencies is 3920.687 ha. Landscape was covered

with wet evergreen, semi evergreen, moist deciduous, grasslands and shoal forests with luxuriant and bewildering array of species. RF of the Division is even now of wet evergreen type, barring few patches. The upper slopes of ridges in the ghat ranges are devoid of tree growth, covered either with grassy patches or open rocky out crops. The forests in Palakkad gap are almost open, with comparatively short boled trees. The natural forests of this division exhibit high degree of variation in floristic composition, quality and condition of crop because of the influence of climate and altitude. Edaphic and Biotic factors have also played a major role in inducing variations in floristic composition. Valleys, saddles, river basins etc have good forest cover. The transition Zone or ecotone is also visible between forest types.

The forests in the region is divided into the following types based on the classification by Champion and Seth.

1) Southern Tropical Wet Evergreen Forest (1A/C4)

2) Southern Tropical Semi-Evergreen Forest (2A/C2)

3) South Indian Moist Deciduous Forest (3B/CI B)

All these types imperceptibly merge into one another with or without an ecotone. Bulk of the moist deciduous forests is of the type described under category 3B/CI B. The distribution of types of forests in the division is shown below.

2.6.1 West Coast Tropical Evergreen Forests (1A/C4)

The special features of this type of forests are the luxuriant growth of vegetation and large number of species growing together with maximum strata, the highest of which contains gigantic lofty mesophytic evergreen trees of 45 m or more in height, often with clean cylindrical boles, plank buttresses at the base, and umbrella shaped crowns at the top, and the lowest containing dense evergreen shrubby undergrowth. In the middle storey, the trees are characterised by candle shaped crown, clean boles and the lower storey is characterised by conical crowns. Presence of epiphytes like orchids, aroids, ferns and mosses on trees is another characteristic feature. Presence of bamboos and reeds along watercourses are also a striking feature in addition to large climbers and creepers. These forests with their multiplicity and diversity of species, grown in a biological equilibrium, attain the highest ecological status viz. climatic climax.

This is the major and important forest type seen in this Division, occupying the undulating hills and valleys, river basins, saddles and other naturally sheltered areas in and around Nelliampathy hills. These forests can be seen in all the three ranges of this Division.

2.6.2 West Coast Semi Evergreen Forests (2A/C2)

This type of Forests is a transitional stage between moist deciduous forests and tropical evergreen forests. It is a closed high forest with trees of large dimensions. These forests are situated generally between 500 m and 800 m elevation. It forms closed high forests with an intimate mixture of species, typical of both evergreen and moist deciduous nature. Presence of bamboos in larger proportion in certain areas is conspicuous. Unlike the wet evergreen forest, the canopy is not so dense. The proportion of evergreen species are more in higher reaches, where it merges with wet evergreen type and proportion of deciduous species are more towards lower elevation where it merges with moist deciduous forest. Buttressed trees like *Bombax ceiba* and *Elaeocarpus serratus* are common. Epiphytes, ferns and climbers are in plenty.

Due to variation in composition of evergreen and deciduous species, determining the status of these forests is difficult. It can be considered as a secondary series to the evergreen forests. Its distribution is restricted to valleys and moist pockets of otherwise deciduous areas. The distribution of this type is very limited to about 1,300 ha. The semi evergreen forests are distributed in two ranges, bout 300 ha in Kollengode range spread over Minnampara, Pannimudi and Thekkady and about 1000 ha in Nelliampathy range spread over Kaikatty, Suryanelli and Padagiri.

2.6.3 South Indian Moist Deciduous Forests (3B)

This is the most important type of forest in the division with high economic value, because of the presence of timber species like *Tectona grandis, Dalbergia latifolia, Terminalia paniculata, Lagerstroemia lanceolata, Xylia xylocarpa* etc. During summer season, the upper canopy becomes leafless, leaf litter increases the fire hazard. The diversity of species is less when compared to evergreen forests. Species with buttresses are very rare with the exception of *Bombax ceiba*. The trees attain 25 to 30 m height. Fluting is common in most of the species. Epiphytes are rare. Large climbers and woody lianas are prevalent. Certain tree species, though exhibit gregariousness in certain places, do not usually form definite associations.

Evergreen species are very few and are mostly seen in the undisturbed areas. The trees are mostly with cylindrical bole with fibrous thick-fissured bark, which often peals off in

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flakes. The crown is mostly round. The forests are characterized in most parts with bamboo as under growth and in certain localities, bamboo grows in pure patches. Annual fires are regular feature in this type of forests, due to the thick layer of leaf litter and other combustible material; it destroys the ground vegetation and the young regeneration increasing the proliferation of grasses. In sheltered localities of increased moisture and deeper soil, they tend to be dense and luxuriant.

Moist deciduous forest occurs both on the lower slopes and on ridges. This type forest has a wide range of distribution and forms the bulk of the forests in the division. Found in Manalkunnu and Vellattimala areas of Alathur range, Pannimudi, Kuchimalai and Mullikkalthittu in Kollengode and Oyarkkunnu, Punngodumala and Nagarmala of Nelliampathy.

2.6.4 Plantations

There area under plantations is 3667.571 ha in this Division. The Department raised plantations in RF. There are extensive teak plantations raised by the ex-owners of the VF. The species are Teak, Cashew, Eucalyptus, Silver oak, Acacia etc. Some of the plantations in the VF are not performing well due to lack of proper care and maintenance, repeated fire, illicit felling etc.

Nelliampathy and Kollengode range have teak plantations raised departmentally where as Alathur range has teak plantation extending over 422.24 ha, raised by ex-owners. Four teak plantations of Nelliampathy were under planted with bamboo.

In addition, over 619 ha of plantations were raised by social forestry wing of the Forest Department in the VF, and other Government lands under various schemes. These plantations are categorised as small block, large block, strip, and avenue and canal bank plantations. They were raised under rural fuel wood programme; National Rural Employment programme; special forestry programme in small block, large block, strip and avenue plantations.

2.7 FAUNA OF NEMMARA FOREST DIVISION

The Parambikulam valley with the adjoining forests of Anamalai Hills and Nelliampathy Hills is rich in wildlife. Opening up of the forests for Parambikulam-Aliyar project and formation of extensive teak plantations under the teak plantation division restricted their movement, the formation of Wildlife Sanctuary, Parambikulam and the adjoining

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Anamalai sanctuary of Tamil Nadu has ameliorated the situation to a considerable extant. Since Parambikulam Sanctuary is adjacent to the division, wildlife is seen moving in the division also. Venganadu Kovilakam VF is lying contiguous to the Sanctuary and form "Buffer Zone". The forests with perennial streams and water holes form a good abode for wildlife and these tracts are therefore rich in wildlife. All the animals that can be seen in the Sanctuary are sighted in these tracts also.

MATERIALS AND METHODS

MATERIALS AND METHODS

3.1 STUDY AREA

3.1.1 Location

The tract dealt with lies between 10° 25' and 10° 49' North latitudes and 76° 26' and 76° 54' East longitudes. The present Nemmara Forest Division has its Headquarters at Nemmara, consisting of 205.517 sq. km of Reserve Forests and 143.3416 sq km of Vested Forests within the Revenue Taluks of Chittur and Alathur, excluding the area of Wildlife Division. The three ranges of the present Nemmara Division are Alathur, Kollengode and Nelliampathy with headquarters at Vadakkencherry, Kollengode and Nemmara respectively. The present Nemmara Division started functioning from 1.4. 1990. The major portions of the forests are situated as contiguous block on the northern and western slopes of Nelliampathy hills. Remaining portion is located as small, scattered bits, spread as isolated pockets, in between Revenue lands. The Division covers one Municipality, 5 Development blocks, 32 Panchayaths and 60 Villages. Even though the Nemmara forest division is a territorial division the increased incidents of human-wildlife conflict were reported as a major constrain to the department officials. The emerging incidents needed further and in-depth study, subsequently Nemmara forest division was selected for the present study.

3.1.2 Boundaries

North: Starting from the point where the common District boundary of Thrissur and Palakkad Districts meet at Lakkidi, the boundary runs towards east along Alathur and Chittur Taluk boundaries till it meets the state boundary.

East: From the above point in the state boundary, it runs along Chittur Taluk boundary (interstate boundary) up to Kuchimalai and thence along the existing boundary of Parambikulam Wildlife Sanctuary up to the point where Bagapallam and Vetiar rivers meet.

South: Thence along the watershed lines of Bagapallam and Pulikkalar and Chakkalithodu and Karapara river along hillocks 2584, 4082, 4016 and 3313 up to the point of confluence of Karapara river till it meets, the common District boundary between Palakkad and Thrissur. Thence along the District boundary up to the point where the Taluk boundary of Alathur and Chittur meets the District boundary.

West: Thence along the District boundary up to the starting point.

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3.1.3 Area

The Gross area of the Division is 35,120.32 ha, which includes 20,551.74 ha of RF and 14334.16 ha of VF. Alathur and Kollengode ranges comprise only VF whereas Nelliampathy range has both RF and VF. Range wise details of the Forests are given in Table No. 33 below.

Table No 33. Distribution of forests in the Nemmara forest division

Sl.No	Range	RF (ha)	VF (ha)	Total (ha)	Leased area (estates) (ha).	Lease area-other agencies
1.	Nelliampathy	20,551.74	85.64	20552.596	3652.107	268.580
2.	Alathur	--	8132.86	8132.86	-	-
3.	Kollengode	--	6115.66	6115.66	-	-
Total		**20551.74**	**14334.16**	**34885.90**	**3652.107**	**268.580**

3.1.4 Topography

Major portion of the forest areas are situated as a contiguous block along the northern and western slope of Nelliampathy hills. Generally, the terrain exhibits ruggedness, a range of altitudes and diversity with open rocky out crops and small patches of grasslands on highest points. Topographical features change abruptly as one proceeds from 40 m to higher elevation. The tract has a number of subsidiary ridges and valleys that extend in all directions connecting the main ridges. Nelliampathy range of hills have very high rocky pyramid like apexes and steep valleys. The highest peak is the Minnamaparamala with an elevation of 1,633 m above MSL. The vested forest bits are isolated and scattered over small hillocks and plains, with sparse tree growth, they are highly degraded with open rocky outcrops.

3.1.5. Geology, Rock and Soil

3.1.5.1. Geology

Geologically, the tract is part of the Archaean series. The underlying rock is quartz and Felspar. The rock is foliated in the foothills. Palakkad gap in the Western Ghats has a special tectonic feature formed as a result of fault during lower Miocene period.

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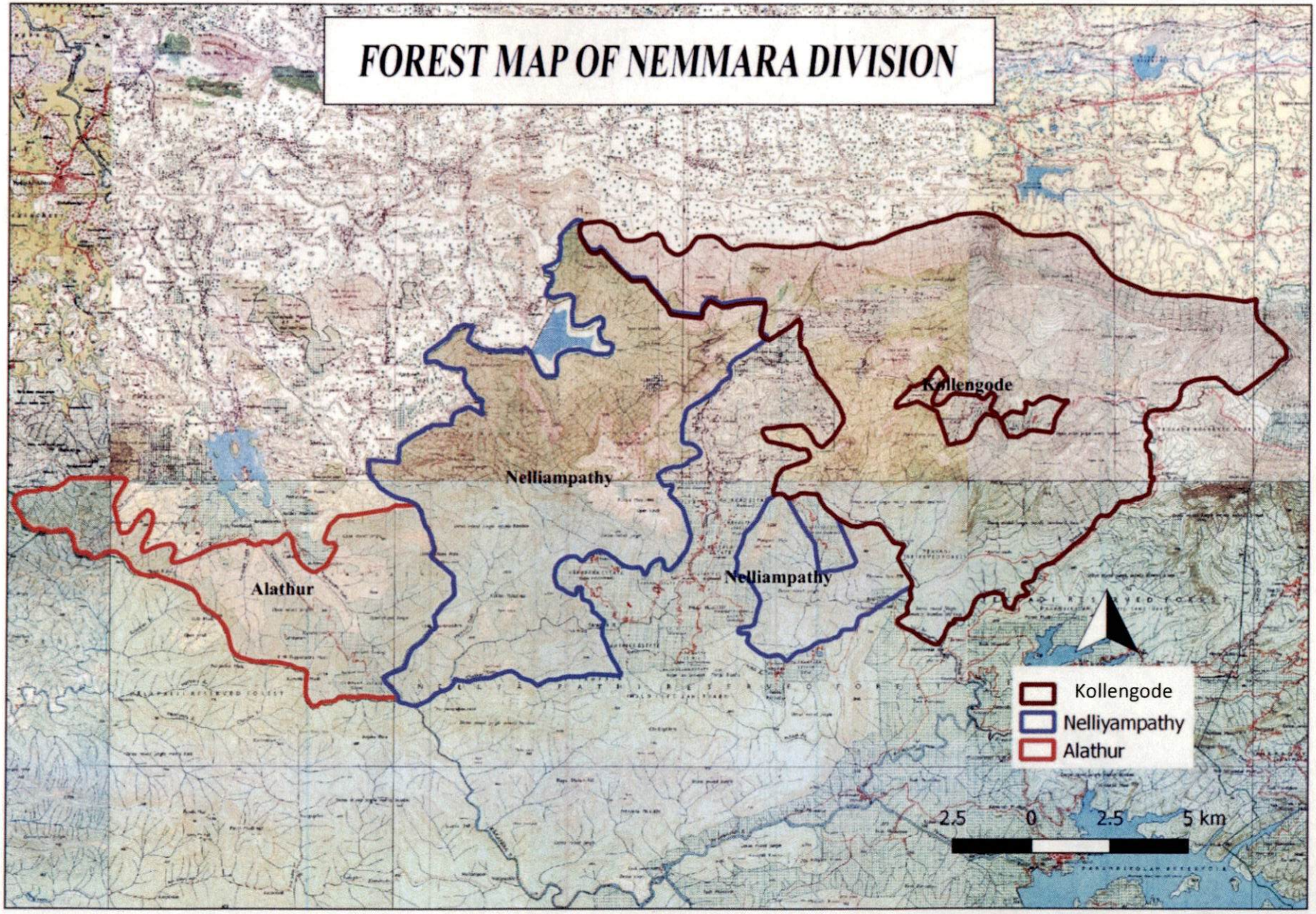
FOREST MAP OF NEMMARA DIVISION
Kollengode
Nelliampathy
Nelliampathy
Alathur
Kollengode
Nelliyampathy
Alathur
2.5
0
2.5
5 km

A6

3.1.5.2 Rock

The main rock type is biotic gneiss. Large extents of rocky blanks with outcrops of sheet rock are found in Nelliampathy Hills. The other types of rocks met with are granite, khondalites with pegmatite's and quartz.

3.1.5.3 Soil

The moist tropical conditions prevailing in these regions have caused active metamorphosis of gneiss, resulting in the formation of laterite, generally seen along the foothills. The soil is red earth, mixed with red and yellow soil. Laterites are generally poor in Iron, Potash, Phosphorous and organic matter, but well drained. High rainfall is conducive to laterisation. It is moderately deep with distinct horizons of A, B, C in soil profile. The ridges are of sheet rock with or without a thin crust of soil. Though the hilltops have fairly good amount of soil, it is often mixed with boulders. The soil on the lower slopes is chocolate coloured loam with sand, can be termed as sandy loam. It is considerably deeper and richer in humus and hence capable of supporting vegetation.

3.1.6 Climate

Due to the peculiar topographical features and conditions, climatic variations are found in different localities. Wide variations are due to difference in altitudes and aspects. The proximity to Palakkad Gap also contributes much to this variation. (KFD, 2011)

3.1.6.1 Temperature

The hottest months are March to May and coldest months are December to January. The dry and desiccating winds blowing through Palakkad gap from the east and the radiating heat from the open rocky hills contributes to raising atmospheric temperature. In plain areas, the temperature during summer goes up to 41°C and the minimum is 21°C. The maximum temperature in the high ranges of Nelliampathy range is 32°C and the minimum is 8°C. (KFD, 2011)

3.1.6.2 Wind

Strong, dry and desiccating winds blow continuously across the state border for a period of 5 months from November to March through Palakkad gap. These winds cause loss of moisture from the soil as well as atmosphere and the effect is more pronounced in the plains

near the gap. The Puramalavaram forests and the plains are affected by this wind. The area receives light breeze from Arabian Sea, which gradually becomes strong with the onset of monsoons and continues to be so till the monsoons are over (KFD, 2011).

3.1.6.3 Rainfall

The tract receives both Southwest and Northeast monsoons. The upper slopes receive maximum rainfall and the annual average is more than 2,300 mm. The highest rainfall received so far was 5,553 mm in 1968. Due to elevation, Nelliampathy get major portion of rainfall from southwest Monsoon, the precipitation being heaviest on the Eastern and Southern aspects. The average annual rainfall varies from 2,512 mm (1990) to 4,780 mm (1998). The Puramalavaram area receives lowest rainfall and is about 1,200 mm. The pre-monsoon showers start by the end of April. Major precipitation is received from the Southwest Monsoon, which becomes active in June and lasts till September. The Northeast Monsoon generally breaks by mid-October and lasts for about two months. The months of January, February, March and April are particularly dry. (KFD, 2011)

3.1.7 Water Supply

Though there are about 26 rivers / streams within the Division, the water is not adequate in some parts, particularly during summer when water table is very low. However, the water supply is just adequate throughout the Division barring certain areas. Most of the hill streams and the wells get dried during summer. Four major irrigation dams are constructed in the Division, they are Chulliyar Dam across Chulliyar, Meenkara Dam across the Meenkara puzha, Pothundi Dam across Pothundi river and Mangalam Dam across Mangalam puzha. These dams are not capable of meeting the water requirements of agricultural sector. In the last few years a number of bore wells were drilled for drinking water in the plains and this has adversely affected ground water table. Similarly, a lot of open wells were also dug by the side of irrigation canals for storing water albeit temporarily, for agricultural purposes. (KFD, 2011).

3.1.8 Forest Classification

3.1.8.1 Reserve Forests

The entire RF, 20,551.74 ha, of this Division is in Nelliampathy range. The notification as per which the tract became RF does not give the exact extent of this block. At the time of notification itself the tract had 25 estates and they were treated as enclosures within the RF.

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Again, in another notification published in Cochin Government Gazette dated 11.2.1933, 11 estates, which were relinquished or abandoned fully or partly were declared as RF. Extensive area within Nelliampathy RF were leased out to private individuals and limited companies even before the settlement, for raising cash crops like coffee, Cardamom, Rubber etc and those areas still exist as such within the RF.

3.1.8.2 Vested Forests

The division has 14,334.16 ha of VF spread over in all the three ranges. Alathur, Kollengode and Nelliampathy ranges have 8132.86 ha, 6115.66 ha and 85.64 ha respectively. Most of the VF areas are bits lying scattered in the plains as well as in hills. There are 108 such bits of VF in Alathur range, 31 bits in Kollengode range and 6 bits in Nelliampathy range. Alathur and Kollengode ranges comprise only VF, whereas Nelliampathy range has both VF and RF. Most of the VF areas are bits lying scattered in the plains and lower hills and they are in a denuded state due to over exploitation and biotic interference in the past. Many areas are rocky in nature and not capable of supporting tree growth. Certain forest tracts vested with Government from the Venganad Kovilakam of Kollengode, Puzhakkalidam, and Nellikkalidam etc are extensive areas lying contiguous with the RF of the Division. Vested Forests in the Division is 14,568.58 ha.

3.1.9 Tribal Settlements

There are 8 tribal settlements within this Division. One is in the RF and the others are in Vested Forests. They belong to Kadar, Malassar or Mala Malassar Tribes. Nelliampathy range has one colony; two in Alathur and four in Kollengode range. All the 7 Tribal colonies together have 50.8 ha of land with a total population of 815, comprising 196 families. The details of Hillman settlements in the Divisions are given below.

The settlements are demarcated and each family is in possession of a definite extent of land for habitation and cultivation. The settlement area enjoys the status of Reserve Forest.

3.2 SELECTION OF SAMPLE AND SAMPLE SIZE

All the three ranges, Alathur, Kollengode and Nelliyampathy ranges of the Nemmara forest division was studied separately. The study area at each range were selected after a preliminary reconnaissance survey and detailed focus group discussions. Selective sampling

was done to identify respondents after focus group discussions and preliminary reconnaissance survey, which included victims of human-wildlife conflict as well as forest fringe dwelling people. To assess the changes over a period of over thirty years it was necessary to find out respondents who was settled in the study area for more than thirty years so the minimum number of respondents was fixed as 100 from each range. A total of 398 individuals were subjected to the interview schedule 164 from Alathur range, 110 from Kollengode range and 124 from Nelliyampathy range. Apart from this three Participatory rural appraisal (PRA) programs were conducted, one each separately at all the three ranges.

Table No 34. Number of individual surveyed at Nemmara forest division

SI. NO	Name of range	Number of individuals surveyed (N)
1	Alathur	164
2	Kollengode	110
3	Nelliyampathy	124
	Total	**398**

3.3 DATA COLLECTION

3.3.1 Interview schedule

A detailed interview schedule was prepared to gather information from stakeholders. Household survey was conducted by using a pre-tested structured schedule (Appendix I) to obtain data of the general characteristics of each household 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 seven sections.

Section I: **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.

Section II: **Natural resource knowledge and use**

The section made use of questions related to natural resources and their usage. Climatic data was also collected and the past 30 years data regarding climatic conditions, land use pattern, cropping pattern, temperature changes, rainfall pattern, wind speed etc. were taken into account.

Section III: **Attitude and awareness towards wildlife and conflict**

The attitude and awareness level of the respondents were assessed based on certain specially designed questions on effectiveness ranking. In this method, the respondents were asked to rank a certain question which they found most appropriate as 1 and the remaining as 2, 3, 4 etc. rendering the answer 1 as most appropriate and the rest in ascending order of numbers as least appropriate. Hence finally the score with the least value will be the most appropriate one and option with the highest value will be the least appropriate of all.

Section IV: **Crops and farming details**

Questions in the schedule under this section included the type of crops cultivated, area, extend, planting period, harvesting period and also questions on effectiveness ranking of crop vulnerability to raiding and also regarding suitability of various mitigation strategies.

Section V: **Assessing damage on infrastructure**

Questions regarding the animal, time of attack, kind of damage, loss due to wildlife were used to assess the damage on infrastructure by wildlife

Section VI: **Assessing attacks on people**

The attack on people was analysed based on the questions such as species name, type of damage, time and extend of injury, details of compensation sought if any , weather the received compensation is satisfactory or not.

Section VII: **Livestock depredation**

The human-wildlife conflict regarding livestock and their depredation was critically viewed through questions from section VII which included effectiveness ranking of various mitigation strategies, livestock population estimation, vulnerability of livestock, animal causing most damage, reasons for livestock depredation.

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Plate 1: Questionnaire survey at Alathur range

Plate 2: PRA at Kollengode range

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3.3.2 Participatory Rural Appraisal (PRA)

PRA approach is a group based method used for obtaining data with better quality than those are normally obtained through interview schedules. Moreover, PRA techniques collect and analyse data more quickly, efficiently and cost-effectively than the conventional questionnaire methods (Waters-Bayer *et al.*, 1994; Mukherjee, 2002).

In this study in addition to the interview schedule detailed PRA was also conducted to analyse the peoples need and their attitude and awareness regarding human-wildlife conflict, perceptions on conservation and protection, and also regarding various conflict mitigation strategies. These were made possible through various techniques such as timeline method and problem tree method. The tools are explained here under;

3.3.2.1 Time Line

Historical narration of events, their impact and changes can differ across participants depending on their perceptions, and it is useful to keep track of the broad time-period to which they refer to rather than specific dates. Time line provides indications of changes in land use, in community preferences, in community problems, in socio-economic changes, changes in biodiversity, land use, water and other developmental activities. 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 and an overall idea about the changes and events.

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 of political, economic or socio-cultural nature.

3.3.2.2 Problem Tree Method

The Problem Tree method is a planning method based on needs, however it is not a mechanical translation of problems into objectives. In this method the participants are asked to list out the problems faced by them in a pictorial manner depicting a tree. The causes of these problem are also listed out and also the consequences. An effective discussion is facilitated between the participants to bring out their true opinion. While

Plate 3: PRA at farmer interation

Plate 4: PRA at Nelliyampathy range

5A

Plate 5: PRA at time line preparation

Plate 6: PRA oral history method

going through the process, taking the different steps, there is continuously room for opportunities, new ideas and contributions from the involved parties. 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.

3.4 DATA ANALYSIS

3.4.1 Measuring dependent variables

The sub sections regarding attitude towards wildlife and human-wildlife conflict, perceived reasons for crop raiding and livestock depredation were analyzed separately using Likert scale (Five-point continuum) to indicate people's response towards each statement. The statements were as follows.

I. Attitude towards wildlife and human-wildlife conflict

1. Wildlife should be conserved
2. Wildlife is getting more priority than humans
3. People should be given the rights to protect their land by any means
4. Conservation policies of the government is not up to the mark
5. Government should keep a check on wild animals by lethal means
6. HWC mitigation by the government is effective

II. Perceived reasons for crop raiding

1. There are too many wild animals
2. Farm owners have been negligent
3. There is insufficient food in the forest
4. Livestock that graze in the forest push wildlife out
5. The government fails to keep wildlife in the park
6. Climate change
7. Deforestation and habitat loss

III. Perceived reasons for livestock depredation

1. There are too many wild animals
2. Livestock owners have been negligent
3. There are too many livestock
4. There is not enough wild prey in the forest

5. Livestock are taken because they graze in the forest
6. The GOV fails to keep the wildlife in the park

The statements were rated using the five-point rating scale viz; (Strongly agree, Agree, Neutral, Disagree and Strongly disagree). The percentage of the responses were found out and was interpreted.

Effectiveness ranking method was also used to assess the dependent variables. The respondents were asked to rank a certain option/statement which they found most appropriate as 1 and the remaining as 2, 3, 4 etc. rendering the answer 1 as most appropriate and the rest in ascending order of numbers as least appropriate. Hence finally the score with the least value will be the most appropriate one and option with the highest value will be the least appropriate of all.

The sub sections in which effectiveness ranking was used and the subsequent options provided are listed below.

I. Opinion regarding "Who should take responsibility for reducing conflict with wildlife?"

1. Forest department
2. Agricultural department
3. Revenue department
4. Local communities
5. Independent NGO's
6. Tourists and urbans

II. Opinion regarding "Why should wildlife be protected and conserved?"

1. They have as much right to live as we do
2. Religious/cultural purpose
3. For future generations
4. Education purpose
5. Tourism
6. Value of wildlife products to the economy
7. Other reasons, specify if any

III. Opinion regarding "What factors are most important when choosing a conflict mitigation scheme?"

1. Proven Effectiveness
2. Low startup Costs (Financial)
3. Low maintenance Costs (Financial)
4. Low Labour Effort
5. High level of household control of scheme
6. Minimal negative effects on wildlife
7. High level of acceptability to other people
8. Fair level of compensation

IV. Opinion regarding best method to manage crop raiding

1. Insurance
2. Compensation
3. Natural fencing (thorn bushes, stone walls)
4. Wire fencing
5. Electric fencing around fields
6. Electric fencing around park boundaries
7. Trenches around fields
8. Trenches around park boundaries
9. Deterrent techniques (firecrackers, noise)
10. Stopping livestock grazing in the forest
11. Improving the habitat within the protected areas
12. Control of problem animals by the Forest Department

V. Opinion regarding best method to mitigate livestock depredation

1. Insurance
2. Compensation
3. Improved herding/livestock guarding
4. Improved fencing for stock corralling
5. Stopping livestock grazing in the protected areas
6. Improving the habitat within the protected areas
7. Control of problem animals by the Forest Department

Other dependent variables were such as: -

1. Changes perceived about wild animals at Nemmara division during the past 30 years

2. Changes in farming practices at Nemmara division during the past 30 years
3. Changes in the interface between people and forests at Nemmara division during the past 30 years
4. Changes in cropping pattern at Nemmara division during the past 30 years

The data was collected in an explorative way using PRA and the interview schedule. The entire changes were categorized into three time periods 2000's, 1990's and the 1980's. Each time period was separately analyzed and the changes were noted. The data collected was analyzed to find out the majority of the response.

3.4.2 Measuring independent variables

Age

Age was operationally defined as "the number of years completed at the time of study". The age of the respondents was categorized as below 20 (including 20), age 21-40 years,41-60 years and above 60 years.

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).

Occupation

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

Education

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

1. Illiterate
2. LP and UP
3. High school

4. Higher secondary
5. Above higher secondary

3.4.3 Statistical Analysis

Primary quantitative data were subjected to statistical analysis by interpreting the interview schedule and the participatory rural appraisal (PRA) responses using computerized means of comparisons and descriptive statistics. In the case of sections involving Likert scale (Five-point continuum) majority of the responses were found out and was expressed in percentage. Mean rank was found out for the sections which included effectiveness ranking. Microsoft excel 2013 statistical package was used for the statistical analysis.

RESULTS

RESULTS

The main objective of this study was to portray the nature and distribution of human-wildlife conflicts in Nemmara Forest Division, Palakkad and to analyze its cause–consequence factors with focus on land use change and land cover change pattern. This study also assessed the awareness and attitude of the forest fringe people, including the victims of human-wildlife conflicts about the forest conservation issues and human wildlife conflicts. The study also focused on the location specific nature of human animal conflicts by comparing in detail the above-mentioned objectives observed in the three forest ranges, namely Alathur, Kollengode and Nelliyampathy coming under this forest division. The results of these observations are outlined below.

4.1 ASSOCIATION OF SOCIO-DEMOGRAPHIC VARIABLES WITH RESPONDENTS' ATTITUDE TOWARDS HUMAN-WILDLIFE CONFLICT

Table 1. Association of Socio-demographic variables with respondents' attitude towards human-wildlife conflict (Chi-square test)

Socio-demographic Variables	**Chi-square value**		
	Nelliyampathy	Kollengode	Alathur
Gender	1.19^{ns}	7.06^{*}	0.08^{ns}
Age	18.44^{*}	2.11^{ns}	9.42^{ns}
Education status	11.83^{ns}	9.17^{ns}	8.69^{ns}
Economic status	4.91^{ns}	0.97^{ns}	--
Type of conflict	10.75^{ns}	6.94^{ns}	7.21^{ns}

*= Significant at 1% ns= Non significant

The test results presented in Table 1 reveals that there was no significant difference between any of the social demographic variables such as age, gender, educational status, economic status and attitude towards human-wildlife conflicts in any of the three ranges.

4.2 ASSOCIATION BETWEEN RESPONSES OF RESPONDENT AT THREE DIFFERENT RANGES

Table 2. Association between responses of respondent at three different ranges. (Kruskal - Wallis one-way analysis of variance)

Ranks			
	Group	Number of individuals	
Total score	Alathur	164	
	Kollengode	110	
	Nelliyampathy	124	
	Total	**398**	**χ^2 =134.927**

From the results of the Kruskal-Wallis one way analysis of variance it is clear that there was significant variation in the responses of the respondents from all the three ranges. (Table 2)

4.3 ALATHUR RANGE

4.3.1 Socioeconomic situation of the respondents

The Alathur range of the Nemmara forest division has a total forest area of 8132.86 hectares and all this area comes under the vested forest category. At Alathur range, a total of 164 individuals affected by human-wildlife conflicts were surveyed. The areas selected for detailed data collection were done after a preliminary reconnaissance survey and focus group discussions. The list of areas selected for detailed study at Alathur is given in Table 3.

Table 3. List of areas studied in Alathur forest range

Sl. No	Location studied	Range
1	Kadappara	Alathur
2	Choorupara	Alathur
3	Nannyangadi	Alathur
4	Oodanthoodu	Alathur
5	VRT	Alathur
6	Mangalam dam	Alathur

The observations recorded for the distribution of gender and age classes among the respondents is given in Table 4. Of the total 164 people surveyed, male respondents constituted 64.02%, and the rest 35.98%, were females. The maximum number of respondents fell under the age class of '41-60 years' (42.68%), while the '21-40 years' age group was represented by 32.93%, which was followed by the 'below 20 years' group (13.41%) and 'above 60 years' (10.98 %).

Table 4. Gender and age class distribution of respondents at Alathur.

Variable	Category	Frequency	Percentage
Gender	Male	105	64.02
	Female	59	35.98
Age (years)	Below 20	22	13.41
	21-40	54	32.93
	41-60	70	42.68
	Above 60	18	10.98

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The educational and economic status of the people surveyed in Alathur is provided in Table 5. From Table 5, it is evident that 38.41% of the people surveyed had high school education, while 22.56% had only upper primary education. Those who had education up to the higher secondary category constituted 17.68%, whereas 14.63% had education above the higher secondary level. Interestingly, among the surveyed population, 6.71% were illiterates. Economically, all the respondents (100%) belonged to the above poverty line (APL) category.

Table 5. Educational and economic status of respondents at Alathur.

Variable	Category	Frequency	Percentage
Education level	Illiterate	11	6.71
	LP&UP	37	22.56
	High School	63	38.41
	Higher Secondary	29	17.68
	Above Higher Secondary	24	14.63
Economic Status	APL (Above Poverty Line)	164	100.00
	BPL (Below Poverty Line)	0	0.00

The occupational status of the respondents at Alathur is given in Table 6. It is clear that majority of the people surveyed were unemployed (40.85 %). Rubber tapping was the main occupation of 29.27% of the respondents, while 13.41% were engaged in agriculture and 5.49 % were waged labourers.

Table 6. Occupational status of respondents at Alathur.

Variable	Category	Frequency	Percentage
Occupational Status	Driver	3	1.83
	Tapping	48	29.27
	Agriculture	22	13.41
	Waged labour	9	5.49
	Carpenter	4	2.44
	Excise officer	1	0.61
	Business	1	0.61
	Tailor	2	1.22
	Manager	2	1.22
	Consultant	1	0.61
	Mechanic	4	2.44
	Unemployed	67	40.85

4.3.2. Nature and distribution of human-wildlife conflicts at Alathur

4.3.2.1 Type of human-wildlife conflict

Table 7. Types of human-wildlife conflicts in Alathur forest range

Sl. No	Type of human wildlife conflict in percentage % (Alathur)	Frequency	Percentage
1	Crop raiding	111	67.68
2	Live stock	0	0
3	Attacked people	0	0
4	Others (e.g. fear of attack/ nuisance)	18	10.98
5	CR / LD (Crop raiding/Livestock depredation	34	20.73
6	CR / O (Crop raiding/Others)	1	0.61

According to the respondents, the main type of human-wildlife conflict at Alathur is crop raiding, which accounts for 67.68% of all the reported ones (Table 7). The second highest was a combination of crop raiding and livestock depredation (20.23%). The third highest (10.98%) was other types of conflict (nuisance, fear factor) and a combination of crop raiding and others (0.61%). The respondents did not report any cases of livestock depredation by the wild animals or attack on people by wildlife.

4.3.2.2 Problematic animals of Alathur

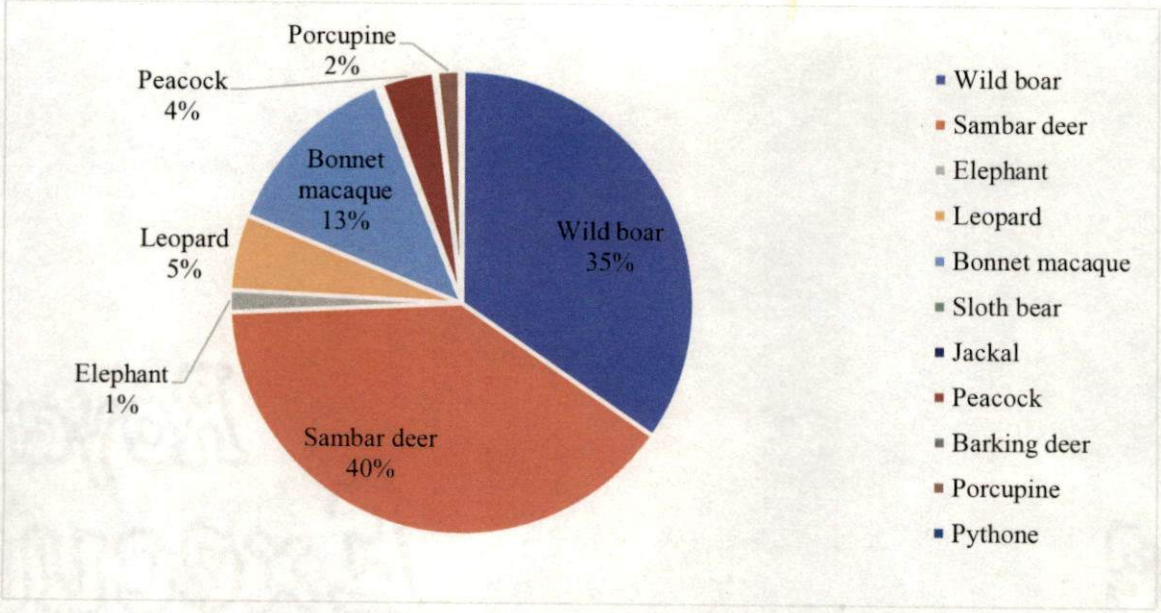

Figure 1. Problematic animals of Alathur

According to the study conducted Sambar deer (*Cervus unicolor*) was found to be the most problematic animal (40%) at Alathur. The respondents reported Wild boar *(Sus scrofa)* as the second most problematic animal which accounted for 35% of all the wildlife induced damages at Alathur. Bonnet macaque (*Macaca radiate*) was the culprit which caused 13 % of all the problems, Leopard (*Panthera pardus*) 5%, Peacock (*Pavo cristatus*) 4%, Porcupine (*Hystrix indica)* 2%, and Elephant (*Elephas maximus*) 1 %. (Figure 1)

4.3.2.3 Animal species with type of damage/conflict and time of activity

Table 8. Problematic animal species with type of damage/conflict and time of activity at Alathur

SI no	Problematic animal species	Type of damage/conflict	Time of activity
1	Sambar deer	Bark stripping	Night
2	Wild boar	Whole area	Night
3	Bonnet macaque	Nuisance	Day
4	Leopard	Fear	Night
5	Peacock	Flushes and shoots	Day
6	Porcupine	Coconut, Fruits	Night
7	Elephant	Whole area	Night
8	Sloth bear	Fear	Night
9	Jackal	Hens	Night
10	Barking deer	Fruits	Night
11	Python	Hens	Night

The animal species with the type of damage/ conflict and the time of activity of Alathur is given in Table 8. Bark stripping of rubber trees as the main damage reported to be caused by the sambar deer. Wild boars were said to damage the whole area searching for tubers and grubs. Bonnet macaques are a big menace and nuisance, while leopard caused fear among the respondents. Peacocks were said to damage the new sprouts, shoots, flushes etc.

4.3.3 Changes perceived about wild animals at Alathur during the past 30 years.

The changes in wild animals according to the respondents at Alathur for the past 10 years (2000's), 10 to 20 years (1990's) and 20 to 30 years (1980's) were analysed separately and the results are given below.

4.3.3.1 Wild animals at Alathur during the past 10 years (2000's)

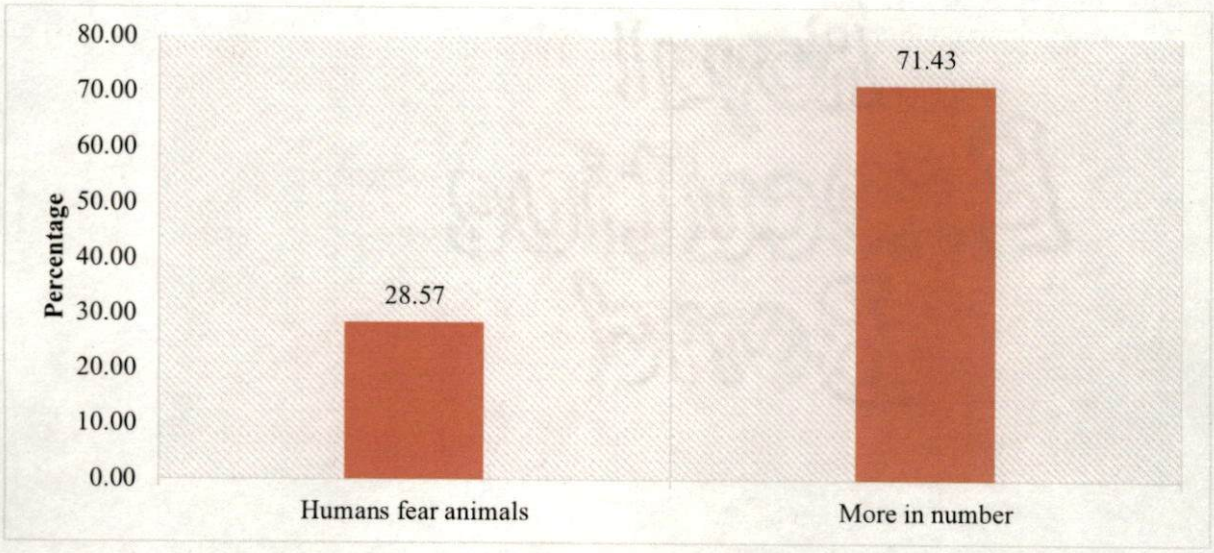

Figure 2. Wild animals at Alathur during the past 10 years (2000's)

The majority of the respondents at Alathur (71.43%) were of the view that for the past 10 years the number of wild animals has increased. The remaining 28.57 % reported that humans fear animals.

4.3.3.2 Wild animals at Alathur during the past 10 to 20 years (1990's)

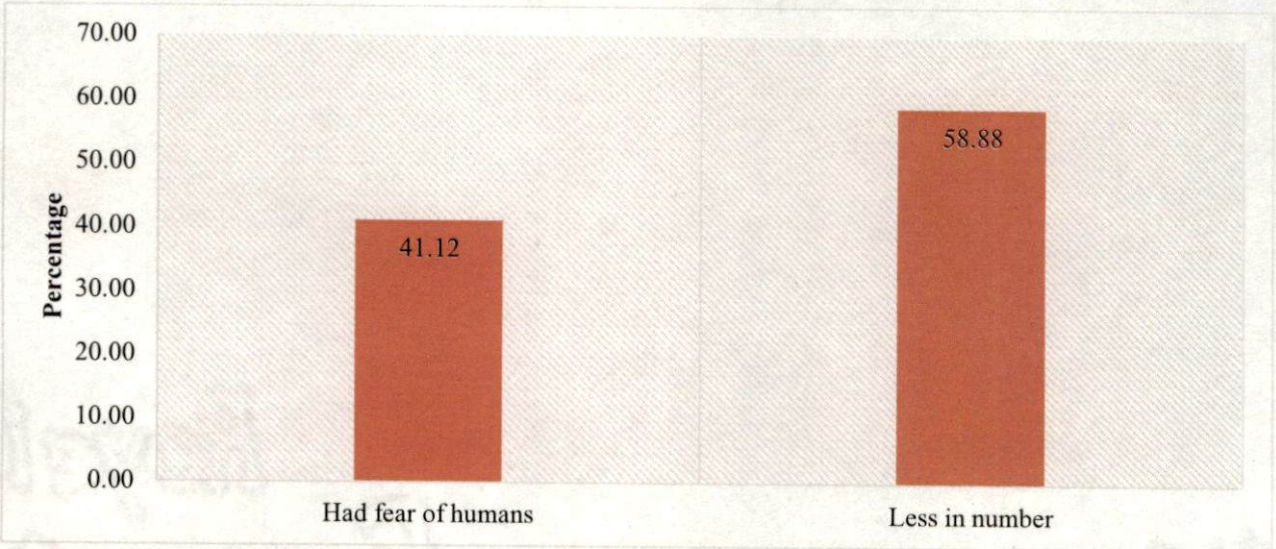

Figure3. Wild animals at Alathur during the past 10 to 20 years (1990's)

A majority (58.88%) of the respondents at Alathur reported that the wild animals were less in number during this period. Many (41.12%) also reported that the wild animals had more fear of humans during this period (past 10 to 20 years).

4.3.3.3 Wild animals at Alathur during the past 20 to 30 years (1980's)

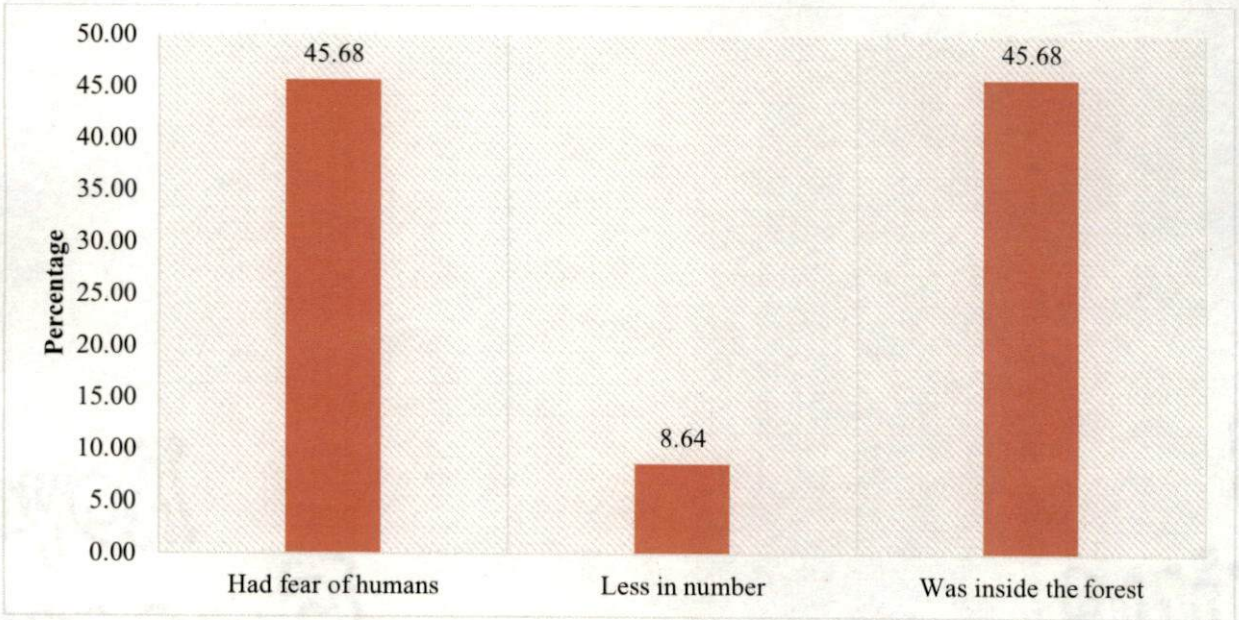

Figure 4. Wild animals at Alathur during the past 20 to 30 years (1980's)

During the past 20 to 30 years at Alathur a majority of 45.68% each reported that animals were inside the forests and that the animals had fear of humans.

4.3.3.4 Perceived reasons for crop raiding

Table 9. Perceived reasons for crop raiding at Alathur

SI No	Reasons for crop raiding										
	Statements	**SA**		**A**		**N**		**D**		**SD**	
		F	**%**	**F**	**%**	**F**	**%**	**F**	**%**	**F**	**%**
1	There are too many wild animals	86	52.44	49	29.88	29	17.68	0	0.00	0	0.00
2	Farm owners have been negligent	3	1.83	9	5.49	24	14.63	69	42.07	59	35.98
3	There is insufficient food in the forest	84	51.22	31	18.90	18	10.98	22	13.41	9	5.49
4	Livestock that graze in the forest push wildlife out	0	0.00	3	1.83	5	3.05	59	35.98	97	59.15
5	The government fails to keep wildlife in the park	69	42.07	51	31.10	28	17.07	12	7.32	4	2.44
6	Climate change	53	32.32	39	23.78	25	15.24	38	23.17	9	5.49
7	Deforestation and habitat loss	154	93.90	2	1.22	3	1.83	2	1.22	3	1.83

(SA- Strongly agree, A-Agree, N-Neutral, D-Disagree, SD-Strongly disagree)

A majority of the respondents in Alathur (strongly agreed= 52.44%; 29.88% =agreed) supported the statement that "There are too many wild animals". While 17.68% of the respondents remained neutral, there was no negative response at all. For the second statement "Farm owners have been negligent" a majority (disagreed=42.07%; strongly disagreed=35.98%) responded negatively. The statement "There is insufficient food in the forest" a majority (52.22% =strongly agreed, 18.90%= agreed) supported. And a majority of

the respondents (35.98% =disagreed; 59.15%= strongly disagreed) did not support the statement that "Livestock that graze in the forest push wildlife out". The fifth statement was that "The government fails to keep the wildlife in the park" for which a majority did support (42.07%=strongly agreed; 31.10%=agreed), while 17.07% remained neutral. The sixth statement "Climate change" as a reason for crop raiding by animals was supported by a majority (93.90%=strongly agreed, 1.22%=agreed).

4.3.3.5 Perceived reasons for livestock depredation

Table 10. Perceived reasons for livestock depredation

Si No	Reasons for livestock depredation										
	Statements	SA		A		N		D		SD	
		F	%	F	%	F	%	F	%	F	%
1	There are too many wild animals	98	60.00	56	34.29	0	0.00	5	2.86	5	2.86
2	Livestock owners have been negligent	6	2.86	9	5.71	9	5.71	61	37.14	80	48.57
3	There are too many livestock	0	0.00	0	0.00	0	0.00	84	51.43	80	48.57
4	There is not enough wild prey in the forest	28	17.14	56	34.29	33	20.00	28	17.14	19	11.43
5	Livestock are taken because they graze in the forest	14	8.57	28	17.14	28	17.14	66	40.00	28	17.14
6	The GOV fails to keep the wildlife in the park	89	54.29	42	25.71	23	14.29	5	2.86	5	2.86

(SA- Strongly agree, A-Agree, N-Neutral, D-Disagree, SD-Strongly disagree)

The response of the reasons for livestock depredation is given in the Table 10. For the first statement "There are too many wild animals" a majority (60%=strongly agreed; 34.29%=agreed) responded positively. The second statement "Livestock owners have been negligent" was not supported by a majority (31.14%=disagreed; 48.57%=strongly disagreed).

The third statement "There are too many livestock" was disagreed by a majority (51.43%=disagree; 48.57% strongly disagreed). For the statement "There is not enough prey in the forest" a majority of the respondents agreed (17.14%=strongly agreed, 34.29%=agreed) and responded positively. "Livestock are taken because they graze in the forest" was the fifth statement for which a majority of 40 % disagreed. For the statement "The government fails to keep the wildlife in the park" a majority of (54.29%=strongly agreed; 25.71% agreed) responded positively.

4.3.4. Land use and land cover change pattern at Alathur

The land use and land cover change pattern were analysed by both the interview schedule method and as well as the time line method used during the PRA exercises. Accordingly, the land use and land cover change pattern was studied based on change in the interface between people and forests, change in farming practices and also by studying the change in cropping pattern and the results are as listed below.

4.3.4.1 Change in farming practices at Alathur during the past 30 years

The changes in the farming practices at Alathur, from the viewpoint of the respondents, for the past 10 years, 10 to 20 years and for the past 20 to 30 years, was studied separately.

4.3.4.1.1 Farming practices at Alathur during the past 10 years (2000's)

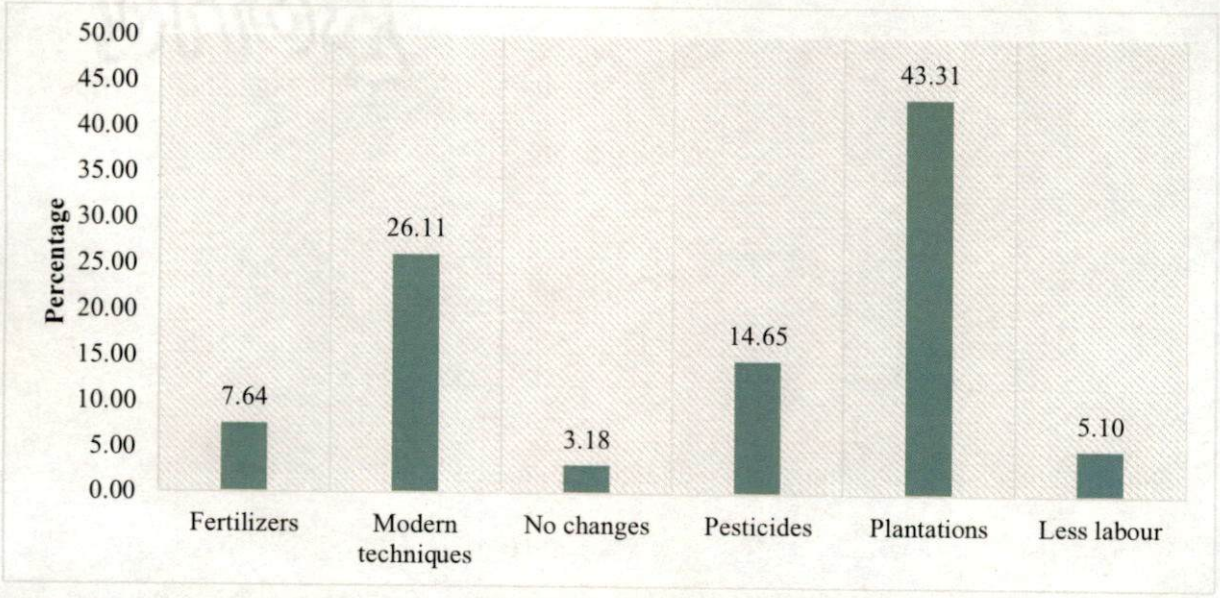

Figure 5. Farming practices at Alathur during the past 10 years (2000's)

A majority of 43.31% of the respondents reported an increase in the area under plantations of cash crops. The usage of modern techniques was highlighted by 26.11%, pesticide and fertilizer usage were reported by 14.65% and 7.64 % respectively. Low labour availability was mentioned by 5.10% (Figure 5).

4.3.4.1.2 Farming practices at Alathur during the past 10 to 20 years (1990's)

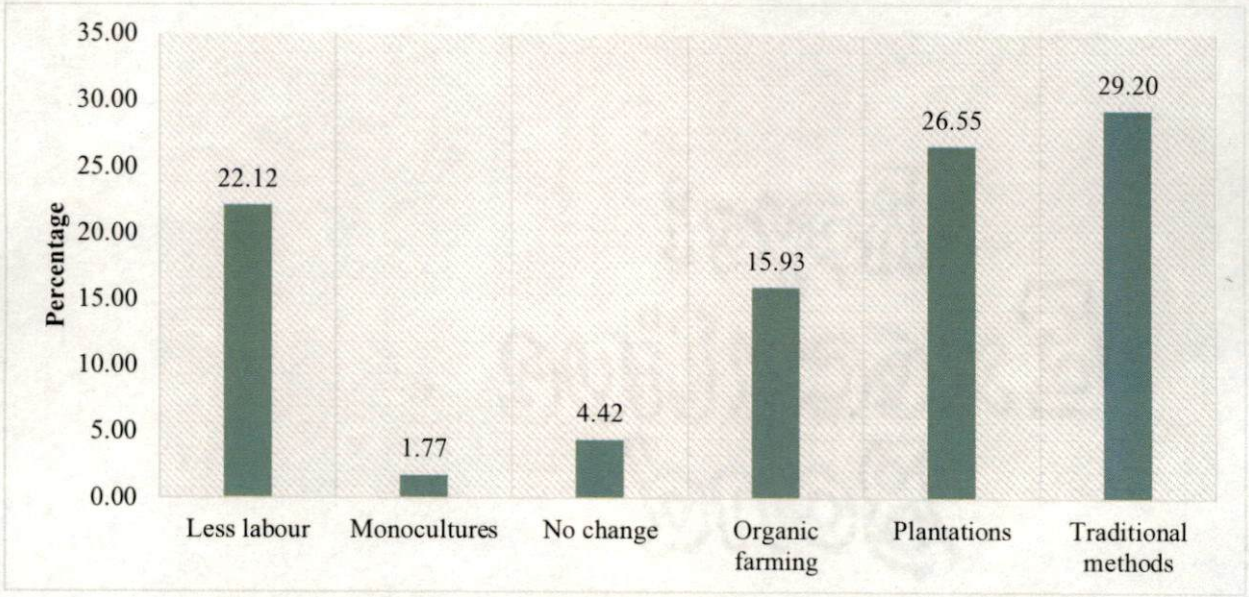

Figure 6. Farming practices at Alathur during the past 10 to 20 years (1990's)

The farming practices at Alathur for the past 10 to 20 years is shown in Figure 6. Of all the respondents, 26.55% reported the increase in the area under plantations and about 22.12% reported the decrease in labour availability. About 29.20% of the respondents continued the use of traditional farming methods, whereas, 15.93% resorted to organic farming.

4.3.4.1.3 Farming practices at Alathur during the past 20 to 30 years (1980's)

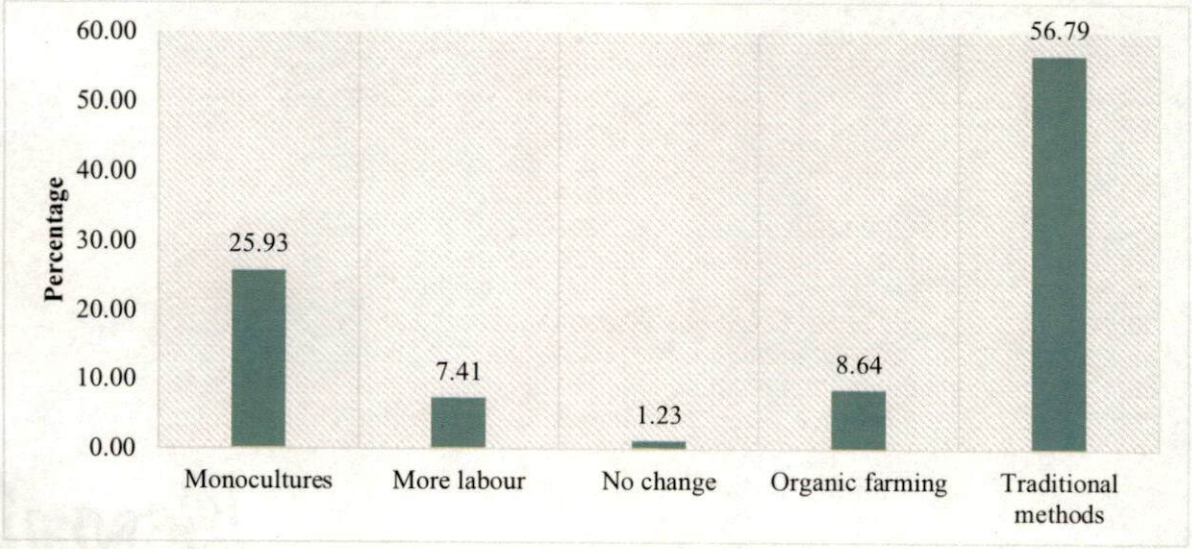

Figure 7. Farming practices at Alathur during the past 20 to 30 years (1980's)

As from Figure 7 during the past 20 to 30 years the use of traditional methods was reported by a majority of 56.79%. The dominance of monocultures were reported by 25.93%. Organic farming and the availability of labour was mentioned by 8.64% and 7.41% respectively.

4.3.4.2 Changes in the interface between people and forests at Alathur

The changes in in the interface between people and forests at Alathur with regard to protection, quality and illegal activities etc. in general for the past 10 years (2000's), 10 to 20 years (1990's), 20 to 30 years (1980's) according to the respondents is listed below.

4.3.4.2.1 Interface between people and forests at Alathur during the past 10 years (2000's)

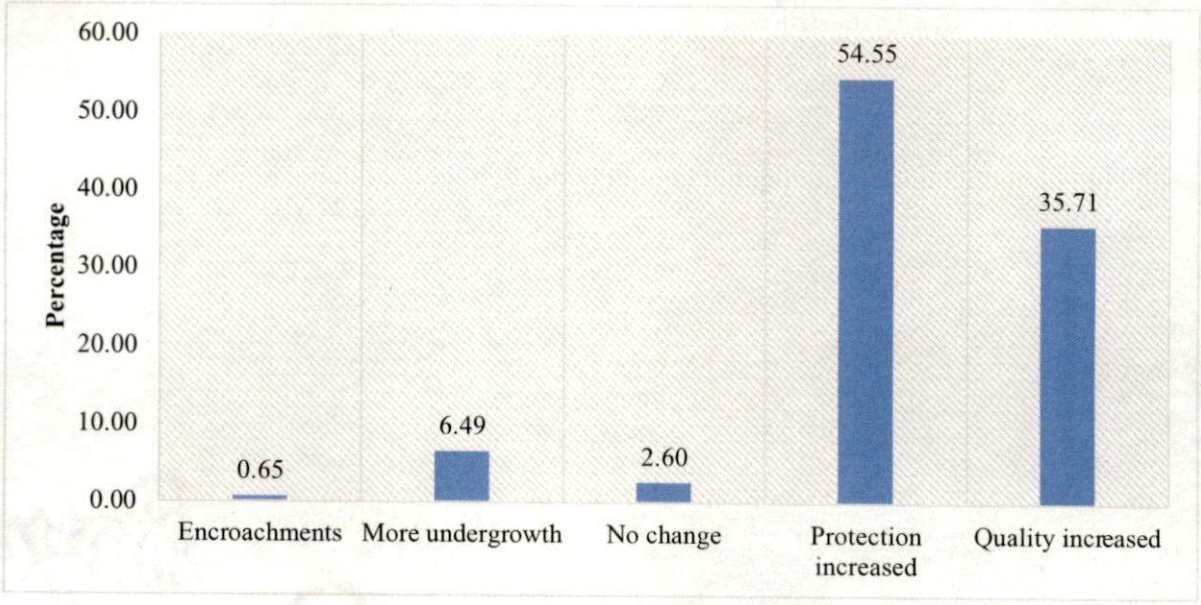

Figure 8. Interface between people and forests at Alathur during the past 10 years (2000's)

The changes in the interface between people and forest at Alathur is given in Figure 8. More than half of the respondents (54.55%) reported the increase in protection of the forests. About 35.71% and 6.49% noted the increase in quality of the forest and presence of more undergrowth, respectively.

4.3.4.2.2 Interface between people and forests at Alathur during the past 10 to 20 years (1990's)

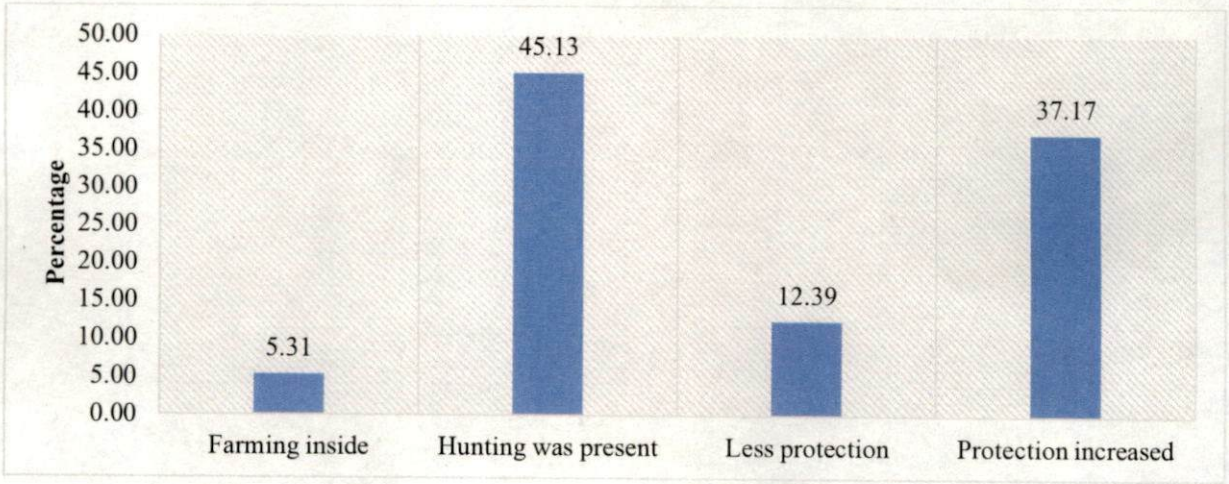

Figure 9: Interface between people and forests at Alathur during the past 10 to 20 years (1990's)

The changes in the interface between people and forests at Alathur during the past 10 to 20 years is represented by Figure 9. A majority of 43.13% respondents reported that hunting was present in the forests of Alathur. Whereas, 37.17% reported that protection of the forests increased; but this was contradicted by 12.39%. Only 5.31% mentioned that farming was present inside the forests.

4.3.4.2.3 Interface between people and forests at Alathur during the past 20 to 30 years (1980's)

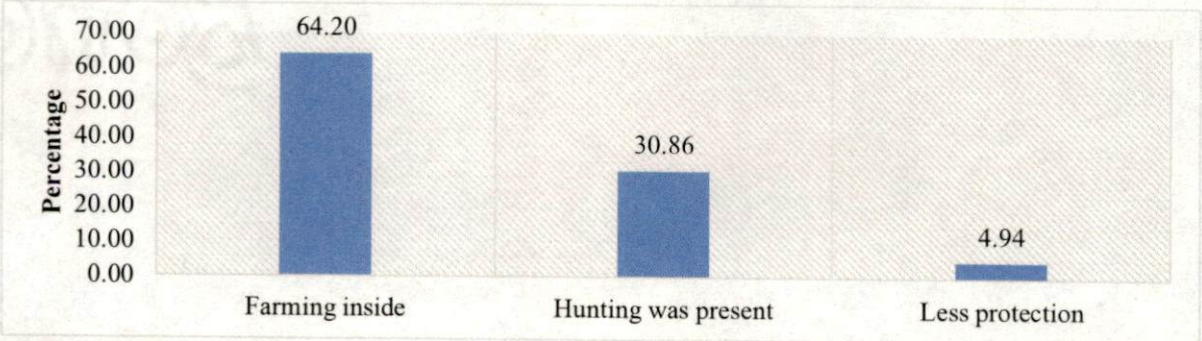

Figure 10: Interface between people and forest of Alathur during the past 20 to 30 years (1980's)

The study on the Interface between people and forests of Alathur during the past 20 – 30 years (1980's) observed a majority of the respondents reporting farming (64.20%) and hunting (30.86%) present inside the forests. Less protection of the forests was reported by 4.94% (Figure 10).

4.3.4.3 Cropping pattern at Alathur

The study observed considerable changes in the cropping pattern at Alathur during the past 30 years. The changes are classified and listed below at intervals of the past 10 years (2000's), 10 to 20 years (1990's) and the past 20 to 30 years (1980's).

4.3.4.3.1 Changes in cropping pattern at Alathur for the past 10 years (2000's)

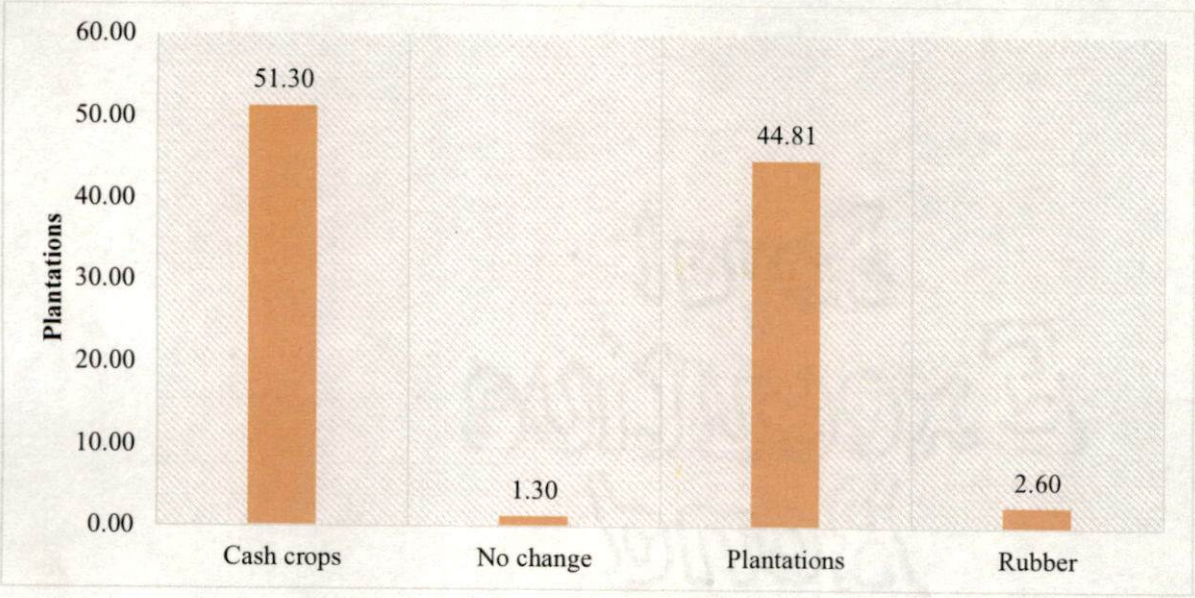

Figure 11. Cropping pattern at Alathur during the past 10 years (2000's)

The study on the cropping pattern during the past 10 years (2000's) at Alathur observed a majority of respondents reporting cash crops (51.30%) and plantation crops (44.81%) to be the most cultivated crops, respectively (Figure 11).

4.3.4.3.2 Cropping pattern at Alathur for the past 10 to 20 years (1990's)

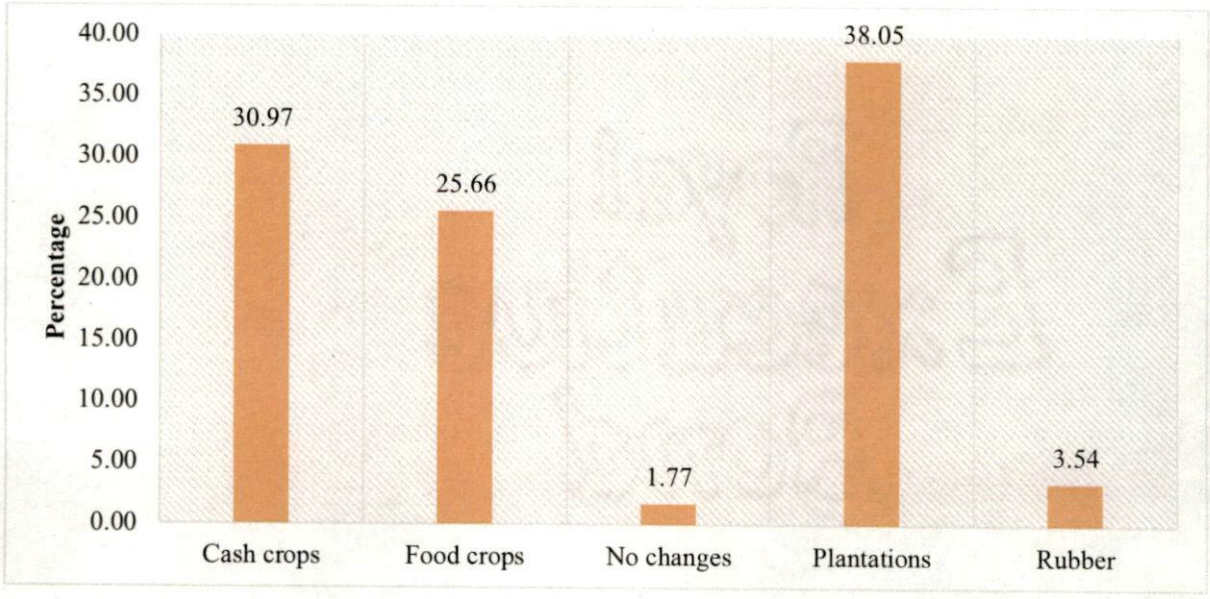

Figure 12. Changes in cropping pattern at Alathur during the past 10 to 20 years (1990's)

The study on the cropping pattern during the past 10 to 20 years (1990's) at Alathur (Figure 12), observed a majority of respondents reported the cultivation of plantation crops (38.05%), followed by cash crops (30.97%) and food crops (25.66%).

4.3.4.3.3 Cropping pattern at Alathur during the past 20 to 30 years (1980's)

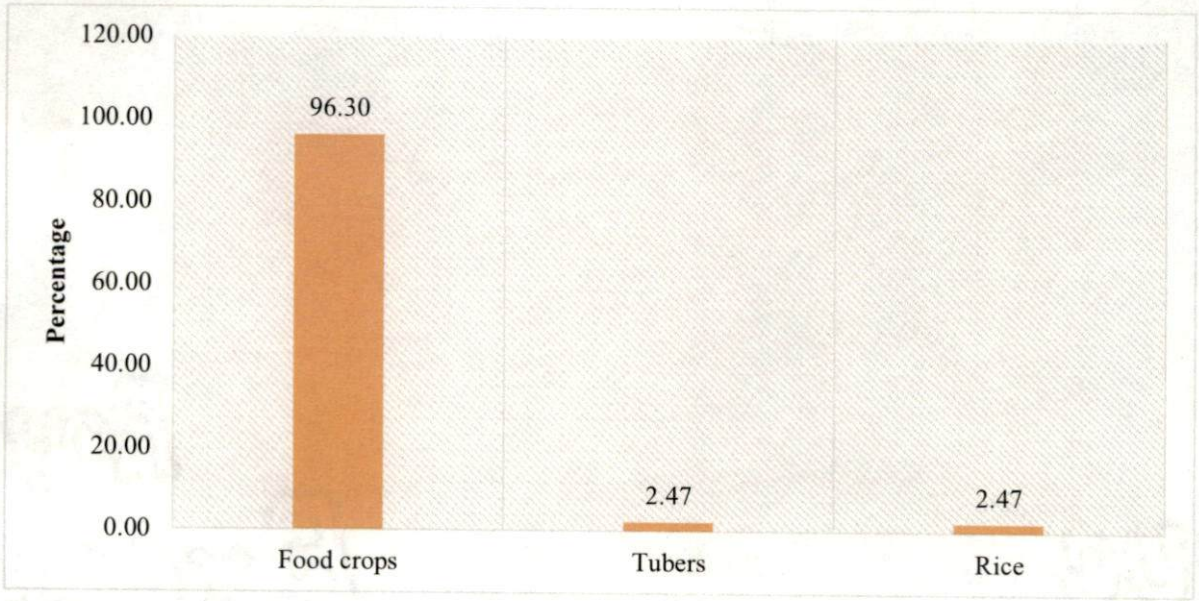

Figure 13. Cropping pattern at Alathur during the past 20 to 30 years (1980's)

As is evident from Figure 13, cultivation of food crops was the major farm activity at Alathur during the past 20 to 30 years (96.30%). Cultivation of rice and tubers was only a marginal activity (2.47% each) as per the respondents.

4.3.5 Awareness and attitude of people

4.3.5.1 Opinion regarding who should take responsibility for reducing conflict with wildlife?

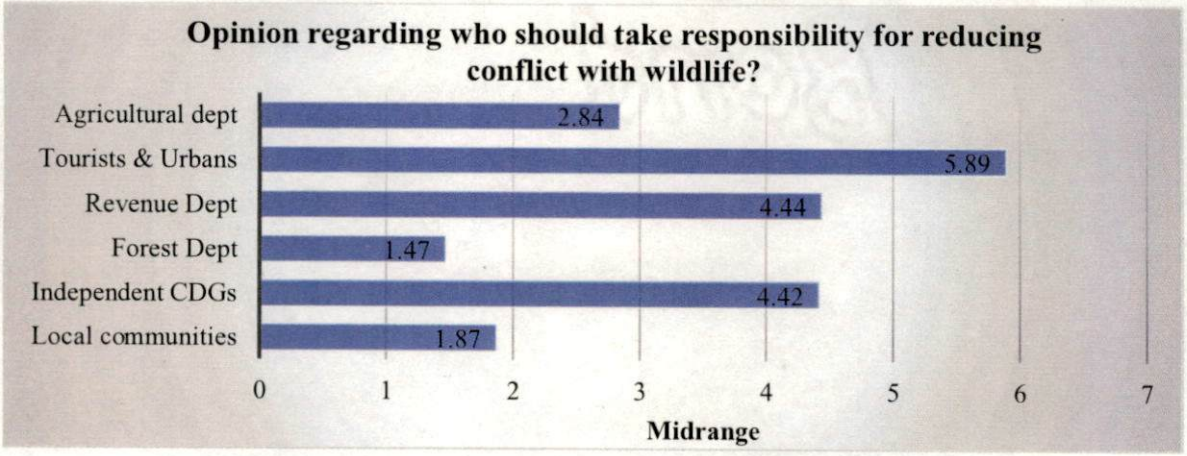

Figure 14. Opinion regarding who should take responsibility for reducing conflict with wildlife?

The respondent's opinion regarding 'who should take responsibility for reducing conflict with wildlife' was recorded (Figure 14). The respondents found the forest department as the most suitable with a midrange value of 1.47 which was followed by the local people with the value of 1.87. The scores for others are as follows - Agricultural department (2.84), Independent NGO's (4.42), Revenue department (4.44), and tourists and urbans (5.89).

4.3.5.2 Opinion regarding why should wildlife be protected and conserved?

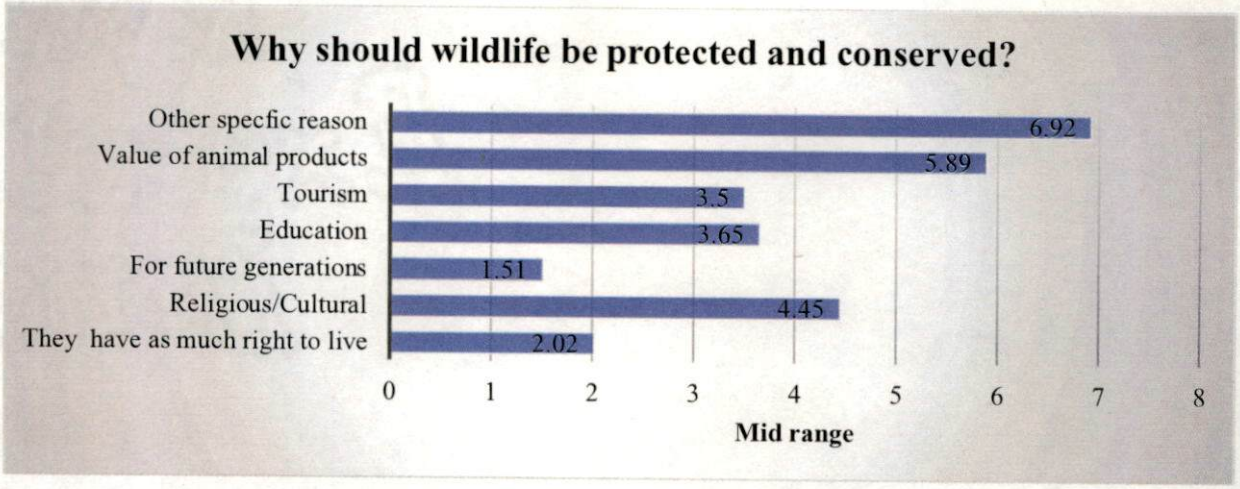

Figure 15. Opinion regarding why should wildlife be protected and conserved?

For the question regarding why wildlife should be protected and conserved the respondents at Alathur gave the opinion "for future generation" as the best option with a score of 1.51, the second best option was that They i.e. animals have as much right to live as humans do with a score of 2.02, protection and conservation of animals for tourism got a score of 3.5, education got a score of 3.65, religious/cultural importance got a score of 4.45, value of animal products got a score of 5.89 and other specific reasons got a score of 6.92 (Figure 15).

4.3.5.3 Opinion regarding factors which are more important when choosing a conflict mitigation scheme.

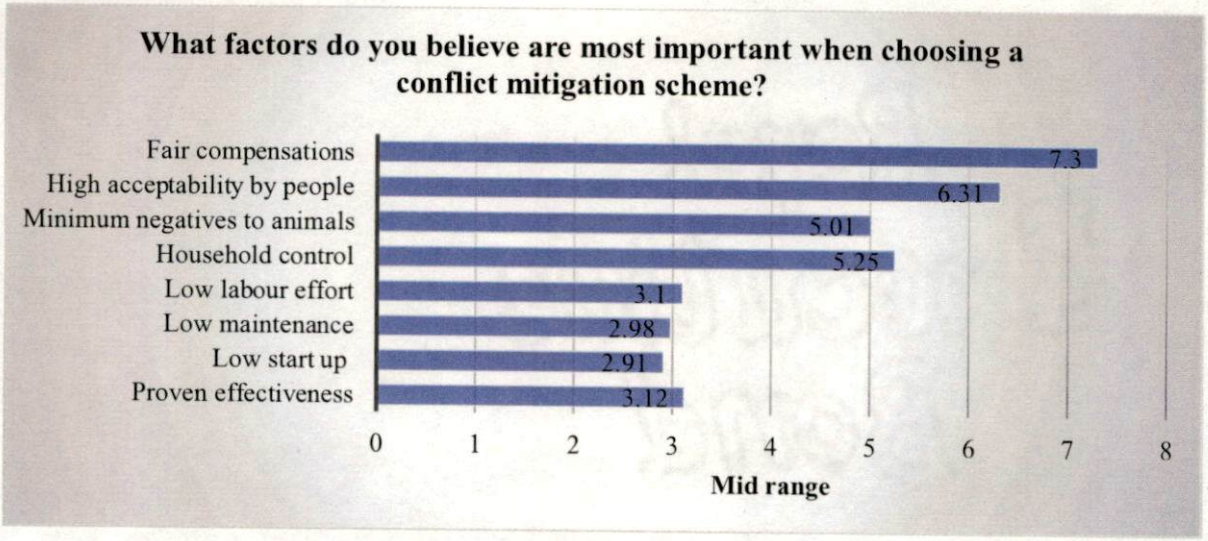

Figure 16. Opinion regarding factors which are more important when choosing a conflict mitigation scheme.

Regarding the results presented in Figure 16 what factors are most important for choosing a conflict mitigation scheme at Alathur the respondents found low start-up cost (Initial money spent for a particular mitigation strategy) as the best one with a score of 2.91 followed by low maintenance with a score of 2.98, 3.1 for low labour effort, 3.12 for proven effectiveness, household control with a score of 5.25 minimum negatives to animals with a score of 5.01, 6.31 for high acceptability by people and the last option was fair compensations with a score of 7.3.

4.3.6 Attitude towards wildlife and conflict.

Table 11. Attitude towards wildlife and conflict.

Attitude towards wildlife and conflict										
Si No	Statements	SA		A		N		D		SD	
		F	%	F	%	F	%	F	%	F	%
1	Wildlife Should be conserved	97	59.50	60	36.80	3	1.84	3	1.84	0	0
2	Wildlife is getting more priority than Humans	76	46.62	65	39.87	20	12.26	2	1.22	0	0
3	People should be given the rights to protect their land by any means	70	42.94	53	32.51	20	12.26	9	5.52	11	6.74
4	Conservation policies of the Government is not up to the mark	34	20.85	49	30.06	34	20.85	32	19.63	14	8.58
5	Government should keep a check on wild animals by lethal means	58	35.58	40	24.53	16	9.81	25	15.33	24	14.72
6	HWC mitigation by the Government is effective	21	12.88	30	18.40	44	26.99	29	17.79	39	23.92

Note: SA- Strongly agree, A-Agree, N-Neutral, D-Disagree, SD-Strongly disagree

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The attitude towards wildlife and conflict of the respondents at Alathur was measured and is presented in Table 11. A majority of respondents strongly agreed for the statements "Wildlife should be conserved" (59.50%) and "Wildlife is getting more priority than humans" (46.62%), respectively. The statements "People should be given the rights to protect their land by any means" and "Government should keep a check on wild animals by lethal means" were also strongly agreed upon by a majority, 42.97% and 35.58%, respectively. A majority (30.06%) agreed to the statement "Conservation policies of the government is not up to the mark. Whereas, a majority (26.99%) remained neutral towards the statement that "Human wildlife conflict mitigation by the government is effective".

4.3.7 Mitigation strategies

4.3.7.1 Opinion regarding best method to mitigate crop raiding at Alathur

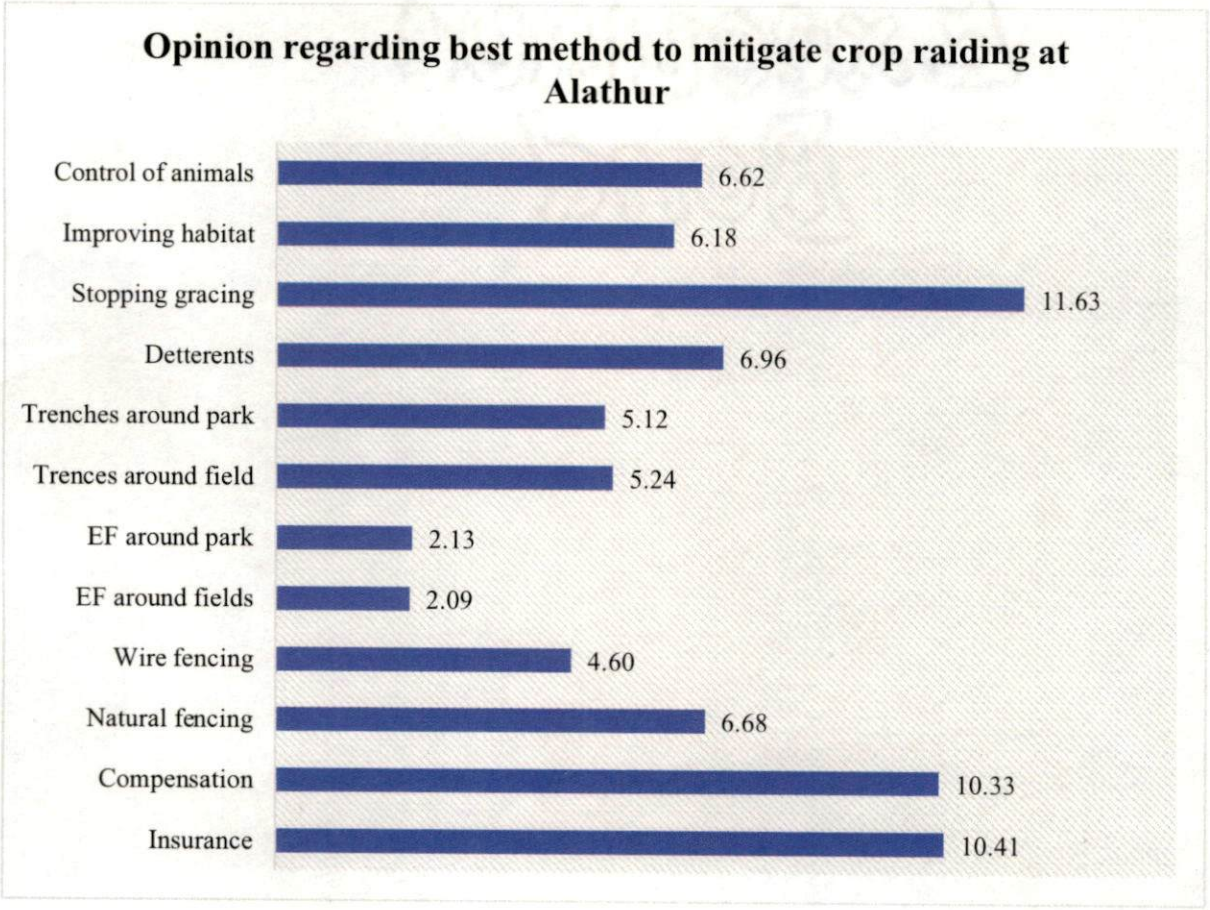

Figure 17: Opinion regarding best method to mitigate crop raiding at Alathur

Based on the respondent's opinion at Alathur on the best method to mitigate crop raiding (Figure 17) was to use electric fencing around farmer's field (2.09). Electric fencing around the park obtained a score of 2.13 and wire fencing obtained a score of 4.60.

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4.3.7.2 Opinion regarding best method to mitigate livestock depredation at Alathur

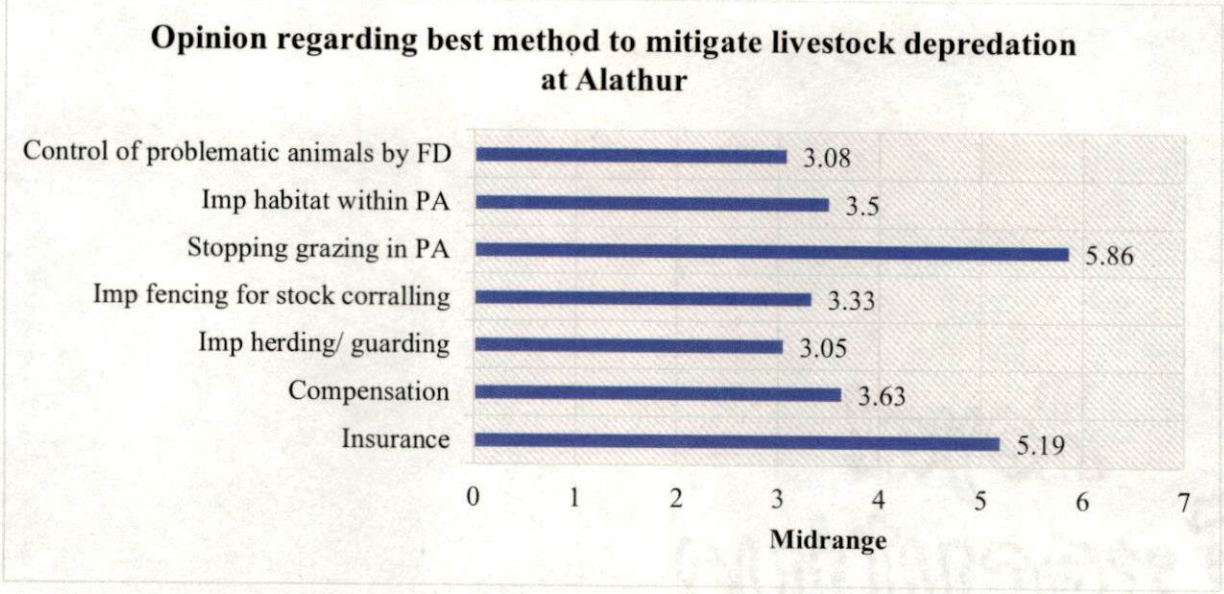

Figure 18: Opinion regarding best methods to mitigate livestock depredation at Alathur

As the best method to mitigate livestock depredation Figure 18 the respondents at Alathur selected improved guarding/ herding as the best option with a score of 3.05, control of problematic animals by forest department obtained a score of 3.08, improved fencing and stock corralling obtained a score of 3.33.

4.4 KOLLENGODE RANGE

4.4.1 Socio-economic situation of the respondents

The Kollengode range of Nemmara division have a total forest area of 6115.66 ha and this area fully belongs to the vested forest category. After preliminary survey and with the help of focus group discussions the following areas were selected for the study (Table 12).

Table 12. List of locations studied in Kollengode forest range

SI no	Location studies	Range
1	Kolumb	Kollengode
2	Koomanadi	Kollengode
3	Chappakaadu	Kollengode
4	Kalmukku	Kollengode
5	Malayankodu	Kollengode
6	Pulizhanthoni	Kollengode
7	Kaarottupara	Kollengode
8	Muthalamada	Kollengode
9	Vellaramkadavu	Kollengode
10	Parashery	Kollengode
11	Vattakadu	Kollengode

A total of 110 individuals were surveyed and the observation of gender and age class distribution among the respondents is given in Table 13. Males constituted 86.26 % and the remaining 13.64% were females. The age class distribution shows that a majority of 57.27 % were between 41-60 years, 21.82% were between the ages 21-40, above 60 years were represented by 20 % and below 20 years was 0.91%.

Table 13. Gender and age class distribution of respondents at Kollengode

Variable	Category	Frequency	Percentage
Gender	Male	95	86.36
	Female	15	13.64
Age	Below 20(including 20)	1	0.91
	21-40	24	21.82
	41-60	63	57.27
	Above 60	22	20.00

The educational and economics status of the people is presented in Table 14. A maximum of 35.45% have received education up till high school level. Of all the respondents 26.36% were illiterate with no formal education. Economically a majority of the respondents 53.64% were below the poverty line.

Table 14. Educational and economic status of respondents at Kollengode

Variable	Category	Frequency	Percentage
Education	Illiterate	29	26.36
	LP&UP	34	30.91
	High School	39	35.45
	Higher Secondary	4	3.64
	Above Higher Secondary	4	3.64
Economic Status	APL (Above poverty line)	51	46.36
	BPL (Below poverty line)	59	53.64

Occupational status of the people surveyed is given in Table 15 and from the table it is clear that a majority of 65.45 % are engaged in agriculture 20.91 % were waged laborers.

Table 15. Occupational status of respondents at Kollengode

Variable	Category	Frequency	Percentage
Occupational Status	Driver	2	1.82
	Herding	1	0.91
	Agriculture	72	65.45
	Waged labour	23	20.91
	Government servant	1	0.91
	Milk business	1	0.91
	Business and farming	1	0.91
	Watcher	1	0.91
	Unemployed	8	7.27

4.4.2. Nature and distribution of human-wildlife conflicts at Kollengode

4.4.2.1 Type of human wildlife conflict.

Table 16. Type of human-wildlife conflict.

SI no	Type of human wildlife conflict in percentage % (Kollengode)	Frequency	Percentage
1	Crop raiding	82	74.55
2	Livestock depredation	23	20.91
3	Attacked people	0	0.00
4	Other conflicts	2	1.82
5	Crop raiding / Livestock Depredation	82	2.73

The type of human wildlife conflicts at Kollengode is given in Table 16. A majority of respondents reported wildlife conflicts related crop raiding by animals (74.55%) and livestock depredation (20.91%).

4.4.2.2 Problematic animals of Kollengode.

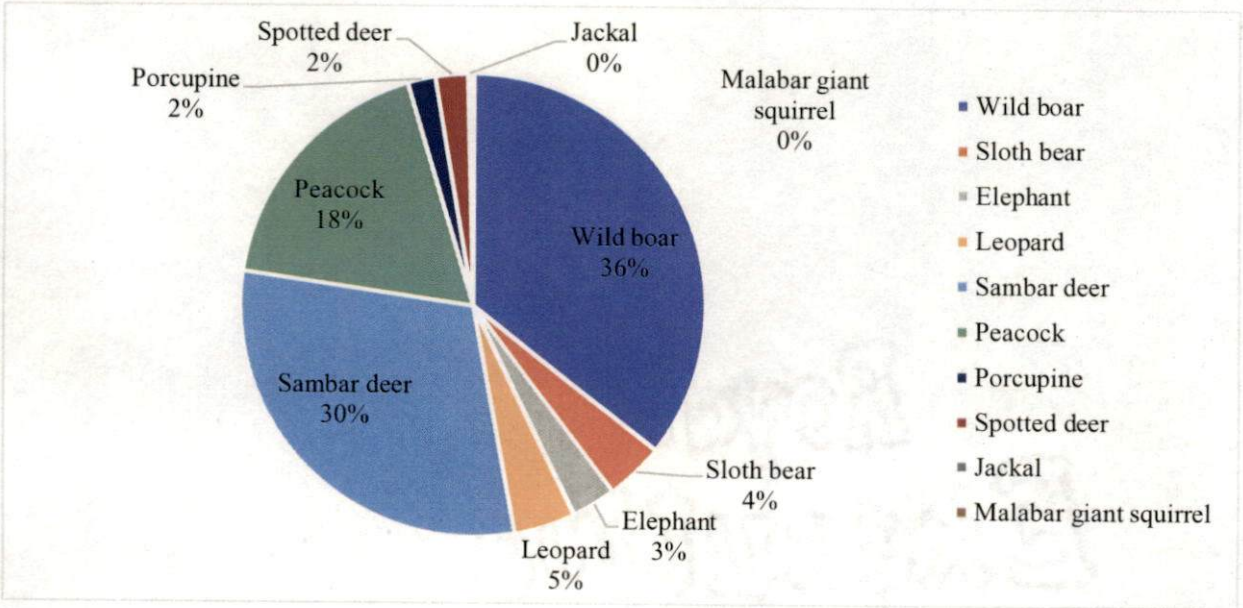

Figure 19. Animals causing most damage at Kollengode

The problematic animals at Kollengode were surveryed and listed (Figure 19). Wild boar (*Sus scrofa*) was found to be the most problematic animal which accounted to about 36% of all the wild animal induced damages. Sambar deer (*Cervus unicolor*) accounted 30% of the damage. Peacock (*Pavo cristatus*) induced damages were 18 % and that for leopard (*Panthera pardus*) was 5%.

4.4.2.3 Problematic animal species with type of damage/conflict and time of activity

Table 17. Problematic animal species with type of damage/conflict and time of activity

SI No	Animal Species	Type of damage/conflict	Time of activity
1	Wild boar	Whole area disturbed	Night
2	Sambar deer	Vegetables	Night
3	Peacock	Flushes and shoots	Day
4	Leopard	Fear	Night
5	Sloth bear	Fear	Night
6	Elephant	Whole area disturbed	Night
7	Spotted deer	Vegetables	Night
8	Porcupine	Fruits	Night
9	Jackal	Hens	Night
10	Malabar giant squirrel	Coconut and fruits	Night

Table 17 presents the observations regarding the type of damage/conflict and time of activity of the animals at Kollengode. Wild boars and elephants were found out to disturb the whole area searching for grubs and worms. Deer species like the sambar and the spotted deer were found to damage vegetables. Peacocks damaged the flushes and new shoots of plants. Leopard and sloth bears caused fear in the villagers. Expect for peacocks all the other animals were found to be active during the night time.

4.4.2.4 Changes perceived about wild animals at Kollengode.

The changes perceived about wild animals according to the respondents at Kollengode for the past 10 years (2000's), 10 to 20 years (1990's) and 20 to 30 years (1980's) were analysed separately and the results are given below.

4.4.2.4.1Wild animals at Kollengode during the past 10 years (2000's)

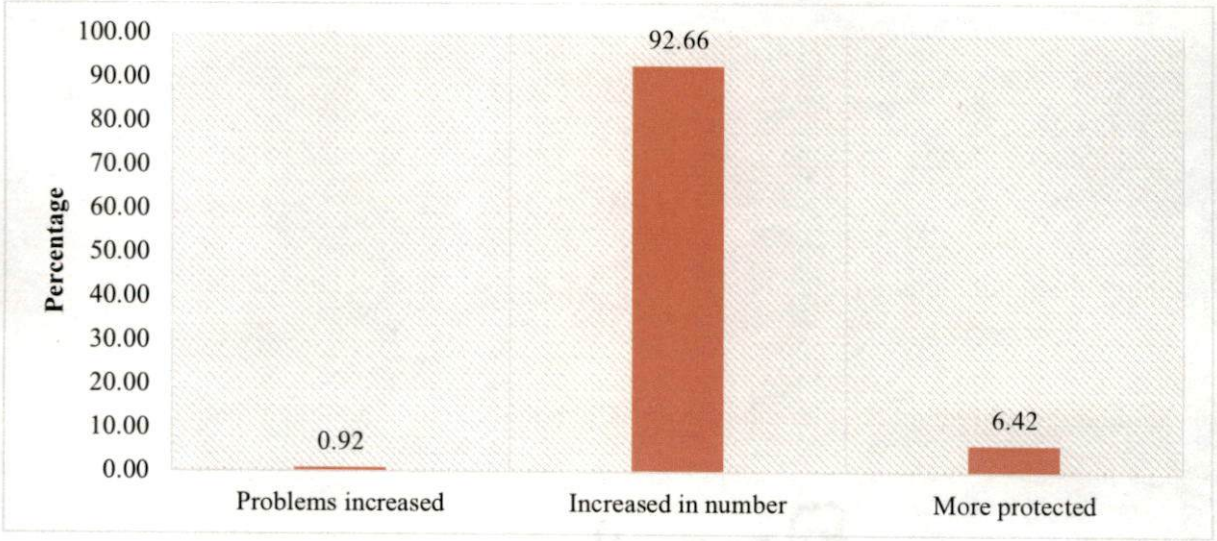

Figure 20. Wild animals at Kollengode during the past 20 to 30 years (2000's)

The change in the number of wild animals at Kollengode is shown in Figure 20. A majority of respondents (92.66%) reported that the number of wild animals have increased.

4.4.2.4.2 Wild animals at Kollengode during the past 10 to 20 years (1990's)

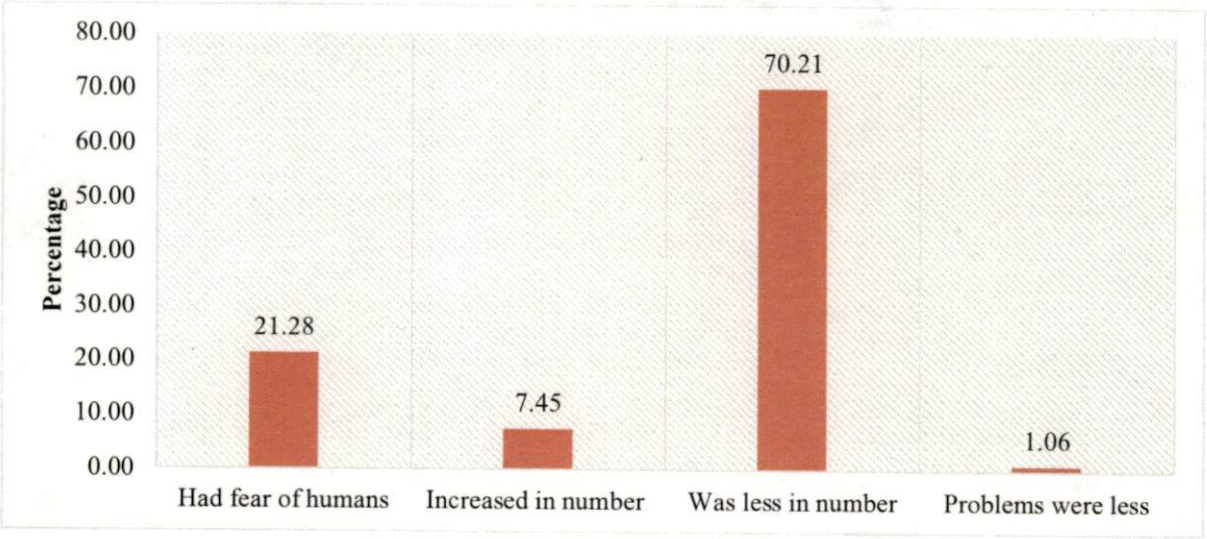

Figure 21. Wild animals at Kollengode during the past 10 to 20 years (1990's)

The changes in wild animals at Kollengode is presented in Figure 21. A majority of the respondents reported that animals were less in number (70.21%). Whereas 21.28% reported that the animals had fear of humans.

4.4.2.4.3 Wild animals at Kollengode during the past 20 to 30 years (1980's)

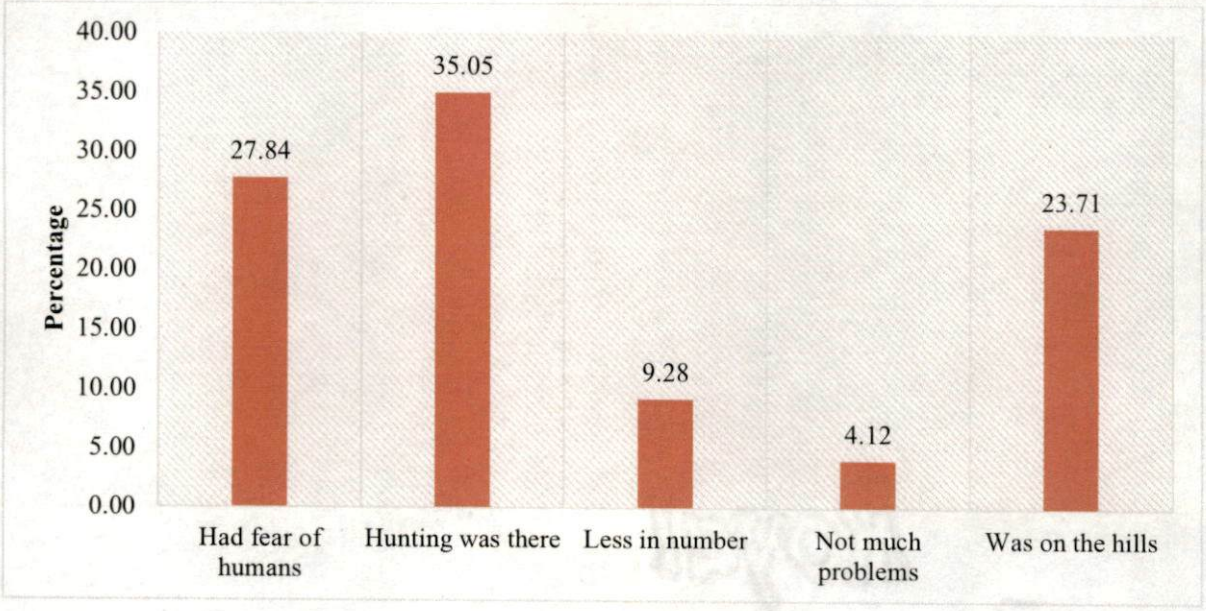

Figure 2. Wild animals at Kollengode during the past 20 to 30 years (1980's)

Figure 22 shows the change in wild animals at Kollengode for the past 20 to 30 years for which a majority of 35.05% reported that hunting was present. A percentage of 27.84 mentioned that animals had fear of humans. Interestingly 23.71 % reported that the animals were on the hills.

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4.4.3.4 Perceived reasons for crop raiding at Kollengode range

Table 18. Perceived reasons for crop raiding at Kollengode

SI No	Reasons for crop raiding										
	Statements	SA		A		N		D		SD	
		F	%	F	%	F	%	F	%	F	%
1	There are too many wild animals	71	64.55	38	34.55	1	0.91	0	0.00	0	0.00
2	Farm owners have been negligent	4	3.64	3	2.73	2	1.82	10	88.17	4	3.64
3	There is insufficient food in the forest	51	46.36	43	39.09	6	5.45	7	6.36	3	2.73
4	Livestock that graze in the forest push wildlife out	0	0.00	15	13.64	15	13.64	37	33.64	43	39.09
5	The government fails to keep wildlife in the park	45	40.91	53	48.18	8	7.27	2	1.82	2	1.82
6	Climate change	13	11.82	48	43.64	21	19.09	24	21.82	4	3.64
7	Deforestation and habitat loss	17	15.45	15	13.64	9	8.18	49	44.55	20	18.18

(SA-Strongly agree, A-Agree, N-Neutral, D-Disagree, SD- Strongly disagree)

The perceived reasons for crop raiding is presented in Table 18. The study observed that a majority of respondents (64.55%) strongly agreed to "There are too many wild animals". Whereas, a majority of respondents (88.17%) was in disagreement with the statement "Farm owners have been negligent". For the statement "There is insufficient food in the forest "a majority of 46.36% strongly agreed and the statement "Livestock that graze in the forest push wildlife out" was strongly disagreed by a majority (39.09%). About 48.18% and 43.64% of the

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respondents agreed to the statements "The government fails to keep the wildlife in the park" and "climate change", respectively. Whereas the statement "deforestation and habitat loss was disagreed by a majority of 44.55%.

4.4.3.5 Perceived reasons for livestock depredation

Table 1. Perceived reasons for livestock depredation at Kollengode

Si No	Reasons for livestock depredation										
	Statements	SA		A		N		D		SD	
		F	%	F	%	F	%	F	%	F	%
1	There are too many wild animals	89	80.77	21	19.23	0	0.00	0	0.00	0	0.00
2	Livestock owners have been negligent	4	3.85	21	19.23	25	23.08	42	38.46	17	15.38
3	There are too many livestock	0	0.00	0	0.00	17	15.38	38	34.62	55	50.00
4	There is not enough wild prey in the forest	0	0.00	0	0.00	17	11.54	38	57.69	55	30.77
5	Livestock are taken because they graze in the forest	0	34.62	0	50.00	13	7.69	63	0.00	34	7.69
6	The GOV fails to keep the wildlife in the park	38	46.15	55	26.92	8	23.08	0	0.00	8	3.85

(SA-Strongly agree, A-Agree, N-Neutral, D-Disagree, SD-Strongly disagree)

The perceived reasons for livestock depredation is presented in Table 19. A majority of 80.77% strongly agreed to the statement that "There are too many wild animals". All the three statements "Livestock owners have been negligent", "There are too many livestock" and "There is not enough wild prey in the forest" was disagreed by a majority of 38.46%, 34.62% and 57.69% respectively. Whereas the statement "livestock are taken because they graze in the forest" was agreed by a majority of 50%. A total of 46.15% strongly agreed to the statement "The government fails to keep the wildlife in the park".

4.4.4. Land use and land cover change pattern

The land use and land cover change pattern was analysed by both the interview schedule method and as well as the time line method used during the PRA exercises. Accordingly, the land use and land cover change pattern was studied based on change in the interface between people and forests, change in farming practices and also by studying the change in cropping pattern and the results are as listed below.

4.4.4.1 Change in farming practices at Kollengode during the past 30 years

The farming practices at Kollengode was studied separately for the past 10 years (2000's), 10 to 20 years (1990's) and for the past 20 to 30 years (1980's).

4.4.4.1.1 Farming practices at Kollengode during the past 10 years (2000's)

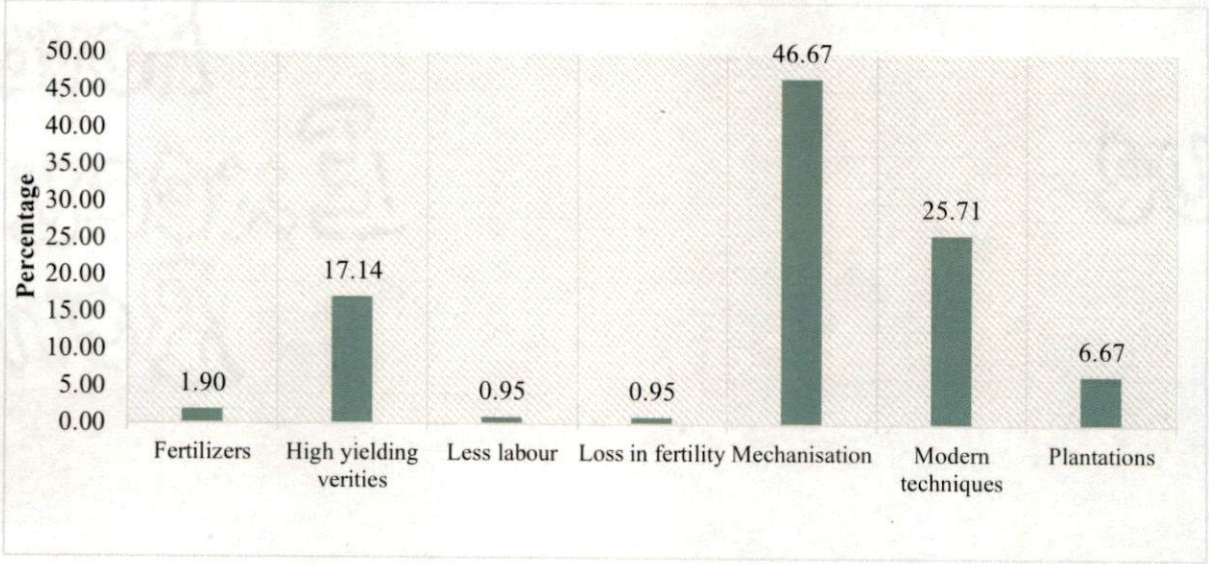

Figure 23. Farming practices at Kollengode during the past 10 years (2000's)

The farming practices at Kollengode is presented in Figure 23. A majority of 46.67% and 25.71% reported the use of mechanisation and modern techniques in farming. The availability and use of better and high yielding varieties were reported by 17.14%. The increase in plantations was reported by 6.67%.

4.4.4.1.2 Farming practices at Kollengode during the past 10 to 20 years (1990's)

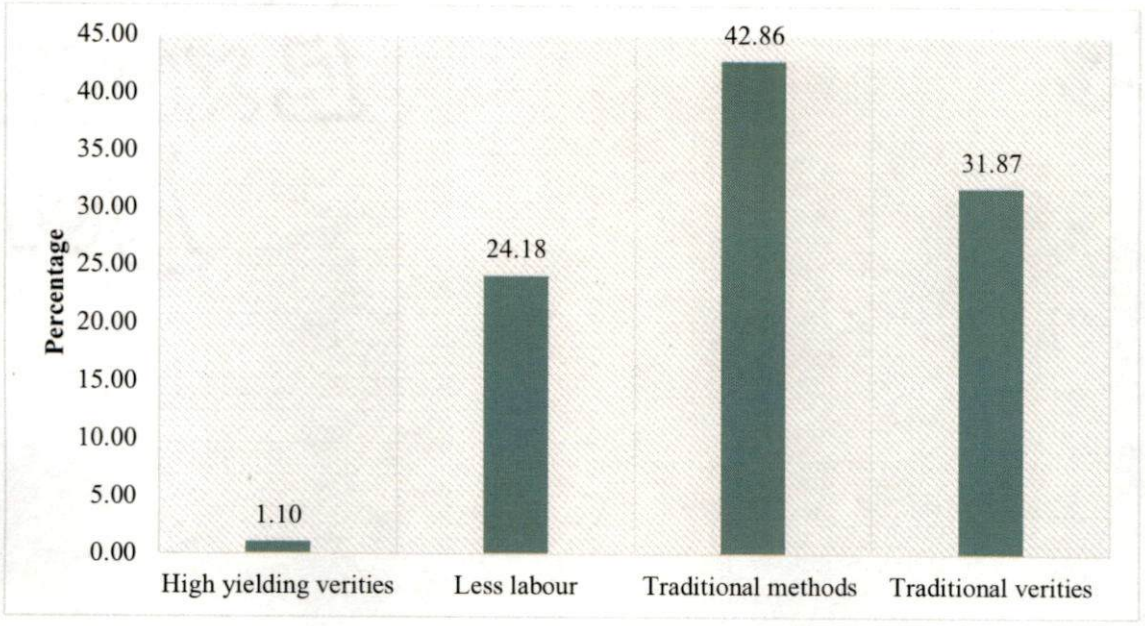

Figure 24. Farming practices at Kollengode during the past 10 to 20 years (1990's)

Farming practices at Kollengode presented in Figure 24 reveals that a majority of 42.86% reported the use of traditional methods. The use of traditional varieties were reported by 31.87% of the respondents, whereas the low availability of labour was pointed out by 24.18%.

4.4.4.1.3 Farming practices at Kollengode during the past 20 to 30 years (1980's)

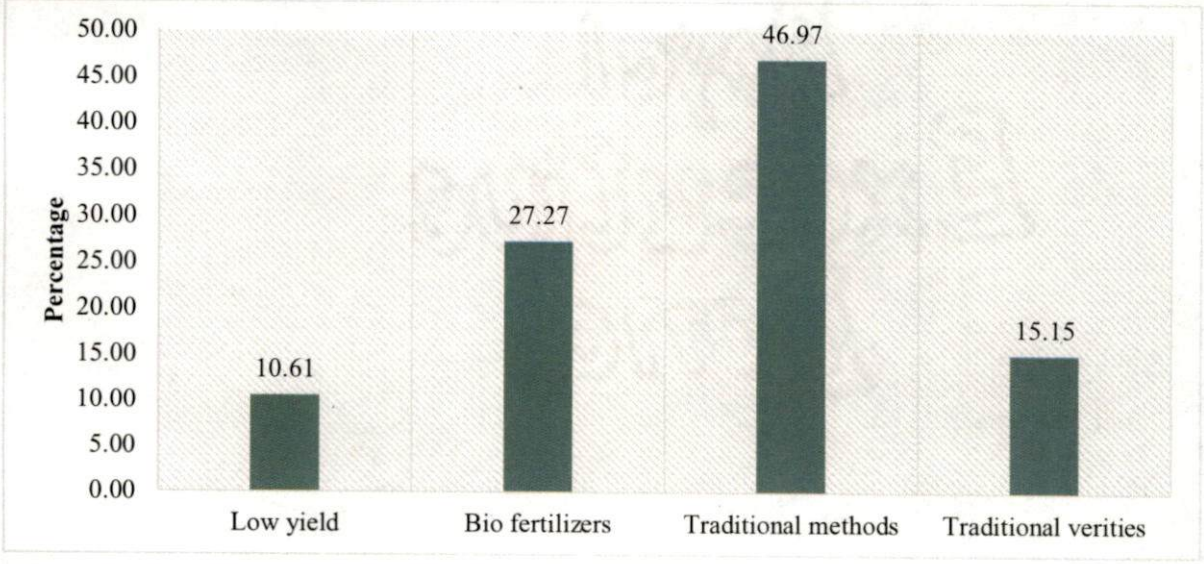

Figure 25. Farming practices at Kollengode during the past 20 to 30 years (1980's)

A majority of 46.97% reported the use of traditional methods and the use of traditional varieties were mentioned by 15.15%. The use of bio fertilizers was highlighted by 27.27% and it was an interesting point that the yield was low during that time and was reported by 10.61%.

4.4.4.2 Change in the interface between people and forests at Kollengode

The changes in the interface between people and forests at Kollengode with regard to protection, quality and illegal activities etc. in general for the past 10 years, 10 to 20 years, 20 to 30 years according to the respondents is listed below.

4.4.4.2.1 Interface between people and forests at Kollengode during the past 10 years (2000's)

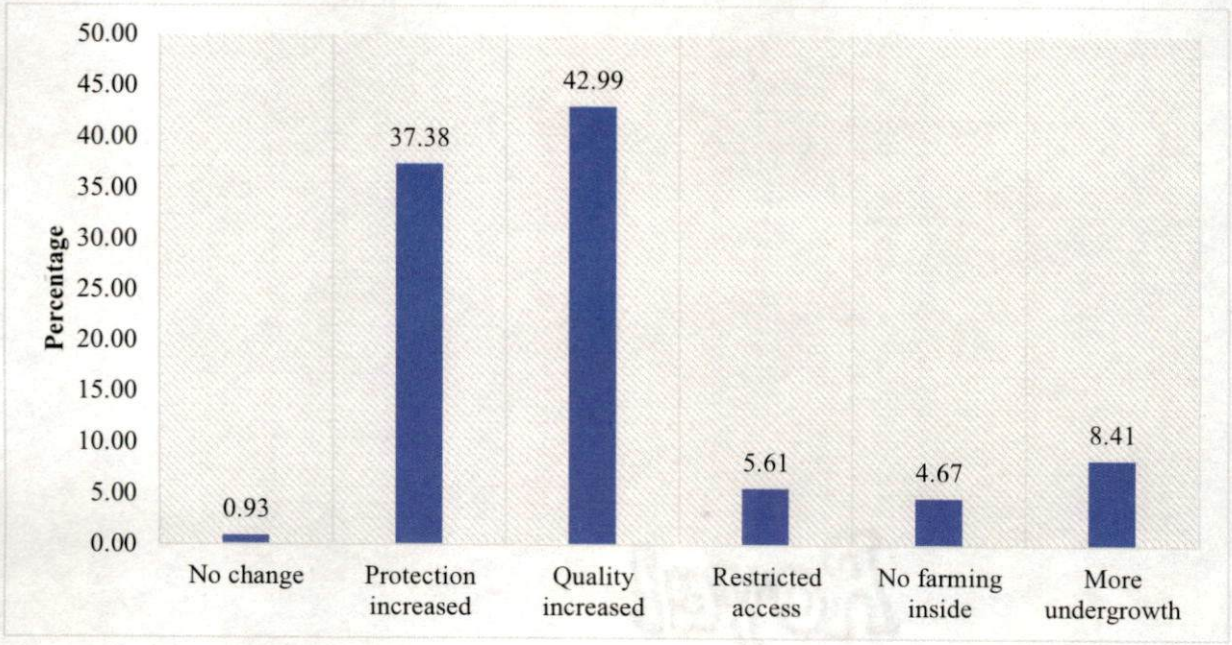

Figure 26. Interface between people and forests at Kollengode during the past 10 years (2000's)

As for the forests at Kollengode during the past 10 years (Figure 26) a majority of 42.99% reported that the quality increased. The increase in protection was mentioned by 37.38%.

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4.4.4.2.2 Interface between people and forests at Kollengode during the past 10- 20 years (1990's)

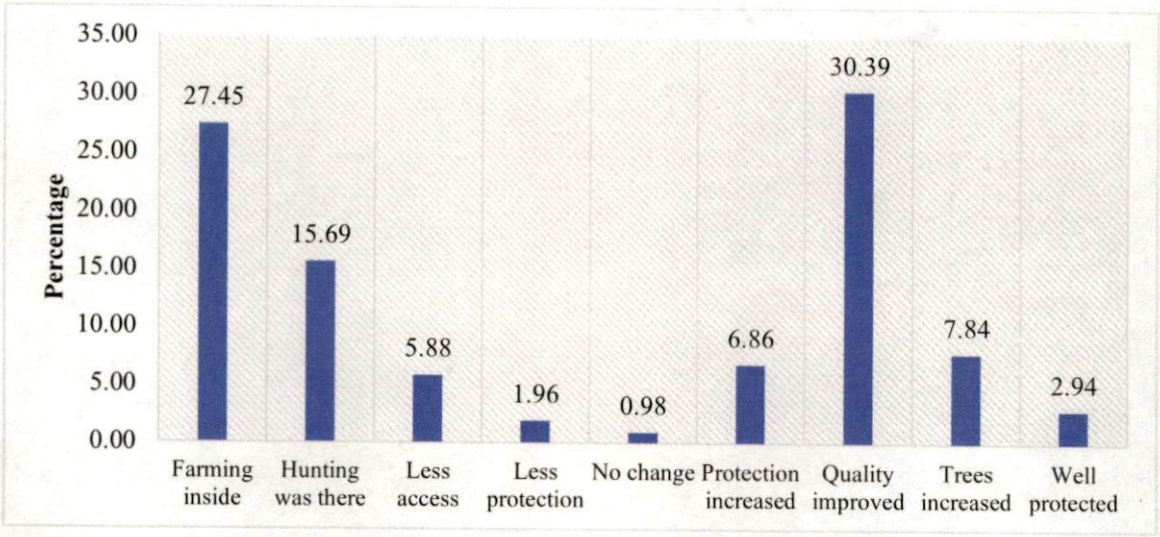

Figure 27. Interface between people and forests at Kollengode during the past 10- 20 years (1990's)

The forests at Kollengode during the past 10 to 20 years is presented in Figure 27. A majority of 30.39% reported that the quality of forest improved. Farming and hunting inside the forest was reported by 27.45% and 15.69% respectively.

4.4.4.2.3 Interface between people and forests at Kollengode during the past 20- 30 years (1980's)

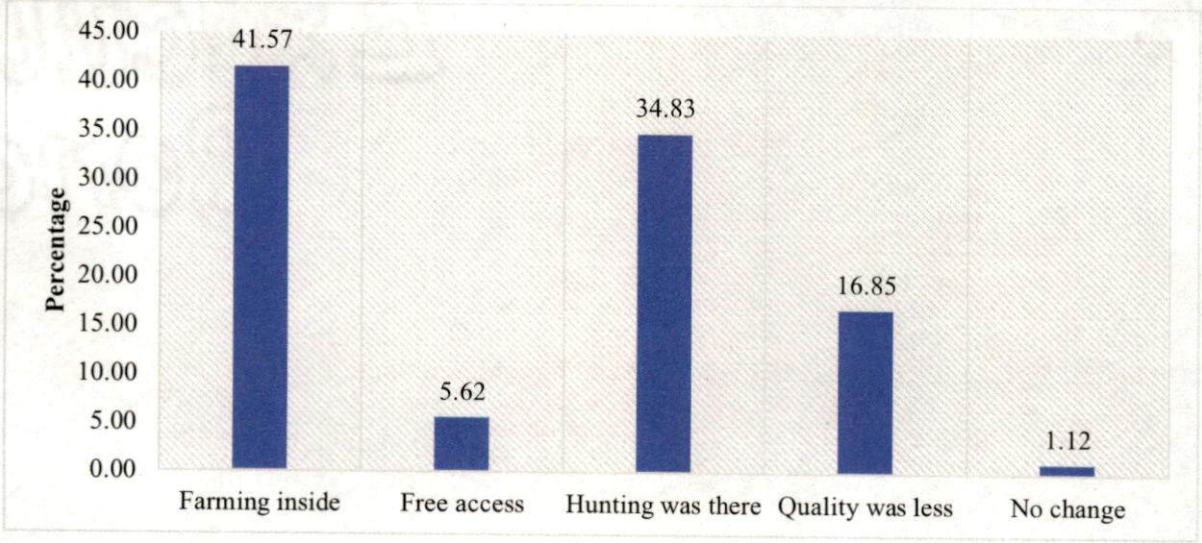

Figure 28. Interface between people and forests at Kollengode during the past 20- 30 years (1980's)

About of 41.57% and 34.83% of the respondents reported farming and hunting, respectively, to be present inside the forest. About 16.85% reported that quality to be low and 5.62% reported that there was free access to the forest.

4.4.4.3 Changes in cropping pattern at Kollengode during the past 30 years

The study on the cropping pattern at Kollengode shows considerably changes during the past 30 years. These changes are listed below at intervals of the past 10 years (2000's), 10 to 20 years (1990's) and the past 20 to 30 years (1980's).

4.4.4.3.1 Cropping pattern at Kollengode for the past 10 years (2000's)

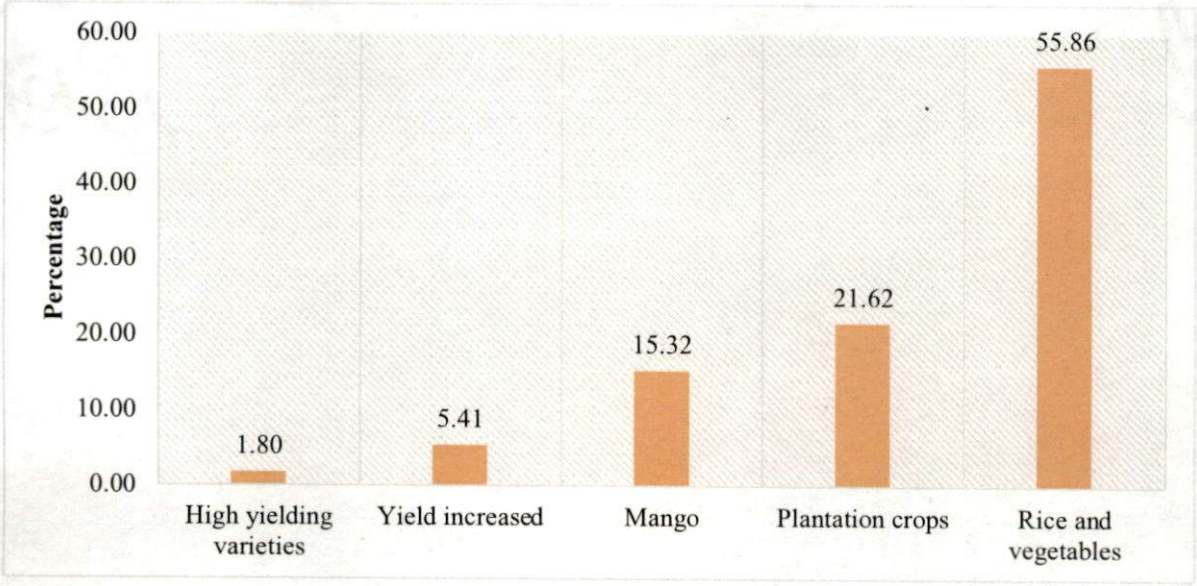

Figure 29. Cropping pattern at Kollengode during the past 10 years (2000's)

The cropping pattern at Kollengode during the past 10 years is presented in Figure 29. A majority of 55.86% reported rice and vegetables as the major crops. The increase in plantation crops and mango orchards were reported by 21.62% and 15.32% respectively. Increase in yield and the use of high yielding varieties were mentioned by 5.41% and 1.80% respectively.

4.4.4.3.2 Cropping pattern at Kollengode during the past 10 to 20 years (1990's)

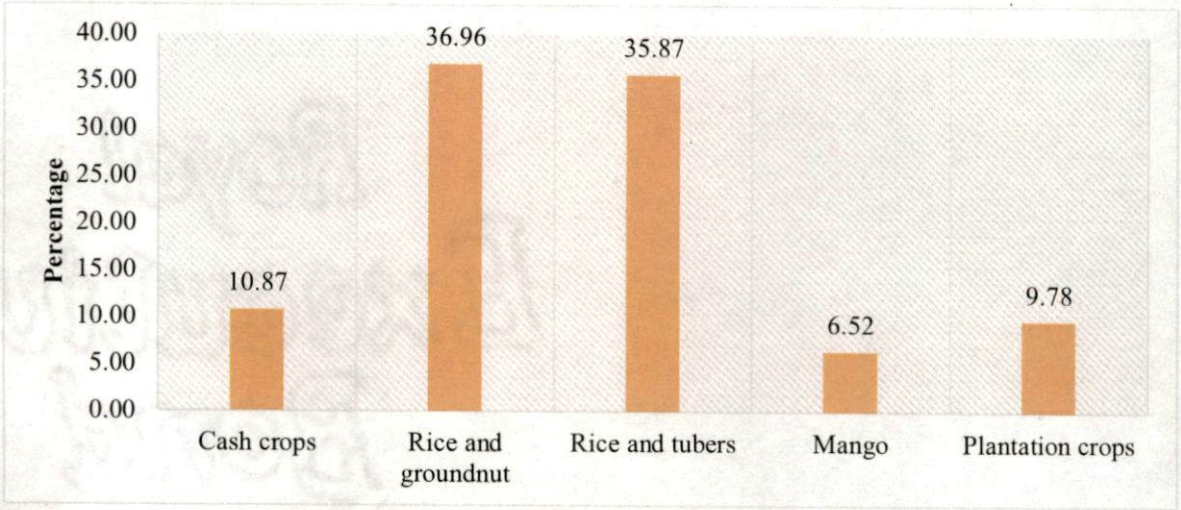

Figure 30. Cropping pattern at Kollengode during the past 10 to 20 years (1990's)

A majority of 36.96 % and 35.87 % reported a combination of rice and ground nut and rice and tubers as the main crops. Cash crops and plantation crops were reported by 10.87 and 9.78% respectively (Figure 30).

4.4.4.3.3 Cropping pattern at Kollengode during the past 20 to 30 years (1980's)

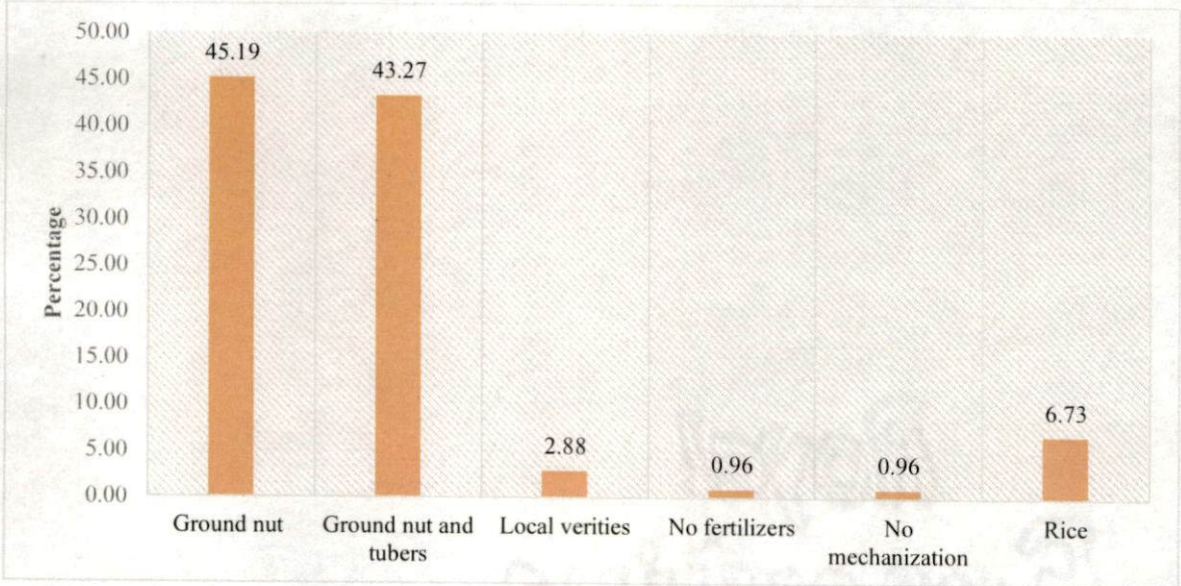

Figure 31. Cropping pattern at Kollengode during the past 20 to 30 years (1980's)

The changes in cropping pattern at Kollengode during the past 20 to 30 years is presented in Figure 31. A majority of 45.19% and 43.27% reported the major cultivation to be ground nut and tubers. Rice cultivation was mentioned by 6.73%.

4.4.5. Awareness and attitude of people

4.4.5.1 Opinion regarding who should take responsibility for reducing conflict with wildlife?

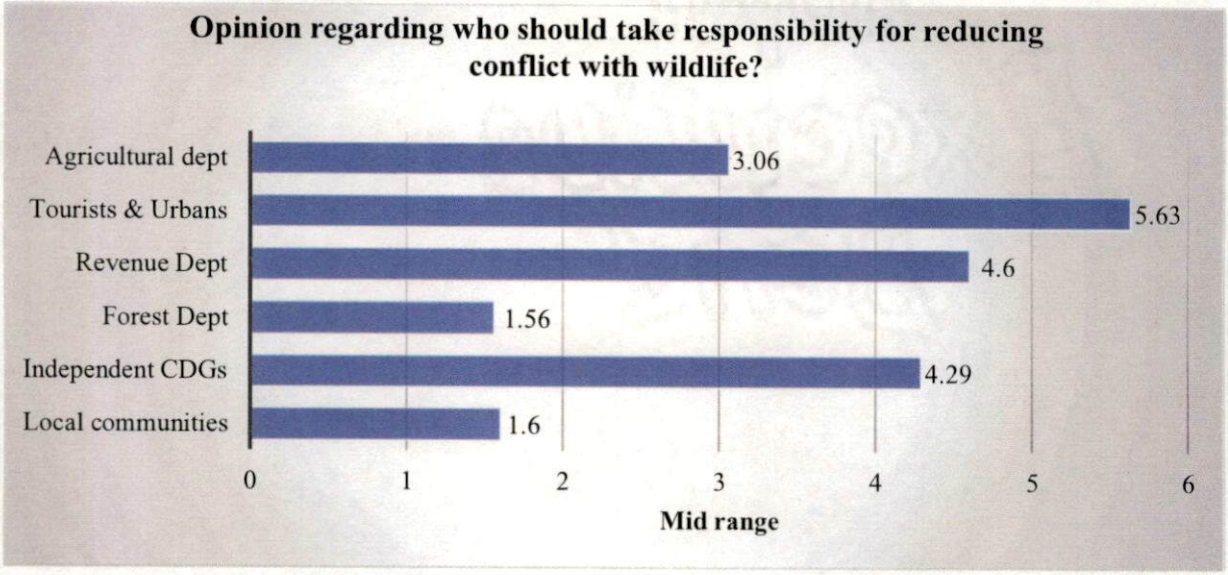

Figure 32. Opinion regarding who should take responsibility for reducing conflict with wildlife?

The study sort opinions from the respondents from Kollengode regarding the question "who should take responsibility to reduce human animal conflict (Figure 32). The respondents found the forest department to be the most suitable option with a score of 1.56 and the second-best option was the local community with a mid-range value of 1.6. The two was followed by the agricultural department (3.06) and Independent NGO's (4.29).

4.4.5.2 Opinion regarding why should wildlife be protected and conserved at Kollengode?

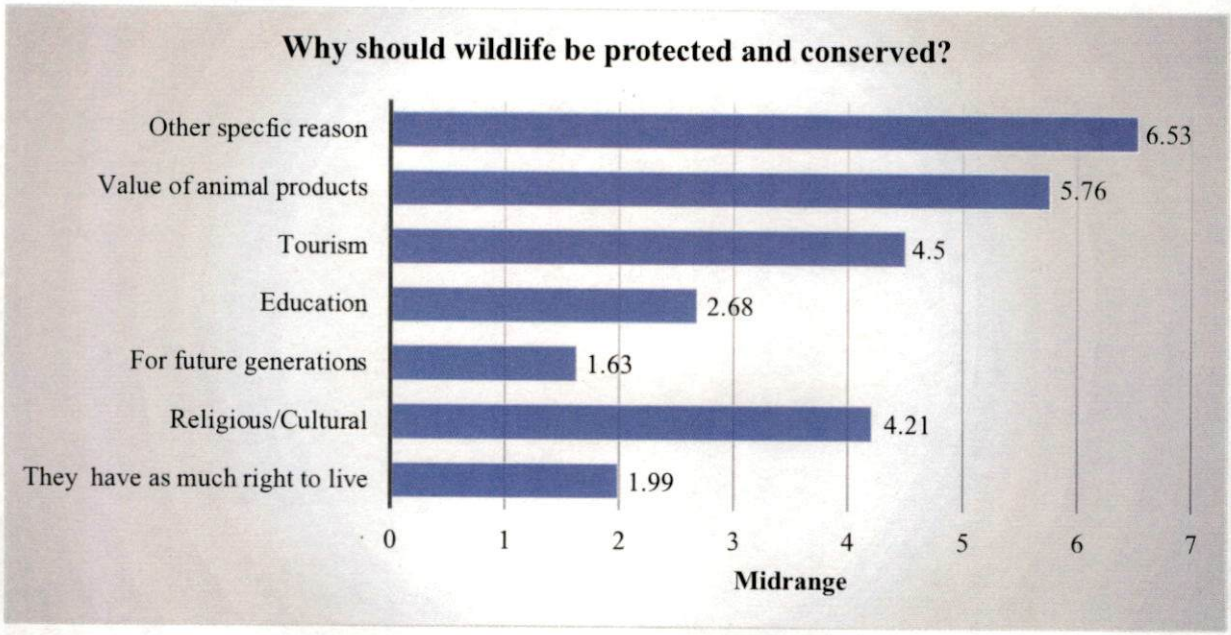

Figure 33. Opinion regarding why should wildlife be protected and conserved?

The study collected the respondent's opinion regarding "why wildlife should be protected and conserved" (Figure 33). This study found out that protection and conservation of wildlife for future generations as the best option by the respondents with a midrange value of 1.63. The second-best opinion was that the wild animals have as much as right to live as we do with a midrange value of 1.99. This was followed by the options "Protection and conservation of animals for educational purpose" (2.68), for religious/cultural reasons (4.21), tourism (4.5), value of animal products (5.76) and other specific reasons such as pest control, dispersal of seeds etc (6.53).

4.4.5.3 Opinion regarding factors which are more important when choosing a conflict mitigation scheme.

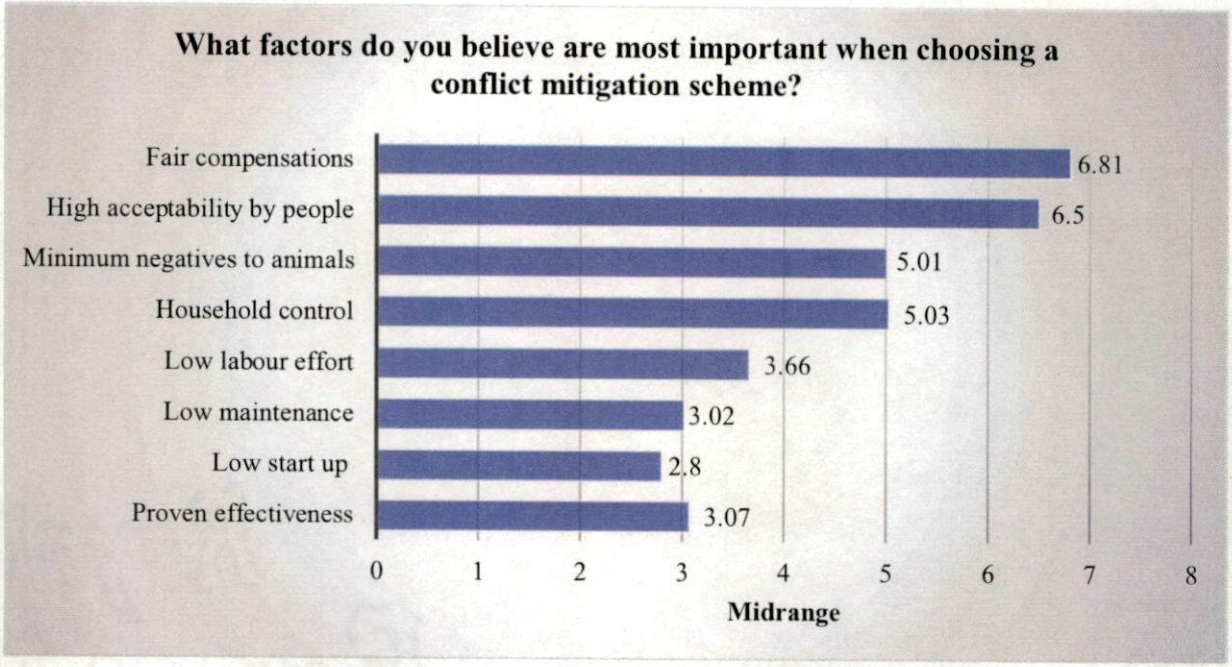

Figure 34. Opinion regarding factors which are more important when choosing a conflict mitigation scheme.

For the opinion regarding the factors most important in choosing a conflict mitigation scheme the respondents at Kollengode found low start-up cost as the most effective one with a score of 2.8 and the second best option was low maintenance cost with a midrange score of 3.03 followed by a midrange score of 3.7 for proven effectiveness, Low labour effort got a score of 3.66 whereas 5.01 was the score obtained for minimum negatives for animals, 5.03 for household control, 6.5 for high acceptability by people and 6.81 was the score obtained for fair compensations.

4.4.6 Attitude towards wildlife and conflict.

Table 20. Attitude towards wildlife and conflict.

Attitude towards wildlife and conflict											
Si No	Statements	SA		A		N		D		SD	
		F	%	F	%	F	%	F	%	F	%
1	Wildlife Should be conserved	55	50.45	45	41.28	1	0.91	6	5.5	2	1.83
2	Wildlife is getting more priority than Humans	53	48.62	43	39.44	6	5.5	6	5.5	1	0.917
3	People should be given the rights to protect their land by any means	70	63.3	31	28.44	5	4.58	4	3.66	0	0
4	Conservation policies of the Government is not up to the mark	18	16.51	46	42.2	19	17.43	20	18.34	6	5.5
5	Government should keep a check on wild animals by lethal means	33	30.27	38	34.86	14	12.84	17	15.59	7	6.42
6	HWC mitigation by the Government is effective	10	9.17	17	15.59	30	27.52	33	30.27	19	17.43

(SA-strongly agree, A-agree, N-neutral, D-disagree, SD-strongly disagree)

The attitude of the respondents at Kollengode towards wild life and conflict is presented in Table 20. A majority of the respondents 50.45% strongly agreed to the statement that "Wildlife should be conserved". Also, the statements "Wildlife is getting more priority than humans" and "People should be given the rights to protect their land by any means" was strongly agreed upon by a majority of 48.62% and 63.3% respectively. Whereas the statements "Conservation policies of the government is not up to the mark" and "Government should keep a check on wild animals by lethal means" were agreed by a majority of 42.4% and 34.86%

respectively. The disagreement of the people was clear (30.27%) for the statement "Human wildlife mitigation by the government is effective".

4.4.7 Mitigation strategies

4.4.7.1 Opinion regarding best method to mitigate crop raiding at Kollengode

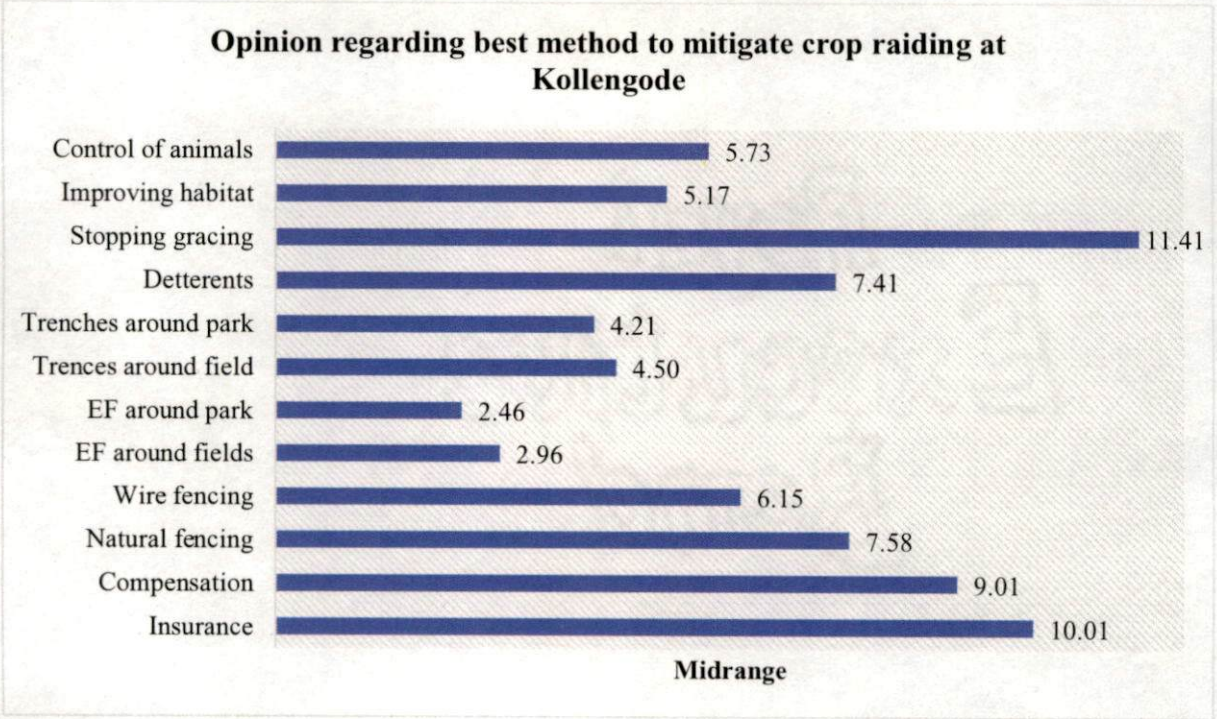

Figure 35. Opinion regarding best method to mitigate crop raiding at Kollengode

The respondents at Kollengode found electric fencing around the park as the best option to mitigate crop raiding at Kollengode with a score of 2.46 from figure 35. The scores obtained by electric fencing around the field, trenches around the field and trenches around the park are 2.96, 4.21 and 4.50 respectively.

4.4.7.2 Opinion regarding best method to mitigate livestock depredation at Kollengode range

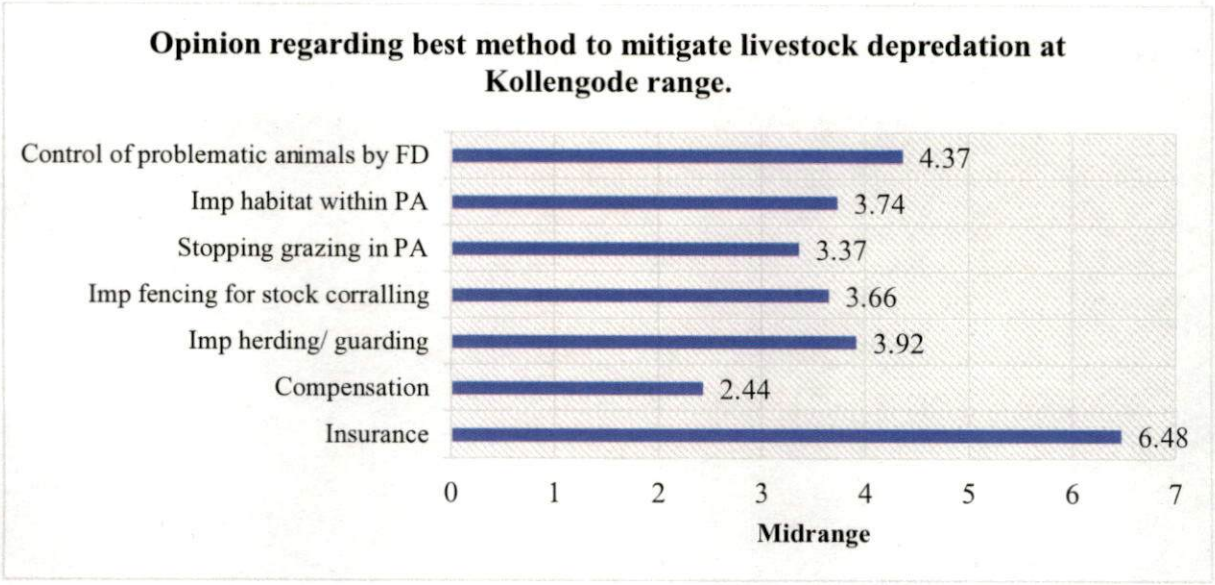

Figure 36. Opinion regarding best method to mitigate livestock depredation at Kollengode range

Figure 36 presents the opinion regarding best methods to mitigate livestock depredation at Kollengode range accordingly. Compensation was found to be the best method with a score of 2.44. The other best scores were 3.37 and 3.66 to stopping grazing in protected areas and improved fencing respectively.

4.5 NELLIYAMPATHY RANGE

With a total forest area 207.4323 sq. km of forest area constituting of 205.5173 sq. km of reserved forests and 0.9575 sq. km of vested forest the Nelliyampathy range is the largest range in the Nemmara forest division. As per the preliminary survey and focus group discussions Kathalam, Manalurchalla and Matai colony were identified as human-animal conflict prone areas and were selected for survey Table 21.

Table 21. List of locations studied at Nelliyampathy forest range

Si no	Locations studied	Range
1	Kathalam	Nelliyampathy
2	Matai colony	Nelliyampathy
3	Manalurchalla	Nelliyampathy

4.5.1. Socio-economic variables of the respondents

The observations recorded for gender and age class distribution is furnished in Table 22. Of total 124 individual's males constituted 49.19 % the remaining 50.81 % were females. For age class distribution 21.77 % were below the age of 20, 21.03 % were between 21-40 years, 36.39 % were between 41-60 years and above 60 years were represented by 12.90%.

Table 22. Gender and Age distribution of respondents at Nelliyampathy

Variable	Category	Frequency	Percentage
Gender	Male	61	49.19
	Female	63	50.81
Age	20& Below	27	21.77
	21-40	36	29.03
	41-60	45	36.29
	Above 60	16	12.90

The educational and economic status of the respondents is given in Table 23. Most of the respondents has received high school and higher secondary level education, 29.84% and 29.03% respectively. Those having received education upto Lower and upper primary constituted 23.39 %. Respondents with education above higher secondary were 11.29 %.

Economically, 97.58% people belonged to the above poverty line category and 2.47 belonged to the below poverty line category.

Table 23. Educational and economic status of respondents at Nelliyampathy

Variables	Category	Frequency	Percentage
Education Status	Illiterate	8	6.45
	LP&UP	29	23.39
	High School	37	29.84
	Higher Secondary	36	29.03
	Above Higher Secondary	14	11.29
Economic Status	APL (Above poverty line)	121	97.58
	BPL (Below poverty line)	3	2.42

The occupational status of the respondents was assessed in this study (Table 24). A majority of 54.03% of the respondents were unemployed. Waged labour was the main occupation of 16.13 % and 8.06 % were engaged in agriculture.

Table 24. Occupational status of respondents at Nelliyampathy

Variable	Category	Frequency	Percentage
	Conductor	1	0.81
	Driver	2	1.61
	Junior Health Inspector	1	0.81
	Agriculture	10	8.06

Occupational Status	Maison	1	0.81
	Mechanic	2	1.61
	Private company	4	3.23
	Quarry worker	1	0.81
	Railway	1	0.81
	Shipyard	1	0.81
	Shop	1	0.81
	Tailor	5	4.03
	Private consultant	1	0.81
	Waged labour	20	16.13
	Teacher	1	0.81
	Watcher	1	0.81
	Tapping	4	3.23
	Unemployed	67	54.03

4.5.2. Nature and distribution of human-wildlife conflicts at Nelliyampathy

4.5.2.1 Type of human wildlife conflict at Nelliyampathy

Table 25. Type of human wildlife conflict at Nelliyampathy

Sl. No	Type of human wildlife conflict in Nelliyampathy	Frequency	Percentage
1	Crop raiding	46	**37.10**
2	Live stock	4	**3.23**
3	Attacked people	0	**0.00**
4	Others	46	**37.10**
5	Crop raiding and livestock depredation	28	**22.58**

The study assessed the types of human wildlife conflicts at Nelliyampathy (Table 25). Crop raiding and other conflicts (nuisance, fear factor etc.), each 37.10%, was reported to be the most prominent type of human wildlife conflict at Nelliyampathy. A combination of crop raiding and livestock depredation constituted to 22.58% of all the reported damages.

4.5.2.2 Problematic animals of Nelliyampathy

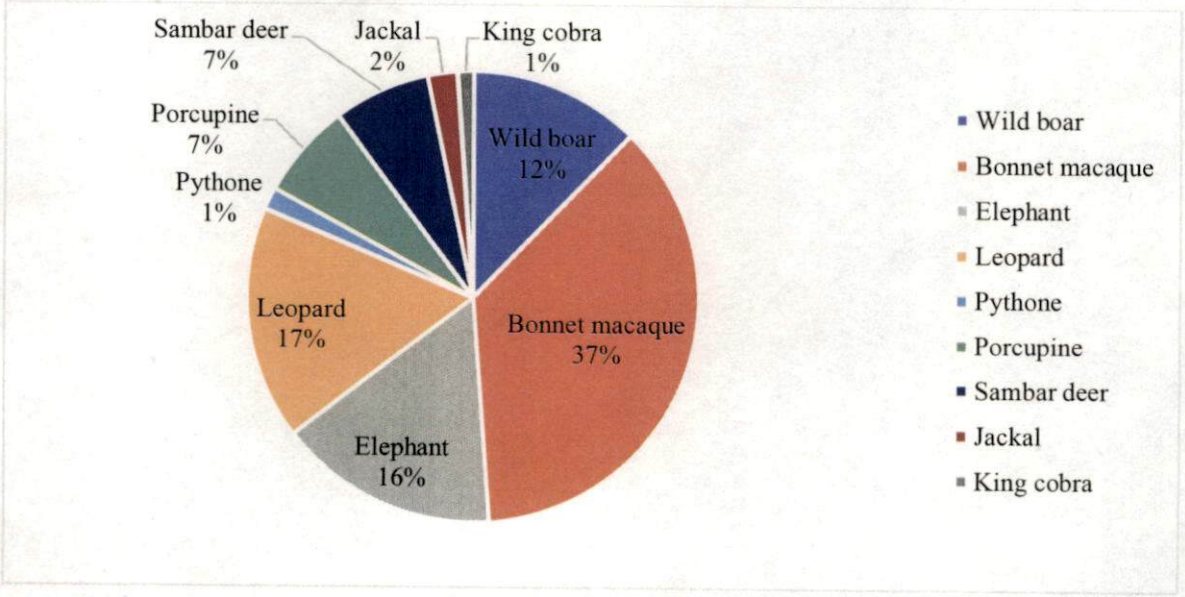

Figure 37. Problematic animals of Nelliyampathy

The problematic animals at Nelliyampathy was assessed based on the responses of the respondents (Figure 37). According to this study, Bonnet macaque (*Macaca radiate*) was found to be the most problematic animal at Nelliyampathy (37%). Bonnet macaque was followed by leopard (*Panthera pardus*) -17%, Elephants (*Elephas maximus*) -16%, Wild boars (*Sus scrofa*) -12 %, Sambar deer (*Cervus unicolor*) – 7% and Porcupines (*Hystrix indica*) – 7%.

4.5.2.3 Problematic Animal species with type of damage/conflict and time of activity

Table 26. Problematic Animal species with type of damage/conflict and time of activity at Nelliyampathy

Si No	Animal Species	Type of damage/conflict	Time of Activity
1	Bonnet macaque	Nuisance	Day
2	Leopard	Fear	Night
3	Elephant	Whole area	Night
4	Wild boar	Whole area	Night
5	Sambar deer	Bark stripping of rubber	Night
6	Python	Poultry birds	Night
7	Porcupine	Fruits and coconuts	Night
8	Jackal	Poultry birds	Night
9	King cobra	Fear	Night

Nuisance was reported as the main conflict caused by bonnet macaques at Nelliyampathy. Leopard caused fear in the respondents. Damage to whole area was reported for elephants and wild boars, whereas bark stripping was reported for sambar deer. From the responses, it was found that all the animals have the peak activity period was during the night, except bonnet macaques.

4.5.2.4 Changes perceived about wild animals at Nelliyampathy

The perceived changes in wild animals at Nelliyampathy according to the respondents were studied separately for the past 10 years (2000's), 10 to 20 years (1990's) and 20 to 30 years (1980's) respectively and the findings are listed below.

4.5.2.4.1 Wild animals at Nelliyampathy during the past 10 years (2000's)

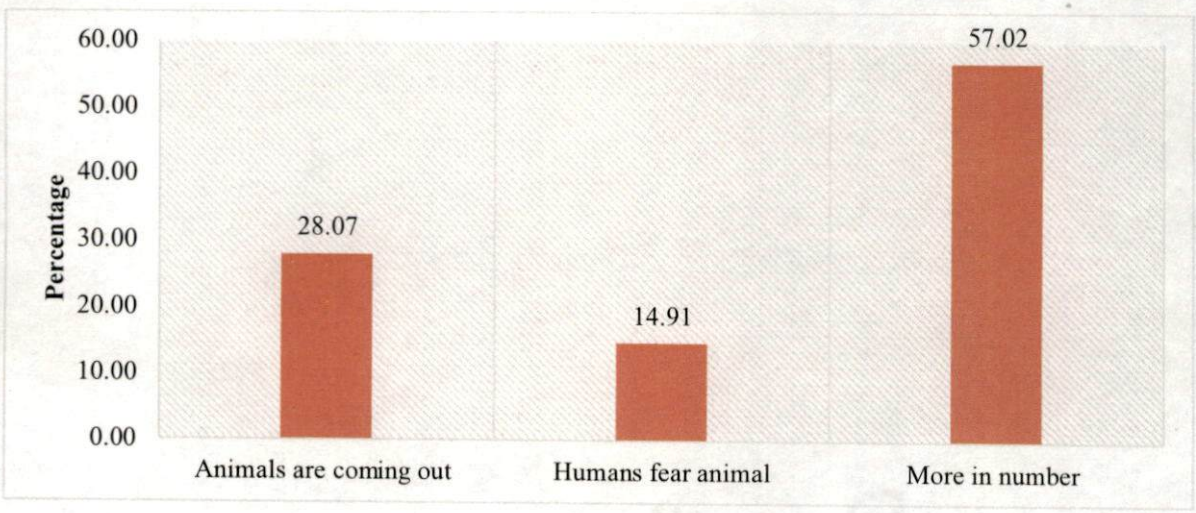

Figure 38. Wild animals at Nelliyampathy during the past 10 years (2000's)

The changes in wild animals at Nelliyampathy a majority of the respondents 57.02% reported that the number of wild animals have increased (Figure 38). About 28.07% of the respondents reported wild animals to be coming out of the forests and 14.91% mentioned that humans fear animals.

4.5.2.4.2 Wild animals at Nelliyampathy during the past 10 to 20 years (1990's)

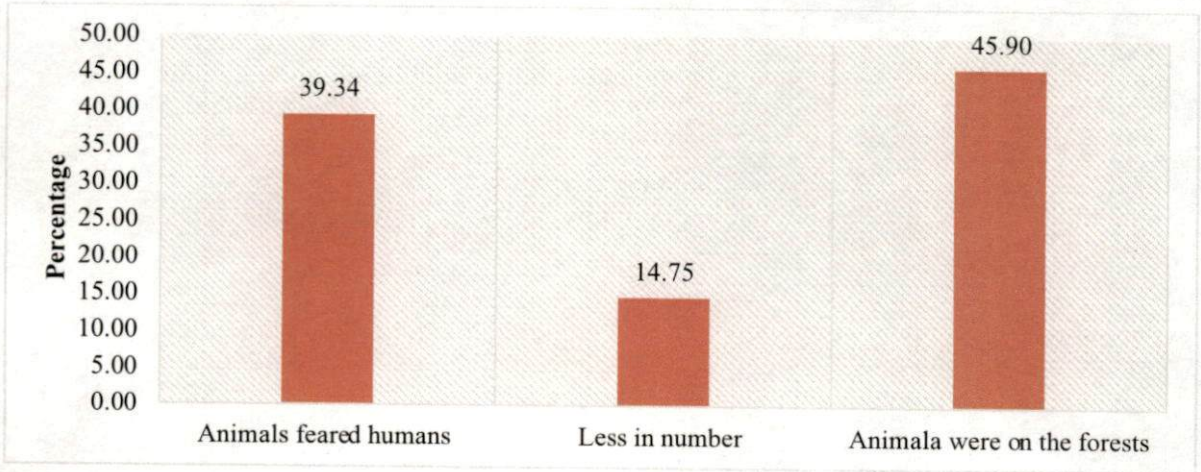

Figure 39. Wild animals at Nelliyampathy during the past 10 to 20 years (1990's)

The changes in wild animals at Nelliyampathy during the past 10 to 20 years (1990's) is presented in Figure 39. A majority of 45.90% reported that the animals were on the forests where as a majority of 34.34% said that animals feared humans and 14.75% mentioned that animals were less in number.

4.5.2.4.3 Wild animals at Nelliyampathy during the past 20 to 30 years (1980's)

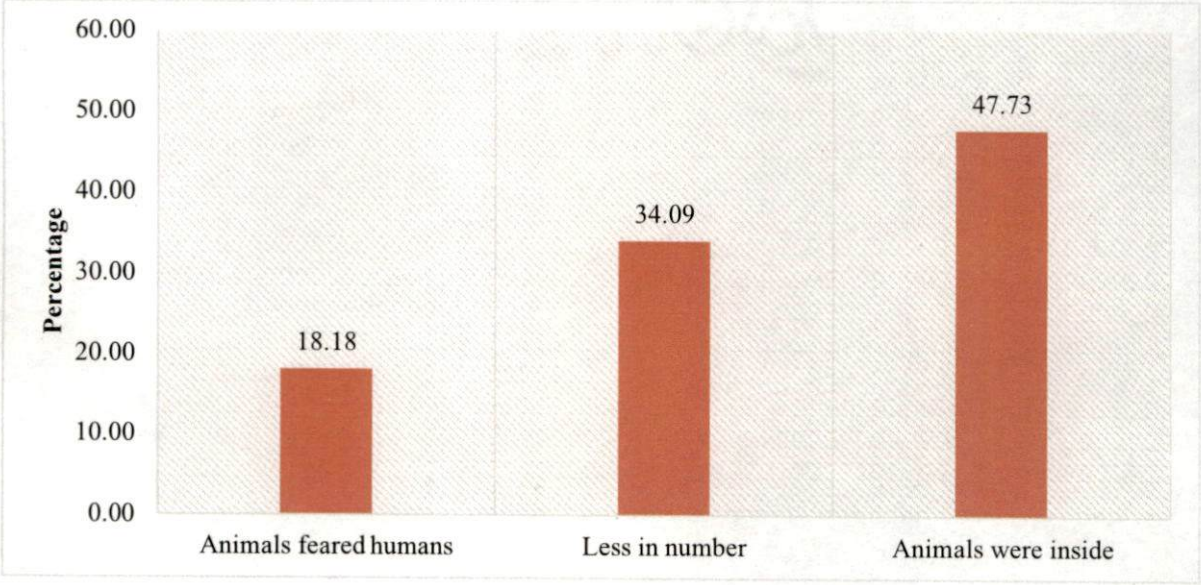

Figure 40. Wild animals at Nelliyampathy during the past 20 to 30 years (1980's)

A majority of 47.73% respondents reported that the animals were inside the forests (Figure 40). Also 34.09% mentioned that animals were less in number and 18.18% reported that animals feared humans.

4.5.3.4 Perceived reasons for crop raiding by animals at Nelliyampathy

Table 27. Perceived reasons for crop raiding

SI No	Reasons for crop raiding										
	Statements	SA		A		N		D		SD	
		F	%	F	%	F	%	F	%	F	%
1	There are too many wild animals	42	33.87	70	56.45	9	7.26	3	2.42	0	0.00
2	Farm owners have been negligent	3	2.42	3	2.42	10	8.06	80	64.52	28	22.58
3	There is insufficient food in the forest	54	43.55	63	50.81	7	5.65	0	0.00	0	0.00
4	Livestock that graze in the forest push wildlife out	1	0.81	5	4.03	12	9.68	72	58.06	34	27.42
5	The government fails to keep wildlife in the park	42	33.87	54	43.55	17	13.71	10	8.06	1	0.81
6	Climate change	30	24.19	51	41.13	15	12.10	21	16.94	7	5.65
7	Deforestation and habitat loss	23	18.55	33	26.61	11	8.87	30	24.19	27	21.77

(SA-strongly agree, A-agree, N-Neutral, D-disagree, SD-strongly disagree)

The perceived reasons for crop raiding at Nelliyampathy is presented in Table 27. The statement "There are too many wild animals" were agreed by a majority of 56.45%. Whereas a majority of 64.52% and 58.06% disagreed to the statements "Farm owners have been negligent" and "Livestock that graze in the forest push wildlife out" respectively. Similarly for the statements "There is insufficient food in the forest" and "The government fails to keep wildlife in the park" a majority of 50.81% and 43.55% agreed. Also the reasons "Climate

change" and "Deforestation and habitat loss" as reasons for crop raiding by wild animals were agreed by a majority of 41.13% and 26.61% respectively.

4.5.3.5 Perceived reasons for livestock depredation at Nelliyampathy

Table 28. Perceived reasons for livestock depredation

Si No	Reasons for livestock depredation										
	Statements	SA		A		N		D		SD	
		F	%	F	%	F	%	F	%	F	%
1	There are too many wild animals	33	26.67	91	73.33	0	0.00	0	0.00	0	0.00
2	Livestock owners have been negligent	0	0.00	4	3.33	45	36.67	29	23.33	45	36.67
3	There are too many livestock	25	20.00	12	10.00	0	0.00	50	40.00	37	30.00
4	There is not enough wild prey in the forest	0	0.00	12	10.00	4	3.33	70	56.67	37	30.00
5	Livestock are taken because they graze in the forest	0	0.00	8	6.67	21	16.67	62	50.00	33	26.67
6	The GOV fails to keep the wildlife in the park	17	13.33	37	30.00	54	43.33	8	6.67	8	6.67

(SA-strongly agree, A-agree, N-neutral, D-disagree, SD-strongly disagree)

For the perceived reasons for livestock depredation at Nelliyampathy presented in Table 28. A majority of 73.33% agreed to the statement "There are too many wild animals". And it was interesting that for the statement "Livestock owners have been negligent" 36.67% each strongly disagreed and as well as remained neutral. For the statements "There are too many livestock" and "There is not enough wild prey in the forest" a majority of 40% and 56.67% disagreed respectively. The statement "Livestock are taken because they graze in the forest" was also disagreed by a majority of 50%. And for the statement "The government fails to keep the wild animals in the park" a majority of the respondents (43.33%) chose to remain neutral.

4.5.4. Land use and land cover change pattern

The land use and land cover change pattern were analysed by both the interview schedule method and as well as the time line method used during the PRA exercises. Accordingly, the land use and lane cover change pattern were studied based on change is forest area, change in farm lands and also by studying the change in cropping pattern and the results are listed below

4.5.4.1 Change in farming practices at Nelliyampathy

There has been a significant change in the farming practices at Nelliyampathy during the past 30 years and was separately studied for time periods starting from the past 10 years (2000's), 10 to 20 years (1990's) and 20 to 30 years (1980's).

4.5.4.1.1 Farming practices at Nelliyampathy during the past 10 years (2000's)

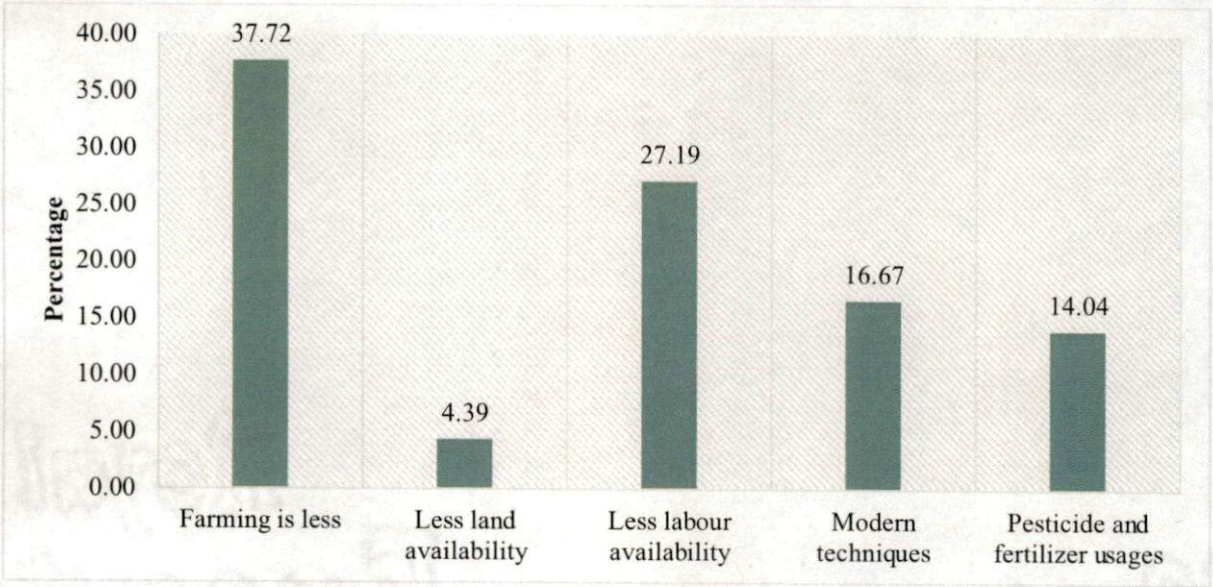

Figure 41. Farming practices at Nelliyampathy during the past 10 years (2000's)

The farming practices at Nelliyampathy during the past 10 years (2000's) is presented in Figure 41. A majority of the respondents 37.72% reported that farming is less. While 27.19% pointed out that less labour was available. Also 16.67% and 14.04% mentioned the use of modern techniques and increased usage of fertilizers and pesticides respectively.

4.5.4.1.2 Farming practices at Nelliyampathy during the past 10 to 20 years (1990's)

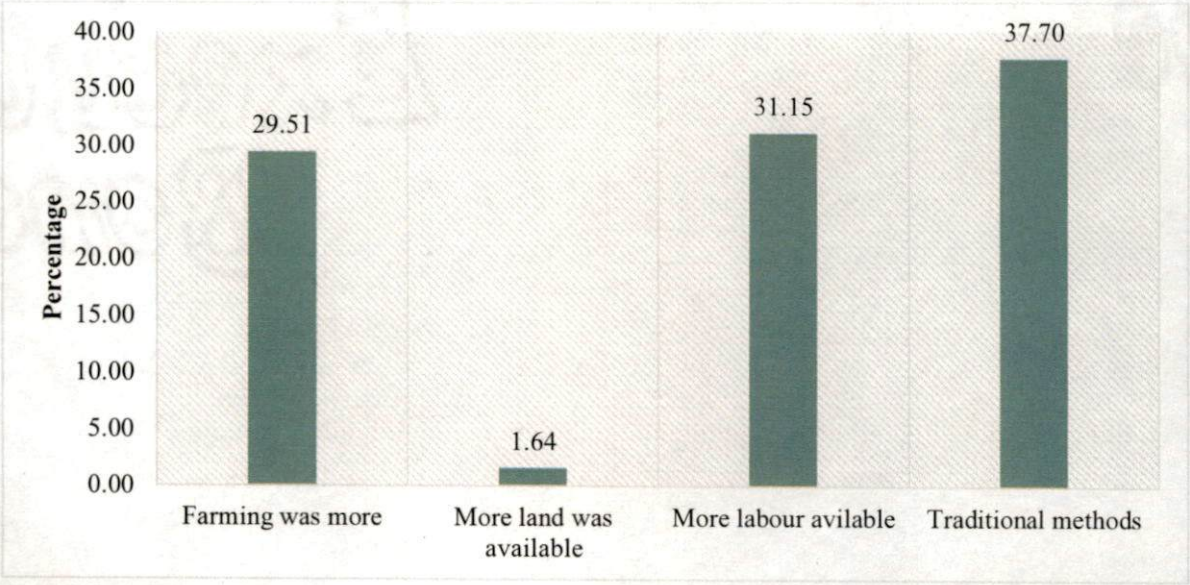

Figure 42. Farming practices at Nelliyampathy during the past 10 to 20 years (1990's)

From Figure 42 the farming practices at Nelliyampathy, a majority of 37.70% reported the use of traditional methods. The abundant availability of labour was reported by 31.15%. A percentage of 29.51 mentioned that farming itself was more compared to the present days.

4.5.4.1.3 Farming practices at Nelliyampathy during the past 20 to 30 years (1980's)

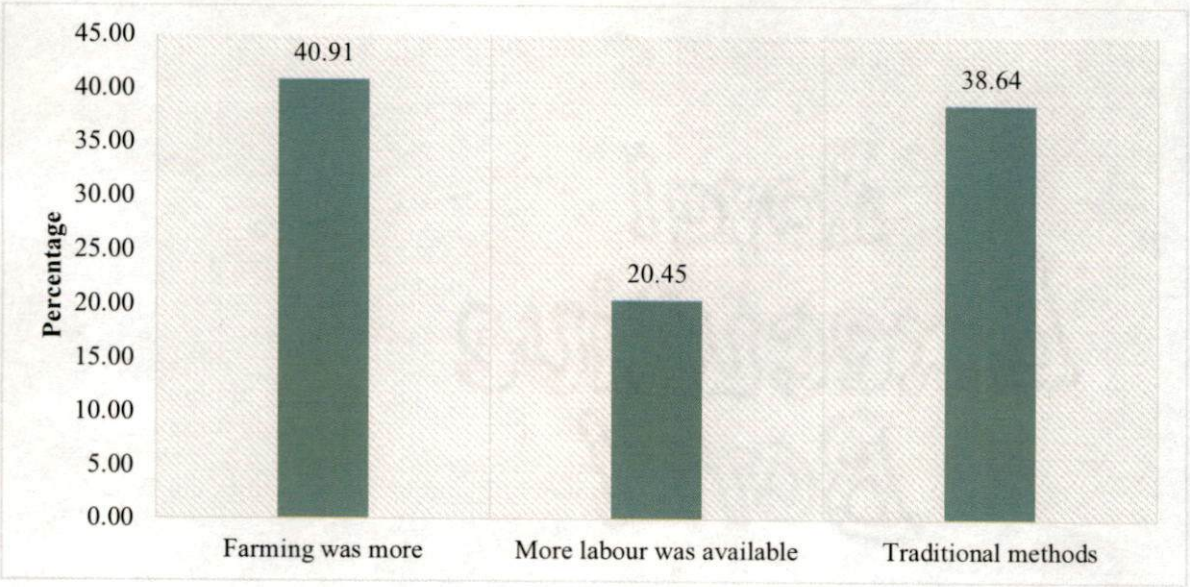

Figure 43. Farming practices at Nelliyampathy during the past 20 to 30 years (1980's)

The farming practices at Nelliyampathy is presented in Figure 43. A majority of 40.91% reported that farming was more, the use of traditional methods and the availability of labour during that time was mentioned by 38.64% and 20.45% respectively.

4.5.4.2 Changes in the interface between people and forests at Nelliyampathy during the past 30 years

The changes in interface between people and forests at Nelliyampathy with regard to protection, quality and illegal activities etc. in general for the past 10 years, 10 to 20 years, 20 to 30 years according to the respondents is listed below.

4.5.4.2.1 Interface between the people and forests at Nelliyampathy during the past 10 years (2000's)

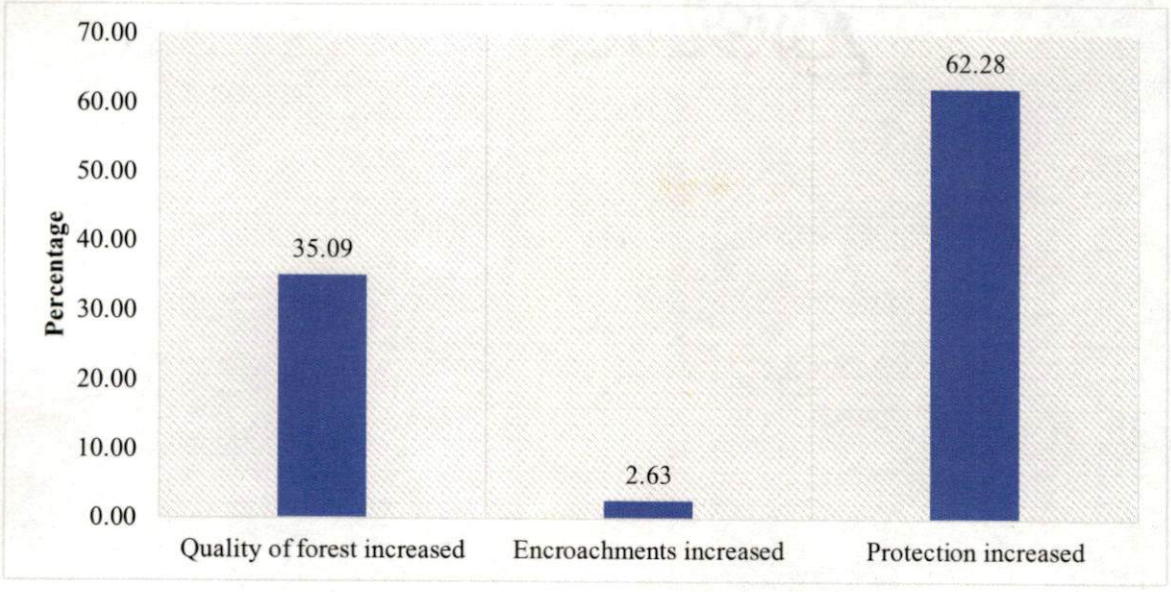

Figure 44. Interface between the people and forests at Nelliyampathy during the past 10 years (2000's)

As represented in Figure 44. A majority of 62.28% of the respondents reported that protection has increased while 35.09% reported that the quality of forests has increased. Interestingly it was reported that encroachments have increased by 2.63%.

4.5.4.2.2 Interface between the people and forests at Nelliyampathy during the past 10 -20 years (1990's)

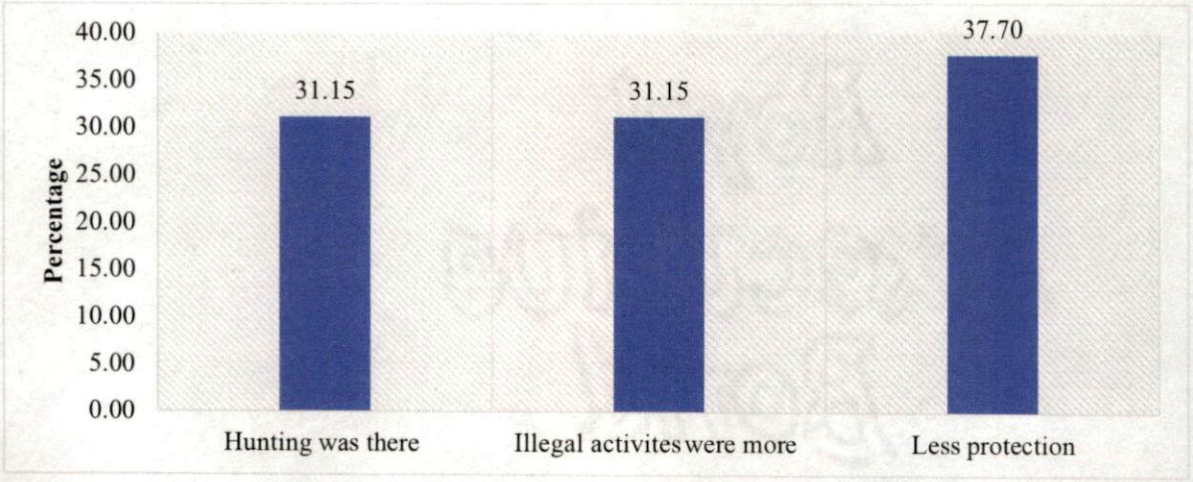

Figure 45. Interface between the people and forests at Nelliyampathy during the past 10 -20 years (1990's)

During the past 10 to 20 years as represented in Figure 45, a majority of 37.07% of the respondents reported that the protection was less. A percentage of 31.15% each reported that hunting and other illegal activities were present during those days.

4.5.4.2.3 Interface between the people and forests at Nelliyampathy during the past 20 to 30 years (1980's)

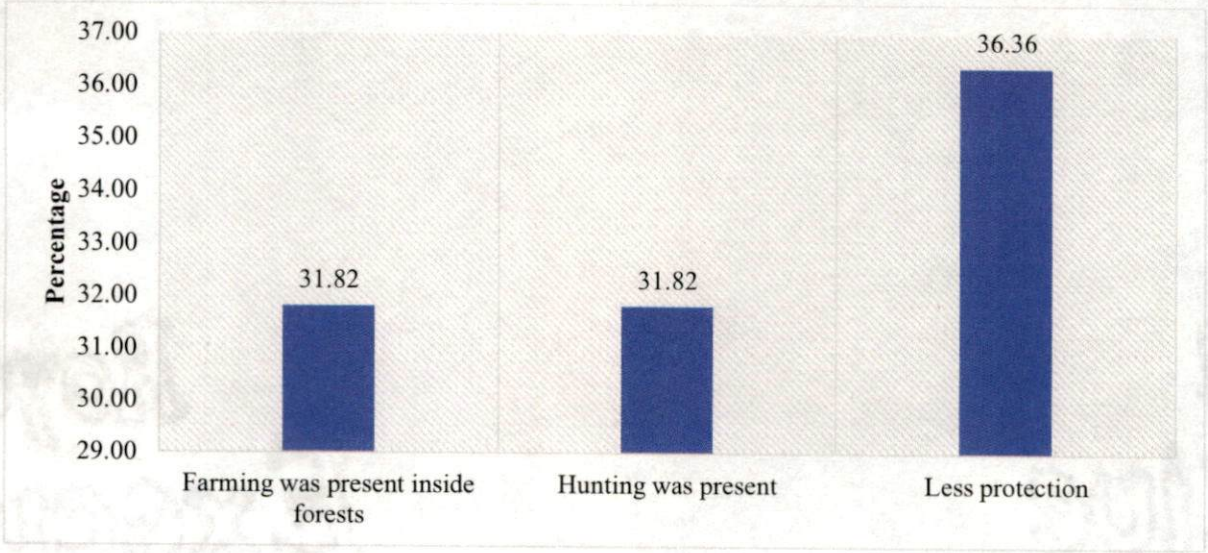

Figure 46. Interface between the people and forests at Nelliyampathy during the past 20 to 30 years (1980's)

The forests at Nelliyampathy during the past 20 to 30 years is presented in Figure 46. A majority of 36.36% reported that there was less protection. A percentage of 31.82% each reported that farming was present inside the forest and that hunting was present.

4.5.4.3 Changes in cropping pattern at Nelliyampathy during the past 30 years

The cropping pattern at Nelliyampathy has changes considerably during the past 30 years and is listed below at intervals of the past 10 years (2000's), 10 to 20 years (1990's) and the past 20 to 30 years (1980's).

4.5.4.3.1 Cropping pattern at Nelliyampathy during the past 10 years (2000's)

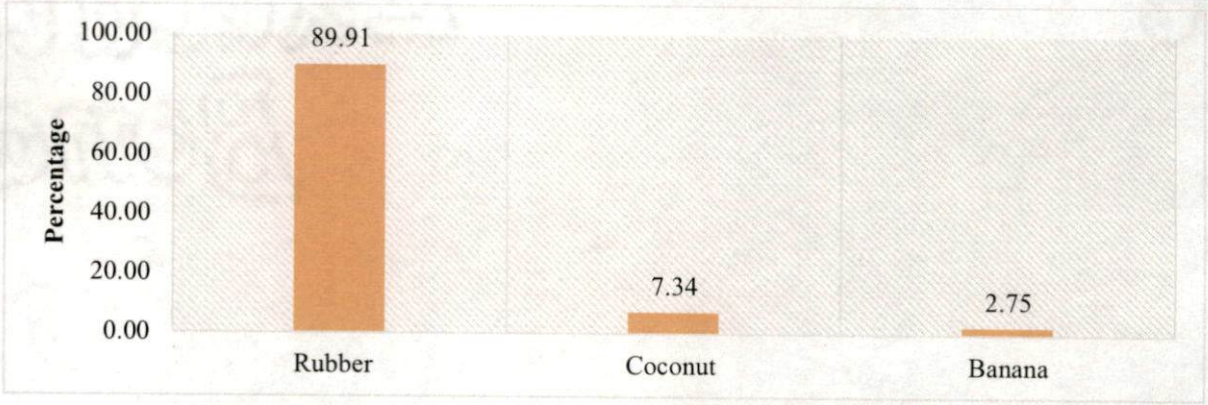

Figure 47. Cropping pattern at Nelliyampathy during the past 10 years (2000's)

The dominant crop cultivated at Nelliyampathy was reported to be rubber by a majority of 89.91% (Figure 47). Coconut and banana was reported by 7.34% and 2.75% respectively.

4.5.4.3.2 Cropping pattern at Nelliyampathy for the past 10 to 20 years (1990's)

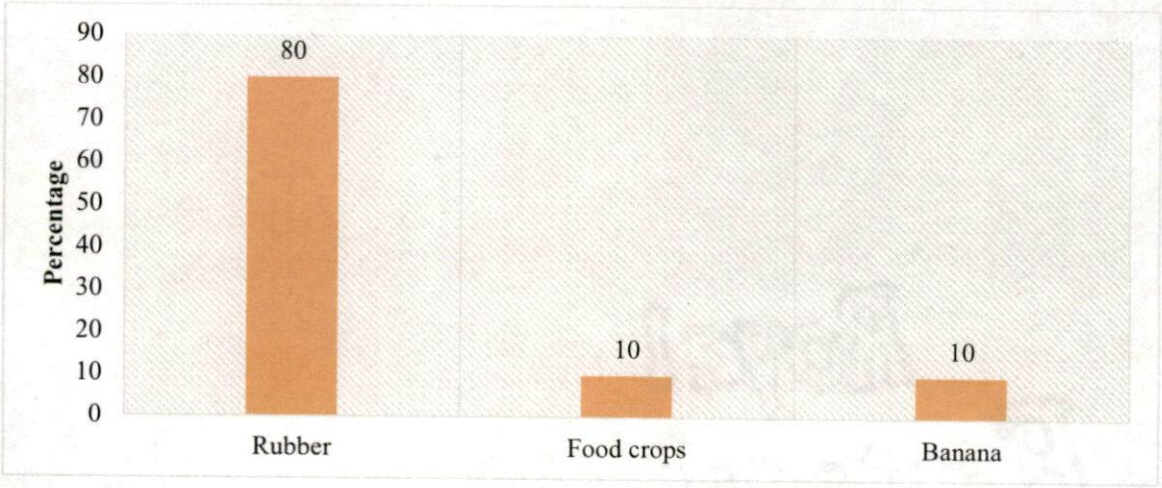

Figure 48. Cropping pattern at Nelliyampathy for the past 10 to 20 years (1990's)

Figure 48 represents the cropping pattern at Nelliyampathy for the past 10 to 20 years. Rubber was reported to be the most cultivated crop by 80% of the respondents.

4.5.4.3.3 Cropping pattern at Nelliyampathy for the past 20 to 30 years

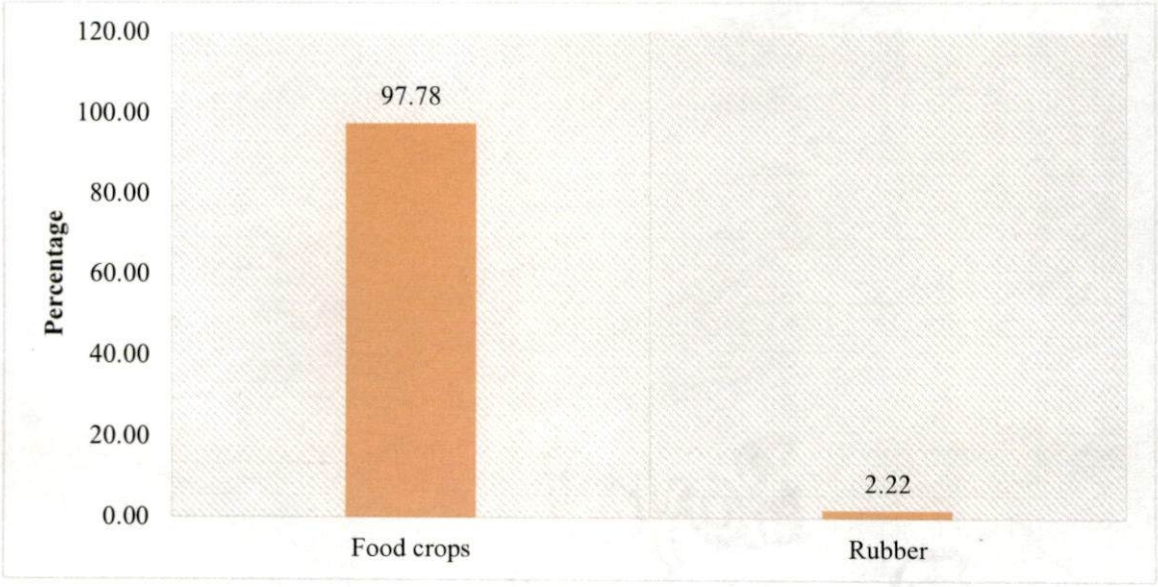

Figure 49. Cropping pattern at Nelliyampathy for the past 20 to 30 years (1980's)

The dominant crops at Nelliyampathy during the past 20 to 30 years was reported to be mainly food crops 97.78% whereas rubber was reported to be 2.22%.

4.5.5 Awareness and attitude of people

4.5.5.1Opinion regarding who should take responsibility for reducing conflict with wildlife?

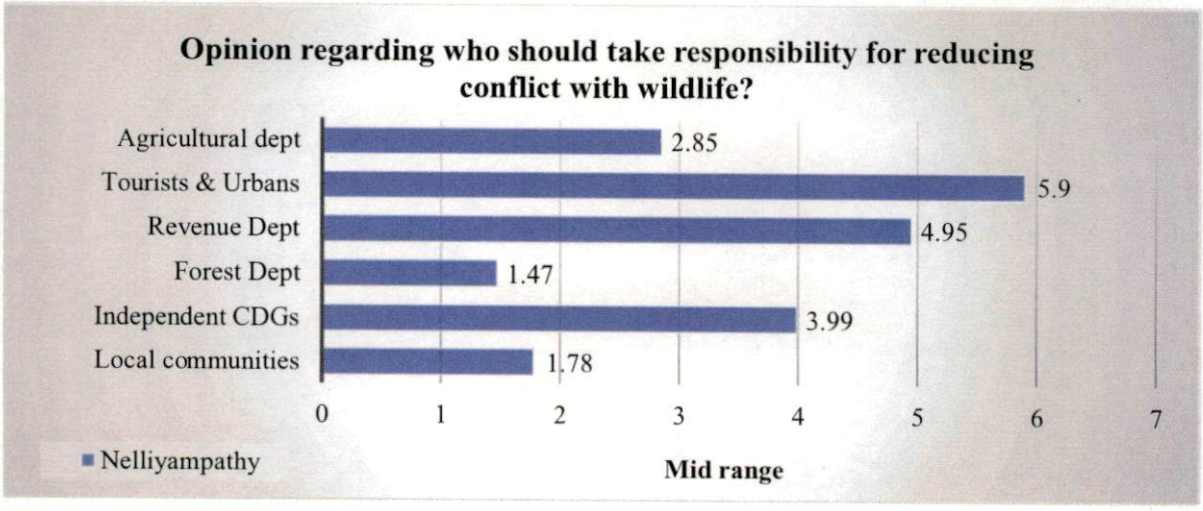

Figure 50. Opinion regarding who should take responsibility for reducing conflict with wildlife?

The respondents from Nelliyampathy for the question regarding who should be responsible for reducing the conflict with wildlife presented in Figure 50. The respondents found Forest department as the most effective with a score of 1.47. Local communities came second most effective with the score of 1.78, agricultural department got a score of 2.85.

4.5.5.2 Opinion regarding why should wildlife be protected and conserved?

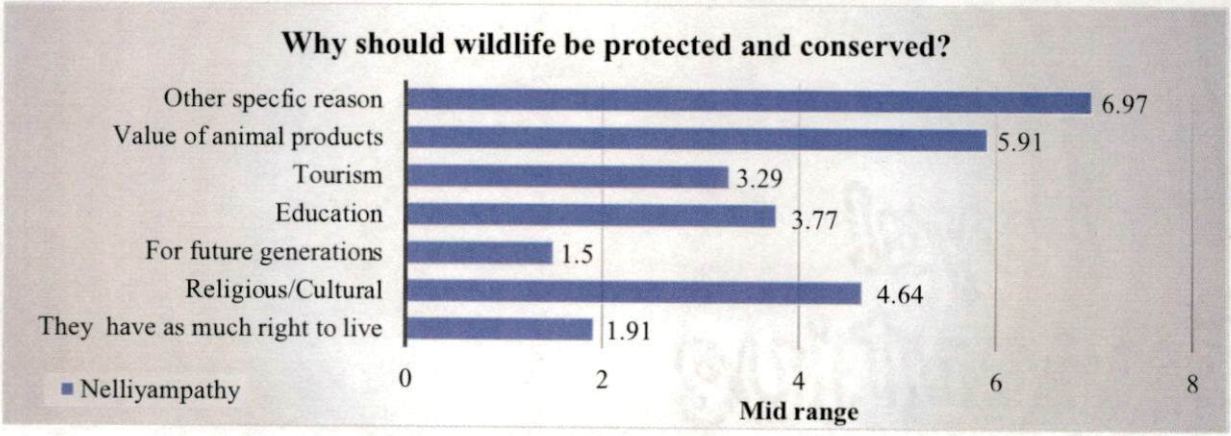

Figure 51. Opinion regarding why should wildlife be protected and conserved?

Figure 51 represents the opinion of the respondents regarding why should wildlife be protected and conserved. Accordingly the most appropriate statement the respondents chose was for future generation with a score of 1.5, second was the statement that they (wild animals) have as much as right to live with a score of 1.91. Tourism received a score of 3.29

4.5.5.3 Opinion regarding factors which are more important when choosing a conflict mitigation scheme.

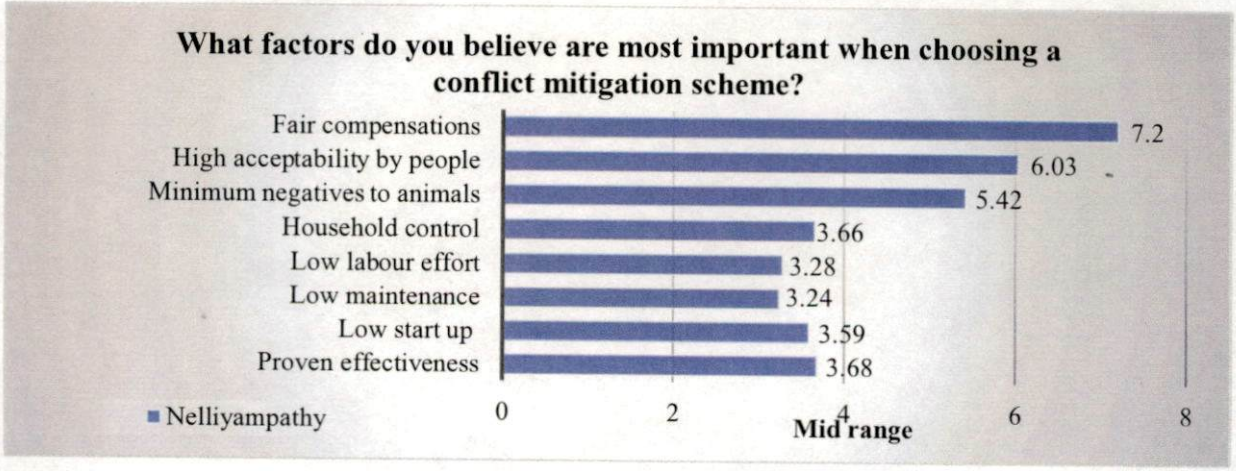

Figure 52. Opinion regarding factors which are more important when choosing a conflict mitigation scheme.

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For the question what factors do you believe are most important when choosing a conflict mitigation scheme? The respondents of Nelliyampathy found low maintenance to be the most effective one with a score of 3.24 and 3.28 for low labour effort. The scores obtained for low start up value was 3.59 and 3.66 for household control Figure 52.

4.5.6 Attitude towards wildlife and conflict

Table 29. Attitude towards wildlife and conflict.

Attitude towards wildlife and conflict											
Si No	Statements	SA		A		N		D		SD	
		F	%	F	%	F	%	F	%	F	%
1	Wildlife Should be conserved	45	36.58	60	48.78	2	1.62	10	8.13	6	4.87
2	Wildlife is getting more priority than Humans	32	26.01	49	39.83	20	16.26	18	14.63	4	3.25
3	People should be given the rights to protect their land by any means	25	20.32	53	43.08	10	8.13	25	20.32	10	8.13
4	Conservation policies of the Government is not up to the mark	23	18.69	35	28.45	35	28.45	23	18.69	7	5.69
5	Government should keep a check on wild animals by lethal means	24	19.51	46	37.39	16	13.00	28	22.76	9	7.31
6	HWC mitigation by the Government is effective	11	8.94	29	23.57	14	11.38	46	37.39	23	18.69

(SA-strongly agree, A-agree, N-neutral, D-disagree, SD-strongly disagree)

The attitude of the people at Nelliyampathy towards wildlife and conflict is presented in Table 29. Of the total number of respondents a majority of 48.78% agreed to the statement

that "Wildlife should be conserved". For the statements "Wildlife is getting more priority than humans" and "People should be given the rights to protect their land by any means" a majority of 38.83 and 43.08% agreed respectively. It is a point to be noted that the statement "Conservation policies of the government is not up to the mark" was equally agreed upon and also equal percentage of 28.45% each remained neutral as well. For the statement "Government should keep a check on wild animals by lethal means" a majority of 37.39% agreed. The sixth statement "Human wildlife conflict mitigation by the government was effective" was disagreed by a majority of 37.39%.

4.5.7 Mitigation Strategies

4.5.7.1 Opinion regarding best methods to mitigate crop raiding at Nelliyampathy range

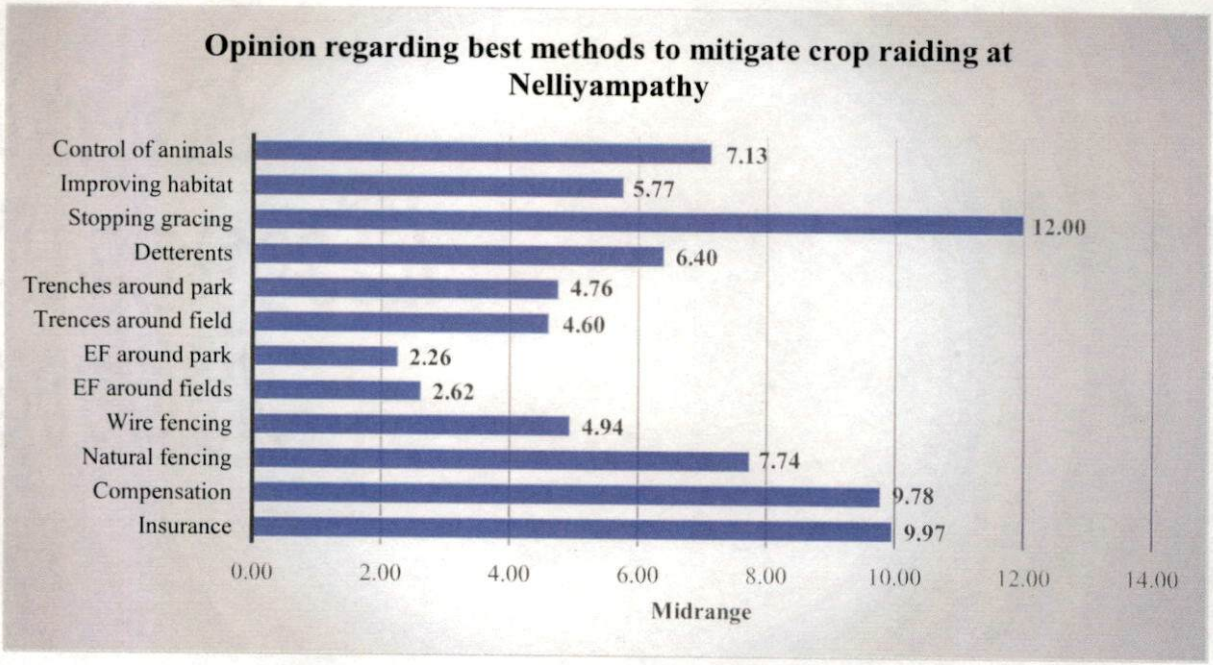

Figure 53. Opinion regarding best methods to mitigate crop raiding at Nelliyampathy range

From figure 53. The best method to mitigate crop raiding at Nelliyampathy was found to be electric fencing around the park and the second best was found out to be electric fencing around the fields with scores of 2.26 and 2.62 respectively.

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4.5.7.2 Opinion regarding best method to mitigate livestock depredation at Nelliyampathy range

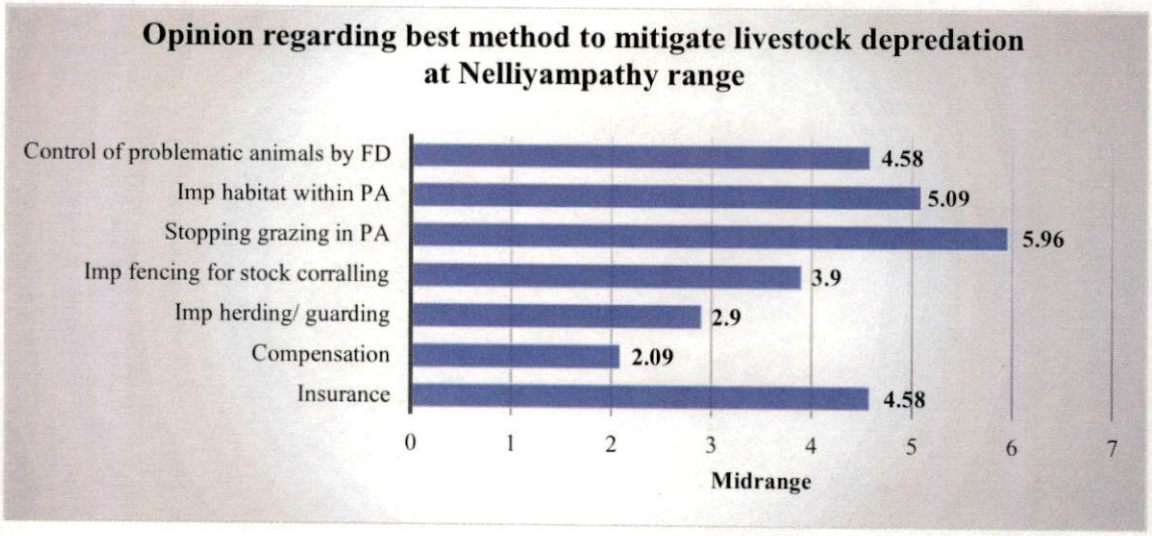

Figure 54. Opinion regarding best methods to mitigate livestock depredation at Nelliyampathy range.

Figure 54 represents the opinion regarding the best methods to mitigate livestock depredation at Nelliyampathy range in which the best scores obtained were 2.09 for compensation, improved herding and guarding obtained a score of 2.9, improved fencing and stock corralling obtained a score of 3.9.

4.6. THE RESULTS OBTAINED THROUGH PARTICIPATORY RURAL APPRAISAL (PRA)

Table 30. Tabulated PRA results of Alathur range

(Translated to English and tabulated)

Time period	Forests	Agriculture	Wild animal conflict	Climate
1980-1990	Farming inside the forests was common. Greenery was more and people had good knowledge about the forest. NTFP collection was present.	Tubers, banana and more of food crops were cultivated. Main purpose of cultivation was daily usage rather than sale. Most of the area belonged to U.T.T Company. Most of the present-day settlers were then recruited by the company as labourers.	Animals were less in number and were not dangerous. Conflict was less since poaching was present. Incidents of leopard and other carnivores were very rare. Problems were less.	Seasonal climate Seasonal rains and plenty of water was available. Water availability was more. Wells were full all year round. Temperature was moderate.
1990-2000	Protection increased overtime but still poaching and farming inside the forests were present.	Cash crop cultivation increased as people started living in nuclear families. Landholding size decreased Land available for large scale agriculture decreased. Rubber became the main crop.	Poaching of animals were present, the animal number was controlled by people itself Problems were less.	Temperatures slowly started to increase. Wind speed increased. Duration of the rains decreased. Climate and weather started to change slowly
	• Protection increased and people were not allowed to go inside the forests. • Animals started coming out of the forest in search of food.	Rubber became the main crop as it was more economical than food crops. The entire area was planted with rubber.	Leopard and other carnivore incidents increased. Problems are more and incidents are also more annually.	Temperature nowadays in unbearable and this rise in temperature in one of the main reasons for human-wildlife conflict.

2000-2015	• The quality of the forests decreased.	Nowadays rubber cultivation is also not profitable.	Straying of animals for food and water could be the reason. Wild animals are given more priority than humans	Rain is very less and water availability decreased.

Table 31. Tabulated PRA results of Kollengode range

(Translated to English and tabulated)

Time period	Forests	Agriculture	Wild animal conflict	Climate
1980-1990	The quality of the forests was less. There was farming inside the forests. People had free access to the forests. There was only smaller trees and under growth was minimum. Protection was very less, poaching and all kinds of illegal activities were present.	In the late 1970's there was a huge land slide in the area. Which altered the entire area. The main crop were ground nut. There was plenty of labour available, along with ground nut rice was also cultivated. The yield was low and there was no usage of pesticides. Traditional methods were practised.	The number of wild animals were less since poaching was present. Animals were mainly inside the forests rather than in the villages. Problems due to animals were less since poaching was present.	Climate was seasonal and both the monsoons were regular with plenty of rain. Wind speed was less and summer had summer rains. Temperature was less. Rainfall was the major source of water for agriculture.

1990-2000	Protection gradually increased and illegal activities decreased. Quality of the forests slowly improved.	The area was found to be best suited for vegetable cultivation and also mango. People changed to cultivating vegetables and mango due to various reasons such as loss in price of ground nut, increased chances of crop raiding and also vegetables being easier to cultivate than ground nut.	Protection increased. Number of animals increased. Loss due to animals increased.	Temperatures increased. Seasons changed. Rainfall pattern changed and agriculture was badly affected.
2000-2015	Bigger trees as a result of better protection and quality of the forests improved. Farming inside the forests and poaching stopped. Undergrowth increased. Quality of the forests improved.	Better yielding verities are present today. Main crops cultivated is rice, vegetables and also mango. Mechanization increased Labour scarcity is a big threat to agriculture.	Animals are getting more priority than humans. If an animal comes and naturally dies in our field we are held responsible. Number of animals have increased. Wild boars cause heavy damage and are mostly residing within the villages. The government should provide subsidy for solar fencing and should also increase their protection activities.	Farmers now a day's use bore wells to irrigate their fields since rains are less and not regular. Farmers were forced to render their farms fallow during summer months due to drought and high temperatures. Drought has become a common thing in recent years.

Table 32. Tabulated PRA results of Nelliyampathy range

(Translated to English and tabulated)

Time period	Forests	Agriculture	Wild animal conflict	Climate
1980-1990	The relation between man and forest was better. There were no fire lines. The forest was high yielding. There was habitation inside the forest	The major cultivation was rice. Tapioca and vegetable cultivation was also present.	Since there was food available inside the forest wild animal conflict was low. Small animals like wild dog, jackal, wild boar was present and they were not too dangerous. Poaching was present	Rains and summers were seasonal. Climate was favourable for agriculture. There was no need for any special projects to conserve water for agriculture.
1990-2000	The relation between man and forest gradually reduced. Fire lines started coming at places. The food resources of animals started to reduce. Forest fires started to appear.	Rice was replaced by ginger and pumpkin. Rubber cultivation also started. Rice cultivation decreased gradually. Rice cultivation became less yielding.	Since the food availability for the animals decreased animals started coming to the villages. Animals became more aggressive in behaviour. Small scale crop raiding and other damages started. Crop raiding started in the fringe areas.	Weather started changing. Rains decreased. Water availability for agriculture reduced and agriculture changed. Increasing temperatures made animals to come to the villages.
	Boundaries came between forests and villages. The sight of people going to the forest was nil. The vegetation inside the forest decreased. Landslides started to occur inside the forests.	Rice cultivation became nearly nil. The once filled with coconut and rice areas were replaced by rubber. Traditional methods of agriculture changed.	Dangerous animals like elephants and leopard started coming out of the forest areas. Frequency of animal attacks increased. Till recently there was no much incidents regarding elephants but	Weather changed a lot rains decreased. Droughts lead to crop failure and loss in agriculture. Temperature increased. Wind speed increased (Palakkadan Wind)

2000-2015	The lack of trees to control soil erosion lead to drought. Encroachments increased.	Since more of cash crops were cultivated there was shortage of food crops. More importance was given to roads and other developmental activities. Land available for farming decreased.	nowadays elephant induced damages are also increasing.	

DISCUSSION

DISCUSSION

Human-wildlife conflict is a major problem to the department and public alike, the lack of scientific studies and abundant grey areas in conflict management worsen the situation. Through this study, it is expected to provide baseline data on the underlying factors behind the current and likely conflicts at Nemmara forest division, which will help to suggest effective mitigatory mechanisms to resolve the crisis. From the above listed results, the following interpretations were deduced and are discussed in detail. This will further help to develop forest management strategies that will balance human aspirations and forest protection in Nemmara Forest Division.

5.1 ASSOCIATION BETWEEN SOCIO-ECONOMIC VARIABLES WITH RESPONDENT'S ATTITUDE AND AWARENESS TOWARDS HUMAN-WILDLIFE CONFLICT AT NEMMARA FOREST DIVISION

All the socio-economic variables in the study namely age, sex, educational status, economic status and also the type of conflict at each range was critically analysed to find out whether they had any association with the attitude and awareness of the respondents towards human-wildlife conflict. It was found that all the factors were non-significant in all the three ranges (Table 1). This reveals that independent of all socio-economic variables the respondents at each range, Alathur, Kollengode and Nelliyampathy responded in a uniform manner and there was no significant variation in their responses despite various classification in the socio-economic strata.

5.2 ASSOCIATION BETWEEN RESPONDENTS FROM THE THREE DIFFERENT RANGES

All the respondents from the three different ranges at Nemmara Forest Division showed significant difference in their responses (Table 2). This difference in opinion confirms the significant differences in the human-wildlife scenarios in the Nemmara forest division. This result is an evidence for the very peculiar feature of all human-wildlife conflict scenarios that human-wildlife conflicts are location specific. This location specific nature was not only found in the type of conflicts but also in the respondents. The respondents at different ranges had location specific responses. So, this study further cements the argument that any mitigation strategy/scheme/interventions etc. should be taken up only after thoroughly understanding this location specific nature of human-wildlife conflicts. For addressing this location specific nature of

conflicts at Nemmara Forest Division, the following ground peculiarities are discussed forest range wise.

5.3 NATURE AND DISTRIBUTION OF HUMAN ANIMAL CONFLICT

As far as the distribution of human wildlife conflict at Nemmara is concerned, the main conflict hotspots were the Nelliyampathy foothills region and the forest fringe areas of Kollengode and Mangalam dam and adjoining areas in Alathur range. These areas were selected for the study after preliminary reconnaissance survey and focus group discussions and are available in Table 3, 12 and 21.

At the Alathur range of the division, the main type of conflict observed was crop raiding with isolated cases of livestock depredation (Table 7) as well. It was an interesting find that the main problematic animal was sambar deer (Figure 1), since the dominant cultivation at Alathur is rubber (Figure 11-13). Sambar deer were reported to strip the bark of the trees (Table 8) thereby damaging the crop. In rubber plantations, the damage done by other animals were minimum. Sambar deer are mainly raiding the plantation at night rendering it difficult to control them due to their silent, shy and elusive nature. The respondents observed that these sambar deers remain grazing near by the fringes of the forests during late evening and slowly enters the plantations and farms as the night advances and they return to the forests during the day.

Similarly, in Kollengode range of Nemmara division, the main human wildlife conflict observed was crop raiding (Table 16). Wild boars were found to be the most problematic animal (Figure 19), since the major cultivation was paddy and vegetables. Wild boars caused heavy damage not only by actually eating the crops, but also by disturbing the whole area while searching for grubs and worms (Table 17). It was an interesting find that sambar deers also caused significant damage to the crops here. Unlike the damage (bark stripping of rubber) caused by sambar deers at Alathur range, the sambar deers at Kollengode were damaging the ripe vegetables (Table no 17) by eating them especially during the harvest season. They also feed on paddy. Wild boars are a big menace due to their aggressive nature and prolific breeding capacity. Wild boars, unlike other wild animals in the region were mainly found to reside within the villages under dried up canal culverts and inside bushy areas, rather than inside the forests.

In the case of Nelliyampathy, the scenario was found to be entirely different. The main type of conflicts was found to be crop raiding and the category "others" which included situations such as the extreme nuisance value and fear factor created by wild animals (Table 25). The main problematic animal at Nelliyampathy was found to be bonnet macaques (Figure 37). Fear of leopard and crop damage by elephants was also important conflict issues. The nuisance and menace created by the bonnet macaques are also prime concern for the respondents. Macaques generally travel in troops of 30-40 individuals and are aggressive in nature and indulge in damaging household articles. These macaques are also found to be highly intelligent and adaptable, rendering them very difficult to control as fencing is not a viable option for containing them. Bonnet macaques are mainly active during day time and they tend to spend their day foraging for food within human inhabited areas. They also damage fruit trees causing fruit loss (Table 26).

5.4 CHANGES PERCEIVED ABOUT WILD ANIMALS AT NEMMARA FOREST DIVISION OVER THE PAST 30 YEARS

Over a period of 30 years there has been much changes, both in the number of wild animals and also in their behavior in Nemmara forest division (Table 30, 31 and 32). According to the respondents at Alathur, over a period of 30 years, the number of various species of wild animals has considerably increased (Figure 2-4). During the 1980's (past 20 to 30 years) these wild animals were mostly confined within the forests/protected areas. The respondents also observed that these animals feared humans more during this period. Nowadays not only has the population of wild animals gone up, it is noted that these animals had progressively shed their fear of humans. Now it is the humans that fears the animals more. The wild animals are also now frequently venturing outside the boundaries of the protected areas.

Similar was the response from Kollengode, the major change people pointed out was the increase in number of animals in the recent years (2000's). They reported that hunting of animals was present in the earlier years (1980's) and also that mainly the wild animals were confined to the forests (Table 31). Animals who feared humans in the earlier periods have changed, and it is now the human living in fear of the animals (Figure 20-22). Observations from Nelliyampathy range also reveals similar finding such as increased number of wild animals and also the factor that in the earlier periods, animals were confined to the forests and were less in number. (Figure 38-40)

The above discussed observations can be taken as evidences for the better protection and conservation activities at the Forest Division resulting in the increase in wild animal population. The strict enforcement of forest and wildlife laws and the good forest management practices are also perhaps contributing to the increase in the wild faunal population.

5.5 PERCEIVED REASONS FOR CROP RAIDING AT NEMMARA FOREST DIVISION

The increase in number of wild animals was agreed upon by a majority of all the respondents in all the three ranges of the division. The increased animal number was highlighted as one of the prime reasons for crop raiding in the entire division.

Even though the statement that "Farm owners have been negligent" as a reason for crop raiding was disagreed by a majority in all the three ranges, it was noted that 90.09% of the respondents disagreed to this statement at Kollengode. Perhaps the reason could be that the respondents at Kollengode who were traditional and conventional farmers, practiced farming all year round and cared for their crops more (Table 9, 18, 27). Whereas at Alathur and Nelliyampathy, most of the farmers were non-resident in nature (absentee farmers) who were not providing such care to their crops. The farmers at Kollengode, since their cropping scheme had mainly rice and vegetables, were more conscious about crop protection and were well aware about crop raiding and crop loss. Even though the farmers and the respondents from Alathur and Nelliyampathy were aware about crop loss and crop protection, the cropping pattern at these areas which was observed to be mainly plantation crops, was less concerned about loss due to crop raiding by wild animals. Moreover, crop protection was comparatively easier when compared to that at Kollengode range.

The statement "There is insufficient food in the forest" as a reason for crop raiding was agreed and strongly agreed upon by majority of the respondents at the division (Table 9, 18, 27). The result can be related to the previous statements that the number of wild animals have increased, which can lead to shortage of food resources inside the forest.

The statement that "Livestock that graze in the forest push wildlife out" as a reason for crop raiding was negatively responded by a majority at Nemmara Forest Division. The prime reason for this view was that in the entire division livestock/domestic animals were less in number. There were only a few respondents who actually kept livestock and allowed them for grazing inside the forests in the entire study area.

The response for the statement "The Government fails to keep wildlife in the park" as a reason for crop raiding showed their dissatisfaction towards the conflict issues as well as towards the governments and its efforts on resolving these.

"Climate change" as a reason for crop raiding was agreed upon by the majority of the respondents at Nemmara division. This can be related to opinion of the respondents towards the statement that 'There is insufficient food inside the forests" as a reason for crop raiding. Insufficient water, food and shelter resources due to climate change can act as factors that promote crop raiding.

There was difference in opinion regarding the statement "Deforestation and habitat loss" as a reason for crop raiding in the Nemmara Division. At Alathur, a majority (93.90%) strongly agreed to the statement showing their dissatisfaction with the management of the forests. At Nelliyampathy, the respondents remained skeptical regarding this statement. Even though a majority agreed to the statement (26.61%) more or less also disagreed and strongly disagreed (24.19% and 21.77% respectively). At Nelliyampathy people's attitude towards the forest department is warmer since more than farming, tourism and other sources of income is more prominent. However, in Kollengode, a majority disagreed to this statement. The people at Kollengode were of the opinion that the quality of the forests have improved in the recent years (Table 31).

In general, at the at the range level, the responses were independent of the socio-economic background of the respondents. But at the division level, between the ranges it was observed that the occupational status (Table 6, 15, 24) of the respondents might have affected their responses to a certain limit. At Alathur even though the majority of the respondents subjected to the study were unemployed, the remaining major chunk were engaged in rubber tapping works and farm works related to plantation crops and hence most of them were not residing near their farms. It was observed that most of the respondents were highly disturbed and was having an overall negative approach towards human-wildlife conflict. This tension in them might have reflected in their responses (Table 9, 18, 27). All of their responses were extreme in nature (either strongly agree or strongly disagree). Whereas at Kollengode, most of the respondents were engaged in agriculture, mainly paddy and vegetables, and most of the farms were adjacent to their homes. The respondents showed a collectiveness in their responses and had specific interests and points regarding crop

protection and damage mitigation efforts. At Nelliyampathy, on the other hand, most of the respondents were unemployed and the remaining major chunk included waged laborers and agriculturists were a few. The respondents at Nelliyampathy was more concerned with conservation and protection issues and was not much worried about human-wildlife conflict issues when compared with Alathur and Kollengode ranges.

5.6 PERCEIVED REASONS FOR LIVESTOCK DEPREDATION AT NEMMARA FOREST DIVISION

The increase in number of animals was pointed out as a major reason for livestock depredation by a majority of the respondents at the forest division (Tables 10, 19 and 28).

The statement "Livestock owner has been negligent" as a reason for livestock depredation discounted by the people of Alathur and Kollengode (Table 10 and 19). However, the respondents at Nelliyampathy in equal majority strongly disagreed as well as remained neutral towards this statement. Even though the number of livestock owners were less, most of them practiced stall feeding and a majority had well protected cages/kraals and grazing inside the protected areas was minimum in the study areas.

The statement "There is not enough wild prey in the forest" as a reason for livestock depredation was agreed by the respondents at Alathur. Previously (Table 9) the same group have pointed towards the reason of increased animal number as reasons for crop raiding. As a change in wild animals over a period 30 year (Figure 2) they have also reported the increase in animal number. This contradiction might be due to their dissatisfaction and tension with the Forest department. Whereas the responses from Kollengode and Nelliyampathy was logical. They disagreed to the statement (Figures 19 and 28) and added that livestock are taken because they are an easier prey.

For the statement "Livestock are taken because they graze in the forest" the respondents at Alathur and Nelliyampathy disagreed (Figures 10 and 28). This was mainly because most of the livestock owners practiced stall feeding. Where as in Kollengode majority of the respondents agreed to this statement, since grazing was done inside the forest (Figure 19). Interestingly the tribal population, when contacted for responses, unlike other people, viewed livestock depredation

as a normal thing and was with the opinion that depredation occur as a natural thing. "Leopards capture goats when they graze inside the forest it is their food" was one of their statements.

"The government fails to keep the animals in the park" was strongly agreed upon by majority at Alathur and Kollengode testifying the peoples urge that the government should improve their efforts. Whereas the respondents at Nelliyampathy remained neutral showing their satisfaction to a certain limit to the livestock depredation situation.

5.7 CHANGES IN LAND USE AND LAND COVER PATTERN

5.7.1 Changes in farming practices at Nemmara Forest division during the past 30 years

The general shift in farming practices noted at Nemmara division in all the three range were the change from traditional methods to modern techniques and mechanization. The low availability of labour was also mentioned as a change (Table 30, 31 and 32).

Specifically speaking at Alathur the respondents reported a change from monocultures to plantation crops (Figures 5-7). At Kollengode the respondents were more specific in nature. They reported the availability of better and high yielding varieties and loss of fertility of the soil (Figures 23-25) showing their keen interest in agriculture. Whereas at Nelliyampathy the respondents specifically mentioned, that compared to earlier years (during the past 20 to 30 years) farming and farm lands are less during recent times (past 10 years) (Figures 41-43).

5.7.2 Change in forests at Nemmara forest division during the past 30 years

In all the three ranges as the change in forests the respondents pointed out that hunting of animals and farming activities were present inside the forest during the past 20 to 30 years (Figures 10, 28 and 46). Gradually the scenario changed during the past 10 to 20 years as protection and conservation efforts of the government increased, but still hunting and farming inside the forests continued in most of the ranges (Figures 9, 27 and 45). During the past 10 years the protection has increased leading to improvement in quality of the forests. The less access to the forests reduced the illegal activities such as hunting and farming inside the forest areas (Figures 8, 26and 44).

5.7.3 Change in cropping pattern at Nemmara forest division over the past 30 years.

There has been a significant change in the cropping pattern at the Nemmara forest division over the past 30 years. Particularly speaking in Alathur and Nelliyampathy ranges the change is cropping pattern was mainly from food crops such as tapioca, paddy, vegetables, pineapple etc. to plantation crops/ cash crops such as nutmeg, arecanut, mainly rubber (Figures 11-13 and 47-49). In the study areas at Alathur and Nelliyampathy most of the respondents were settlers who came there for job purposes and their main occupation was found to be waged labour which included rubber tapping and other such works.

The change in cropping pattern at Kollengode range during the past 20 to 30 years is an entirely different scenario. The major crops cultivated at Kollengode was found to be ground nut and rice (Figures 29-31). Later during the past 10 to 20 years a few areas started cultivation of plantation crops mainly mango in areas such as Muthalamada which is presently known as mango city. People also started cultivating coconut arecanut etc. in small patches. But still rice and groundnut remained. During the past 10 years groundnut cultivation has entirely changed to vegetable cultivation due to various reasons such as a landslide in 1970s, loss in price of groundnut, increased loss due to crop raiding of ground nut since it is a tuber crop. When the entire area was identified suitable for vegetable cultivation, people switched to vegetable and rice cultivation (Table 31).

5.8 AWARENESS AND ATTITUDE OF THE PEOPLE REGARDING WILDLIFE AND HUMAN-WILDLIFE CONFLICT AT NEMMARA FOREST DIVISION

5.8.1 Opinion regarding who should take responsibility for reducing conflict with wildlife at Nemmara forest division?

In all the three ranges of the forest division, the respondents identified Forest department as the best responsible agency for taking the responsibility for reducing human-wildlife conflict. The respondents selected local communities as the second best option (Figures 14, 32 and 50). This reveals that the respondents looked upon the forest department for major actions and was also aware that the local communities also play a significant role in conflict mitigation. The respondents strongly understand the fact that mutual understanding and cooperation is essential for evolving location specific conflict mitigation schemes.

5.8.2 Opinion regarding why wildlife should be conserved

In all the three ranges, the respondents had a positive regard to conservation of wildlife and nature this is justified by their opinion regarding why wildlife should be conserved in all the three ranges "For future generations" were selected as the best option and the second-best opinion was that "They (animals) have as much as right to live" as we do. There was a little difference regarding the third best option. While the respondents at Kollengode chose conservation of animals for "educational" purposes the respondents at Alathur and Nelliyampathy chose "tourism" (Figures 15, 33 and 51). Revealing their attitude to economic returns and income to a certain level over the people at Kollengode who was mainly involved in agriculture, hence were more attached to nature.

5.8.3 Opinion regarding factors which are more important when choosing a conflict mitigation scheme at Nemmara Forest Division.

A conflict mitigation scheme should not only be location specific it should also be animal as well as people specific. The location specific nature of human-wildlife was also evident in the respondent's opinion regarding mitigation scheme in all the three ranges.

In Alathur range, the people chose low start-up cost, low maintenance cost, low labour effort, and proven effectiveness as their best four options (Figure 16). Since the major crop cultivated was rubber and most of the farmers were non-residents they chose low labour effort before proven effectiveness. This showed that they were in favor of mitigation strategies which were cheap both initially as well as in the long run.

In Kollengode range the major cultivation was rice and vegetables with also plantations of mango in areas of Muthalamada. The respondents chose in the order low start-up cost, low maintenance, proven effectiveness and low labour effort (Figure 34). Being residential and hard-core farmers with year-round cultivation and they were mainly in search of effective low cost mechanisms for conflict mitigation.

Nelliyampathy where farming was comparatively low. The people chose in the order of low maintenance, low labour effort, low start-up cost and household control (Figure 53). They were mainly interested in easier methods to prevent wildlife conflict.

Plate7: Solar fencing and Diamond net fencing at Kollengod

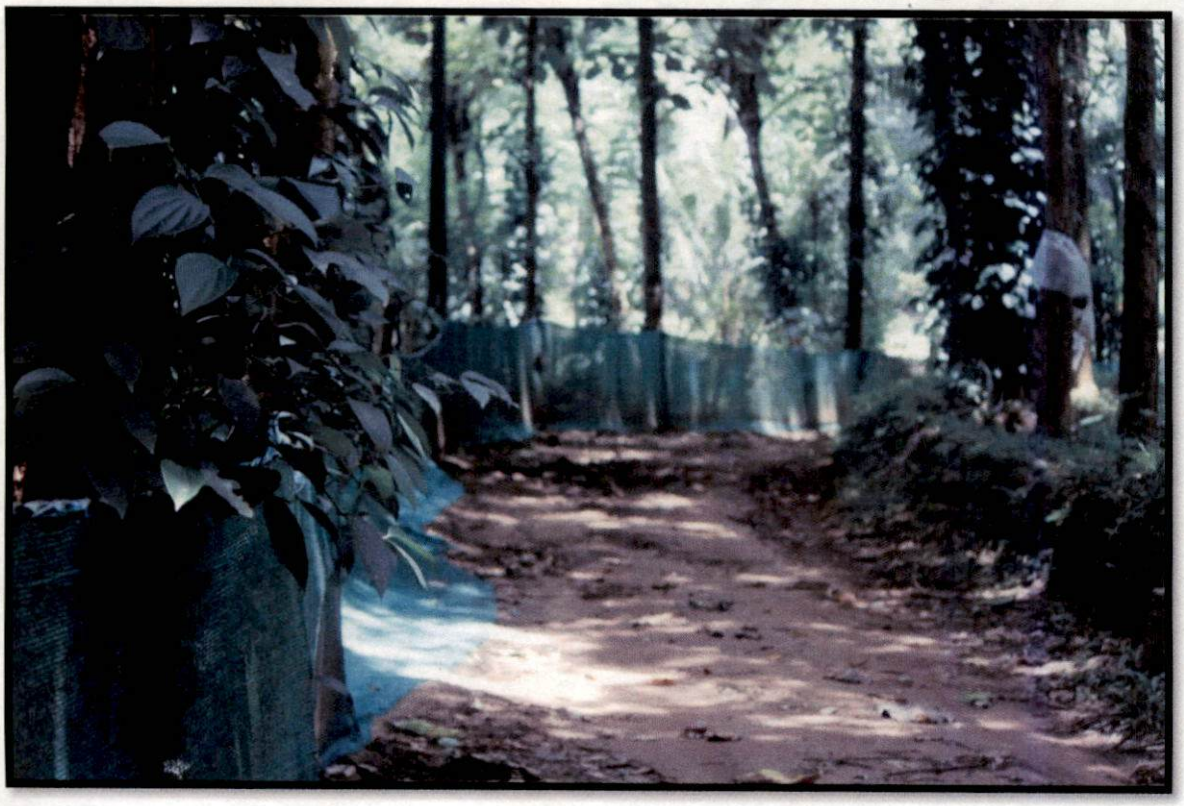

Plate 8: Green sheet fencing at Alathur range

5.8.4 Attitude towards wildlife and human-wildlife conflict

The attitude of the people towards wildlife and human-wildlife conflict at Nemmara forest range was found to be highly varying. The respondents in all the three ranges positively backed the statement that "Wildlife should be conserved" (Table 11, 20 and 29). While the respondents at Alathur and Kollengode strongly agreed to this statement the respondents at Nelliyampathy agreed. Even though in all the three ranges the respondents positively approached to the statement, the respondents at Kollengode and Alathur were stronger in making their point.

The respondents at Kollengode and Alathur were comparatively more inclined to farming than the respondents at Nelliyampathy. Therefore, the respondents at Kollengode and Alathur strongly agreed to the statement that "Wildlife is getting more priority than humans" while the respondents at Nelliyampathy agreed. The main problematic animals at Alathur and Kollengode was found to be Sambar deer and wild boar respectively (Figure 1 and 19). This perhaps would have influenced their stronger opinion compared to the response from Nelliyampathy where the main problematic animal was bonnet macaque (Figure 37).

Since at Kollengode the respondents were core farmers and the cropping pattern was majorly rice and vegetables which needed round the clock protection, they were keener and stronger in registering their opinion regarding the statement "People should be given the rights to protect their land by any means". The people at Alathur also backed up by agreeing strongly.

The dissatisfaction of the respondents was evident in their response to the statement "Conservation policies of the government is not up to the mark". The respondents in all the ranges agreed to the statement while in Nelliyampathy equal majority agreed as well as remained neutral.

The people's opinion was that the government should improve their conservation policies. This was evident from their response to the statement "Conservation policies of the government is not up to the mark" which clearly showed their dissatisfaction (Table 11, 20 and 29). The people also favored lethal control of problematic animals if it is done by the government.

The people at Alathur were skeptical in revealing their opinion regarding the effectiveness of the government in mitigation human wildlife conflict whereas the respondents from Nelliyampathy and Kollengode made their point clear.

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5.9 MITIGATION STRATEGIES

5.9.1 Opinion regarding best method to mitigate crop raiding at Nemmara forest division

The people at Alathur chose the best method to mitigate crop raiding in the following order. The best five options in the descending order included electric fencing around farmer's field, electric fencing around the park, wire fencing, trenches around the park and trenches around the farmer's field (Figure 17). One of the possible reason behind this sequence at Alathur range can be due to their cropping pattern which is mainly rubber and the farmers were non-residents so the protection to private property was essential for them.

At Kollengode the top five options were in the order electric fencing around the park, electric fencing around the fields, trenches around the park, trenches around the fields and habitat improvement (Figure 35). The respondents at Kollengode were core farmers and hence had a unity among them and were residential. The main problematic animal at Kollengode was wild boar which was normally residing in the villages so they suggested habitat improvement also as a mitigation strategy.

In Nelliyampathy range despite being a small farming group and despite the problematic animal being bonnet macaque they chose in the order electric fencing around the parks. Electric fencing around the fields, trenches around the fields, trenches around the parks and wire fencing (Figure 53). The type of damage caused by bonnet macaques did not bother much to the respondents. The above order reveals that the respondents were keen in preventing the subsequent problematic animals which were found to be Leopard, Elephant and wild boar.

It was noted that in all the three ranges in the Nemmara forest division the respondents didn't favor compensation as well as any insurance schemes to crop loss. The reason being the delay and expensive process of application approval and sanctioning of funds. Most of the farmers being uneducated find it difficult to apply for compensation and once if they overcome all these hurdles the sanctioned amount was said to be far less than their actual loss.

5.9.2 Opinion regarding best method to mitigate livestock depredation in Nemmara forest division

Livestock depredation even though at Nemmara forest division was not a major problem the respondents at all the three ranges had different opinion to mitigate it. The respondents at Alathur chose the following as the best five options in the order guarding of livestock, control of problematic animals by forest department, improved fencing and stock corralling, habitat improvement and compensation (Figure 18). In Alathur the people favored actions to be taken up by the forest department to control problematic animals in case of livestock depredation.

The respondents at Kollengode chose compensation, stop grazing in protected areas, improved fencing and stock corralling, habitat improvement and guarding as the best five options for managing livestock depredation (Figure 36). Most of the livestock owners at Kollengode were satisfied with compensation for their livestock and they were well aware that the main cause of their livestock depredation was grazing inside the forests.

Whereas in Nelliyampathy the respondents chose the best five as compensation, guarding, improved fencing and stock corralling and the chose both insurance schemes and control by forest department as fourth option (Figure 54).

To conclude the present study has taken into account the human-wildlife scenario at Nemmara forest division its causes, consequences and social dimensions. Human-wild life conflict is a complex multi-dimensional issue which is sensitive in the present situation.

Even in the Nemmara forest division there is significant difference in opinion among the people and each and every situation is also different. The very location specific nature of human-wildlife conflict is evident in the present study. The study also points to the fact that human-wildlife conflict is dependent on various factors such as problematic animals, cropping pattern and as well as the occupation of the people.

The study also focuses on the people's point of view of human-wildlife conflict and conflict mitigation at range level. Conflict mitigation should not only be location specific it should be both people specific as well as animal specific. Conflict mitigation is a never ending adaptive process which needs constant adaptation to the current situations.

Based on the observations obtained from this study, the following recommendations are put forth;

1. Location specific studies should be conducted on all the seasons and specific site plans evolved. These studies should consider;
    a. Constant monitoring of wildlife movement and creation of database of conflict incidents with all attributes such as animal causing damage, type of damage, with location data (GPS readings) should be recorded and maintained.
    b. Periodic wildlife population studies to assess the carrying capacity of forest areas.
2. The influence of crops and cropping pattern on human-wildlife conflict must be scientifically studied. This would further help in preparing site specific plans.
3. Awareness generation programs should be conducted to make the forest fringe people aware about forest laws and rules. This could further improve the attitude of the people towards wildlife and conflict. There should be deliberate programs to raise the tolerance level of the people.
4. Human-wildlife conflict mitigation is an adaptive process and should be updated from time to time.
5. People's participation should be ensured in all the levels of conflict management from the initial discussion stage to actual field implementation and monitoring stage.
6. Faster and easier compensation claim process should be made possible. This would help improve the relationship between the forest department and people.
7. Converged efforts of all allied departments (Forest and wildlife, agricultural, tribal welfare, animal husbandry) should be ensured.
8. Formation of village action councils under the leadership of the allied departments for effective conflict mitigation and awareness generation
9. Involvement of local self-governments should also be ensured in all human-wildlife conflict issues.

SUMMARY

SUMMARY

Human-wildlife conflict is a hot topic of prime importance in our present generation. Incidents of human-wildlife conflict are increasingly reported day by day all over the world. Simultaneously the tolerance level of the people towards human-wildlife conflicts is decreasing. The human victims are developing negative attitudes towards wildlife and conservation of nature, making it difficult to manage and resolve conflict issues. Since these conflicts are as a result of several factors such as animal behaviour, human behaviour, locality, cultural etc. scientific studies should be undertaken to evolve location specific effective conflict mitigation plans.

The present study was under taken to document the human-wildlife conflicts at Nemmara forest division, Kerala. The specific objectives of the study were to understand the nature and distribution of human-wildlife conflict in this forest division. The study also explored the land use and land cover change pattern, and assessed the awareness and attitude of the people including the victims of human-wildlife conflict, towards human-wildlife conflict issues and forest conservation. Another objective of the study was to evolve location specific mitigation strategies based on the findings of the study. A total of 398 individuals from all the three ranges, namely Nelliampathy, Alathur and Kollengode forest ranges under this division were subjected to the interview schedule and selected Participatory Rural Appraisal (PRA) tools to realise the above mentioned objectives.

The salient findings are summarized below.

1. 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.
2. However, there was significant difference between the opinions of the respondents drawn from the three forest ranges under the division, which indicates the location specific nature of the human wildlife conflicts.
3. Crop raiding was the main type of human-wildlife conflict observed in all the ranges under the Nemmara forest division. The increased animal number was highlighted as one of the prime reasons for crop raiding in the entire division.
4. The most problematic animal at Alathur range was identified to be sambar deer.
5. At Kollengode range, wild boar was the most problematic animal.

6. In Nelliyampathy range, bonnet macaques posed the maximum threat.
7. In the last thirty years, the respondents highlighted the change in behaviour of the wild animals. While the number of wild animals has increased in numbers, their behaviour too have changed. Wild animals have lost their fear of humans, while the humans are now living in fear of wildlife.
8. The statement "There is insufficient food in the forest" as a reason for crop raiding was agreed and strongly agreed upon by majority of the respondents at the division.
9. The statement "government fails to keep the animals in the park" was strongly agreed upon by majority at Alathur and Kollengode testifying the peoples urge that the government should improve their efforts.
10. The cropping pattern in Nemmara have also changed over a period of 30 years. Generally, agriculture practices moved from food crops to cash crops.
11. At Alathur and Nelliyampathy, cropping patterns shifted from food crops to cash crops such as rubber. Most of the farmers here were non-resident in nature (absentee farmers).
12. At Kollengode, people moved from ground nut cultivation to rice farming and cultivation of vegetables.
13. In all the three ranges the respondents had a positive regard to conservation of wildlife and nature. They also opined that wildlife should be conserved for future generations. They (animals) have as much as right to live" as we do was also echoed by a majority.
14. The respondents identified forest department as the best responsible agency to take action regarding mitigation of human wildlife conflict. The respondents selected local communities as the second best choice to mitigate conflicts. The respondents also expect the forest department and public to join forces in conflict mitigation.
15. Mitigation strategies should be not only location specific it should also be both people and as well as animal specific. At Alathur, people favoured mitigation strategies which were cheap both initially as well as in the long run. At Kollengode, they preferred strategies that have a low start-up cost, low maintenance, proven effectiveness and low labour effort. On the other hand, at Nelliampathy the preferred mitigation strategy must be a combination of low maintenance, low labour effort and low start-up cost.

16. The people at Alathur chose electric fencing around farmer's field, electric fencing around the park, wire fencing, trenches around the park and trenches around the farmer's field as their preferred strategies.
17. At Kollengode the top options were electric fencing around the park, electric fencing around the fields, trenches around the park, trenches around the fields and habitat improvement works.
18. At Nelliampathy, electric fencing around the forest, electric fencing around the fields, trenches around the fields, trenches around the parks and wire fencing were the preferred suggestions.

REFERENCES

REFERENCES

Alfa Gambari Imorou, S., Mama, A., Tehou, A and Sinsin, B. 2004. Les conflits hommes/éléphants dans les terroirs villageois du parc national du W du Niger: cas des villages riverains d'Alfakoara dans la zone cynégétique de la Djona au Bénin. In: Actes du 6e Symposium International sur l'Utilisation Durable de la Faune Sauvage "La faune sauvage : une ressource naturelle", 6-9 juillet 2004, Paris, France, P. Chardonnet, F. Lamarque & M. Birkan, coord., Tome *Game Wildl. Sci.* 21(4): 553-569. Available at: http://www.redlist.org/

Barlow, A. C. D. 2009. The Sundarbans Tiger: adaptation, population status, and conflict management. PhD Thesis, University of Minnesota, Minnesota. 96p.

Berger, L. R. and Clarke, R. J. 1995. Eagle involvement in the accumulation of the Taung child. *J. Hum. Evol.* 29: 275–299.

Berger, L. R. 2006. Predatory bird damage to the Taung type-skull of Australopithecus Africanus Dart 1925. *Am. J. Phys. Anthropol.* 131: 166–168.

British Columbia, Ministry of water, land and air protection - Wildlife-Human Conflict Prevention Strategy. 2003. Available at: http://wlapwww.gov.bc.ca/eeeb/info/wildlife_human_interaction/

Butler. J. 2000. The economic costs of wildlife predation on livestock in Gokwe communal land, Zimbabwe. *Afric. J. of Ecol.* 38. (1): 23-30

CGSAFED [Centre for Gender Studies in Agriculture and Farm Entrepreneurship Development], KAU [Kerala Agricultural University] and KSWC [Kerala State Women's Commission]. 2012. *Recommendations for Formulating Women Inclusive Agriculture Policy*, Joint Report submitted to Kerala Government, 64p.

Coetsee, A. M. 1996. Elephant translocations: summary of presentation compiled from reporter notes. *Pachyderm*, 22: 81-82

Conover, M. 2002. *Resolving human-wildlife conflicts: the science of wildlife damage management*. Lewis Publishers, New York, 418 p.

150

Elephant Pepper Development Trust, 2006. *Community-based Problem Animal Control: Livelihood security for people living in elephant range. A Training Manual version, 4.1, March 2006*. Elephant Pepper Development Trust, Livingstone, Zambia.

Fall, J. and Jackson, 2002 The tools and techniques of wildlife damage management-changing needs: an introduction. *Int. Biodeterioration and Biodegradation.* 49(2-3): 87-91.

FAO, 2005. Strategies to mitigate Human-Wildlife Conflict in Mozambique. Anderson, J. & Pariela, F. Report for the National Directorate of Forests & Wildlife. 68p.

GoN [Government of Namibia]. 2007. National Policy on Human-Wildlife Conflict Management. Ministry of Environment and Tourism, Government of Namibia. 34p.

Gubbi, S. 2010. Making governance effective. Seminar, 613, 61–65.

Hanks, J. 2006. *Mitigation of Human-Elephant Conflict in the kavango-Zambezi Transfrontier Conservation Area, with particular refrence to the use of Chilli peppers. Conservation international*, SDC, 68 pp.

Hill, C. 1998. Conflicting attitudes towards elephants around the Budongo Forest Reserve, Uganda. *Environ. Conserv.* 25(3): 244-250.

Hill, C.2000. Conflict on interest between people and baboons: Crop raiding in Uganda. *Int .J.Primatol*, 21,299-315

Hoare, R. E. 1995. A decision support system for managing human-elephant conflict situations in Africa. IUCN /SSC African Elephant Specialist Group, Nairobi, Kenya. 111p.

Hoare. R. 1992. The present and future use of fencing in the management of larger African mammals. *Environ. Conserv.* 19(2): 160-164.

Hugh-Jones, M. E. and de Vos, V. 2002. Anthrax and wildlife. *Rev. Sci. Tech. Off. Int. Epiz.* 21(2): 359-383.

Human-Elephant Conflict Working Group (HECWG) – IUCN. 1992. [On-line] Available at: http://www.iucn.org/themes/ssc/sgs/afesg/hectf/

International Union for the Conservation of Nature (IUCN), 2005. Benefits beyond boundaries: Proceedings of the Vth IUCN World Parks Congress. Durban, South Africa, 1–17 September 2003. Gland, Switzerland & Cambridge, UK.

Iqbal, M. A. 2011. Study on human wildlife conflict in selected Forest Divisions of Kerala. B. Sc (Forestry) Dissertation, Kerala Agricultural University, Thrissur. 43p.

IUCN [International Union for Conservation of Nature] World Conservation Union – Red List of Threatened species. 2003. [On-line].

Jayson, E. A. and Christopher, G. 2008. Human-elephant conflict in the Southern Western Ghats: A case study from the Peppara Wildlife Sanctuary. *Indian For.* 134(10): 1309-1325.

Kenya Wildlife Service - Wildlife-human conflicts, Sources, Solutions and Issues. 1996. [On-line] Available at: http://www.safariweb.com/kwild/wildlife.htm

KFD (Kerala Forest Department). 2011. Working plan of Nemmara forest division. 379 p.

Kumar, M. 2012. Human-wildlife conflict in a degraded habitat of lower Chambal valley. *Asian J. of Res. in Social Sci. and Humanities* 2(4): 193-205.

Lamarque, F., Anderson, J., Fergusson, R., Lagrange, M., Osei-Owusu, Y., and Bakker, L. 2009. Human-wildlife conflict in Africa: Causes, consequences and management strategies. *FAO Forestry Paper.* 112p.

Linnell, J. D. C., Nilsen, E. B., Lande, U. S., Herfindal, I., Odden, J., Skogen, K., Andersen, R. and Breitenmoser, U. 2005. Zoning as a means of mitigating conflicts with large carnivores: principles and reality. In R. Woodroffe, S. Thirgood & A. R. Rabinowitz eds. *People and Wildlife: Conflict or coexistence?* pp. 162175. Cambridge, UK, Cambridge University Press, 516pp.

Madhusudan, M. D. 2003. Living amidst large wildlife: livestock and crop depredation by large mammals in the interior villages of Bhadra Tiger Reserve, South India. Environ. Manag. 31, 466–475.

Maïga, M. H. 1999. Les relations homme/éléphant dans le Gourma malien. *Flamboyant*, 50: 20-27.

Messmer, T. A. 2000. The emergence of human– wildlife conflict management: turning challenges into opportunities. *Inter. Biodeterioration and Biodegradation,* 45(3-4): 97-102.

Mishra, C. 1997. Livestock depredation by large carnivores in the Indian trans-Himalaya: conflict perceptions and conservation prospects. *Environ. Conserv.* 24(4): 338-343.

Mishra, C., Allen, P., McCarthy, T., Madhusudan, M., Bayarjargal, A., and Prins, H. 2003. The role of incentive programs in conserving the Snow Leopard. *Conserv. Biol.* 17(6):1512-1520.

Muruthi, P. 2005. Human Wildlife conflicts: Lessons learned from AWD's African heratlands. *AWF Working Papers*, 12p.

Musiani, M., Mamo, C., Boitani, L., Callaghan, C., Gates, C., Mattei, L., Visalberghi, E., Breck,S and Velpi, G. 2003. Wolf Depredation Trends and the Use of Fladry Barriers to Protect Livestock in Western North America. *Conserv. Biol.* 17(6):1538-1547.

Naughton, L., Rose, R., and Treves, A. 1999. Social dimension of human-elephant conflict in Africa. A report to the African Elephant Specialist, Human-Elephant Task Conflict Task Force of IUCN. Gland, Switzerland. 15p.

Naughton-Treves, L. 1996. Whose Animals? A history of property rights to wildlife in Toro, western Uganda. *Land Degrad. and Dev.* 10: 311-328.

Naughton-Treves, L. 1998. Predicting the patterns of crop damage by wildlife around Kibale N P, Uganda. *Conserv. Biol.* 12(1): 156-158.

Naughton-Treves, L. and Treves, A. 2005. Socio-ecological factors shaping local support for wildlife: crop-raiding by elephants and other wildlife in Africa. In: Woodroffee, R., Thirgood, S., Rabinowitz, A. (Eds.), People and Wildlife: Conflict or Coexistence? Cambridge University Press, Cambridge, UK, pp. 252– 277.

Nyhus, J. P., Sumianto, and Tilson, R. 2000. Crop-raiding elephants and conservation implications at Way Kambas National Park, *Oryx,* 34(4): 262-274.

Nyphus, P. J. and Tilson, R. 2004. Characterizing human-tiger conflict in Sumatra, Indonesia: implications for conservation. *Oryx,* 38(1): 68-74.

O'Connell-Rodwell C.E., Rodwell T., Rice M., and Hart L. A. 2000. Living with the modern conservation paradigm: can agricultural communities co-exist with elephants? A five-year case study in East Caprivi, Namibia. *Bio. Cons.* 93(3): 381-391.

Ogada, M., Woodroffe, R., Oguge, N., and Frank, G. 2003. Limiting depredation by african carnivores: the role of livestock husbandry. *Conserv. Biol.* 17(6): 1521-1530.

Ogada, O. O. and Ogada, D. L. 2004. Factors influencing levels of carnivore-livestock conflicts in Samburu Heartland and proposed mitigation measures. Unpublished consultancy report to African Wildlife.

Ogra, M. and Badola, R. 2008. Compensating human–wildlife conflict in protected area communities: ground-level perspectives from Uttarakhand, India. *Hum. Ecol.* 36: 717–729.

Omondi, P., Wambwa, E., Gakuya, F., Bitok, E., Ndeere, D, Manyibe, T., Ogoloa, P., and Kanyingi, J. 2002. Recent translocation of elephant family units from Sweetwaters Rhino Sanctuary to Meru National Park, Kenya. *Pachyderm*, 32: 39-48.

Osborn, F. V. and Parker, G. E. 2002. Community-based methods to reduce crop loss to elephants: experiments in the communal lands of Zimbabwe. *Pachyderm*, 33: 32-38.

Packer, C., Ikanda, D. Kissui, B., and Kushnir, H. 2005. Lion attacks on humans in Tanzania. *Nature*, 436(7053): 927-928.

Parker, G. E. and Osborn, F. V. 2006. Investigating the potential for chilli Capsicum annuum to reduce humanwildlife conflict in Zimbabwe. *Oryx,* 40(3): 1-4.

Patterson B. D., Kasiki S. M., Selempo, E., and Kaya, R.W. 2004. Livestock predation by lions (*Panthera leo*) and other carnivores on ranches neighbouring Tsavo National Parks, Kenya. *Biol. Conserv.*119(4): 507-516.

Pimentel, D., Zuniga, R., and Morrison, D. 2005. Update on the environmental and economic costs associated with alien-invasive species in the United States. *Ecol. Econ.* 52: 273–288.

Polisar, J., Maxit, I., Scognamillo, D., Farrell, L., Sunquist,M. E., and Eisenberg. J. F. 2003. Jaguars, pumas, their prey base, and cattle ranching ecological interpretations of a management problem. *Biol. Conserv.* 109(2): 297-310

Quigley, H. and Herrero, S. 2005. Characterization and prevention of attacks on humans. In R. Woodroffe, S. Thirgood and A. R. Rabinowitz eds. *People and Wildlife: Conflict or coexistence?* Cambridge, UK, Cambridge University Press, 516 pp. ecological interpretations of a management problem. *Biol. Conserv.* 109(2): 297-310.

Siex, K. S. and Struhsaker, T. T. 1999. Colobus monkeys and coconuts: a study of perceived human–wildlife conflicts. *J. of Appl. Ecol.* 36(6): 1009-1020.

Studsrod, J. E. and Wegge, P. 1995. Park-people relationships the case of damage caused by animals around the Royal Bardia National Park, Nepal. *Environ. Conserv.* 22: 133-142.

Treves A. and Karanth K. U. 2003. Human carnivore conflict and perspectives on carnivore management worldwide. *Conserv. Biol.* 17(6): 1491-1499.

Vijayan, S. and Pati, B. P. 2002. Impact of changing cropping patterns on man-animal conflicts around Gir protected area with specific reference to Talala sub-district, Gujarat, India. *Population and Environ.* 23(6): 541-559.

Woodroffe, R., Thirgood, S., Rabinowitz, A., 2005. The impact of human–wildlife conflict on natural systems. In: Woodroffe, R., Thirgood, S., Rabinowitz, A. (Eds.), People and Wildlife: Conflict or Coexistence? Cambridge University Press, Cambridge, UK, pp. 1–12.

WWF SARPO. 2005. *Human Wildlife Conflict Manual.* Southern African Regional Programme Office (SARPO). Action Set Printers, Harare Zimbabwe, 30p.

CAUSE-CONSEQUENCE ANALYSIS OF HUMAN-WILDLIFE CONFLICT AT NEMMARA FOREST DIVISION, KERALA

BY

ANAND R.

(2013-17-108)

ABSTRACT OF THE THESIS

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DEPARTMENT OF FOREST MANAGEMENT AND UTILIZATION

COLLEGE OF FORESTRY

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ABSTRACT

A study titled "Cause-consequence analysis of human-wildlife conflict in Nemmara forest division, Kerala" was conducted during 2013-2017. The main objectives of the study were to portray the nature and distribution of human-wildlife conflict, study the land use and land cover change pattern. Another objective of the study was to assess the attitude and awareness of the people including the victims of human-wildlife conflict about forest conservation and human-wildlife conflict. The observations of the study would be made useful to evolve location specific management strategies at Nemmara Forest Division. A detailed pre tested questionnaire was used to gather information regarding socio-demographic details, land use and land cover change patterns, human wildlife conflict data, crop farming details and also attitude and awareness of the people. A total of 398 individuals were surveyed from Alathur, Kollengode and Nelliyampathy ranges of the forest division. Participatory Rural Appraisal (PRA) methods such as oral history, time line and problem tree methods were used to collect additional information. The study found out that major conflict areas were along the fringes of the forest areas. The type of conflict even though was mainly crop raiding, the nature of damage and the animal causing the damage were found to be different in different ranges in the forest division. Over the past 30 years there was significant change in the land use and land cover in the division. Over all, cropping pattern has changed from food crops to cash crops. The number of wild animals has increased and this was portrayed as the main reason for human-wildlife conflict. The people found the forest department as the best responsible agency to look up to take action regarding conflict mitigation and were also ready to join hands with them to resolve such issues. Even though the people had a positive attitude towards forest conservation and wildlife they were not satisfied with the conservation policies and human-wildlife conflict mitigation schemes of the government. The people did not favour compensation or insurance schemes as a mitigation strategy towards crop raiding mainly because of the low compensation amounts and difficulty in applying for such schemes. Site specific plans, based on the data generated from this study can be used to develop not only location specific plans but also both animal as well as people specific plans for conflict management and mitigation.

APPENDIX

DATE:

PLACE:

College of Forestry

Department of Forest Management and Utilization

Cause-consequence analysis (Human wildlife conflict)

Objectives of the study:

- To portray the nature and distribution of human-wildlife conflicts in Nemmara Forest Division
- To analyze its cause–consequence factors with focus on land use change and land cover change pattern.
- To assess the awareness and attitude of the forest fringe people, including the victims of human-wildlife conflicts about the forest and related biodiversity laws and rules.

Section I **Type of human wildlife conflict analyzed**

Crop raiding Livestock raiding Attack on people Others

I (a).Basic details (Household Particulars)

A. Date:	B. Forest Range		C. Location (Forest range)
D. Name and address of person	E. Household members Male: Female: Children: Total:		
F. Community	G. How long have been living in this village:		H. Occupation
I. Age	J. Gender	K. Education	L. Economic status APL/BPL/OTHERS

(b).Main sources of livelihood and season of the activity

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

(c). Has your traditional livelihood changed?

.....

.....

Section II Natural resource knowledge & use

II (a).Do you think natural areas around your village have changed over the last 10, 20, or 30 years yes/no if so please specify?

	10 years	20 years	30 years
Forest area			
Wild animals			
Domestic animals			
Water sources			
Agricultural Land			
Cropping pattern			

(b).Do you think the climate has changed over the last 10, 20, or 30 years yes/no if so please specify

Climatic condition	10 years	20 years	30 years
Temperature			
Wind speeds			
Rainfall patterns			

(c).Do you have any traditions related to the wildlife or the forest?
How do you use the forest?

Resources	*Type of forest (administrative)*	*How important is this activity/resource to you? Quantify if possible*
Honey		
Medicinal plants		
Firewood		
Fodder		
NTFP for subsistence		
NTFP for trade		
Water		
Religious ceremonies		
Burial grounds		
Stone for building		

Section III **Attitude towards Wildlife and Conflict**

III (a).Attitude towards wildlife conservation and human wildlife conflict.

Statement	*Strongly agree*	*Agree*	*Neutral*	*Disagree*	*Strongly disagree*
Wildlife should be conserved					
Wildlife is getting more priority than humans					
People should be given the rights to protect their farms and land from animals by any means					
Conservation policies of the Government is not up to the mark					
The Government should keep a check on the wildlife population by lethal means					
HWC mitigation by the Government is effective					

Further comments.....
.....

(b).Awareness about Forest and Related biodiversity rules and laws

Question	Not answered	Correct	Incorrect
Name the Forest related laws and rules that you have heard and are aware of?			
As per the Wildlife Protection Act 1972 what is hunting?			
How many Schedules of animals and plants are there in the Wildlife Protection Act 1972?			
Tiger belongs to which schedule as per the Wildlife Protection Act?			

Further comments.....
.....

(c).In your opinion who should take responsibility for reducing conflict with wildlife?

Stakeholder	*Effectiveness Ranking (1=most effective, 5- least effective)*
Local communities	
Independent conservation and development groups	
Forest Department	
Revenue department	

Tourists and urban citizens	
Agriculture department	

(d).Do you believe wildlife should be protected? **Yes** **No**

Value	*Effectiveness Ranking (1=most effective, 5- least effective)*
They have as much right to live as we do	
Religious/cultural purpose	
For future generations	
Education purpose	
Tourism	
Value of wildlife products to the economy	
Other reasons, specify	

(e).What factors do you believe are most important when choosing a conflict mitigation scheme?

Criteria	*Effectiveness Ranking (1=most effective, 5- least effective)*
Proven Effectiveness	
Low startup Costs (Financial)	
Low maintenance Costs (Financial)	
Low Labour Effort	
High level of household control of scheme	
Minimal negative effects on wildlife	
High level of acceptability to other people	
Fair level of compensation	

Section IV **Crops and farming details**

Location of Farm: Owned/Leased: Latitude: Longitude:

IV(a).Is there any wildlife attack on crops here in the past 5 years ? Yes/no

Distance from the farm to nearby natural forest/plantation? .....Kms

A) Land owned (acres):	B) Land owned 10 years ago(acres):	C) Land Sold (acres): Please Specify Price and Reason.

(b).Ranking of crops with respect to their vulnerability to crop damage?

Crops	*Effectiveness Ranking (1=most vulnerabl,5= least vulnerable)*
Rice	
Coconut	
Arecanut	
Banana	
Vegetables	
Tapioca	
Other Tuber crops	
Ginger	
Turmeric	

(c). What are the other crops present but not damaged?.....
.....

(d). Whether the neighboring fields/gardens were raided?
.....

(e). Where do the wildlife species come from ;are they moving out specific areas such as PA's to enter fields or they live in and around the fields?.....

(f).Why does crop raiding occur?
Details:.....

Statement	*Strongly agree*	*Agree*	*Neutral*	*Disagree*	*Strongly disagree*
There are too many wild animals					
Farm owners have been negligent					
There is insufficient food in the forest					
Livestock that graze in the forest push the wildlife out					
The government fails to keep wildlife in the Park					
Climate change					
Deforestation and habitat loss					

(g).In your opinion which of these could be effective human- wildlife conflict mitigation practeises?
How:.....

Scheme	*Effectiveness Ranking (1=most effective)*
Insurance	
Compensation	
Natural fencing (thorn bushes, stone walls)	
Wire fencing	
Electric fencing around fields	
Electric fencing around park boundaries	
Trenches around fields	
Trenches around park boundaries	
Deterrent techniques (firecrackers, noise)	
Stopping livestock grazing in the forest	
Improving the habitat within the protected areas	
Control of problem animals by the Forest Department	

(h).What do you do when you lose crops to wildlife?

Complain to Forest Dept	Complain to elected representatives
Retaliatory actions	Compensation claim to Forest Dept
Increase in protection measures	Scare away or deter animals
Complaint to panchayath	Insurance claims

Other:.....
.....

(i).What other reasons have caused crop loss in the past 2 years?

Other cause	*Crop types*	*Value lost in last 2 years (Rs & subsistence)*	*Acres lost in last 2 years*
Disease			
Insects/pests			
Rodents			
Drought			
Heavy rainfall			
Other			

Crops and farming details

(j)

Crop	Grown in which part of farm	Extent (in acres)	Time of planting	Time of harvesting	Investment	Yield/ha	Species causing damage	Plant part damaged	Value lost to wildlife	Protection mechanism	Timing of crop raids	Frequency of raiding

(k) Grown near to reserve forest boundary – (1) mid zone – (2) further end of field – (3)

Animal Species	Methods used (guarding, barriers, deterrents)	Household unpaid time (person days)	Money lost through time and money spent protecting	Management level: household/community/govt	Effectiveness Ranking (1=most harmful)

(l).Compensation for loss, have you ever sought compensation for crops destroyed by wild animals? Yes No

Crop type and acres/value lost	Date compensation claimed	Compensation sought from	Date received	Amount received	Satisfication with compensation?

If you have not sought compensation, why ?

Section V **Assessing Damage to infrastructure**

V(a). Have you ever sought compensation for attacks on property? Yes No

If you have not sought compensation, why?

.....

Species	location	Month/season/year	Type of damage	Value of damage (Rs)	Possible Reason	Date compensation claimed	Compensation sought from	Date received	Amount received	Adequacy of compensation

Section VI **Assessing Attacks on People**

VI(a). Have you ever sought compensation for attacks on people? Yes No

If you have not sought compensation, why?

.....

Species	Location (village/forest etc)	Month/season/year	Distance from village	Severity &Type of injury	Possible Reason	Date compensation claimed	Compensation sought from	Date received	Amount received	Adequacy of compensation

(b).What do you do when you lose human to wildlife?

Complain to Forest Dept	Complain to elected representatives	Retaliatory actions	Compensation claim to Forest Dept	Increase in protection measures
Scare away or deter animals	Nothing	Others		

Section VII **Livestock Depredation**

VII(a).Where do you obtain food for your livestock?

Personal land/ fodder Unprotected common land Reserve/Protected forest .

(b).Other reasons livestock have been lost in the last 2 years

Other cause	*Livestock type (animal-age-sex)*	*Numbers lost*
Disease		
Drought		
Fodder availability		
Other:		

(c).Why does depredation occur?

Statement	*Strongly agree*	*Agree*	*Neutral*	*Disagree*	*Strongly disagree*
There are too many wild animals					
Livestock owners have been negligent					
There are too many livestock					
There is not enough wild prey in the forest					
Livestock are taken because they graze in the forest					
The government fails to keep wildlife in the Park					

(d).How can human-wildlife conflict over livestock be reduced?

Scheme	*Effectiveness Ranking (1=most effective, 5-least effective)*
Insurance	
Compensation	
Improved herding/livestock guarding	
Improved fencing for stock corralling	
Stopping livestock grazing in the protected areas	
Improving the habitat within the protected areas	
Control of problem animals by the Forest Department	

(e)

Assessing Livestock Depredation

Livestock	Management: household /community/Gov)	Number	Value of individual	No: Bought (last 2 years)	No: Sold (last 2 years)	Protection measures	Cost of Protection	Money lost through time spent protecting	Effectiveness: Little, Moderate, Very

(f).What do you do when you lose livestock to wildlife?

Complain to Forest Dept	Complain to elected representatives	Retaliatory actions	Compensation claim to Forest Dept	Increase in protection measures
Scare away or deter animals	Nothing	Others		

(g).Have you ever sought compensation for livestock killed by wild animals? Yes No. If No why ?

Livestock	Main Predator	Season and Time activity of predator	Type of damage caused	Compensation sought from	Date claimed	Date received	Amount received	Adequacy of compensation

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