15 –ാം കേരള നിയമസഭ

8 –ാം സമ്മേളനം

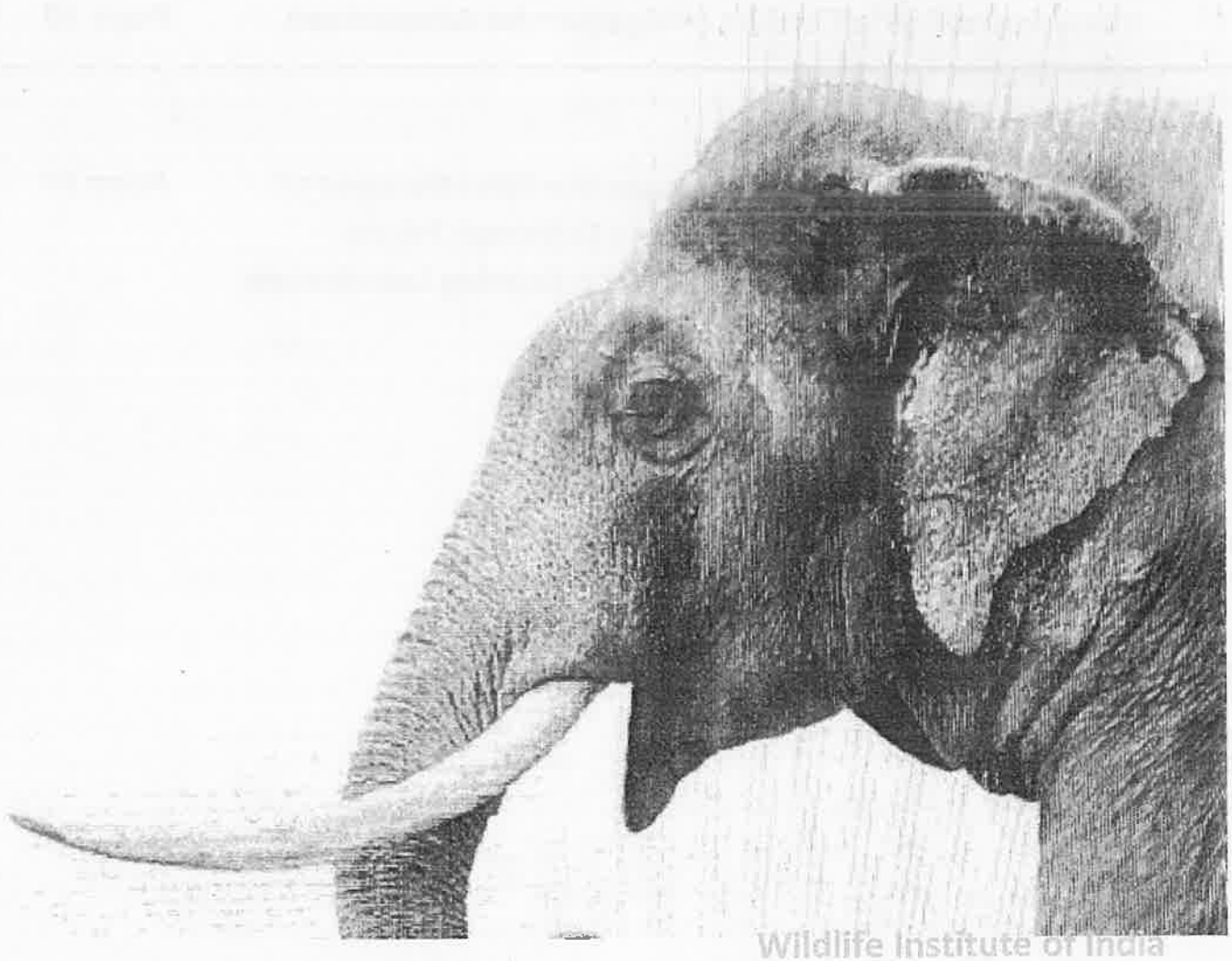
നക്ഷത്ര ചിഹ്നം ഇല്ലാത്ത ചോദ്യം നം. 983 **06-02-2023 - ൽ മറുപടിയ്ക്ക്**

വന്യജീവികൾ ജനവാസ കേന്ദ്രങ്ങളിലേക്ക് ഇറങ്ങുന്നതിനുള്ള കാരണം

ചോദ്യം		ഉത്തരം	
ശ്രീമതി.ഉമ തോമസ്		**ശ്രീ. എ. കെ. ശശീന്ദ്രൻ (വനം-വന്യജീവി വകുപ്പ് മന്ത്രി)**	
(എ)	വൈൽഡ് ലൈഫ് ഇൻസ്റ്റിറ്റ്യൂട്ട് ഓഫ് ഇന്ത്യയും പെരിയാർ ടൈഗർ കൺസർവേഷൻ ഫൗണ്ടേഷനും ചേർന്ന് വന്യജീവികൾ ജനവാസ കേന്ദ്രങ്ങളിലേക്ക് ഇറങ്ങുന്നതിനുള്ള കാരണങ്ങളും പ്രതിരോധ മാർഗ്ഗങ്ങളും സംബന്ധിച്ച് നടത്തിയ പഠനം പൂർത്തിയായിട്ടുണ്ടോ; എങ്കിൽ പ്രസ്തുത പഠന റിപ്പോർട്ടിന്റെ പകർപ്പ് ലഭ്യമാക്കുമോ;	(എ)	കേരളത്തിലെ മനുഷ്യ വന്യജീവി സംഘർഷം ലഘൂകരിക്കുന്നതിനുള്ള സംസ്ഥാന തല സ്ട്രാറ്റജി രൂപീകരിക്കുന്നതിനുള്ള പഠനത്തിനായി വൈൽഡ് ലൈഫ് ഇൻസ്റ്റിറ്റ്യൂട്ട് ഓഫ് ഇന്ത്യ, കേരള വനം വകുപ്പ്, പെരിയാർ ടൈഗർ കൺസർവേഷൻ ഫൗണ്ടേഷൻ എന്നിവർ ചേർന്ന് 13/11/2018-ൽ ഒരു MOU ഒപ്പ് വയ്ക്കുകയും ആയത് പ്രകാരം പ്രസ്തുത പഠനം ആരംഭിക്കുകയും ചെയ്തിട്ടുണ്ട്. എന്നാൽ പഠനം പൂർത്തിയാക്കി അന്തിമ റിപ്പോർട്ട് ലഭ്യമായിട്ടില്ല.
(ബി)	പ്രസ്തുത പഠനം പൂർത്തിയായിട്ടില്ലെങ്കിൽ ഇടക്കാല റിപ്പോർട്ടുകളുടെ പകർപ്പ് ലഭ്യമാക്കുമോ?	(ബി)	വൈൽഡ് ലൈഫ് ഇൻസ്റ്റിറ്റ്യൂട്ട് ഓഫ് ഇന്ത്യയും, പെരിയാർ ടൈഗർ കൺസർവേഷൻ ഫൗണ്ടേഷനും ചേർന്ന് നടത്തിയ പ്രസ്തുത പഠനത്തിന്റെ ഇടക്കാല റിപ്പോർട്ട് ലഭിച്ചിട്ടുണ്ട്. ആയതിന്റെ പകർപ്പ് അനുബന്ധമായി ചേർക്കുന്നു.

സെക്ഷൻ ഓഫീസർ

Assessment of the Status:
Human – Wildlife Conflict in Kerala



Content

i: Assessment of the Current Status of Human – Wildlife Conflict in Kerala

Human-wildlife conflict is part of human society since time immemorial. It became pronounced with advent of domestication of plants and animals; as human society moved from day today sustenance to exploitation for futuristic persistence value. The direct conflicts between humans and wildlife (e.g., crop raiding) is obvious but it is Human–human conflicts over how tomanage wildlife;which can often prove more complicated for conservation management (Dickman 2010). Conflict largely occur in a situation where forests are bordering human use areas, animals are behaviourally adopted to survive in human occupied areas, animal's traditional long range movement got disrupted over time due to land use changes and animals become overabundant due to protection accorded to them due to religio-cultural values and implementation of protection laws.

Kerala has a vast forest cover which approximates to 11309.47 sq. km, extending over 29.1% of the total geographical area of the state (http://www.kerenvis.nic.in/Database). The HWC is common along the fringes along some of these forests and is estimated roughly to a linear distance of 6000 Kms. While there are 725 tribal settlements with a population of more than one lakh residing within the boundaries of these forests, an additional five lakhs non-tribals also reside in these forests, in the form of enclosures and settlements. Besides this, a considerable population is also living on the fringe areas which are lying adjoining to these forest areas. With drastic increase in these populations and resultant increase in anthropogenic pressures on the forest areas, human-wildlife interaction and resultant conflict has seen a sharp rise in recent past. Conflict is in the forms of either human casualties or damage to crops, cattle lifting, damage to houses and property.Human wildlife conflict thus emerging as one of the major challenges for foresters and wildlife practitioners of the state.

As per the records of Forest Deptt of Kerala there is along list of animals for which people demanded compensation: Elephant, Wild Pig,Bonnet Macaque,Snakes,Leopard,Tiger,Sambar,Wild Dog,Gaur,Spotted Deer,Porcupine, Malabar Gaint

Squirrel,Peacock,Jackal,Indian Fox,Mongoose,Flying Squirrel,Sloth Bear,Barking Deer,Squirrel,Honey Bee ,Civet,Rock Python,Jungle Cat,Pangolin,Wolf,Bear,Civet,Eagle,Leopard Cat,Lion Tailed Macaque ,Nilgiri langur, Swamp Hen and Wasps. This document described in details those species which are in maximum conflict and general strategy for conflict management.

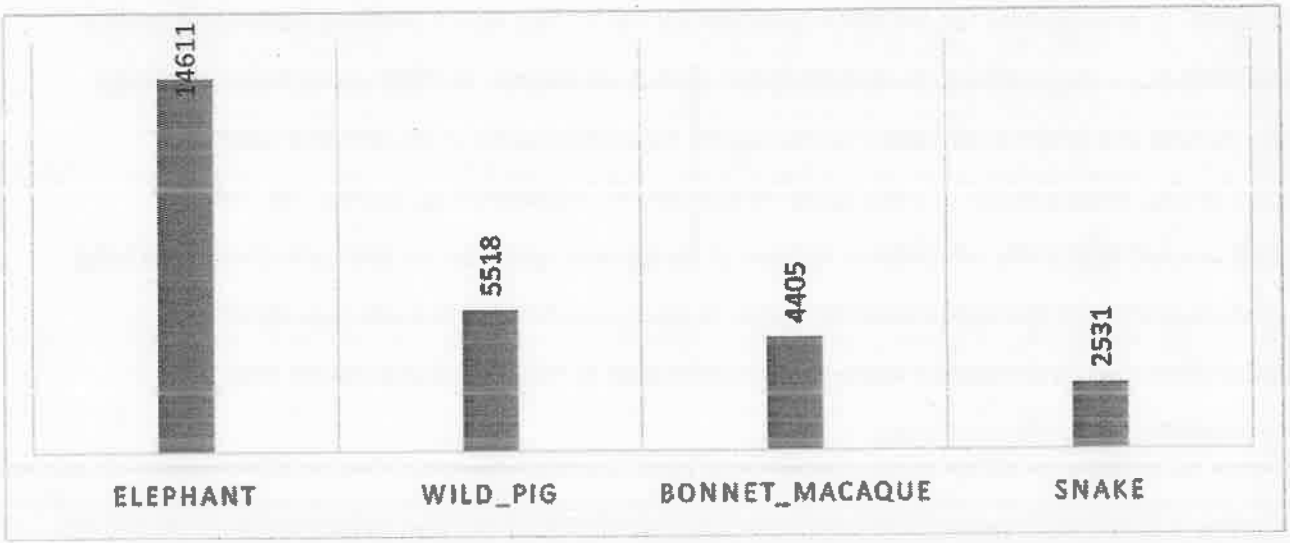


Fig i.a: Human wildlife conflicts from 2013 to 2018/2019 in Kerala (Source: Kerala Forest Deptt.)

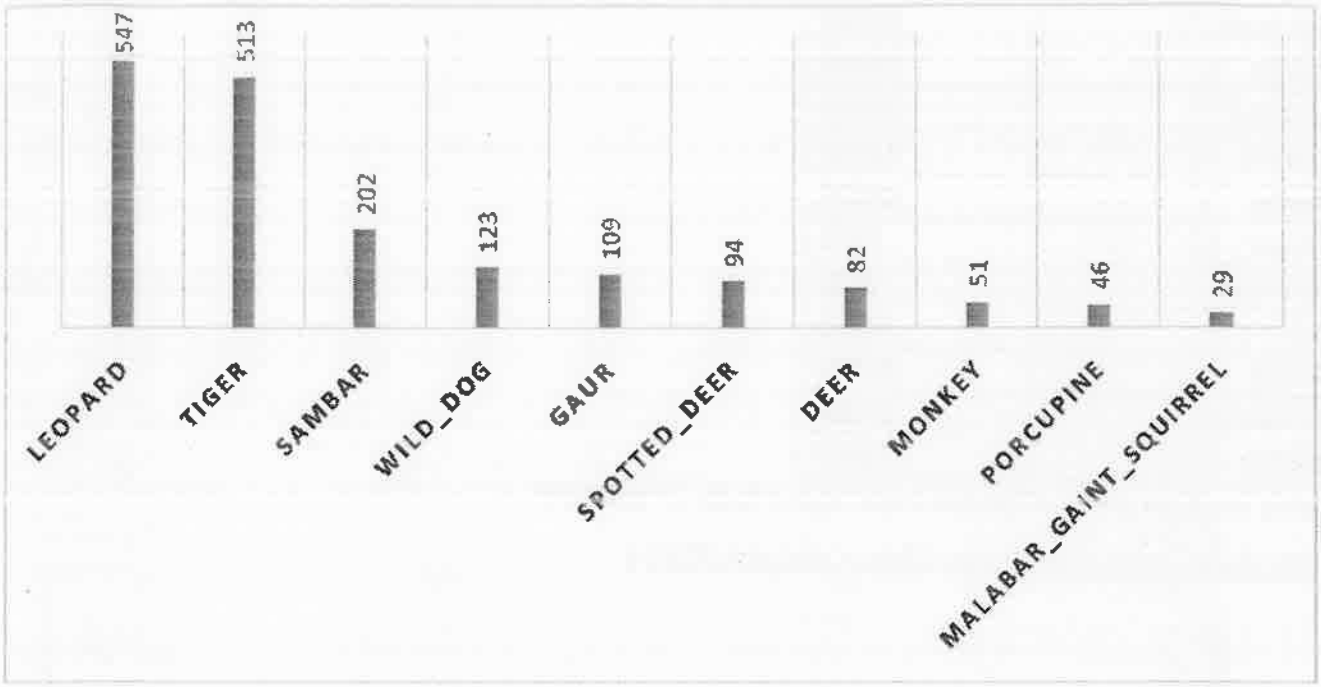


Fig i.b: Human wildlife conflicts from 2013 to 2018/2019 in Kerala (Source: Kerala Forest Deptt.)

Elephant, Wild pig, Bonnet macaque and snakes top the list for conflict followed by predators like Tiger, Leopard and Wild dog(Fig i.a and b). Other herbivores like Sambar, Chital and Gaur (Fig i.b) contribute to crop depredation depending on the proximity to forests especially Protected Areas.

Agriculture in Kerala has recorded declining trend in states economy in comparison to past and stabilized now (http://www.kerenvis.nic.in/Database/Agriculture). Coconut has highest acreage (7814.96 sq.Km), followed by Rubber (5510.50 sq. Km) and Paddy(1713.98 sq.Km) (Table i.a, http://www.ecostat.kerala.gov.in/index.php/agriculture)

Paddy	171398
Coconut	781496
Arecanut	97696
Tapioca	68664
Banana	57158
Plantain	57140

Jack fruit	91982
Mango	79496
Pappaya	19694
Cashew	41661
Pepper	85207
Ginger	5151
Turmeric	2632
Tea	30205
Coffee	84976
Cardamom	39080
Rubber	551050

Table i.a: Area under different crops as per 2016-17 estimate

(http://www.ecostat.kerala.gov.in/index.php/agriculture)

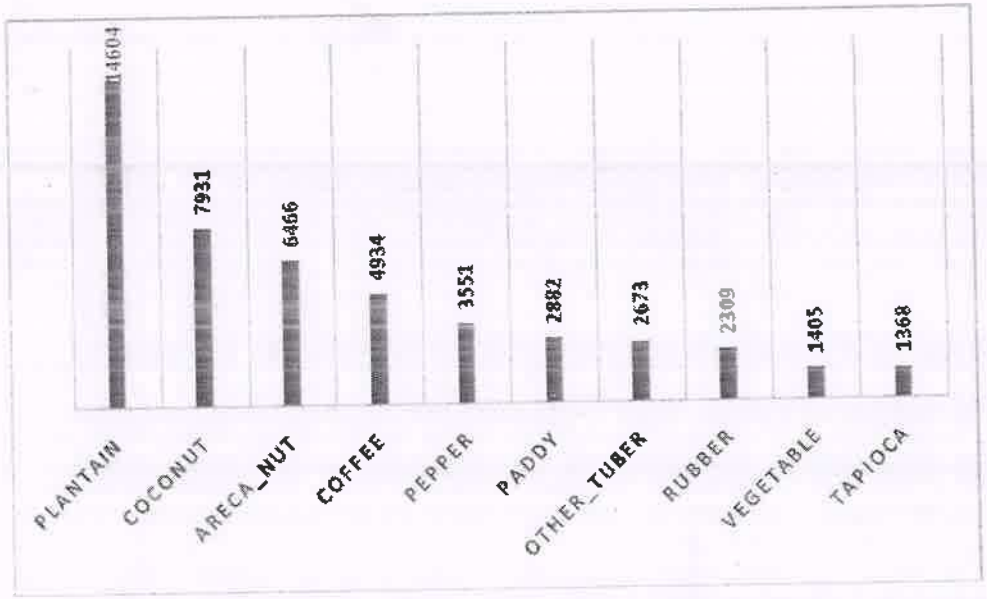
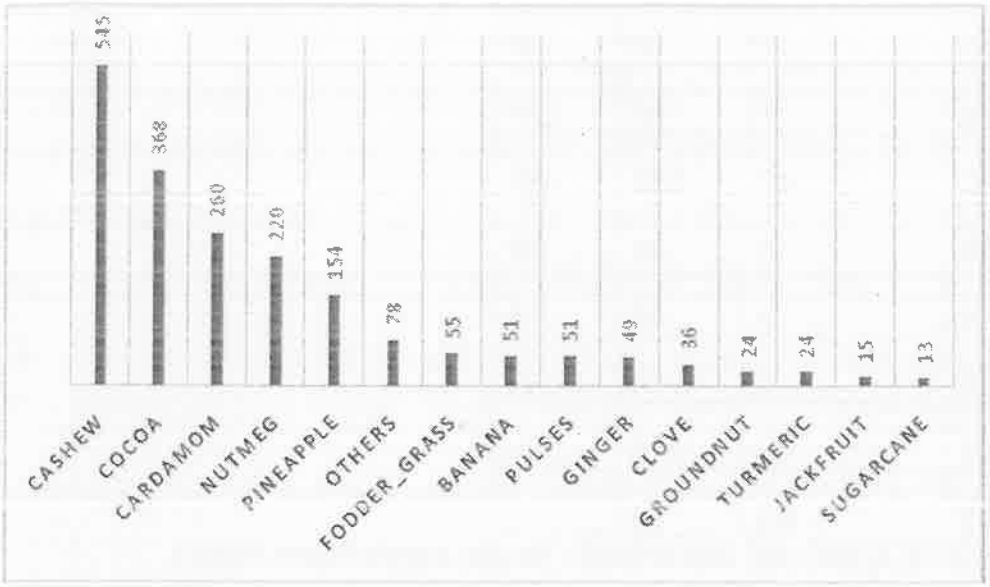


Fig i.c: Damage to agriculture and horticulture from 2013 to 2018/2019 in Kerala (Source: Kerala Forest Deptt.)



Figi.d: Damage to agriculture and horticulture from 2013 to 2018/2019 in Kerala (Source: Kerala Forest Deptt.)

	Elephant	Bonnet	Wild Pig	Sambar	Chital	Gaur
Coconut	4991	2139	886			
Areca nut	4441	1819	608			
Plantain	8926	2973	3074	83	50	23
Coffee	3109	1701	432			
Paddy	1739	65	1050		41	
Tubers	1103	885	802			

Table i.b: Wild species wise damage of Crops and Plantations (Sourse:Kerala Forest Deptt.)

	Cattle	Buffalo	Goat	

Elephant	20	0	6	26
Leopard	93	2	78	173
Tiger	250	47	123	420
Snake	58	5	35	98
Wild Dog	8	2	54	64
Wild Pig	18	1	14	33
Total	447	57	310	814
Annual	74.5	9.5	52	

Table i.c: Livestock death and injury different wild animals (Source: Kerala Forest Deptt.)

Maximum damage was to Plantain, followed by Coconut, Areca nut, Coffee, Pepper and Paddy (Fig i.c and d).Elephant, Bonnet Macaque and Wild Pig (Table i.b) cause major damage to most of the main agricultural crops of the state. Livestock depredation is mostly done by Tigers, followed by Leopard and Wild Dog (Table i.c)

1. Elephant-Human conflict

Current population status and distribution of species: Historically elephants (*Elephas maximus indicus*) were distributed all across India, starting from the southern Himalaya, excluding only the arid tracts in the country. The current distribution is however restricted to only the Himalayan foothills in the north, the hills of the Western Ghats in the south, forests of north-eastern states and the forests of east-central India (Baskaran et al., 2011; Sukumar, 2006). Habitat loss, poaching and other threats over their distribution range have reduced the elephant population by more than 50% over the last three generation and as a result, the species has been listed 'Endangered' by the IUCN (www.iucnredlist.org)and in Appendix-I of CITES which prohibits any form of international trade (www.cites.org). Elephants have also been listed in Schedule-I of the Indian Wildlife (Protection) Act, 1972.

Current estimates indicate a countrywide population size of 27,000-28,000 in the wild Kerala holds the third largest population of elephant (*n= 3054*) in India(www.moef.nic.in)., distributed over an area of 9670 km^2 in four Elephant Reserves (ER), viz; Anaimudi ER, Periyar ER, Wyanad ER and Nilambur ER.Maximum occupancy () is in ?followed by ? and ?.

Status of negative interaction: Statistics indicate that the interactions between humans and elephants are becoming more hostile over the years, leading to loss of human life (> 400 deaths annually), crop-damage (~ 330 km2 every year) and elephant deaths (100 annually in retaliation) (MoEF, 2010). The conflict has increased to such an extent that more than half the expenditure incurred by the Project Elephant goes for the Human elephant conflict mitigation (ETF, 2010).

Fig 1.3: The over all incidence of conflict by top four species, Elephant, Wildpig, Bonnet Macaque and Snakes.

Elephant is involved in maximum damage, Plantain recorded maximum damage followed by coconut, Arecanut and Coffee (Table 1.1)

	Elephant	Bonnet	Wild Pig	Sambar	Chital	Gaur
Coconut	4991	2139	886			
Areca nut	4441	1819	608			
Plantain	8926	2973	3074	83	50	23
Coffee	3109	1701	432			
Paddy	1739	65	1050		41	
Tubers	1103	885	802			

Table 1.1: Crop damage incidences by various herbivores and Bonnet macaque.

Reasons for negative interaction: Elephant habitats quality is deteriorating and fragmentation of landscape across the country coupled with increase in population of elephants and humans has created difficult environment for managing conflict (Bist, 2002; Choudhury, 2004; Fernando et al., 2008). Infrastructure development leading to fragmentation of elephant habitats is an

overriding factor in conflict cases across Asia (Leimgruber et al., 2003). Depletion of food resources directly due to degradation of habitats caused by humans and biomass extraction and indirectly due to spreading of weeds in elephant habitats are resulting in aggravated crop-depredation episodes (Boominathan et al., 2008).Behavioural changes and the associated increased stress levels caused by harassment due to interaction with humans in rural landscape. It is one of the major issue to deal with in elephants; it is long-lived species and retain memories for long term.

Current mitigation measures: Currently, a variety of short-term strategies are used to mitigate the elephant conflict in the India as an immediate tactical strategy to deter elephants, which include: creating a barrier (i.e., electric fencing, boundary wall, ditches etc.), compensation schemes and translocating or capture and rehabilitationof "problem" individuals from the population. The efficacy of barrers and other measures adopted in state is given in chapter 2. The deciosion process for mitigation is given in chapter 4.

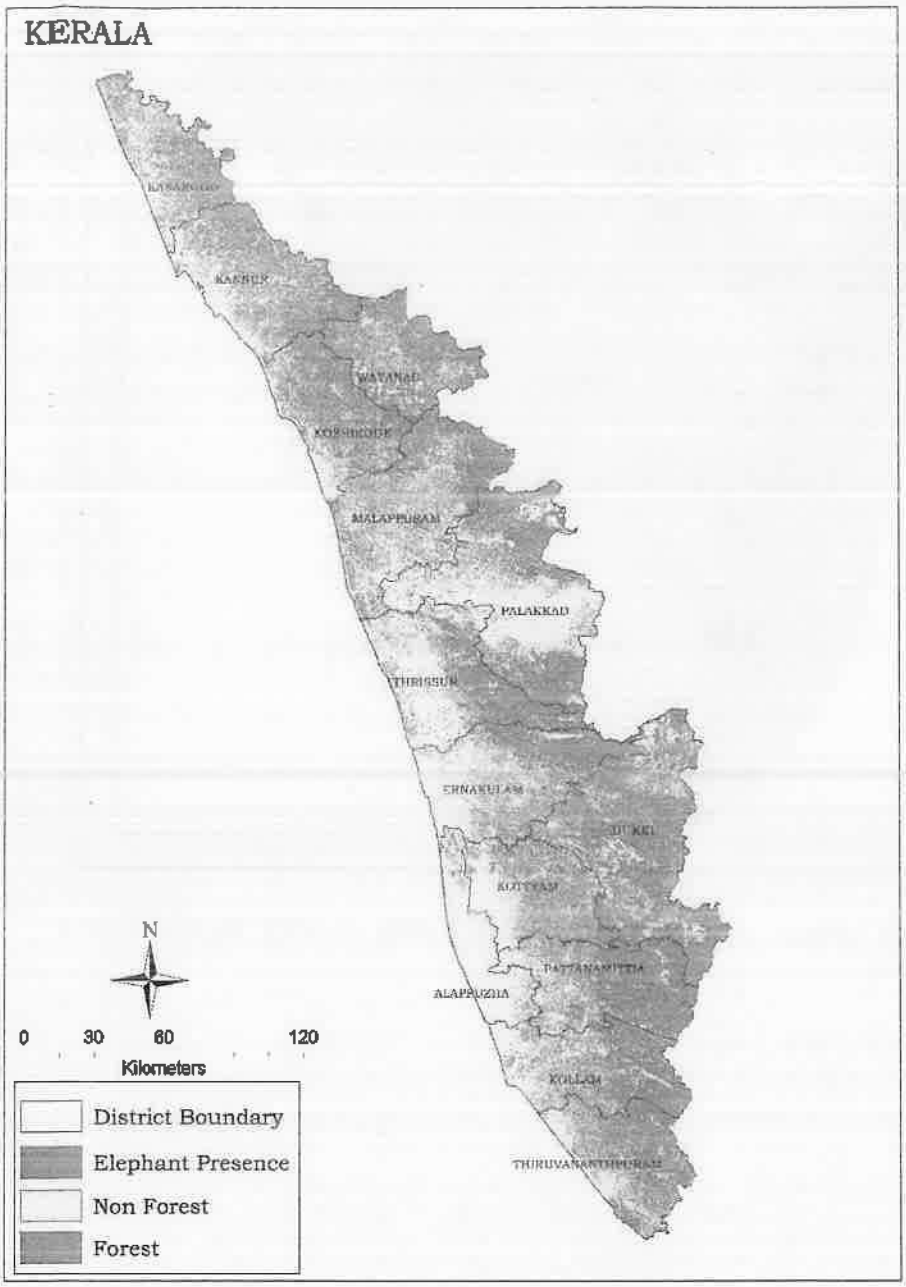


Fig 1.1: Distribution of elephant in Kerala (source: Jhala et al 2019)

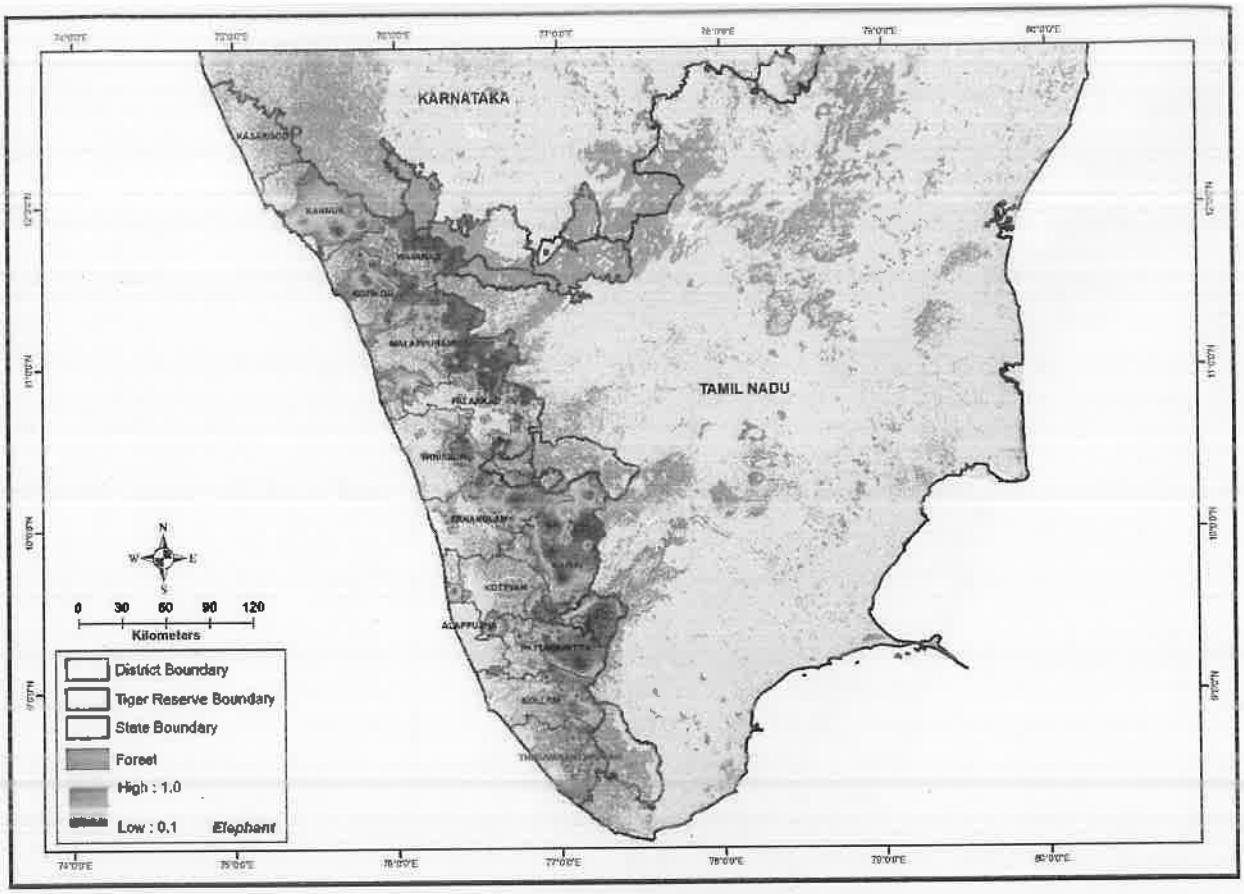


Fig 1.2: Distribution of elephant human conflict incidences in Kerala (source: Kerala Forest Deptt.)

2. Human-Wild Pig conflict in India

Current population status and distribution of species: The wild pig (Sus scrofa) is one of the most widely distributed terrestrial mammals amongst allSuiformes. This range has been greatly expanded by humans as the species has successfully associated itself with man, by utilizing the human altered landscape (Fadeev 1975, Erkinaro et al. 1982). Being a resilient and fast breeding animal, it is also capable of expanding and establishing its population in new areas (Erkinaro et al. 1982, Ahmed 1991, IUCN 2008). It is commonthroughout India except Jammu and Kashmir, upper Himalayas and desert, (Chauhan 2004). The species (Sus is protected under Schedule-III species of Indian Wildlife Protection Act, 1972. Population estimate of wild pigs is not available but information about the extent of their occurrence in forest habitat and relative abundance index is available (Fig 2.1, Jhala et al 2019).

Status of negative interaction: The wild pig is considered as a universal crop pest (Tisdell, 1982). They invade human habitations and agricultural and horticultural farms and feed on variety of crops. Wild pigs were reported to cause 46% of the damage to crops in central Saurashtra (Mehta, 2014), whereas Dave (2010) reported the damage in terms of percentage of agriculture field area affected near the Little Rann of Kachchh to be between 10% and 25% for cash crops (cotton and cumin), millet and pulses and oil seeds. They have also been implicated in human fatalities; in many states (Chauhan et al. 2009). Wild pig is second in rank after elepahnet in terms of number of conflicts reported (Fig 1.1). It causes maximum damage to plantain followed by paddy, coconut and tubers (Table 1.3). The overall compensation paid for it amounts to ????.

Reasons for negative interaction: Prater (1971) reported that there is no animal more destructive to crops than the wild pig. It causes extensive damage to agricultural crops and utilizes agro-ecosystems for food resources and shelter. In many areas they have become locally overabundant and depend upon agricultural crops, especially in and around protected areas or managed forests, for a major part of their food requirements. Besides agricultural crops, they cause damage to orchards and forest plantations and possibly act as carriers of infectious diseases. According to Mackin (1970), Andrzejwski & Jezierski (1978) and Genov (1981), the damage caused to crops by wild pigs vary with availability of natural food available in forests or forested patches.

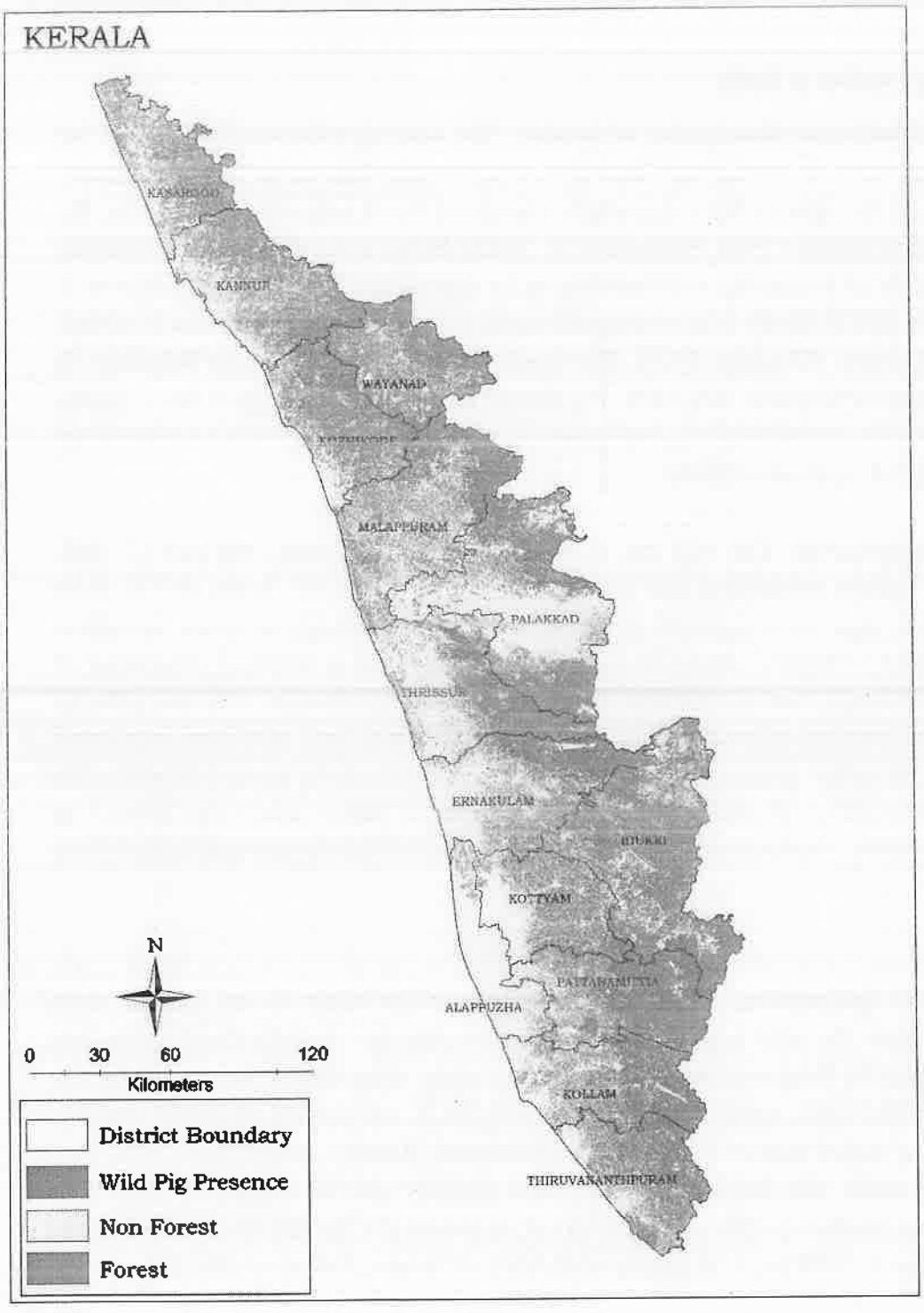


Fig 2.1: Distribution of wild pig in sampled forest of Kerala (source: Jhala et al 2019)

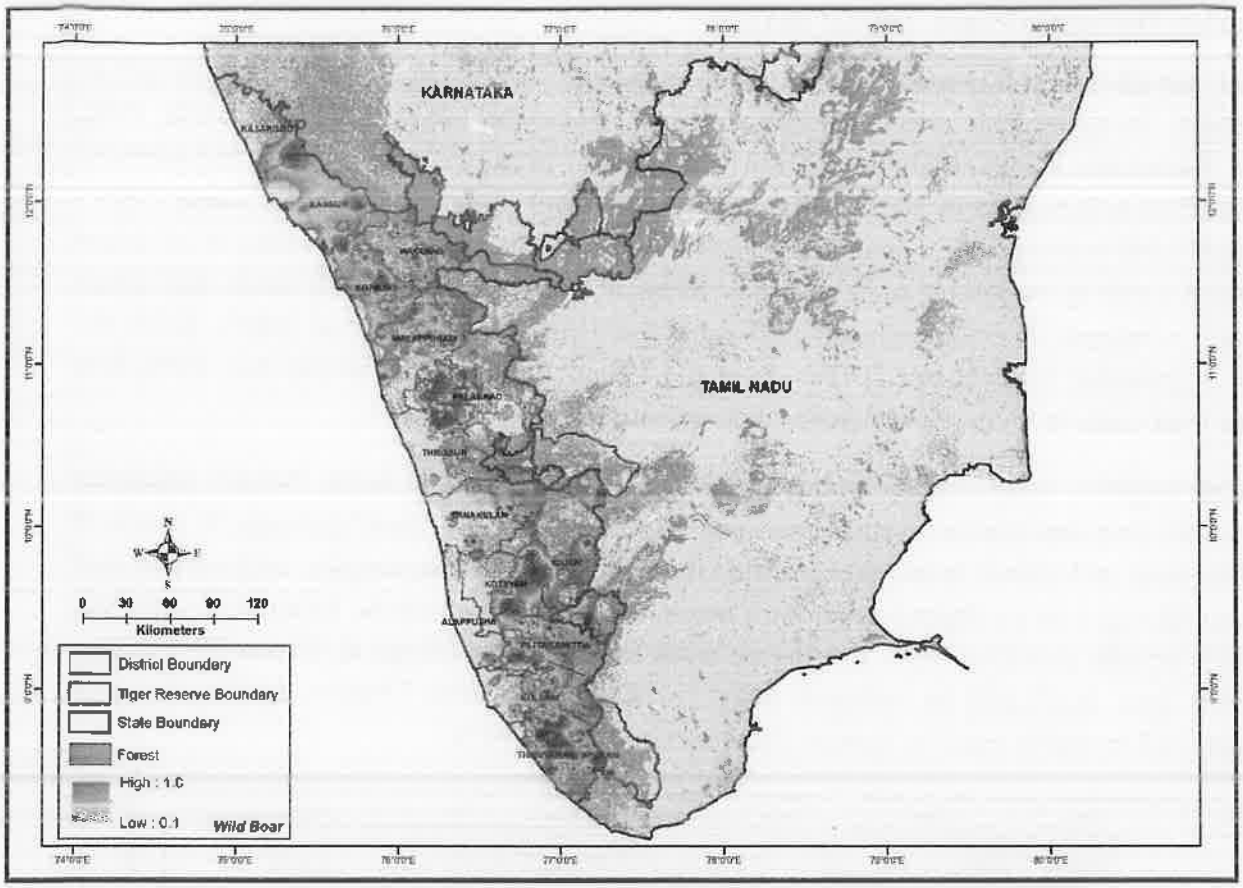


Fig 2.2: Conflict hotspots of wild pig in Kerala (source: Kerala Forest Deptt.)

Current mitigation measures: Farmers manually guard their farms, create noise, fire crackers and even use guns, to scare away wild pigs from farms (Ahmed 1991, Mehta 2104). At times pig bombs are also employed illegally to eliminate wild pigs. Creating a barrier (i.e., electric fencing, boundary wall, barbed wire etc.) is also used to contain the damage done to crops by wild pigs.Uttarakhand, Bihar, Goa, Maharashtra and Karnataka states have declared the species as vermin, and allow culling of individuals in cultivated areas.

3. Bonnet Macaque-Human conflict in India

Current population status and distribution of species: The Bonnet Macaque is endemic to south India. Its geographic range extending across peninsular India (Andhra Pradesh, Goa, Gujarat, Karnataka, Kerala, Maharashtra and Tamil Nadu) to southern tip of India and northern most distribution is marked by Krishna River and Tapti River (Singh et al., 2008). Kurup (1981) estimated11,000 individualsin Kerala. It is both arboreal and terrestrial. It is found in all forest types from scrub to evergreen and deciduous forest, plantations, agricultural lands, and urban areas, and is tolerant of disturbed habitats (Corbet and Hill 1992; Molur *et al.* 2003). While the species is protected by Schedule II (Part I) of the Indian Wildlife (Protection) Act, 1972, it is listed as least concern by the IUCN (www.iucnredlist.org).

Status of negative interaction: Similar to Rhesus macaques in the north, Bonnet macaques cause severe crop depredation in rural areas and also raid houses in urban landscape in search of food. Devotees and animal lovers feel gratified in feeding monkeys in temples, highways or roof tops, considering it as a religious deed. As a result, monkeys have become habitual of snatching food from people, attacking them, in extreme cases causing death (Singh & Thakur 2012). They have also been implicated as reservoir hosts for Kyasanur Forest Disease, leading to sever morbidity and mortality cases in humans (Sadanandane et al. 2017).

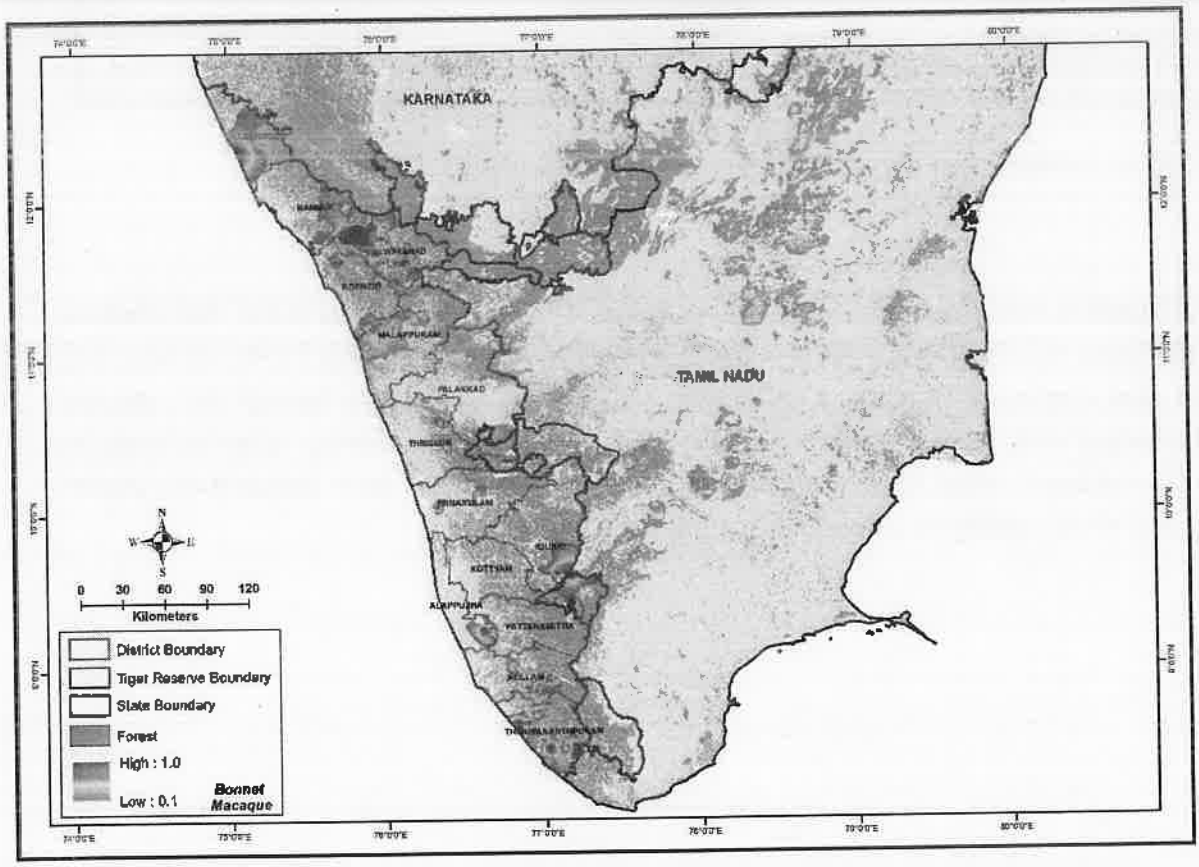


Fig 3.1: Bonnet macaque conflict hot spots for year 2018 (Source: Kerala Forest Deptt.)

Reasons for negative interaction: Agricultural expansion, land use change and habitat degradation has resulted in contraction of natural habitats, (Molur *et al.* 2003, Southwick & Siddiqui 2011) but their behavioural and dietary adaptation have made them to expand their range in human occupied landscape. Further to this, their ability of benefitting from human-disposed food has acted as a prime precursors of conflict with humans (Singh & Thakur 2012,Sinha, 2014).

Current mitigation measures: The prevalent management strategy to reduce such conflicts is by capturing and translocating bonnet macaques to forest patches (Fooden 2000, Mathur et al., 2015). However, such translocations, if not done carefully, may lead to transfer of conflict to new area or to spread of zoonotic diseases. See chapter 4 for decision process for managing bonnet macaque conflict.

4. Leopard-Human conflict

Current population status and distribution of species: India hosts substantial numbers of the subspecies *Panthera pardus fusca*, the Indian leopard which survives in protectedareas and multiple use forests all across India, exceptfor the arid deserts and regions above the timberlinein the Himalayas and Sundarban mangroves (Johnsingh et al., 1990; Khan, 1986, Muliya et al., 2017). Due to its wider niche breadth and ability to adapt to human landscape make it most versatile and widespresd predator (Athreya et al., 2014). The he estimated population around 7910 individuals (Jhala et al. 2014).The species is included in Schedule-I of the Wildlife Protection Act 1972, and the IUCN has recognized the leopard as a Near Threatened species (http://www.iucnredlist.org). Because of a thriving international illegal trade in leopard parts, the species has also been listed in Appendix-I of CITES.

Status of negative interaction: The behavioral plasticity of the leopard and its wide choice of prey (Mathur et al. 2015), coupled with high density of food resource in human use landscapes in the form of domestic animals (Athreya et al., 2014) and it's protection under laws in India which prohibits the killing of species (Singh, 2005) make it adapted to a wide range of habitats altered by humans and capable of tolerating human pressure. As a result, this species is highly involved in conflict with human in the state, however less compared to Himalayan states. The conflict in Kerala involves depredation of livestock (Karanth et al. 2013), injury or human death (Karanth et al. 2013) and death of leopard in retaliation (Sanjay Gubbi. Pers. Comm.).

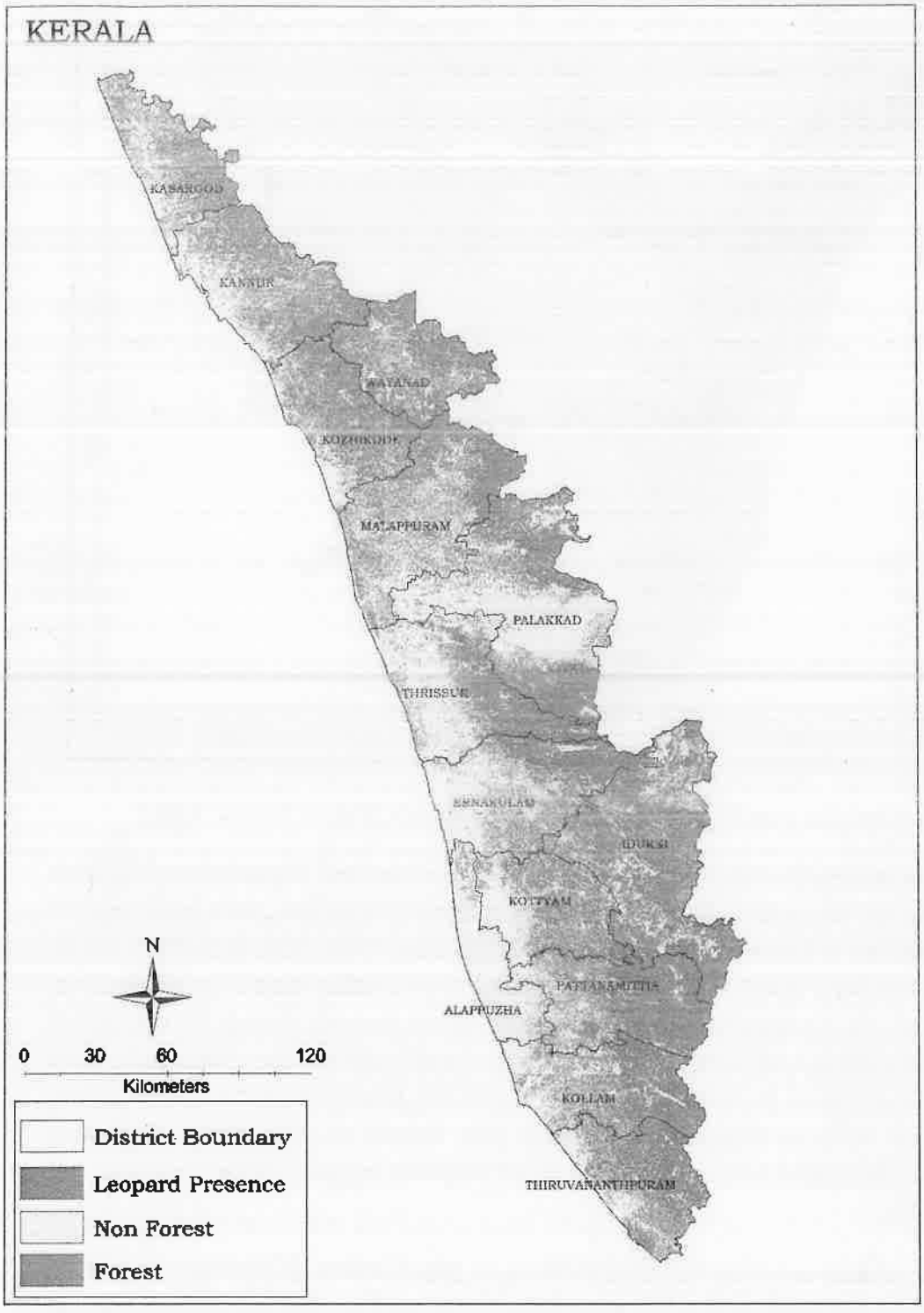


Fig 4.1: Distribution of leopard in Kerala (Jhala et al 2019)

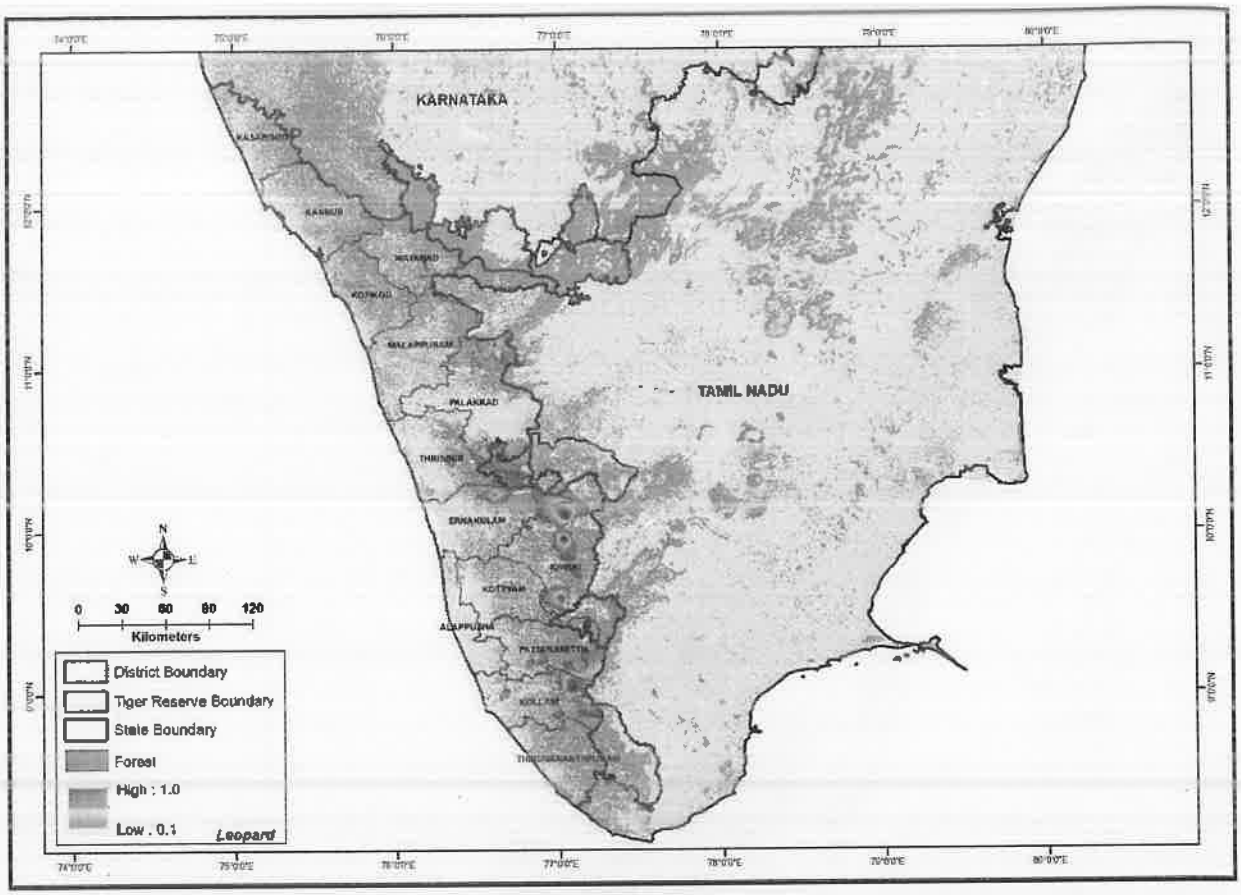


Fig 4.2: Distribution of leopard conflict hot spots in Kerala (Source: Kerala Forest Deptt.)

Reasons for negative interaction: Reduction of prey, fragmentation and degradation of habitats are often stated to be the key reason for the increasing number of conflict cases involving the leopard in India (Chauhan & Goyal, 2000; Edgaonkar & Chellam 1998; Kala & Kothari 2013). However these have not been tested and baseline information on conflict itself is sorely lacking. Furthermore, 100 year old documents such as Gazetteers and/or hunting records by the British also mention leopards visiting settlements to prey on domestic animals at a time when there were more wilderness areas and prey. Increasingly, all over the world, there is a greater understanding about wild carnivores such as leopards, which are now known to use human dominated landscapes due to the abundant food resources by way of domestic animals, organic garbage, pet food (Gehrt et al. 2010).

Current mitigation measures: Mitigation translocation or translocation of problem animals to captive facility or other potential habitat has been extensively used by the forest department as the immediate measure for mitigating conflicts (Athreya et al., 2011; Edgaonkar and Chellam, 1998). Additionally, paying compensation for loss of livestock or loss of life or injury to humans has also been practiced (Edgaonkar and Chellam, 1998). States like Uttarakhand and Himachal Pradesh have also adopted the policy of legal elimination of leopards confirmed to have caused human deaths.

5. Tiger-Human conflict

Current population status and distribution of species: In India, the tiger (*Panthera tigris*) is currently distributed across seventeen states. It occurs in a variety of habitats, from rainforests to grasslands and from dry deciduous forests to mangroves. Considering its role as a top predator in various ecosystems and as a flagship species, the Government of India started a countrywide effort for conservation of the tiger, named Project Tiger, in 1972 (http://envfor.nic.in/division/introduction-18). A recent census conducted in year 2014 indicate numbers of tigers to range from 1949 to ???? (Jhala et al., 2019). The IUCN has designated the tiger an endangered species due to the decline in its occupancy as well as population size within its geographic range over the past three tiger generations (www.iucnredlist.org). It is listed in the Appendix-I of CITES, which makes it illegal to trade in the species. Indian laws provide the highest degree of legal protection to the tiger by listing it in Schedule-I of the Wildlife Protection Act (1972).

Status of negative interaction: Human–tiger conflicts can be grouped into three categories: (1) attacks on humans, (2) livestock depredation and (3) tigers that stray into human-dominated areas. Depredations on domestic animals are the most common type of human–tiger conflict. In extreme situations, losses might be as high as 12% of local herds and 17% of annual household incomes (Madhusudan & Mishra, 2003; Sangay & Vernes, 2008; Wang & Macdonald, 2006), and livestock can make up over 25% of the tiger's diet (Wang & Macdonald, 2006). India harbours the highest number of tigers (Jhala et al., 2014) and has the largest number of man-eating cases (Corbett, 1991; Khan, 1986; McDougal, 1987). Tigers killed 19% of all the livestock killed by carnivores in Bhutan from 2003 to 2005 (Sangay & Vernes, 2008).

Reasons for negative interaction: Tigers require abundant large prey (Smith et al., 1987; Smith et al., 1998) and extensive forested habitats to sustain themselves (Smith et al., 1987; Smith et al., 1998; Sunquist, 1981). With the rising human population and increasing requirement of resources to sustain it, vast stretches of wild lands have been fragmented and cleared to make way for agriculture. Rapid encroachment and habitat fragmentation have resulted in tigers occupying only isolated small pockets of forest (Jhala et al., 2011, Smith et al., 1998,). For instance, in Tadoba-Andhari as well as in theSundarbans, local people frequent the forested areas to collect firewood and other forestproducts. This has been identified as the major reason of conflict (Das, 2012; Dhanwatey et al.,2013). Corridors are crucial to connect source populations to other protected areas for tiger movement, which is important for long-term tiger conservation and conflict management (Qureshi et. al., 2014).

Poaching is the primary reason for local extinction, followed by prey depletion, in the past 100 years (Karanth & Stith, 1999). Tigers readily kill livestock and dogs in areas where the wild prey is depleted, the reasons for which are usually hunting, habitat degradation and competition offered by livestock (Johnson et al., 2006; Miquelle et al., 2005; Sangay & Vernes, 2008; Wang & Macdonald, 2006). Local people have poisoned and hunted down tigers to avenge personal and economic losses.

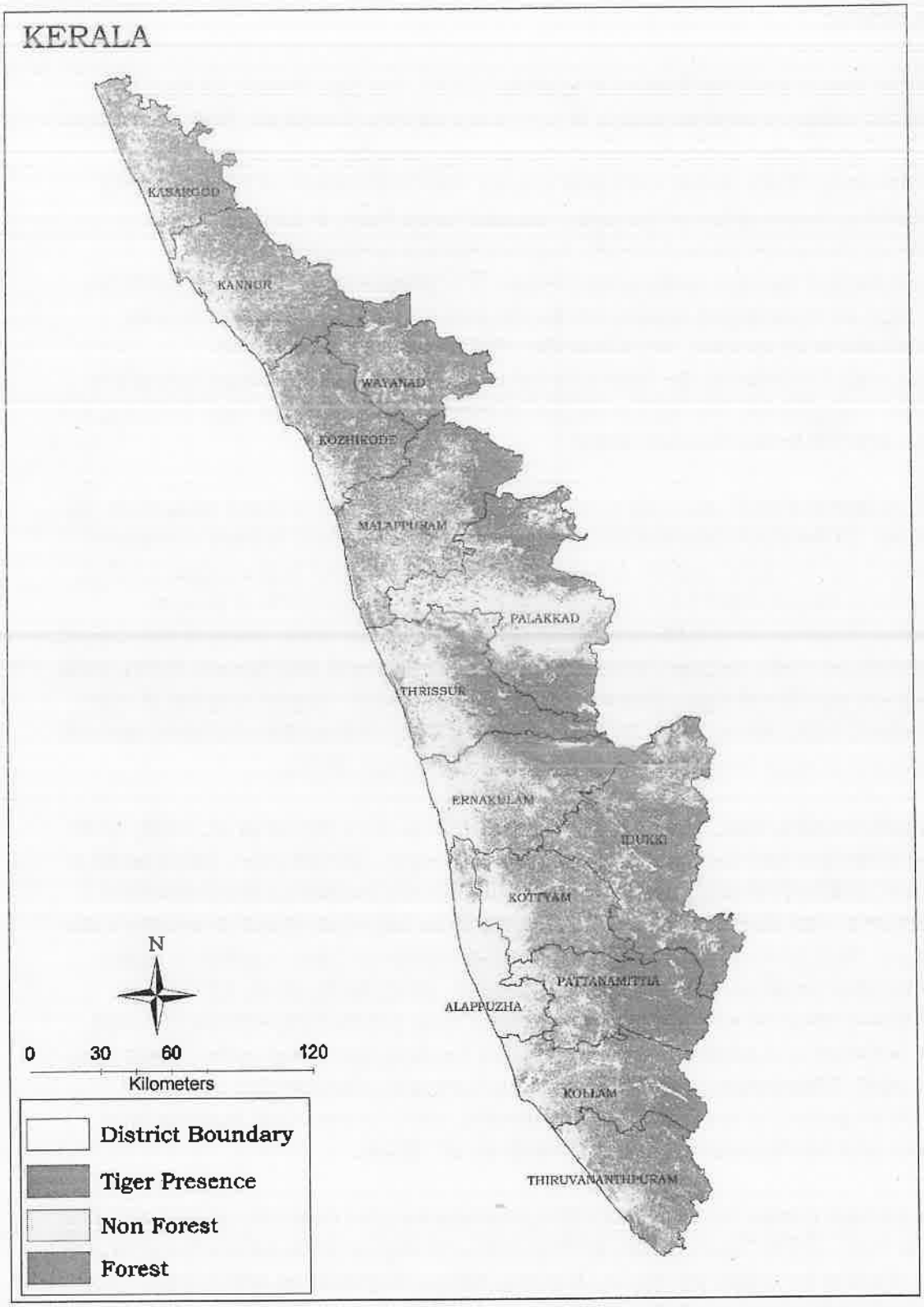
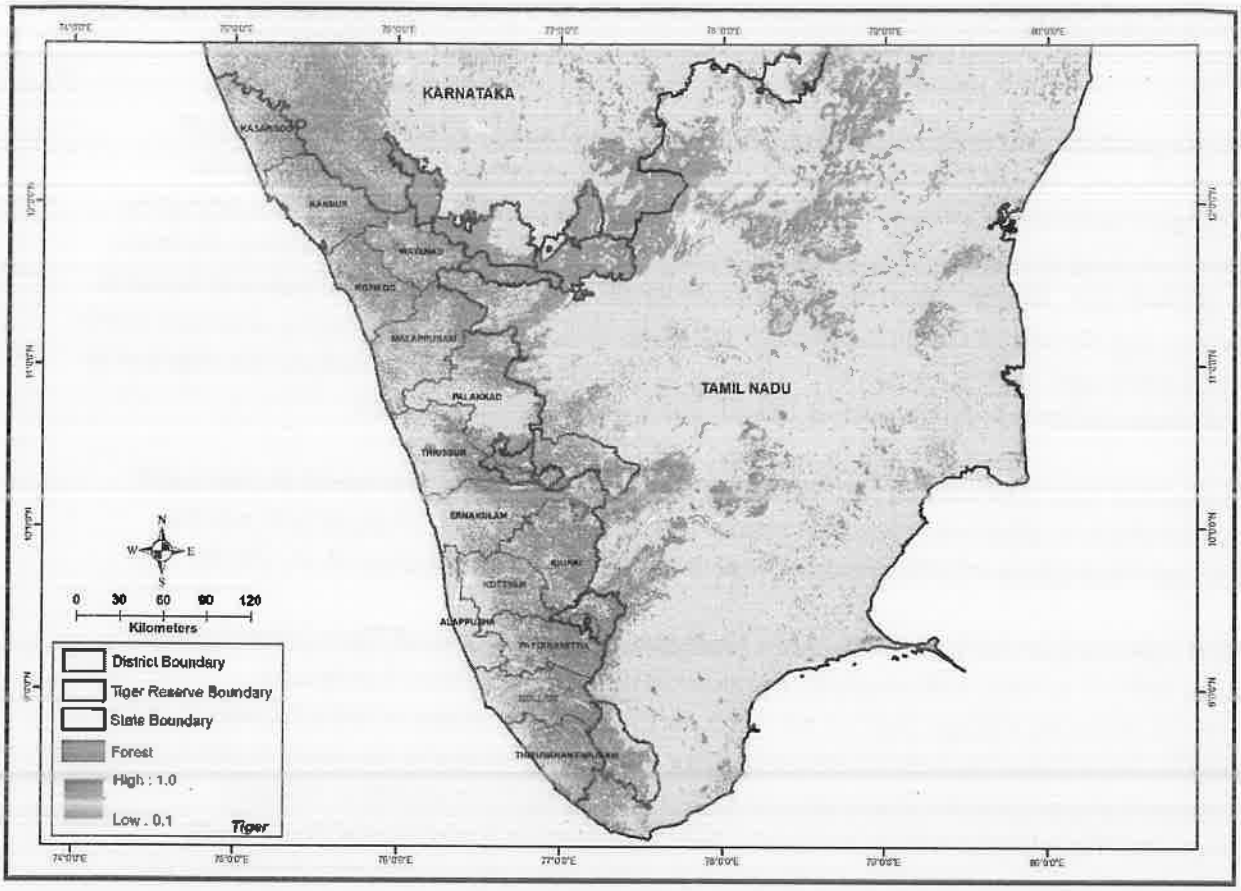


Fig 5.1: Distribution of Tiger in Kerala (Jhala et al 2019)



Management of negative interaction:

Tiger involved in attacks on humans (especially man-eaters) are either translocated to a captivity or killed. Often, it's the only resort available to the managers for a strayed out or alleged "problem" animal. However, in areas with small population such repeated lethal control may result in local extirpation of the species, as many non-problem tigers are generally killed in the process of controlling the problem one (Karanth & Gopal, 2005).
The traditional method of guarding and fencing was found to be the most effective measure in reducing livestock losses across protected areas in different biogeographic zones (Karanth et al., 2013a). WWF-India and the Corbett Foundation, apart from the government, provide "interim relief" compensation for loss of livestock and human lives for providing immediate assistance to the victim.The two biggest problems with this approach are the high level of donor input required and unavailability of the scheme in remote areas with potentially high levels of conflict. In Sunderbans, a couple of innovative preventive methods have been tested so far. The use of nylon mesh in villages vulnerable to tiger entry is one of these. The use of electrified human dummies as an aversive conditioning of tigers is another. Although the authorities involved claim that the deployment of these methods has resulted in a reduction in the number of conflict cases, no experiment have been conducted to test their efficacy

(Karanth & Gopal,2005). Sunderban methods are site specific and have application in Mangrove habitat.

Translocate problem animal and/or dispersing individual, reaching to close proximity of human settlement, in suitable tiger habitat based on sound science i.e., accounting for biogeographic differences in tiger population, proximity to other tiger populations and prey densities.Reducing the dependence of local people on forest products by providing alternate energy sources (i.e., biogas, solar power, etc.) could reduce the frequency of entry of humans into forests and therefore conflicts (Dhanwatey et al., 2013). Regulating grazing activities within protected areas and having human herders guard herds are expected to reduce the number of livestock depredation cases (Karanth & Gopal, 2005; Karanth et al., 2013).

Rapid response teams should be formed to deal with emergencies. This could prevent and mitigate conflicts in affected areas. The teams should be composed of experts in wildlife capture, veterinarians and officials of the forest department (Dhanwatey et al., 2013)

Standard operating procedures have been formulated by the National Tiger Conservation Authority (NTCA) to deal with straying carnivore in human dominated landscape (http://projecttiger.nic.in/Final_SOP_11_01_2013.pdf). The Government of India has decided to request the State Governments of increasing the amount of ex-gratia payment in cases of death or permanent incapacitation of any person by a wild animal from 20000 to 100000.

- The National Tiger Conservation Authority (NTCA) and state forest departments help resolve human–tiger conflicts in India by providing compensation for livestock injured or killed by wild animals and by providing cages/traps, tranquilizers and rescue vehicles for capturing problem animals (projecttiger.nic.in).

6. **Dhole-Human Conflict**

Current population status and distribution of species : Three subspecies of dhole have been reported from India, *Cuon alpinus laniger*, *Cuon alpinus primaevus* and *Cuon alpinus dukhunensis*. Only *Cuon alpinus dukhunensis,* found south of Ganges, faring better. Historically distributed throughout Indian subcontinent, the Asiatic wild dog or dhole currently exists in fragments of its past distributional range. Presently dholes are found in the Ladakh area of Kashmir, central Indian highlands and peninsular India and North-East India. Recent estimates indicate a population size of no more than 2500 individuals in the wild (http://www.iucnredlist.org/details/5953/0). Various threats in the form of prey depletion, persecution, disease and competition with other wild and free-ranging carnivores are responsible for the decline of the species. Recognizing these threats, the IUCN has categorized the species as Endangered (http://www.iucnredlist.org/details/5953/0), and CITES has placed dholes in its Appendix-II (www.cites.org). In India, bounties were paid for carcasses until the Wildlife Act (1972) was enacted. Under this act, dholes were given legal protection and classified under Schedule–II.

Status of negative interaction: In Arunachal Pradesh, north-east India, dholes are persecuted for livestock depredation (Mishra et al., 2006). In Kanha-Tiger Reserve of central India, 16 of a pack of 24 were found dead due to strychnine poisoning (http://www.iucnredlist.org). In Nepal, dholes were reported to have killed 14 large-sized prey animals (yaks and cattle) in 2007, which led to retaliatory killing by locals (Khatiwada et al., 2011). In Bhutan, the dhole was the fifth largest predator and accounted for 13% of the total livestock loss (Wang & Macdonald, 2006). Local communities use guns and poison to kill dholes. They also seal their kill and kill pups from dens.

Reasons for negative interaction: Dholes were not found to be in conflict with people in a study conducted across five tiger reserves in southern India (Karanth et al., 2013a). A few studies on the diet and foraging ecology of dholes in southern India indicate that their dependence on domestic prey and livestock is low (Karanth & Sunquist, 1995; Selvan et al., 2013; Madhusudan, 2003). However, occasional attacks on livestock in the distributional range of the dhole have resulted in retaliatory killings even without proof of depredation. Wild prey densities in most of the dhole's distribution range have declined considerably, especially in north-east India. Therefore, prey depletion in the dhole's habitat could be one of the reasons for livestock depredation. In southern India, the densities of the food resources of dholes are good, which might be responsible for the low conflict level in this region (http://www.iucnredlist.org/details/5953/0). On the other hand, conflict rates are higher in North-East India, where the wild prey densities have declined drastically. An increased inflow of livestock in the Kanchenjunga Conservation Area, Nepal was considered to be a reason for increased interaction with dholes and loss of livestock (Khatiwada et al., 2011).

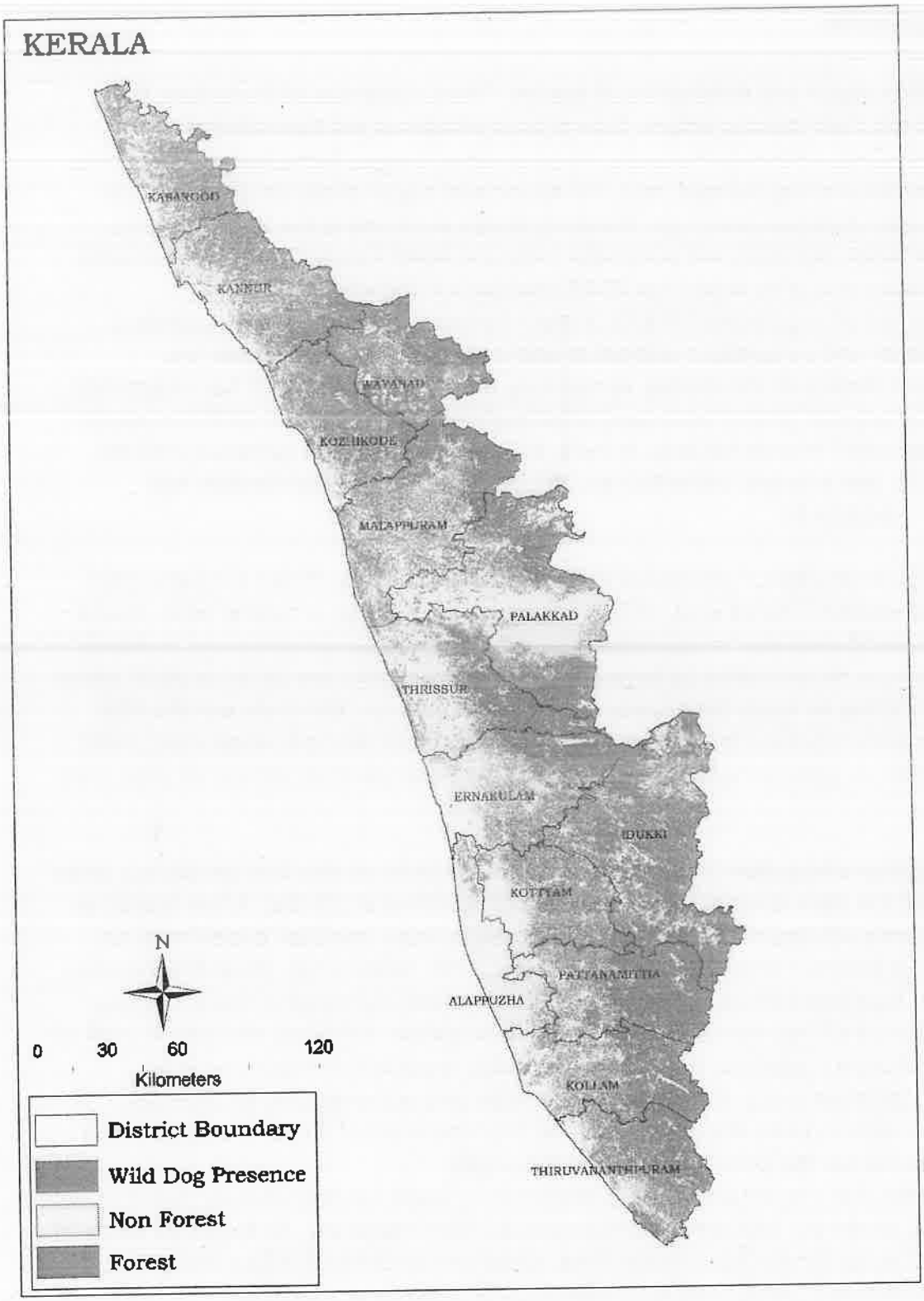
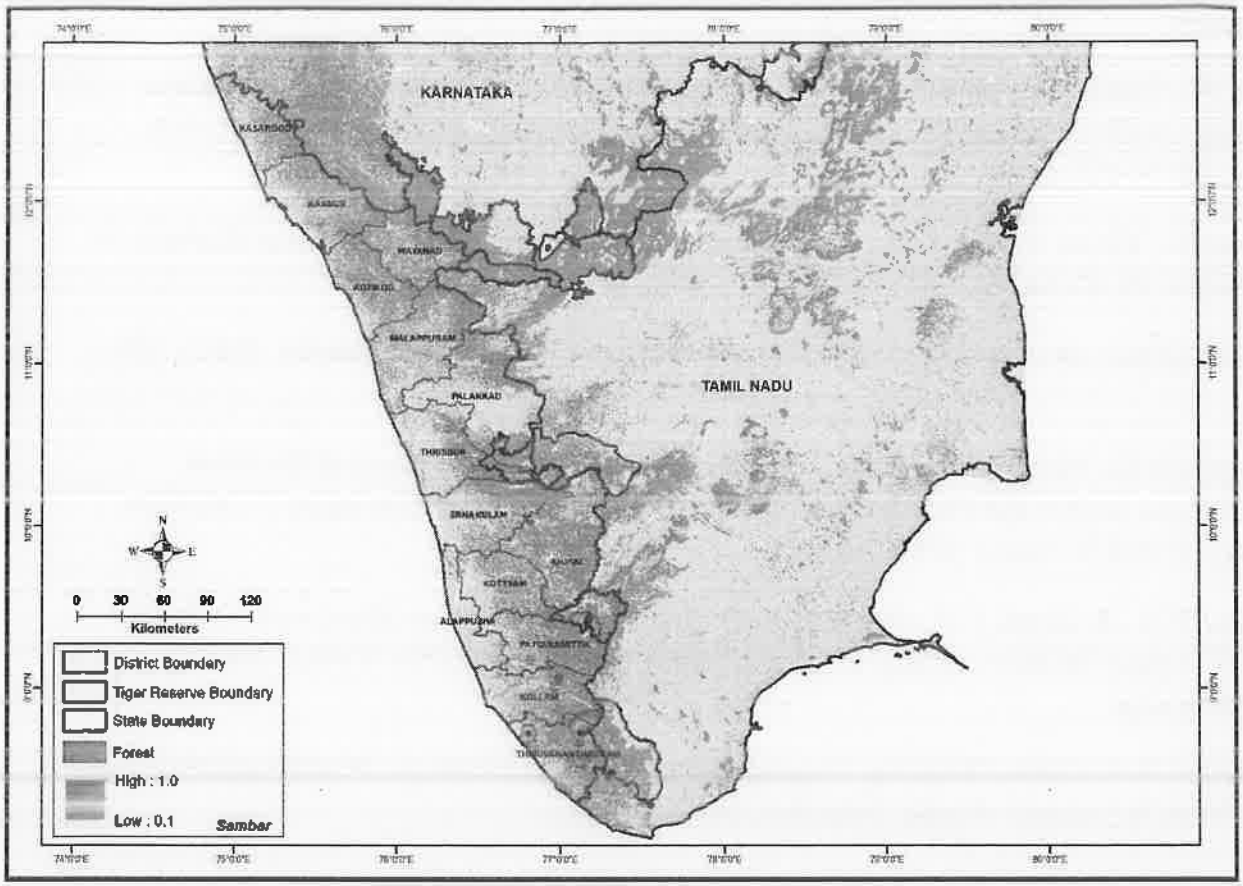


Fig 6.1: Distribution of Dhole/Wild Dog in Kerala (Jhala et al 2019)



Management of negative interaction

Due to the low frequency of conflicts with the dhole, there are hardly any special mitigation measures adopted by locals. Dholes co-exist with other large carnivores (tigers, leopards, etc.) that are more frequently involved in conflicts. Therefore measures used to protect livestock help reduce the damage caused by dholes as well. The traditional methods of guarding and fencing were found to be the most effective measure in reducing livestock losses across protected areas in different biogeographic zones (Karanth et al., 2013a). Grazing livestock should be accompanied to keep away dholes which are shy of people. State-wise *"ex-gratia"* funds are released by government to provide relief to local people and the funding amount depends upon the intensity of the conflict. However, seldom compensation money is paid for cattle kills.

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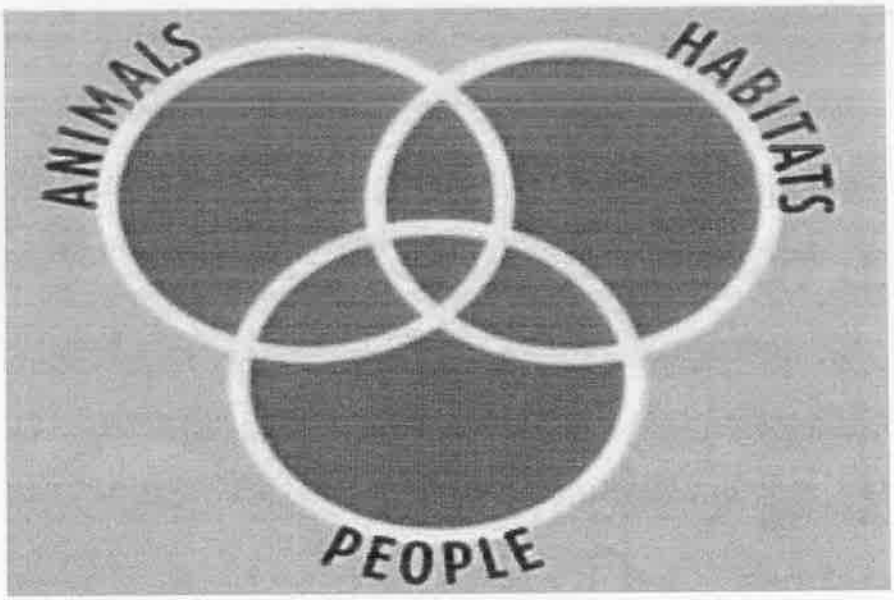
Human-Wildlife Conflict Mitigation
An Assessment of Strategies in Kerala

A Report

Submitted to

Wildlife Institute of India, Dehra Dun



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CONTENTS

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A number of people have contributed during the field visits. Shri N. Badusha accompanied and introduced a number of farmers in Wayanad. Shri Vishnu, Wildlife Biologist in Wayanad Wildlife Sanctuary helped to fill the gaps in information and provided the Display board and capture photos. Dr. Ramesh currently working in UNDP programme in Munnar assisted with information on Anayirangal. Shri Nagaraj, Asst Conservator of Forests provided details on Crash Guard Fence.

The following People's Representatives and farmers in Wayanad expressed their opinion on managing the conflict.

Kanniyan Mohamed, Councillor, Wayanad
Shri Jose of Kattikulam, Member, Thirunelli Grama Panchayath
Shri Mohan, Member, Nulpuzha Panchayath
Shri Elias, Molath, Farmer, Valluvadi.
Shri Karunan, Convenor, Vadakkanad Grama Samrakshana Samithi
Shri Baijunath, Dy. Range Officer, Wayanad
A number of farmers relocated from enclosures in Wayanad

Introduction

One of the major challenges in wildlife management is the Human-wildlife interaction, which is normally phrased as human wildlife conflict (HWLC). Human wildlife conflict (HWC) can be considered inevitable in all communities where human and wildlife coexist and share the same habitat competing for the meagre resources. Attempts to define the HWC have taken different parameters. The most accepted ones have taken the negative impacts both on human and wildlife. Accordingly, it is defined as "Any interaction between humans and wildlife that results in negative impacts on social, economic or cultural life of humans; on the conservation of wildlife populations; or on the environment". HWLC occurs "when needs and behavior of wildlife impact negatively on the goals of humans or when the goals of humans negatively impact needs of wildlife".

Though a few sections of the people consider the conflict situation as of recent origin, the historical records indicate that this has always been there and one of the records in the early 1990s states that "Wayanad is dotted with machans" implying that the people have resorted to tree top guard stations to scare the animals entering the agricultural fields. The conflict had been there even in 1818, which can be gleaned from the proclamation of Maharani of Travancore. This proclamation specifies arms and ammunitions provided to the farmers to scare away the animals.

Of late, the conflict has become graver as intrusion of people into wildlife habitat has increased and subsequently land use pattern got changed. Along with such a change, there occurred attitudinal change among those dwelling in the fringes of forest and habitations circumscribed by the forest. The in-migrated cultivators no more accept crop raids by wildlife when compared to the past few decades. This is mainly because the in-migrant population is galvanized into 'developmentalism'. Developmentalism is a belief that 'development' will resolve or mitigate all the problems that emerge within the material and social processes that take place in a society. Developmentalism advertently and inadvertently assumes that state (in this context the Forest and Wildlife Department) is the agent of development process and the 'people' are the recipients/beneficiaries of such governmental initiatives materialised using state and 'project'

funds. It is quite often assumed that whether development projects take place outside the forest or within the forest or at the fringes of the two, ultimate responsibility for the success and failures of such projects rests with the government institutions. Within developmentalist attitude, the conflict between human life and wildlife is bound to take place. Only solution is mitigation of the conflict. For this, both the state and society (communities) have to converge as an entity and alter perspectives towards wildlife and human existence in the forest and its fringes. Parallel to this, conservation of the forest should be made more effective. In short, the binary distinction between *kaadu* and *naadu* has to be waned. It is in this context the concept of 'people's participation' becomes relevant and effective.

A distinction is suggested between human-wildlife conflict and agroeconomic-wildlife conflict. This distinction is pertinent mainly because crop-raids are more prevalent and predominant. What attracts wildlife, especially elephants and other mammals, to the human habitat is the kind of cropping pattern. The cropping pattern is such that it invariably invites wildlife to the human habitat and causes destruction of crops for subsistence and marketable surplus of agricultural produces. Conflict arises from economic losses to agriculture, including loss of cattle through predation and destruction of crops. The recurring visitations of the wildlife to the habitats create somatic preoccupations irrespective of the area that the settlers have been owning. In general, visitations of wildlife—recurring, sporadic or not—create psychosomatic disorders among the settler cultivators who follow agronomic practices which encourage cropping pattern such that it attracts visitations of wildlife. Cultivated area may also be located on the elephant's habituated movement path. Psychosomatic disorders are more pronounced among the in-migrated settlers rather than the tribes who have been living within the forest or at its fringes. Therefore, the term 'human' cannot be conceived as homogenous, rather it has to be viewed as heterogeneous while considering conflict situations due to wildlife. The complex consisting of eco-psycho-socio-economic factors warrants mitigation measures of different types especially fencings. Such a complex situation has been in vogue for a long time, therefore any action towards mitigation has to take into account of long term consequences of wildlife and human mobility.

Human-wildlife conflict – National scenario

The available statistics indicate death of about 400 people annually, damage to thousands of acres of crops and the unmeasured psychological stress on the affected community. Further there had been retaliatory killings of a number of wildlife species, especially elephants, tiger and leopard. About fifty elephants are reportedly killed in defence of crops. The attempts by Government and Non Governmental agencies have helped to some extent to contain the damage and regulate the ill effects of the problem. The most 'problematic' among the animals reported by the people are elephants, wild boar, tiger and leopard in some locations. Of late, people have started complaining about monkeys and peafowls.

The results of an Indo-Norwegian project carried out by Wildlife Institute of India during 2007-2011 provide some information about the extent of this problem in the country. During the project period, there have been 888 human deaths and 7381 human injury cases due to human wildlife conflict. About 91.20 million rupees have been claimed/paid as ex-gratia to the victims. There has been 14,144 cases of livestock kill and about 80956 cases of crop damage for which an ex gratia payment of about 137.40 million rupees has been disbursed. Two hundred and three cases of electrocution and poisoning as retaliation to human wildlife conflict were reported. Thirty one animals have been officially permitted to be killed considering them as dangerous to human life and property. Ministry of Environment, Forests and Climate Change records report 98 human deaths due to tiger attack from 2013-14 to 2016-17. The number of human deaths due to elephant from 2009-10 to 2015-16 was 2804. Government of India has been providing assistance to the state. About Rs. 15 crore were provided for conflict mitigation from 2013-14 to 2016-17. Simultaneously, Rs.567.2 crore and Rs 61.08 crore were provided by the central government under Project Tiger and Project Elephant respectively from 2013-14 to 2016-17. The assistance also included assistance for mitigation of human wildlife conflict. State Governments are also providing support for compensation to victims of conflict as well as other related activities of human wildlife conflict management.

Kerala scenario

During the past few years, human-animal conflict has become a serious wildlife management problem in Kerala. People who are living in and around the Reserve Forests and Sanctuaries are

under high sense of insecurity from wildlife. A number of reasons have been attributed to the present state of affairs. The growing pressure of ever increasing human population, habitat loss and fragmentation and change in cropping pattern adopted by the farmers, increase in the number of various forms of wildlife are reported among the causes. Damages due to wildlife are in various forms including damage to cultivated crops, cattle lifting, injury to people and loss of human life. An analysis of threats for biodiversity conservation and management of natural resources in various Forest Divisions of Kerala shows that human-wildlife conflict is a threat in almost all Divisions, especially in the northern regions particularly Wayanad.

Dr. P. O. Nameer of Kerala Agricultural University presented the information compiled from Forest Department records for the period 2006-2015. According to the statistics presented in the workshop, there had been 523 human causalities and 1627 injuries to humans due to wildlife in Kerala during the period. The livestocks killed during the ten year period was 1645. There had been 33,473 cases booked by the State Forest Department related to HWC. Rupees 22.22 crores were paid to the affected as ex-gratia by the Forest Department. According to his analyses, 86% of the conflict is caused by three species and Northern Kerala is the major conflict area, especially Wayanad district.

The number of reported incidences, as in the records of Kerala Forests and Wildlife Department, during 2002-2012 is given in Table 1. A huge sum is paid to the affected people as "compensation" (ex-gratia) (Table 2). The number of incidences in areas under different Forest Circles is given in Table 3. The highest is in Wildlife Circle in Palakkad and Northern Circle. This figure is due to Wayanad, which falls in these two Forest Circles. The figures as presented by Shri Rajesh Ravi, Addl Principal Chief Conservator of Forests in the Workshop (Table 4) indicate the increasing number of incidences.

The Kerala Forests and Wildlife Department has attempted to mitigate the problem through various measures. The Department thus has so far provided 584 km of Elephant Proof Trenches, installed 1501 km of solar powered fences, 35 km of elephant proof walls, 3.5 km of stone-pitched trenches, 259 km of kayyala and 43 km of biofences. This of course does not

include about 1.3 km of Crash Guard Rope Fence in Mankulam and the ongoing works of Rail Fences, Crash Guard Rope Fences and Solar Powered Fences in different areas. Plans were also prepared to go for voluntary relocation of settlements from the enclosures and a few of the identified areas are freed of settlements through relocation. The NGOs also contributed to the programme by acquiring and transferring land falling under elephant corridor. A few attempts have also been made to capture and translocate problematic elephants and tiger. At least one attempt has been experimented with beehives and replay of tiger roaring sound. The Forest Department has also formed Rapid Response Teams for immediate action in case of emergencies and work with the affected people.

Table 1. The number of incidences and the animals involved (2002-2012)

Type of Interface	Tiger	Elephant	Leopard	Bear	Wild Dog	Gaur	Snake	Wild boar
Human death	15	120	02	05	0	08	119	0
Human injury	02	118	13	15	17	27	199	114
Livestock killed	301	91	152	0	87		02	16
Livestock injured	16	06	0	0	0	0	0	29

Table 2. The number of applications and payments made as a mitigation measure (Ex-gratia)

Year	No. of applications received	Compensation paid (Rs. In Lakhs)
2009-10	2846	119.27
2010-11	3447	200.96
2011-12	6426	454.42

2012-13	6355	460.74
2013-14	7416	659.05
2014-15	7694	782.45
Total		**2676.89**

Government of Kerala also initiated a project named *Fencing along forest boundary* with financial assistance from Kerala Infrastructure Investment Fund Board (KIIFB) and administrative sanction was accorded for the first phase to be implemented in Thiruvananthapuram, Thenmala, Punalur, Palakkad, Mannarkad, Nilambur South, Wayanad Wildlife Sanctuary and Wayanad North. As per the order, the proposal is for about 220.5 km solar fence @ Rs. 1.8 lakhs/km, 2.91 km Elephant Proof Wall @ Rs. 140 lakhs/km and 11.35 km rail fence@ Rs. 150 lakhs/km.

Table 3. Number of conflict related incidences in different Forest Circles

Human Death				Human injury	Crop loss	Property loss	Cattle lifting	Cattle death
Name of Circle	Wildlife attack	Snake bite	Total					
SC, Kollam	0	27	27	60	239	0	57	0
HRC, KTYM	02	08	10	33	116	24	18	0
CC, TCR	02	27	29	57	166	07	06	13
EC, PKD	04	40	44	54	679	0	37	10
NC, Kannur	07	26	33	286	3939	46	99	0
ABP,TVM	0	0	0	02	99	0	0	0
FD, PT, KTYM	03	0	03	09	120	0	08	0
WL, PKD	03	0	03	15	1225	14	105	02
Total	21	128	149	516	6583	91	330	23

Table 4. Details of applications and ex-gratia paid during 2012-13 – 2017-18

Year	No. of applications for compensation (death, injury, crop damage etc.)	Total Compensation paid (in Lakhs)	Human deaths reported
2012-13	6355	460.74	7
2013-14	7416	659.05	20
2014-15	8200	782.45	21
2015-16	5915	681.68	18
2016-17	7765	963.9	22
2017-18	9333	933.71	36
Total		**4481.53**	**124**

The Kerala Forests and Wildlife Department entrusted Wildlife Institute of India to prepare a State Level Strategy for Mitigation of Human Wildlife Conflict in Kerala. To achieve the objectives, Wildlife Institute of India engaged expert resource persons for understanding the efficacy of mitigation strategies and barriers currently being used by the state.

The Objectives of the consultancy work is to document HWC mitigation strategies currently used in Kerala and assessment of the existing strategies for its effectiveness along with suggestions for improvements.

The Process

The process involved scanning literature pertained to Human Wildlife Conflict and extracting relevant information from the recent studies/observations in the state. In addition, field visits were conducted to selected areas (Munnar, Wayanad and Aralam). Discussions were also held with Forest Officers/NGO representatives/farmers in different areas. The author has also benefitted from the presentations and discussions during the workshop organized by Wildlife Institute of India at Kerala Forest Research Institute. In addition to the field visits and discussions as part of this consultancy, the observations made by the author during visits for assessment of a proposal for mitigation measures in the state have also helped while commenting on the conflict mitigation measures and their effectiveness. These observations in different parts of the state is also given to make an assessment of the present state of the mitigations measures already in place.

Mitigation Measures in the State

Crop-raiding variables are strongly environmentally spatial rather than numerical; factors such as habitat, day timerefuges for elephants, water distribution, human settlement patterns, physical defences, or cultural and agricultural practices may be locally important determinants of HWC levels. However, most of the conflict mitigations measures in the country are copied from elsewhere, mostly from Africa. The methods adopted in different parts of the state are detailed below.

Traditional

Traditional methods followed is mostly guarding from machans (raised platforms mostly on trees) and scaring using sound making devices. This is reported to be the most effective. One of the farmers in Sholayur (An Award winner for agriculture) in Agali, during an interaction, informed that he has no problem from wildlife as he has engaged watchers to guard the cultivation areas during night. The farmers in Nulpuzha in Wayanad did not agree as there is scarcity of labour force for such works. Saree fences are used in some parts of the country and even in Kerala to prevent easy entry of animals into the cultivation areas. Fences with locally available bamboos and other materials are being used to act as a thick fence making the animal entry difficult. This has been reported to be very effective against wild boar and is successfully used in Pottamaavu Kaani Colonyin Arippa in Trivandrum.

The traditional methods also include the sound scaring mechanisms like blasting of crackers and the replay of recorded tiger roar. Unfortunately, animals get used to the sound. Presence of fire used to deter the animals, even elephants. Of late, the reports from the farmers indicate that this is no more effective. Dried fish hung on the border claims to have some impact on monkeys. But this was countered by others, who failed. Soaps were used as deterrent in some parts of Kerala especially against sambar deer. But there is no such measures practiced now. Though not traditional, the affected people have gone for their own inventions as a solution to the conflict situations. In one of the places in Wayanad Wildlife Sanctuary, the cultivation is protected by using thin steel wire fences on which used plastic water bottles are hung. The farmers claim that these would deter the animals mostly because of the sound. The Mancheeri Cholanaikan Colony in Karulai Range in Nilambur is protected on one side with trench. Being not effective, the Cholanaikans spend their nights on the roof top which is covered with tarpaulin. This is to escape from the elephants visiting the area during nights. A crude wooden ladder is also provided to go up the roof.

Providing water and increasing food availability in the forest

There is a strong belief among the people that the animals stray into the habitation because of scarcity of food and water in the forest. During the interaction with the farmers and people's

representatives in Wayanad, this has been pointed out as the major causes for conflict in the area. For example, Shri Karunan, the Convenor of Vadakkunad Grama Samrakshana Samithi in Wayanad expressed the concern of lack of food for wildlife due to plantations of teak and eucalypts. The records from different parts of the state show that most of the crop raiding is during rainy season. In fact, it is the crops during the season, which attract animals, especially elephants. A study in Wayanad also indicates good availability of food inside the forest plantations. For example, the teak plantation in most of Kurichiat Range is as good as natural forests. However, there are issues in areas in some of the Ranges. Lack of food in these areas could be attributed to the cattle grazing and in some places the fire degrading the forests. According to the farmers and the people's representatives, about 80% of the estimated 10,000 cattles graze in the forests. Interestingly, these are given to the tribal people by a Meat Processing Unit on a buy back system and the Forest Department is helpless since tribals are involved.

An analysis of water availability in Wayanad has indicated that there is at least one water hole per 2.5 km^2 of the forest areas (Kaler, pers. Commn.). The water holes are currently monitored for information on the use by wildlife. The non-availability of water in the area does not hold true for most of the locations.

Translocation of problem animal

Capture and translocation of problem animal had been suggested on many occasions. Experience in Hassan in Karnataka and once in Kulathupzha suggest that the translocation does not help. The released one returns to the site of capture or recreate the same problem at their release site. There is also the possibility that a proportion of the translocated animals dies either due to the stress of capture, endangers a resident population through introduction of disease or increase competition for territory or food. Removal of the animals from the 'problem component' does not reduce the number of raiders, because other recruits in the 'occasional raider' subpopulation merely replace them. However, the people of Wayanad feels that the capture of the identified habitual crop raider "Vadakkanad Komban" (Vadakkanad tusker) has helped a lot and the number of visits to the affected area has come down considerably.

However, this tusker was taken to captivity. People of Wayanad has even protested when the captured "problem animal" was about to be released.

In the case of tiger and leopard, capture of problem animals in cages use to be usual practice in the state. A number of leopards have been trapped from different places and were normally released in Wayanad. However, the practice is currently discontinued and the government of India Guidelines is followed as far as possible. One of the major issues currently managed by the Forest Department is regarding tiger involved mostly in cattle lifting, especially in Wayanad. Most of these were captured and shifted to zoos or the animal dies due to various reasons.

Monkey, especially the bonnet is considered to be a problem even in villages far away from forested areas. The Department attempted to solve the "monkey menace" in Sasthamkotta near Quilon by trapping the so called "market monkeys" and releasing them in the forest areas in Kulathupuzha. The vacant space in Sasthamkotta is now occupied by the "temple monkeys" in the same area. The people of Kulathupuzha, where the trapped ones were released complain of the monkey problem in their area. Basically, problem was shifted from one area to the other and the problem in the source still remains. There had also been some attempts to capture bonnets from Kalpetta of Wayanad. The process resulted in mortality and was discontinued due to public protest.

Elephant Proof Trenches

This could be even treated as a traditional method since this has been an old practice in several parts of the country. One of the reasons for acceptance of the trench as a mitigation was because of the employment generation. However, of late the manpower is replaced by the machines. This is not effective in heavy rainfall areas and depends a lot on soil conditions. In addition, the method needs heavy initial investment and if not maintained annually, becomes ineffective. Elephants learn to kick the sides of trenches and cross them and are also undeterred by narrow stretches of water. An unpublished report based on observations by the Soil Conservation Officer in Wayanad indicate that the trenches disturb the first order streams in the area and rain water is artificially diverted leading to scarcity in the marshy areas of Wayanad. So there is also an unestimated environmental cost involved while going for

trenches. The stone pitched trenches, which is the latest trend is costly (95 lakhs/km) and there is also the issue of environmental cost by way of quarrying for the construction material. The trenches also are considered to be a permanent scar on the earth, wherever it is done. Problems with ditches or trenches are the massive investment required both to construct them and maintain them, the latter because of their extreme vulnerability to soil erosion.

According to Shri Mohanan, Ward II Member of Nulpuzha Panchayath, the trenches dug out in 2000 do not serve the prupose because of the loose soil. Packing might help. The 35.5 km long trench in his area was crossed by elephants. The marshy areas were left out and later completed by Grama Panchayath. All along the trench, solar power fence was installed (6 km by District Panchayath and the rest by Forest Department). But nobody cared after installation and there was no maintenance and became non-functional. Almost 80% is not effective.

There was a trench in Thoova area from Marappalam to Kodankarappallam in Agali in Mannarkad Division. Major part of this is almost gone. About 8 km is present. In Olavakkod Range in Palakkd Division, in addition to solar power fences, a one kilometre trench exists between Kayyara and Koothramkapu.

In Kulathupuzha Range of Thiruvananthapuram Division, the Panchayath has dug a 600 m long trench near Rockwood Kadavu with no effect as the area is still open. At Vattakkarikkakom in Kulathupuzha Range has 110 m trench dug by Forest Department in 2013 and also a few stretch by Panchayath. There was a proposal for solar fence at this location. Two trenches of 110 m each were dug in 2013 around Dally Karikkakom settlement in Kulathupuzha Range. There is also a proposal for 5 km long solar fence. The Panchayath has dug about 40 m long trench on the forest boundary with habitations in Milpaalam – Pathekkar – Beedikunnu – Mylamoodu area in Kulathupuzha Range and is of course not all effective as the entire length will be about 5 km. Mathrakarikkam is anarea surrounded by forest with about 37 families in 120 acres. Trenches of 110 m each was dug in 2013 and 2014 and are said to be effective in that place.

In Paruthippally Range in Thiruvananthapuram Division, Kuttapara-Aryanadu- Palode, Kaithakkaparappu – Aryanad – Palode and Ottakudi – Aryanad – Palode areas have trenches taken around five years back and are intermittent in all places. This is of no use as the gaps

between the trenches are still open. There was an attempt to protect about 25 families in Manithooki in Palode Range with about 127 m trench along the 3 km stretch. At Valiyakaala, about 2.2 km stretch has just 127 m long trench to protect 35 Kaani families.

In Nilambur South Forest Division, about 800 m trench is in place at Suharamukku – Kalkulam and solar fence is proposed to complete the area.

Wayanad areas have almost all types of mitigation measures in place. This was the area where the first long trench was done probably for the first time near Kuruva in South Wayanad. Appappara colony in North Wayanad Forest Division has a trench around with most of the areas damaged and is reinforced with solar fence, which are also not in very good shape due to bad maintenance. Wayanad Wildlife Division has trenches in almost all the Ranges and are mostly reinforced either with wall or solar fence. The Puthuveedu – Pannikuzhimoola area has a trench with vegetation all over and damaged to some extent. This was reinforced with solar fence. None of these are effective because of lack of maintenance. As mentioned earlier, there are trenches in Vadakkanad which became useless because of bad implementation leading to elephants crossing through the gaps. One can see trenches reinforced with solar fence and walls. The trenches are ineffective in most of Wayanad areas also because of the marshy areas (*kollies*).

Solar Power Fence

Solar power fencing is a technologically effective elephant deterrent. This is one of the most popular mitigation measures extending to about 1501 km. Fences are successful only if it is encircling the layout to avoid wildlife entering, and where scrupulous daily maintenance is possible. Clearing vegetation near the fence on a regular basis and using strong supporting poles can definitely help. A team of people patrolling along the fence at night (human presence) will add to the effectiveness. This has been proved in a few places in Wayanad and at least one place in Punalur Division. The maintenance deficiencies are almost always caused by weak institutional arrangements (to do with contracts, wages, work schedules, disputes) rather than by any technological shortcomings. A few examples from different parts of the state would

highlight the issue of non-maintenance of the solar fencing and then going for additional works in the same area.

In Mannarkad Range of Mannarkad Forest Division, about 1.5 km of solar fence was installed during 2011-2012 around a Muduga Colony at Vellathod. This is not functional due to lack of maintenance. About 8 km long fence was installed in 2011-2012 in Pandan – Tharippapathy area. Since this is not functional, there was a proposal for repairing. The proposal was for extending protection to Achilatty Colony of Muduga community. There was a proposal to maintain about 9 km fence at Velikadu – Cherumala. This was installed in 2011-2012 and was not functional. There was a 10 km long solar power fence along Karimala – Ottamoochi. In Agali Range, Moochikadavu was solar fenced leaving gaps. Sambarkodu – Moochikadavu was fenced for a length of 3.5 km. In 2010, Moochikadavu-Kottamal was fenced for about 3.5 km. There was a fence installed years back at Vellakulam – Vechapathy and is not functional and hence a new proposal was made. The solar power fence was installed at Bodhichala – Noorekar. But was not functional. Moolagangal was provided with 3 km fence in 2013 and is not functional. Gonchiyur Adivasis have installed fences around their cultivation. There are a number of private properties in Thoova areas, which are effectively protected with fence.

In Walayar Range of Palakkad Forest Division, about 7.6 km of solar power fence was installed between Poozhikunnu and Anakkal sometime during 2008-09 and has not been working for a long period though watchers were reportedly present till November, 2015. A 5 km solar fence is installed and maintained by the Elak estate to protect their pineapple and rubber cultivation. This is functional. KFDC had fenced around their areas in 2009-2010 and have problems.

In Olavakkod Range of Palakkad Forest Division, a 2 km fence from Bugalow to Valluvakaad is maintained by private individual and functional. The 3 km long fence from Korma to Kayyara (installed in 2015) is not functional due to maintenance problem. At Mamparam to Kattikallu, Mundur Section, a 5 km long solar power fence was installed by the Panchayath in 2007-08 and became non-functional due to lack of maintenance.

In Thenmala Forest Division, about 5 km stretch in Thonichal – Paruthippallom area was fenced in 2010. But it was dismantled and used elsewhere (Chalikkara – Poopathikunnu plantation) in

2015. A new proposal was placed later for fencing. A 6 km long fence between Mavinchuvadu and Kaduvakalunku is not functioning because of failure of energizer and the batteries. There was about 12 km long fence installed around Villumala north, Peruvazhikaala, Peramkovil and Kolambi in 2010 or so. None of these are functional.

In Patahanapuram Range of Punalur Division, a 2 km fence was installed around plantation in 2012 at Uppukuzhy – Inchappally Chappath and is not functional. There was also a fence of 6.9 km in Inchapara – Cherukadavu installed in 2012, which is not functional. About 1.5 km long solar power fence at Mampazhathara is not maintained properly because elephants break it and the battery is not in condition. Interestingly, the fence installed in 2006 around the Mampazhathara tribal settlement has been functional for many years. A one kilometre fence in Kuravanthavalam – Ambathekkar is not functional

In Kulathupuzha Range of Thiruvananthapuram Forest Division, a 2 km solar power fence was installed at Dally Karikkakom settlement in 2014 and not maintained.

Wayanad is the area with highest number of solar power fenced areas. The fences in most of these areas are not functional due to lack of maintenance. The area could be called a *cemetery of solar fences*. At least in some places (example, Thirunelli, Puthuveedu-Pannikuzhimoola and Vadakanad), the power fences were installed as a measure to strengthen the existing trenches. Unfortunately, both became non – functional. About 80% of the 35 km long fence along the trench in Vadakkanad area in Wayanad is functional. About 6 km of this was funded by the District Panchayath. A number of farmers have installed solar power fences in Vadakkanad area though the larger area is protected with solar fences by the Department. All the privately installed fences are effective. However, there are occasional damages by elephants. These are immediately repaired by the owners.

According to the Vadakkanad Grama Samrakshana Samithi Convenor, solar became non-functional because of lack of maintenance. Part of Vadakkanad area has been protected using wires hanging from the main line, which is kept beyond the reach of elephants. This is claimed to be very effective as damages are almost nil. However, there should be someone to switch on and off in the morning and evening to avoid accidents.

A very effective solar power fence was seen in Sholayur area of Agali Range of Mannarkad Division. This was installed at a cheaper rate by the private person to protect his farm.

Chilly related, Grease and hot Pepper oil

This has been reported to be successful in Africa and attempted in several places in the country. Using chilly with grease smeared on rope and tying along the border did not work in high rainfall areas. Chilli smell alone may not be fully effective and some simple supplementary efforts are still needed. It has been suggested that 5 m wide clearing of any thick vegetation surrounding crop fields helps with elephant detection. Sounding device hung on the chilli fence can alert sleeping farmers to an elephant contacting the string barrier. Farmers should maintain good vigilance during crop maturity (eg. taking turns to man watchtowers).

Unpalatable crops as buffer

Growing unpalatable crops (decoy crops) as a buffer to farm lands is mainly directed to provide alternate revenues to farmers in the high human-elephant conflict zones (coffee, lemon, chilly) Use of these crops as buffers is restricted by the type of soil, rainfall, topography, availability of water, and market prices. Change of crop pattern from traditional livelihood farming to alternate crops by farmers does not seem to be practical and unacceptable to cultivators in many areas. Pilot studies on effects of alternate crops such as capsicum, lemon, with introduction of Citrus spp as elephant deterrents along with other economically viable crops are in experimental stages in Chirang-Ripu Elephant Reserve in Manas National Park. Medicinal and Aromatic Plants (MAPs) are being tried in Nepal. According to Ashwin Bhat working in Hassan in Karnataka, chilly was planted in the buffer. Elephants damaged the plants by trampling.

Bio-fencing

Agave, reportedly avoided by elephants, and xerophytes might help. Unfortunately, the thornless agave is not effective and is fed by elephants. The thorny one is of some effect, it is reported. There had been suggestions a few years back to try *Salaca,* an exotic similar to oil palm. However, literature mentions it as food of elephants in Myanmar and the fruits of the palm, when ripe can attract other animals also. There is no report of success from any part of the state and even country.

Beehives as deterrent

Following the success stories in Kenya, beehive fence attracted the enthusiastic conservationists in some parts of Asia. This was also because of the income expected from the honey and was affordable to small-scale farmers However, this method failed in Indonesia and Sri Lanka and *the results of bee research so far do not match the hype.* Dr. Lucy King, leader of the Elephants and Bees Project, who supervised the work in Sri Lanka commented. *So, what are my final thoughts about introducing beehive fences to farmers in Sri Lanka, or indeed the rest of Asia? Well, even if the stings of Asian honeybees prove too gentle to scare away all of the crop-raiding Asian elephants, the farmers will still benefit from the health and financial benefits of beekeeping. It seems to me that any investment risks are far outweighed by such numerous benefits.*So the very purpose of conflict mitigation failed.

There was also an attempt in Wayanad under the leadership of ATMA. The elephants dismantled the whole thing. There was a reportedly successful attempt in the borders of Peechi-Vazhani Wildlife Sanctuary. However, the beehive fence was supported by solar power fence. So the success has to consider this factor also. An experiment done by a Researcher in KFRI reported success. But the experiment seems to have not considered other factors. One has to be cautious while implementing beehive fence in areas where sloth bears are present. This may attract bears thereby adding to the problem.

Radio-collaring elephants and early warning

A section of the scientific community claims that problematic animal could be captured and radio collared for monitoring the movement. This requires identifying and collaring individual problem animal, receiving GPS locations via satellite or GSM technology, mapping the location on GIS maps, and informing the particular farmers who are at risk. The cost is very high. This would definitely generate information on temporal and spatial patterns of crop raiding, possible contributory factors, effectiveness of preventive methods etc. Moreover, if elephants are not resident, only seasonal visitors, theoretically it is possible to monitor the movements of individual crop raiders through GPS satellite radio collars and warn villagers of their presence. It

is not applicable in areas with significant number of animals. This did not help in Wayanad and North Bengal, where the issue remains as it was.

Kayyala and Elephant Proof Walls

This is one of the latest trends in Kerala. The implementation cost is very high (140 lakhs/km) and moreover, the building materials have to be at the cost of environment elsewhere. According to one report, about 9000 cubic feet granite stone is required for construction of 100 m wall.

This was implemented in Aralam, where the height had to be ultimately increased and still not successful as the work could not be at the required length (only 5.065 km) obviously due to lack of funds and high cost. A 10 km wall was erected on the southern side of Aralam (from Valayamchal to Kariamkappu) and is reported to be successful in preventing even elephants. A proposal had been presented to TRDM for about Rs. 22 crores for construction of walls and rail fence.

There are other areas in entire Wayanad, where walls have been constructed mostly to block entry of animals through marshy areas. There are also proposals for new ones (eg. 210 m in Kurichiat Range). Shri Jose at Kattikulam, a Member of Thirunelly Panchayath reported seeing elephants crossing even 2 m high walls.

A stone wall exists near Paduka station in Nilambur South Division. This is from Theekady colony of Kattunaikar to Balankulam outpost. This was finished in various years starting from 2013 - 14. However, elephants made an attempt to break it open in one place and reinforced with a strand of solar power fence on the top. The recent one in Padiri South in Wayanad was demolished by elephants. Another one in Vadakkanad area was partly damaged and reinforced with solar power fence and trench. The 4 km wall from Chelakkolli to Koodallur in Irulam Forest station in South Wayanad Division is continuous wall with 1.8 m height.

Steel structures with spikes

Spikes fixed on concrete structures has been tried in a number of places in Coorg. About 1.88 km steel fence with spikes was installed in Aralam. In Aralam, this was a part of a 10.5 km barriers along the boundary with the human habitation. This boundary has also 5.065 km stone walls and 3.55 km trench. Solar power fence was also seen parallel to the steel fence with spikes. Obviously and also as reported, the steel fence was broken open by a herd of elephants crossing to the nearby areas. This has to be considered as one of the worst conflict mitigation measure as this would lead to injury to the elephants while attempting to break open. And moreover, it has been proved to be ineffective. In South Wayanad area, very strong steel gates with spikes fixed are in place to close the roads. This has been complemented by solar power lines also. However, the strong steel gates were bent by elephants.

Dung and chilly smoke

Hand-held pepper sprays (aerosols) or smoke canister bombs fired from simple mortar-like launchers and pepper dung (chilli-dung) burnt to produce a noxious smoke have also been tried in other parts of Asia and was found to be ineffective as the success depends on direction of the wind.

Early warning electronic systems

Early warning system has been functional in Wayanad Wildlife Sanctuary. Elephant Information Groups were formed in different areas and information on elephant sightings are received by the Divisional Control Room managed by RRT. These sightings are forwarded to the concerned area staff and watchers for verification of facts and if found correct are displayed in the concerned area display boards. The display boards are installed at four places, one each in each Range. Wherever there is no display board, the information is passed through SMS alerts. Unfortunately, the display boards were removed because of the complaints from the public due to social reasons. The SMS alert system is currently not functional and is waiting for updation of the software.

The South Wayanad Forest Division has formed a WhatsApp Group and information on elephant sightings are passed on to the Group members so that people could be alert on the

presence of elephants, if any in their area. The Divisional Forest Officer and some of the stake holders are very happy with the arrangement.

Use of Drones for scaring

A recent study finds that small unmanned aerial vehicles, also known as UAVs or drones help reduce human-wildlife conflict. Since late 2014, quadcopter drones have been used by Rangers in Tanzania to safely shepherd elephants away from farms and communities. Elephants seem to keep away because of the buzzing sound the drones make. There have been some pilot studies in Sri Lanka last year. Though found to be effective during field trials, according to the Researchers in Sri Lanka, there is every possibility of elephants getting used to the drones.

In India, the Air Force had reportedly used an aircraft to scare away elephants from its Tezpur station in Assam some years back but perhaps did not find the effort worth it. The West Bengal Forest Department used a drone in July this year in Bankura district to locate and monitor a tusker proclaimed as rogue. It was reportedly not of much use as compared to the trained elephants (kumkis) and on-foot parties. There are also regulations from the Director General of Civil Aviation and is understood to have banned civilian use of drones in some areas in the country till finalisation of guidelines. In Kerala, drone was once used to locate the strayed out herd.

Population Regulation

One of the major contentions of the public on the conflict issue is mostly related to increase in the population. Based on the local knowledge and experience, they claim that there is an increase in the population of elephants, wild boar and tiger (Wayanad). Unfortunately, there had been no attempts to analyse the population estimation data for different landscape to prove/disprove the claim.

The management interventions in the state and even in the country have been limited to habitat management under the assumption that addressing the habitat degradation issue would help in the recovery of habitat and also compel the animals to stay back in the natural

habitat. The management population has not been in the agenda mostly because ethical issues and also data deficiencies.

Immuno-contraceptives are successfully used to control the elephant population in Africa. Though there are demands from wildlife managers to use the technique in India, there are issues of standardisation of the method in Asian Elephants. Surgical sterilisation is reported to be successful on monkeys. The results of the attempts in Wayanad is yet to be known. The method to be successful, ay least 70% of the females need to be sterilised and there should be continuous monitoring of the population. Moreover, the population should be a closed one with no possibility of immigration from nearby troops.

The captive deer population in Kapprikad of Malayattur was sterilised while shifting from the old enclosures. But some of the deers were carrying and there had been recruitment of males to the population thereby failing the attempt.

Crash Guard Rope Fence

This is a new mitigation measure designed by Shri B. N. Nagaraj, Asst. Conservator of Forests in Kerala Forests and Wildlife Department. He had the input from an Engineering Expert from IIT and Wildlife Biologist and a Veterinarian. The method was first done along the left bank of Eettacholayar from Anakulam towards west direction. ISMC series galvanized channel placed in pits of 90cm x 90cm x 90 cm at 4 m interval and stabilized with reinforced cement concrete 1: 1.5: 3. At both the ends, pits of size 1.1m x 2.1m x 1.4m were taken and three U clamps were placed and stabilized with reinforced cement concrete 1: 1.5: 3. In each ISMC channel, three 18mm holes were made at a height of 90cm, 180cm and 270cm. Two 8mm holes were made at a height of 45cm and 135cm. Three strands of 16mm dia steel rope passes through the holes at 90cm, 180cm and 270cm and two strands of 6mm dia steel rope passes through the holes at 45cm and 135cm height. Both ends of the five strands are connected to the heavy anchor blocks with the help of tightner assembly. Twenty nine stay wire ropes and 12mm dia steel rope wereplaced on either side of the collapsed anchor hook with the help of tightner assembly fixed in concrete block.

Shri Nagaraj tested the effectiveness by placing camera traps and the conflict incidences came to almost zero. Currently proposals are in place for about 46 km long fences in Nilambur (6 km), North Wayanad (6 km), South Wayanad (22 km) and Wayanad Wildlife Sanctuary (12 km). Nagaraj suggested modifications to the foundation according to the soil type and has designed for different areas. Accordingly, the cost also varies. The cost in Nilambur is about Rs. 58 lakhs/km where as it is about 49 lakhs/km in Mankulam and Rs. 56 lakhs/km in North Wayanad. In Kerala, Near Kabani area in North Wayanad, modifications have been made in the design so that an under pass, which can be closed is provided for people to take their cattle to the river for various purposes. Ladders are also provided for people to access the water source.

Having heard about the success story, the people of Wayanad travelled all the way to Mankulam for first hand information. According to them, it is agood solution, especially in marshes.However, they foresee an issue since most of the boundary of the private areas with the forests are in zigzag manner. Since the crash guard rope fence are to be in straight line, a part of the private land will have to be outside once fenced and part of the forest areas will have to be inside the private property. Since the fence is normally taken as the boundary, there could be disputes in future. This issue needs to be resolved.

Rail Fence

Originally known as Armstrong fence named after its developer Graham Armstrong, Park Manager of the Addo Elephant Reserve used it as a barrier during 1950s. These fences are built with steel railway tracks grouted deep in the ground. Between the two railway tracks, 9 thick wooden poles are also dug into the ground. They are then bound by five strands of very thick steel cables horizontally along the poles. Then there is a short electric fence covering the entire stretch of the fence. South Africa discontinued this method due to high cost. The fence with rails is one of the recent suggestions in the state and other parts of the country. Such fences were seen used in Jharkhand areas to prevent elephants entering the railway lines and was reportedly functioning. The Karnataka Forest department has made use of this method in Protected Areas. Though there had been claims on the success of this method, reliable sources from the area cites two incidents. In one, elephants removed earth under the rail and squeezed

through (the first horizontal bar is at 2' ~) and in another case, an elephant tried to cross and got stuck between two rails.

In Kerala, there had been suggestions to go for rail fences in Palakkad Division to stop the entry of elephants to the railway tracks, in Wayanad North Division along Kabani river and also in one part in Wayanad Wildlife Sanctuary. The proposed one in North Wayand is currently replaced with a proposal for Crash Guard Rope Fence. The work was in progress in Moodakkolli – Sathramkunnu area of Kurichiat Range. This 10 km long stretch has trench and solar power fence in place. However, these were not effective. The solar power fence lines will be dismantled and at least the energizer, battery, T angles and corner posts of the dismantled one could be reused. According to the Deputy Range Officer, dismantling of the lines will be really difficult. However, he suggests removal for fear of using these as snares by miscreants.

The Deputy Range Officer suggests site specific designs for the rail fence to make it effective in different soil conditions. At present, the gap between horizontal lines from lower side is 6.5 cm +85 cm+85+15 cm. Pit depth is 1.10m. In marshes, design has to be different with stay wires for alternate pillars. The rail fences cost about Rs. 1.58 crores/km. However, these are very effective especially in areas like Wayanad, which have marshes. But availability of the materials for the fence is a problem.

Voluntary Relocation of people in the enclosures

There are areas where enclosures are scattered in the forest areas. Wayanad is a good example, where the Sanctuary alone has at present 106 or so settlements within. The conflict issues have forced them to express willingness to be relocated. The relocation of enclosures will ensure availability of disturbance free areas (inviolate) for wildlife and would reduce conflict. This is definitely the best option in places like Wayanad.

In Wayanad, people were relocated from Arakunji, Golur, Ammavayal, Eswarakolli, Vellakod and Kottankara. Most of the people in Chetty Alathur, Kurichiat, Narimundakolli, Pilakavu and Puthur – Manimuda have also been moved. The vacant settlement areas show good regeneration and animals have started utilizing the habitat. Interviews with the a few of the

relocated people indicate overall satisfaction though a few of the old generation complain about lack of good quality air and availability of fresh food materials.

Rapid Response Team

Presence of a team of people lead by well trained officials and equipped to deal conflict situations often pacify agitated people and help assure them safety. This is actually equivalent to guarding making the human presence felt. Unfortunately, the attempt is after the occurrence of incidence unlike guarding, where precautionary measures are taken. About thirteen RRTs are in place in different locations of the state. The members of the team are reported to be handpicked. They are given training on various aspects of wildlife management including the biology and behaviour of animals involved in conflict, public relations and also on handling different situations. However, they are not well equipped and feel tired because of 24 hour duty and lack of proper sleep.

Payment of *Ex -gratia*

This is an approach popular with communities adversely affected by wild animals. Unfortunately, the word "compensation" replaced the ex-gratia and people are given wrong message that the entire damage will be compensated. "Compensation" also reduces the incentive for self defence by farmers and therefore could even exacerbate the scale of the problem. Moreover, "compensation" is unable to decrease the level of the problem and the cause of the problem is not being addressed. There had also been an argument that "compensation" does not address the unquantifiable social 'opportunity costs' borne by affected people. Clinical ethnographic inquiries conducted in Assam make visible the hidden mental health dimensions of human–elephant conflict. According to the case study, the health impacts of conflicts penetrate far deeper than immediate physical threat from elephants, worsens pre-existing mental illness of marginalised people, and leads to newer psychiatric and social pathologies. Timely payment is also crucial to get the conservation support from the people.

Policies and Provisions in Act

The Wildlife Action Plan, 2002 mentions about mitigation of human wildlife conflict in and around PAs, use of professional and innovative approaches, provision of adequate resources for "compensation" and other means of managing this problem, research and good practices as well as policies programs and schemes. Wildlife Protection Act, 1972 provides necessary guidance to deal the problem of human wildlife conflict under section 11 (1)(a) and (b). These sections empower Chief Wildlife Warden for dealing with problem animal under schedule I to III and IV. Under section 62 of the Act, Central Government is empowered to notify wild animals other than specified in schedule I or part 2 of schedule II to be vermin for a specific period and area. Government of India has also issued a series of advisories and guidelines for human wildlife conflict management. Recently, Government of India has also notified some problematic animals (nilgai, wild boar and rhesus macaque) as vermin in accordance with section 62 of WLPA as per the request received from states of Bihar, Uttarakhand and Himachal Pradesh. Kerala Forests and Wildlife Department had also formed a Committee to look into the problem of wild boar and suggested some measures.

The Government policy of relocating people to areas adjacent to wildlife habitat has contributed to /aggravated the conflict situations. The best examples are Aralam and Anayirangal in Munnar. Lands were allotted to people from the Aralam Farm adjacent to Aralam Wildlife Sanctuary leading to escalation of conflict incidences. A similar action by the Government in Anayirangal brought in people to the elephant habitat depriving the animals of the available areas. The people now complain of damage due to wildlife and has even resulted in the death of people. The original inhabitants of the area were in five settlements with not much complaints about animal presence. These Muduvan community were in Chembakathozhukudy, Kozhippannakudy, Tankukudy, Pachappulkudy and Aduvilanthankudi. In 2003, land was assigned to people from different areas and settled in 301Acre Colony, 80 Acre Colony, Panthadikkalam Colony, Vilakku Colony and Suryanelli Colony. Most of the settlers were not familiar with wildlife areas and are with comparatively low tolerance to the animal presence.

In addition to the arrival of new settlers, the Anayirangal and adjacent areas experienced large scale developmental activities related to tourism. A number of tourism facilities such as resorts

came up and a network of roads developed for access to these facilities. The presence of estates, network of roads, resorts, day and night movement of people resulted in fragmentation of the already shrunk area. The Forest Department is under pressure to address these man-made problems. In addition to the usual strategies of the Department, private property owners started protecting their areas with solar power fences without considering the movement path of the animals, especially elephants. Unfortunately, there was no permission from the Department nor was it required. All these activities aggravated the issues leading to changes in the animal behavior becoming aggressive leading even to the loss of human life. It will be interesting to study the ecological and socio-economic changes in these two areas, Aralam and Anayirangal to understand the pre and post settlers' scenario.

The policy of paying compensation to snake bite victims even outside the forest areas put the Department to severe economic pressure spending a major share of the meagre financial resource for the purpose. One of the major complaints from the public is on the cumbersome procedures involved in claiming the "compensation" and the delay in payments. Shri Jose of Kattikulam feels that the procedure could be simplified and entrusted to the concerned Grama Panchayaths. There are a few others who do not consider this to be a good suggestion.

Janajagratha Samithis formed with People's representatives, farmers' representatives and Forest Range Officer function at Panchayath level. Currently, the MLA of Bathery constituency have taken the initiative to form Ward level Samithiswhere local issues arediscussed. These Samithis are said to be effective because conflict issues are discussed in detail and solutions suggested. Moreover, the public support is ensured in meeting the challenge. There are suggestions to form a district level statutory committee with Dist. Panchayath President, Collector and representatives of Panchayath level Janajagratha Samithis.

There are at least a few LSGs, who have contributed to the implementation of conflict mitigation measures. There could be a Government order in this respect empowering the Panchayaths for financial support.

There had been initiatives from the Forest Department to organise Interaction Meetings with People's Representatives and also with the media persons. Such meetings were regularly

organised in Wayanad and exchange ideas. Moreover, a lot of misconception on the wildlife management issues are cleared. Such interactions may be organised in high conflict areas.

Attributed causes of conflict

There had been several reasons cited for the conflict situations. Animals, especially elephants when crammed into smaller areas by habitat loss and poaching leading to localised high densities could end up in crop-raiding in the surrounding areas. Farmers abandoned communal planting and guarding activities that once reduced crop loss. It has been argued by the affected that increase in numbers (especially elephants) in PAs following improved anti-poaching measures has led to some elephants losing their fear of people. Though there is not enough evidence, it is also told that human intrusions displace elephants which in turn come to depend on crop-raiding to survive in resource poor habitats. Other reasons attributed to conflict situations are creation of abundant secondary vegetation due to human activities in the fringes attracting elephants bringing them closer to human settlements, artificially maintained water sources attract elephants during drought and traditional migration routes (movement paths) severed by human intervention (e.g. canals, power installations, agriculture, settlements and fences), leading to aggressive behaviour in elephants and thus increasing conflict. Unfortunately, no attempt has been made to analyse various circumstances under which a person dies due to wildlife. This would have helped in planning proper strategies to avert such accidents.

There are several economic and social costs borne by the villagers around wildlife habitats and can outweigh the direct costs of agricultural damage and can influence the perception of the affected people. The human death, restrictions on movement, competition for water sources, the need to guard property (which may lead to loss of sleep), reduced school attendance (through loss of sleep, or fear of travel), poor employment opportunities, increased exposure to diseases and psychological stress are a few of the sacrifices of the affected community for the sake of wildlife. The conflict situation can culminate in potential harm to all involved, and lead to negative human attitudes, with a decrease in human appreciation of wildlife and potentially will have detrimental effects for conservation. The ultimate goal of wildlife damage

management is to increase the net benefit of wildlife for society. This is achieved through purposeful interventions that address the adverse effects of wildlife and wildlife management that matter most to stakeholders.

Suggestions

The field observations and discussion with Forest Officials, farmers and People's representatives in different parts of the state indicates the haphazardness in addressing the conflict situations and also in the implementation of mitigation measures.

- The present mitigation measures do not consider the landscape as a unit. Thus, the unit for mitigation is either the Forest Divisions or even Ranges. The landscapes should be identified based on contiguity of geographical areas/forests. Conflict areas requiring interventions should be prioritised based on selected parameters such as the severity of conflict incidences, number of affected people, location of the areas and the socio-economic status of the affected people.
- The attempt should be to utilise the meagre resources in the best effective manner avoiding even political considerations.
- Mitigation measures should be selected based on the cost effectiveness, nature of the terrain, soil types and social acceptability and also the movement path of animals.
- The details of selected areas, the planned mitigation measures and the implementation procedures should be publicised through websites and preliminary discussions could be held with the elected representatives of the people. General public could also be requested to comment on the plan. However, the decisions should never be subjective and not influenced by considerations other than technical. This comprehensive landscape level plan should be the basis for further activities.
- Alternatively, the whole process of prioritisation, selection of sites and the mitigation techniques could be done by a team of experts and presented before the Forest Officials for improvement.

- Failure of Solar Power Fences is mostly because of problems of low quality materials, improper implementation and lack of maintenance and care by the beneficiaries. A local Panchayath level Committee should oversee the implementation of the mitigation measures. They should ensure the quality of the materials used and also the quality of the work.
- If solar power is adopted, it is suggested to have at least one field watcher/km for guarding at night and maintain fences. Discussions may be held with Panchayaths to meet the related expenditure.
- The suggestion from experienced Foresters indicate that there should be an enrgiser and a battery for every 1.5 km of solar power fence. This may be evaluated technically.
- Maintenance for a fixed period should be ensured while selecting the agency and in the case of solar power fence, the size of the posts, specifications of the Energizers and Battery should be tested by the Panchayath level committee.
- Arrangements should be made to address any technical problem, especially of solar power fences within one or two days.
- There should be periodic performance auditing by the staff for immediate repair, if required. The Panchayath Members also may be involved in monthly review of performance. A Committee may be constituted to monitor and evaluate the performance at least once in six months. The field staff and Division level officials should also monitor the measures taken periodically.
- Currently, a number of Government Departments extend financial support to mitigation measures. As can be seen in different areas, District Panchayaths, Grama Panchayaths and Tribal departments are involved in the activities. There is not much co-ordination between departments and the decisions are subjective. The Forest Department should present the details of the report having prioritisation and mitigation actions before the concerned line departments and seek assistance. At any cost, the line departments

should not be allowed to implement any mitigation activity without the approval of the Head of the Forest Force.

- Permission from the Forest Department should be made mandatory for any type of physical barriers planned by private people or departments. This is to ensure that the natural movement of animals are not hampered.
- Priority should be given to voluntary rehabilitation of people, with priority for Wayanad, to make available inviolate areas for wildlife and reduce the chances of conflict. This would be the ultimate solution to the problem.
- If the responsibility of maintenance of the barrier is on the beneficiaries, claims for ex-gratia (compensation) for crop/property damage from areas where human habitations are completely secured should not be entertained.
- Stone wall construction should be avoided because of the high cost and environment related reasons. Likewise, trenches and steel structures with spikes should not be allowed.
- The RRTs should be strengthened and well equipped. The man power should be increased so that there are enough people to be engaged on rotation.
- Periodic Interaction Meetings with elected People's Representatives should be organised for better public relation. Workshops for media persons could also be organised.
- It has been argued that a person's social network, social standing, gender, financial stability, beliefs and values all contribute to their decisions about how to engage with their environment. The attitude and behaviour of the people influence the relationship with the local authorities. It is important to cultivate trust with the local people while maintaining authority. This has been evident at least in Wayanad while managing conflict situations. Though skilled in dealing with illegal activities, the Department staff needs training in gaining trust of the people. In service training for the staff may be thought of. This could also be a part of the syllabus in Forest schools.

- A staff who is knowledgeable and good at communication should be selected and entrusted to deal with the media at the time of conflict.
- The State should utilise the provisions of Wildlife Protection Act to deal with the issue of wild boar, which is considered to be the major problematic animal by farmers. Any such actions should be monitored and corrective measures taken.
- In the case of tiger and leopard, the guidelines issues by the Ministry of Environment, Forests and Climate change should be followed.
- Each incidence of accidents leading to human death should be analysed with details for understanding the situations leading to the death and make corrections in management.
- The data on population ('wildlife census') collected periodically may be analysed to see the trend in the population at regional and landscape level. Appropriate population management following the provisions of the Act could be considered based on the information.
- The leftovers (or the waste) of all the fences in different parts of the state should be collected and disposed appropriately so that the area will not look like a dumping place.
- Impact of tourism on wildlife, especially in the conflict areas need to be evaluated.
- Considering the number of complaints from the public regarding monkey menace, feeding the monkeys in any place should be made a punishable act. The Local Self Governments should be directed to adopt scientific waste management to avoid visit of monkeys and wild boars.
- Awareness programmes may be organised for the general public in conflict affected areas. The programme should include introduction to the biology and behaviour of animals involved in conflict, the precautions to be taken while living in wildlife areas and the local conservation issues to be discussed.
- The Kalpetta Municipality, on an initiative of the Forest Department formed "Vanara Sena" consisting of paid watchers engaged by the Local Self Government.

- Local Self Government may be requested to promote monkey proof designs for buildings. This may be insisted while approving building plans.
- The local traditional knowledge of the people in Wayanad talks about jackal in the area, which they feel was controlling the population of wild boar in the area. Earlier, jackals were captured by people from outside imitating the calls of jackal. The skin and the meat were taken. The possibility of reintroducing jackal in Wayanad could be thought of after proper investigation.

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IDENTIFY, DOCUMENT AND ASSESS THE EFFECTIVENESS OF IMPORTANT WILDLIFE CORRIDORS IN DIFFERENT FOREST LANDSCAPES OF KERALA AND ASSESS THE EXISTING LANDSCAPE MANAGEMENT POLICIES OF THE STATE

I. INTRODUCTION

The first forest policy came into existence in 1894 which was based on a report published by Volcker (1893) on improvement of agriculture with revenue generation as main objective. Subsequently, the second forest policy published in 1952, emphasised sustained supply of timber and other produces for defence, communication and industry. These approaches in the policies has led to fragmentation of natural forests. Considering the hardships faced by long ranging species like the Asian elephant (*Elephas maximus*), tiger (*Panthera tigris*) and other larger herbivores.

Landscape level approach has been emphasised in the National Wildlife Action Plan (2017-31) (Anon, 2017) which states that 'identify ands set boundaries of key landscapes and describe the land use; assess and evaluate status of all wildlife species and their habitats outside PAs but within the landscape'. Although the Ministry of Environment and Forests (MoEF) has initiated landscape programmes like Project Elephant and Biosphere Reserve, but could not give much positive results due to lack of legal support. Conservation planning calls for landscape sensibility taking the ecological and geographical distinctions (Sanderson *et al.*, 2002).

A nationwide assessment on fragmentation carried out by Roy *et al.* (2012) reported that a considerable area of forest is under low fragmentation (49.63% of the total geographical area of the country), 21.89% under medium while 5.16% was under high fragmentation.

However, the 2006 amendment of Wildlife (Protection) Act, 1972 has incorporated the provisions of management at landscape-level. Similarly, the National Working Plan Code 2014 also prescribes landscape management. The Kerala Forest Department has also conducted many studies in association with the research organizations related to management of forest and wildlife at landscape level.

1.1. Problems associated with elephant management

The elephant, a keystone species of Asian tropical forests is an animal with potential to act as an umbrella or flagship species on the one hand, and act as Landscape architects on the other. The elephant, being a large herbivorous animal, needs vast areas to roam for browsing, foraging, and moving from place to place in search of food and water with the changing seasons. Research shows that the more forest habitat is degraded, the farther an elephant herd has to roam in search of food and water. It is said that the 'home range' of an elephant herd can vary from an average of about 250 km^2 (in Rajaji National Park) to over 3500 km^2 (in the highly degraded, fragmented landscapes of West Bengal).

As elephants are forced to range farther and farther, this brings them into conflict with humans. And as humans encroach on forest areas, planting nutritious crops near forest lands, building homes and roads and railways, invites conflict with elephants. Human- elephant conflict (HEC) is a very serious issue in India today: over 400 humans are killed in encounters with elephants annually, and crops and property worth millions of rupees are damaged. It is estimated in fact that elephants damage 0.8 to 1 million Ha. of agricultural crops every year, and assuming that an average family holds one or two Ha. of land, HEC can be said to affect at least 500,000 families. Of course, there are also elephants killed in turn (about 1500 in the last 15 years) by human greed and indifference, and in retaliation for conflict, through train-hits, poaching for ivory, poisonings and electrocutions.

Fragmentation of available habitats has confined most of the elephant populations to small islands. In addition, the threat from poaching for ivory is said to have considerably depleted the number of tuskers, in many parts of the country often leading to a highly skewed sex-ratio. Developmental programmes and encroachment within and around elephant habitats have also led to the loss of the elephants' traditional movement paths. All these factors have contributed to increased HEC, which has often led to the loss of both human and elephant lives.

Going by records, India has the largest number of wild Asian elephants in the world, estimated from block count method at 27,312 (2017 enumeration) (Anon, 2017a), which is about 55% of the global elephant population. The elephant population in Kerala has been estimated at 6000 (Anon, 2017b).

1.2. The need for securing Elephant/Wildlife corridors

The loss of natural habitats and fragmentation of forest areas are resulting in ecosystem degradation and biodiversity loss across the globe. Elephants, with large home range and food requirements, have been among the species most affected by habitat alteration and loss of habitat connectivity. The fragmented nature of the Indian landscape, with people all around, has increased human-elephant conflict in most parts of the country. Human-elephant conflict is having a negative impact, especially on rural communities, so far causing economic losses amounting to millions of rupees. Intensive crop damage and the increasing frequency of animal attacks on both humans and their cattle have made communities less tolerant towards wildlife, mainly due to the emotional stigma attached. Mitigation of human-wildlife conflict is thus becoming one of the key issues of concern for both wildlife managers and the scientific community. There is a need to create an enabling environment for them to address the situation, and to strengthen their capacities in the most efficient and effective manner. Securing wildlife habitats and their corridors is one of the many long-term steps to tackle Human-Wildlife conflict.

Elephants in wild, show nomadic behaviour and the daily and seasonal migrations they make through their home ranges – is immensely important to the environment. Elephants create clearings in the forest as they move about, preventing the overgrowth of certain plant species and allowing space for the regeneration of others, which in turn provide sustenance to other herbivorous animals. Elephants consume plants, fruits and seeds, releasing the seeds when they defecate in other places as they travel and helps in seed dispersal. This allows for the distribution of various plant species, which benefits biodiversity. Elephant dung provides nourishment to plants and animals and acts as a breeding ground for insects. During drought, elephants access water by digging holes, which benefits other wildlife too. Furthermore, their huge footmarks help collect water when it rains, benefitting smaller creatures. Predators at times hunt young elephants and elephant carcasses invariably provide food for other animals. While we attempt preserving large areas for elephant, it helps developing the entire ecosystem. And hence to have elephants in isolated groups, unable to move freely through their home ranges, would therefore have a devastating effect on the ecosystem. Many animal species would suffer and the ecosystem balance of several wild habitats would be unalterably upset. It would also, of course, eventually lead to the local extinction of India's National Heritage Animal. And all these points to the importance of preserving the pathways of elephants, the corridors and their home range.

The various policy documents issued by authorities also emphasis the management of corridors. It is specifically stated in para 5.2.3.1 of 'National Conservation Strategy and Policy Statement on Environment and Development', June 1992 (Anon, 1992) issued Ministry of Environment and Forests, Government of India (MoEF, GoI) to maintain corridors between National Parks / Sanctuaries / Forests and other PAs. The National Forest Policy, 1998 (Anon, 1998) para 4.5. also states that it is especially essential to provide for corridors linking the PAs in order to maintain genetic continuity between artificially separated sub sections of migrant wildlife. The National Wildlife Action Plan, 2017-31 also emphasis to identify corridors and describe land use. These corridors need to be demarcated on land and ecologically compatible land use need to be ensured in these areas for habitat connectivity in the landscape.

In the above context, a consultancy namely **'Identify, document and assess the effectiveness of important wildlife corridors in different forest landscapes of Kerala and assess the existing landscape management policies of the State'** was floated as part of a larger study namely 'preparation of state-level strategy for mitigation of human-wildlife conflict in Kerala'.

Tasks assigned and deliverables/outputs expected from the above-mentioned consultancy were as follows:

1. To identify, document and assessthe effectiveness of important wildlife corridors in different forest landscapes of Kerala and assess the existing landscape management policies of the state.

2. To document and analyse the existing landscape policies for effective management of these corridors, and suggest measures for making landscape management more effective in context with Human-Wildlife Conflict (HWC) conflict.

3. To study the status of wildlife habitats in one of the high conflict Forest Divisions and suggest broad measures for strengthening/improving the habitat conditions, which could be replicated in other divisions of the State.

II. METHODS

The following methods were followed for each output assigned in the consultancy:

For Output 1: Information on both secondary and primary sources were collected. Initially the secondary information was collected from the existing literatures such as published papers, reports, etc. Then the investigators collected the primary information by visiting each elephant corridor in the State and corroborated the secondary information collected.

The following reports were reviewed for collecting the secondary information on elephant corridors in Kerala.

a. List of important corridors for elephant movement in Kerala. A report prepared by Asian Elephant Research & Conservation Centre, Bangalore (Letter dated 11.11.1998 from Centre for Ecological Sciences, Indian Institute of Science, Bangalore) (Anon. 1998a).
b. Prioritization of areas of elephant movement. A note prepared by Kerala Forest Research Institute, Peechi, Kerala (KFRI/WILD/CCF/98) (Anon. 1998b).
c. Biodiversity Conservation Strategy and Action Plan for Kerala. French Institute of Pondicherry. Pondicherry (Ramesh et.al., 2002).
d. Conservation Review for Rationalization of Protected Area Network in Kerala. French Institute of Pondicherry. Pondicherry (Ramesh et. al., 2003)
e. Gajah. Securing the Future for Elephants in India. The Report of the Elephant Task Force, Ministry of Environment and Forests, Government of India (Rangarajan et. al., 2010).
f. Right of Passage: elephant corridors of India. Wildlife Trust of India. Conservation series No-3 (Menon et. al., 2005).
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h. Technical Workshop on Elephant Conservation in South Indian States. Organized by Ministry of Environment and Forests, Government of India, Government of Kerala and Wildlife Institute of India in association with World Wide Fund for Nature-India, Wildlife Trust of India and Periyar Tiger Conservation Foundation held at Thiruvananthapuram during 11-12 January 2018 (Anon, 2018).

The following primary information were collected by the investigators on each corridor by making field trips and verified with the secondary information collated from the literatures.

a. Name of the corridor
b. Administrative units (Division, Range, Section/Station) where the corridor situated
c. Size/extent of the corridor (length and width)
d. Land use of corridor
    a. The status of natural forest (Reserved Forests or any other status)
        i. Land use in RF with extent of each use with type of forest and plantations
    b. Private area/estate/village (extent and number of families, population, etc)
        i. Land use in private area/estate/village with extent of each use
e. Biotic pressure (grazing, fuel wood and NWFP collection, etc) and agricultural practices
f. Information on infrastructure development in the corridor and physical barriers like linear intrusion of road network

g. Willingness of land owners for acquisition of land in the corridor
h. Utilization/movement of animals in the corridor
a. Opinion/view of forest personnel and local community
b. Field observation by the investigators
i. Basic requirements of animals such as availability of cover, water and forage in the corridor
j. Land use in adjoining areas of corridor (on either side)
k. Wildlife damage in the adjoining area of corridor
l. Natural features of the corridor (geographical and other issues)

In addition to the above, the recommendations of existing National-level policies were also reviewed and appropriately referred for this output.

For Output 2: This task was carried out by reviewing the legal provisions, polices and studies related to landscape management. The following activities were carried out as part of this task:

a. Review of Kerala Forest Department's existing landscape polices for effective management of corridors
b. Review of legal provisions related to landscape management
c. Review of National Working Plan Code (2014)
d. Review of National Wildlife Action Plan (2017-31)
e. Review of studies related to landscape management in Kerala
f. Status of acquisition of corridors for linking forest landscapes by State Forest Department.

For Output 3: The Wayanad North Forest Division, one of the high conflict Forest Divisions in the State, was selected to study the status of wildlife habitats to suggest broad measures for strengthening/improving the habitat conditions, which could be replicated in other divisions of the State. In order to carry out this task the following activities were carried out:

a. The Working Plan (for the period from 2015-16 to 2024-25) of Wayanad North Forest Division prepared by William, S. (2015) was reviewed. The prescription related to management and maintenance of wildlife habitats of each Forest Working Circle was also thoroughly reviewed for their compliance.
b. The prescriptions in Wildlife Working Circle was reviewed in the context of National Working Plan Code - 2014 (Anon, 2014).
c. Guidelines for silvicultural prescriptions for wildlife in managed forests (Reserved Forests) issued by Wildlife Institute of India (Bruce and Darden, 1996) were reviewed.
d. Analysis of expenditure for last three years for the management of wildlife habitats was also reviewed.

III. OUTPUTS

Output 1: Review of existing information on corridors of Kerala

The Asian Elephant Research & Conservation Centre, Bangalore (Anon, 1998a) identified the following four corridors in Kerala.

a. Tirunelli corridor in Wayanad North Forest Division (link between Wayanad WLS and Brahmagiri hills through Kudrakote RF and Tirunelli RF) – Very High Priority

b. Periyar corridor in Wayanad North Forest Division (link between Hilldale RF and Kottiyur RF) – High Priority
c. Pakranthalam corridor in Wayanad North Forest Division (link between Kottiyur RF and Kannoth RF) – High Priority
d. Vazhikadavu corridor in Nilambur North Forest Division (link between Nilambur Kovilakam and New Amarambalam/Silent Valley)) – Potentially Very High Priority

The Kerala Forests and Research Institute (Anon, 1998b) identified and prioritized a total of seven areas in Kerala for facilitating the free movement of wild animals especially elephants. The prioritized areas are as follows:

a. Shanamangalam_Padiri – corridor
b. Pakranthalam – corridor
c. Periya-Kottiyur – consolidation of area
d. Settlements in Begur Range – consolidation of area
e. Settlements in Bathery & Kurichiat Ranges – consolidation of area
f. Ayyankavu in Irutti – problematic settlement
g. Nilambur-Kovilakam – problematic settlement

Ramesh et. al. (2002) identified the following four elephant corridors in Kerala.

a. Periyar corridor
b. Pakranthalam corridor
c. Brahmagiri and Tirunelli corridor
d. Pallivayal – Tattur corridor

Ramesh et.al. (2003) states that the some of the forest areas in Kerala are fragmented in the Malabar region due to proliferation of commercial and forest plantations. Some of the existing and proposed reserves in the region are isolated. The same study identified some of the reserves that could be linked through narrow patches of disturbed and degraded forests to restore contiguity. The identified corridors are as follows:

a. Mukkali (link between Attapadi – Chenat Nair Conservation Reserve on southern side and Attapadi Conservation Reserve on northern side)
b. Gudalur (link between the forest patches of proposed New Amarambalam and Camel Mount WLS (Nilambur and Manjeri Kovilakam forests) of Nilambur North Forest Division)
c. Kottiyoor (link between habitats of Hilldale Reserve Forest and Kottiyoor Reserve Forest)

Rangarajan et. al. (2010) prioritized the elephant corridors in the country and mentioned a total of four elephant corridors in Kerala which are as follows:

a. Tirunelli-Kudrakote – Priority I corridors in Kerala
b. Nilambur Kovilakam -New Amarambalam – Priority II corridors in Kerala
c. Periya at Pakranthalam – Priority II corridors in Kerala
d. Kottiyur-Periya – Priority II corridors in Kerala

Menon et. al. (2005) and Ramkumar et. al. (2017) identified the following corridors in Kerala:

a. Begur – Brahmagiri (Ecological priority: High; Conservation feasibility: Medium)
b. Thirunelli – Kudrakote (Ecological priority: High; Conservation feasibility: High)
c. Kottiyur – Periya (Ecological priority: Medium; Conservation feasibility: Medium)
d. Periya at Pakranthalam (Ecological priority: Medium; Conservation feasibility: High)
e. Nilambur at Appankappu (Ecological priority: High; Conservation feasibility: High)
d. Nilambur Kovilagam - New Amarambalam (Ecological priority: Medium; Conservation feasibility: High)

With the above review, the seven elephant corridors located in Kerala mentioned in the latest report on "Right of Passage (Elephant Corridors of India)" published in 2017 by Wildlife Trust of India and other NGOs in collaboration with MoEF &CC (Ramkumar et. al., 2017) were considered as the final list. The details are given in Table 1.

Table 1: Identified elephant-corridors in Kerala

Sl. No.	Name of Corridor	Division under which the corridor falls	Remarks
1	Begur – Brahmagiri (Inter-State Corridor)	Wayanad WLS with Brahmagiri WLS &Nagarhole TR (Karnataka)	Land to be acquired
2	Thirunelli- Kudrakote (State Corridor)	Wayanad (N)	Secured and notified
3	Kottiyur – Periya (State Corridor)	Kannur, Wayanad (N)	Land acquisition in progress and is to be completed. More areas to be acquired to secure the corridor completely
4	Periya at Pakranthalam (State Corridor)	Wayanad (N)	Land to be acquired
5	Nilambur – Appankappu (State Corridor)	Nilambur North & South Divisions	Land to be acquired
6	Nilambur Kovilakam- New Amarambalam (State Corridor)	Nilambur North & South Divisions	No acquisition needed
7	Mudumalai – Nilambur via O' Valley (Ouchterlony Valley) (Inter-State Corridor)	Nilambur North Forest Division and Mudumalai Tiger Reserve (TN)	No acquisition needed on Kerala side

Of the above seven identified corridors, one corridor (Thirunelli – Kudrakote corridor) has been completely secured. Two corridors *viz.* Nilambur Kovilakam- New Amarambalam and Mudumalai – Nilambur via O' Valley (Ouchterlony Valley) does not need any land acquisition. The acquisition of Kottiyur- Periya corridor is in progress and some more area need to be acquired. This leaves us with three identified corridors where land acquisition is to be carried out afresh and one corridor where more land needs to be acquired. Of the four identified corridors which need land acquisition for

securing them, three corridors fall in Wayanad District and one in Malappuram District. it was revealed by the forest personnel that the KFD is proceeding the acquisition in consultation with the revenue authorities. The details regarding the securing of the following four corridors are dealt below.

1. Periya - Pakranthalam
2. Kottiyur - Periya
3. Begur – Brahmagiri
4. Nilambur – Appankappu

The details of the above corridors are as follows:

1. Periya - Pakranthalam Corridor

The proposed Periya - Pakranthalam elephant corridor (Figures 1 and 2) connects the northern and southern portions of the Periya Reserve Forest located between Kunhome Section of Periya Range and Makkiyad Forest Station of Mananthavady Range in Wayanad North Forest Division. Elephants from Wayanad North Forest Division move to Kozhikode Forest Division through this narrow and undulating forest area between Periya and Pakranthalam villages.

The extent of this corridor is 300 m. length and 500 m. width. The natural forest within this corridor consist of tropical moist deciduous forest. Private land belonging to five families exist within this corridor with an extent of 13.3995 ha. (reported by the local forest staff in charge of the area). The details of lands with five different owners are detailed below:

Name of Owner(s)	Extent (Ha.)
Thacharoth Naushid, E.K. Kunchammed, Usharani, Hashkar, K.K.	5.4231
Ambika, P	0.8499
Sasikala, W/o Dr. Chandrmohan	2.7236
Harija Retreats privated limited	3.1887
Hameed, Riyas, P.K.Jamal	1.2142
Total	**13.3995**

Fig. 1: Periya-Pakranthalam corridor in Nilambur North Forest Division

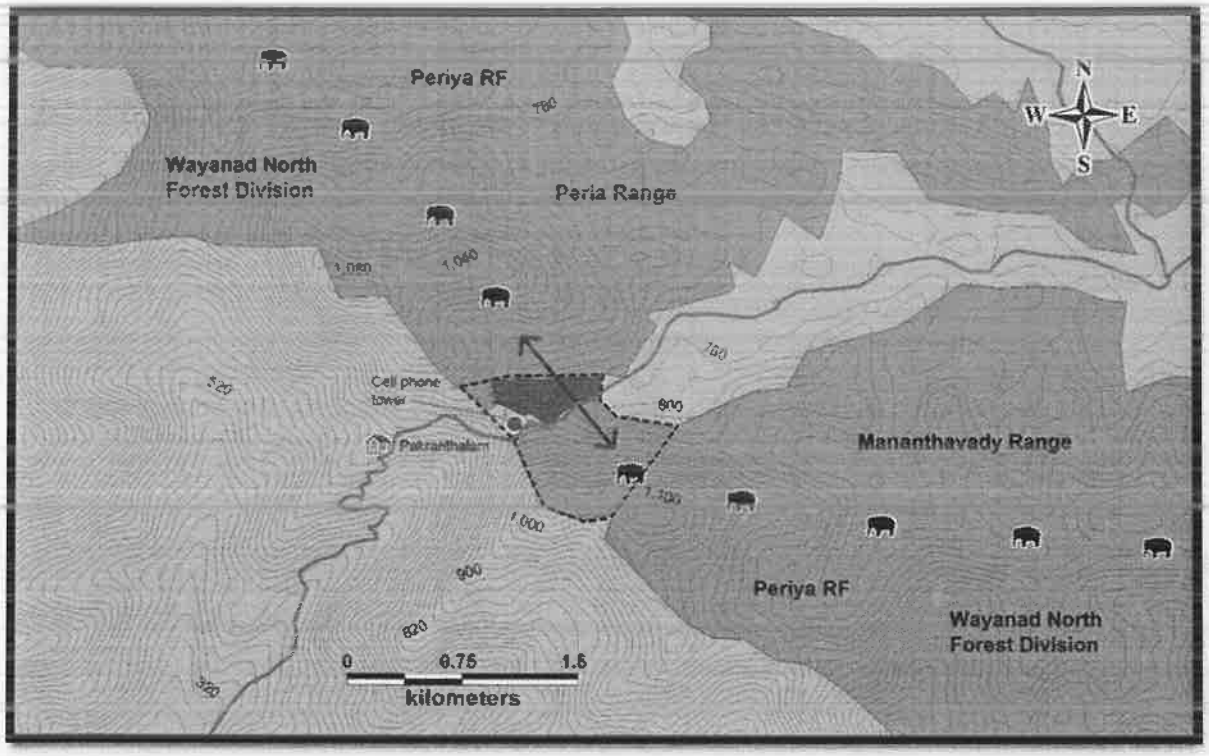
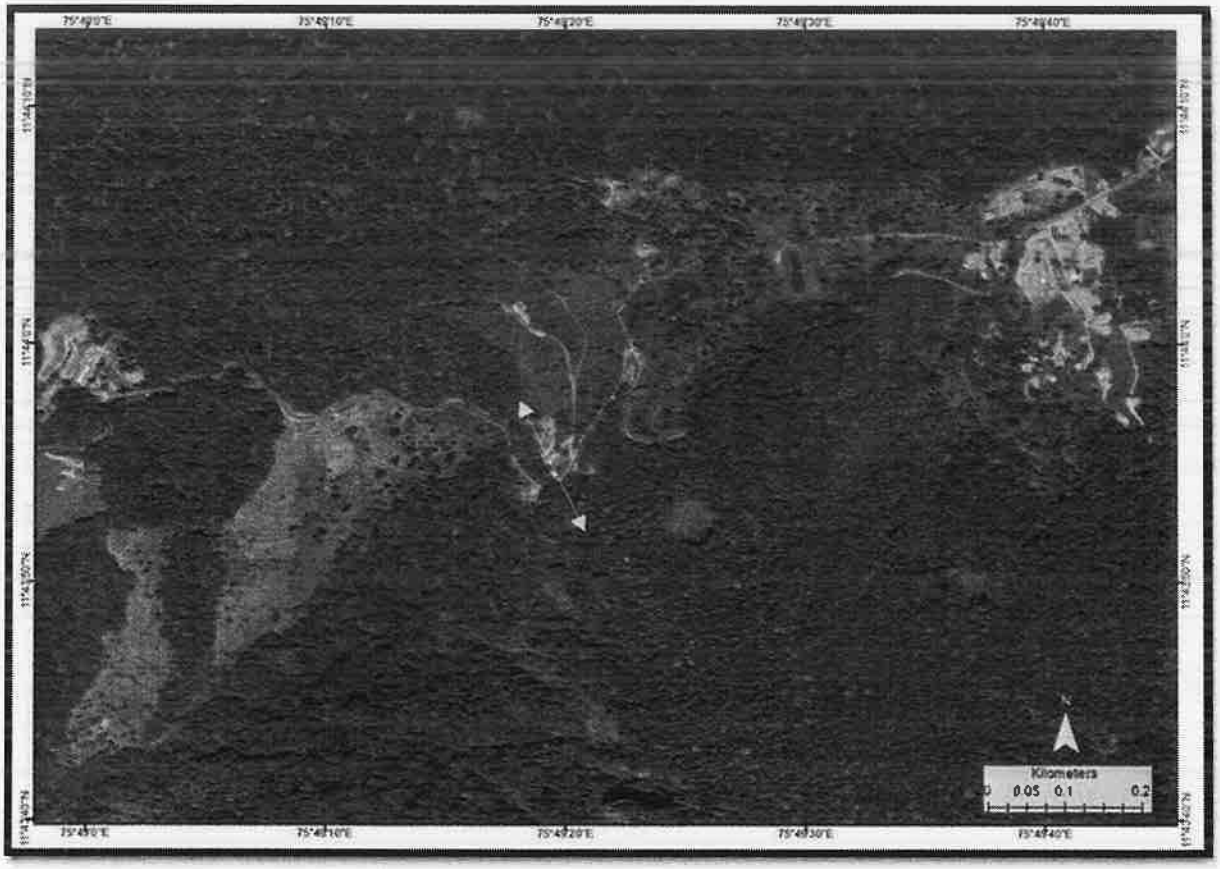


Fig. 2: Landuse in Periya-Pakranthalam corridor



Two properties have been left as such without any cultivation. In other three properties, cultivation of coffee, pepper, jackfruit and arecanut are found to be cultivated. There is a good source of water (pond) exist within the private land. The cultivated area is secured by solar power fence by the owners themselves. Though the forest department is planning to acquire the private land within this corridor, the willingness of the owners was not ascertained yet.

As part of preventing human-wildlife conflict, power fence (3.5 km length) was erected during 2016 in Valamthode-Maradi area by the Kerala Forest Department all along the boundary of the corridor (along a perennial water source namely Valamthode). The fence erected along this water source aggravated the problem since animals could not get access to the water source. Moreover, the animal create havoc in other locations since they could not get access to the water source and prevented the movement. Biotic pressures from the nearby human settlements exist in the natural forests of the corridor.

Apart from the private lands, other barriers also exist in the corridor. Though a cell phone tower exists in a private property within this corridor, it does not find to prevent the movement of animals. However, the state-highway running between Mananthavady and Pakranthalam act as a barrier for the movement of animals due to heavy traffic along the road. Assessment of traffic in this road was reported as 100 vehicles/hour (Ramkumar *et al.*, 2017).

The details of the corridor are given in the following table.

Name of the corridor	Periya-Pakranthalam (connects Periya Range on the north with Mananthavady Range on the south; both side have Periya RF)
Forest Division(s) where the corridor exists	Wayanad North Forest Division
Forest Range(s) and Forest Section(s)/Station(s)	Kunhome Section of Periya Range and Makkiyad Forest Station of Mananthavady Range
Name of Reserved Forests	Periya RF on either side of the road between Mananthavady and Pakranthalam
Dimension of the corridor (length and width)	300 m. x 500 m.
Land use in Reserved Forests with extent of each use with type of forests/plantations	Tropical moist deciduous forests
Private area/estate/village – extent and number of families, population, etc.	The private land exist within the corridor belong to five owners
Land use in private area/ estate/ village – extent of each use.	In two properties no cultivation; three properties cultivation and buildings exist. Coffee, pepper, arecanut are being cultivated. A

	good source water (pond) also exists in the private land. A BSNL cell phone exist within a private property.
Biotic pressure	Exist in the natural forests from the neighbouring human settlement
Development/infrastructure/linear intrusions	A state highway between Mananthavady and Pakranthalam prevent free movement of animals
	WTI estimated traffic as 44 to 100 vehicles per hour plying on the road
	A BSNL cell phone exist within a private property.
	Power fence erected by KFD with an extent of 3.5 km. (2016)
	Power fence being created by private owners in the corridor
	A stone crusher exists in Surani which is located about 1 km. away from the corridors
Willingness for acquisition of estates/ villages	KFD identified 13.3995 ha. for acquisition. But no dialogues have been so far carried out with the owners for their willingness
Utilization/movement of animals in the corridor	
• Opinion/view of forest personnel and local community	
	Elephant mainly visit the area by June-july and November-December. No elephant is found to cross the corridor for the past two years. Gaur

	is always found the corridor. Sambar and other herbivores are also found. Leopard was found to cross the road during 2018.
• Field observation by the investigators	
	Old elephant dung piles were found in the corridor. Fresh dung piles of elephants were found in areas of conflict (near Valamthode forest checkpost)
Basic requirements of animals such as availability of cover, water and forage in the corridor	Cover, water and forage exist in the corridor. Found good growth of grass in the private land within the corridor WTI reported 17 sp. Of trees; 40% shrubs; 30% each of grass and herbs. A perennial water source (Valamthode stream existing on the edge of the corridor was found blocked by electric fence erected during 2016 which totally prevented the movement presently.
Land use in adjoining areas of corridor (on either side)	On the west (Kuttiyadi Range of Kozhikkode Forest Division), the terrain is very steep which is a geographical barrier for the movement of elephants On the east, 300 m width of private land
Wildlife damage in the adjoining area of corridor	Elephants raid crops in the adjoining area. The elephant that comes to the corridor raid crops in the adjoining areas (problem shifted to other areas from due to power fencing in the corridor)
Natural features of the corridor (geographical and other issues)	As mentioned above.

Recommendations

1. The entire private land (with an extent of 13.3995 ha. belonging to five owners) in the corridor area should immediately be acquired and notified as Reserve Forest under Kerala Forest Act, 1961.
2. After acquisition, an eco-restoration plan may be prepared and implemented to improve the habitat parameters.
3. The corridor area and its surroundings to be notified as eco-sensitive zone under Environment Protection Act, 1986 as decided by the Indian Board for Wildlife held during 2002 (Sharma, 2002).
4. The existing system of erecting physical barrier like solar power fencing should be placed judiciously so as to ensure free movement of animals and access to water sources.
5. A convoy system needs to be implemented along the road between Mananthavady and Pakranthalam to control the night traffic so as to facilitate free movement of animals at least during night hours.
6. The maintenance or upgrading of the roads that are passing through forest area especially in corridor region should be done in consonance with wildlife movement and involvement of forest officials concerned so as to avoid physical barriers.
7. Speed breakers need to be installed in strategic locations along the roads passing through the corridor.
8. Implement night road patrol system to regulate the traffic and protection along the roads passing through the corridor.
9. Display sign boards depicting the contact number of forest personnel for sharing the information regarding elephant or any wild animal on the road side in the corridor region to notify the forest officer for reaching the site to control the traffic and facilitate the movement of the animal(s).
10. Details of wildlife corridors as well as prescriptions and management strategies (including habitat management) for the effective management this corridor need to be incorporated in the Working Plans of Wayanad North Forest Division.
11. Sensitization of frontline staff, managers including Working Plan Officers and stakeholders on importance of wildlife corridors and landscape management.
12. Involvement of stakeholders including line departments (in this case, Road Authorities, State Transport Corporation, BSNL, etc) and local dependent communities in planning and management of corridor.
13. Surveillance cameras may be placed at strategic locations of animal crossing on the roads in the corridor region.

2. Kottiyur-Periya Corridor

The Kottiyur-Periya corridor is located within the Periya Reserve Forest (Periya Range) of Wayanad North Forest Division (Figures 3, 4 and 5) and Kottiyur Reserve Forest (Kottiyur Range) of Kannur Forest Division extending up to Kottiyur Reserve Forest of Kottiyur Wildlife Sanctuary under Aralam Wildlife Division. Elephants from Wayanad North Division move to Brahmagiri Wildlife Sanctuary through Kannur Forest Division and Wayanad Wildlife Sanctuary, via the narrow and undulating forests, rubber estates and agricultural lands at Boys Town village. The corridor forest is disconnected due to the steep edges that were cut into the mountain while constructing the Palchuram road between Boys Town and Kottiyur. Elephants can now cross the corridor only near a bridge located 500 metres from Boys Town junction. Habitations/ settlements in three bits such as CRP Kunnu, 37th mile and Chapparam villages exist in Varayal Forest Station of Periya Range fall within this corridor area. Apart from this, people of Alattil village are also dependent on the corridor. Road traffic along Kottiyur-Palchuram-

Mananthavady Road is the major problem preventing movement of animals in this corridor in addition to narrow bottleneck at CRP Kunnu (with steep cuttings on one side and on the other with electric fencing in the private land). The width of the corridor is varying from less than 5 m. (in CRP Kunnu top) to 500 m.

Fig. 3: Kottiyur-Periya corridor in Wayanad North Forest Division

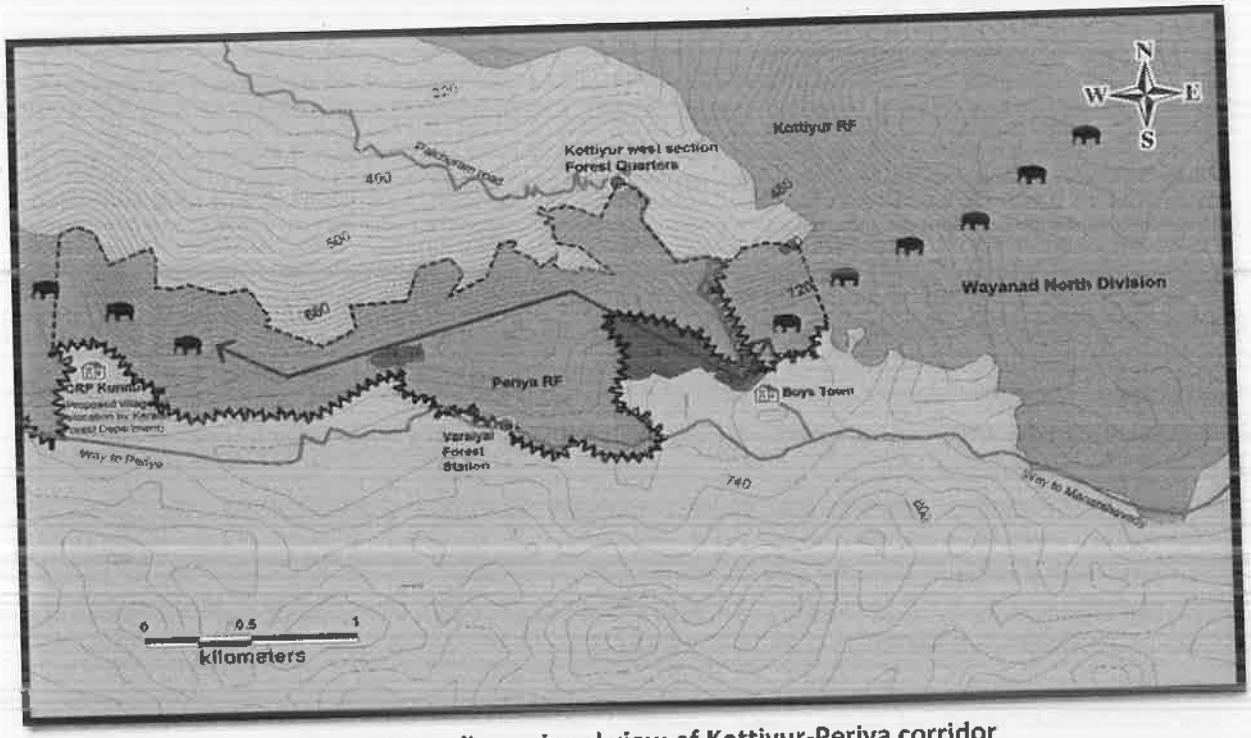


Fig. 4: Three-dimensional view of Kottiyur-Periya corridor

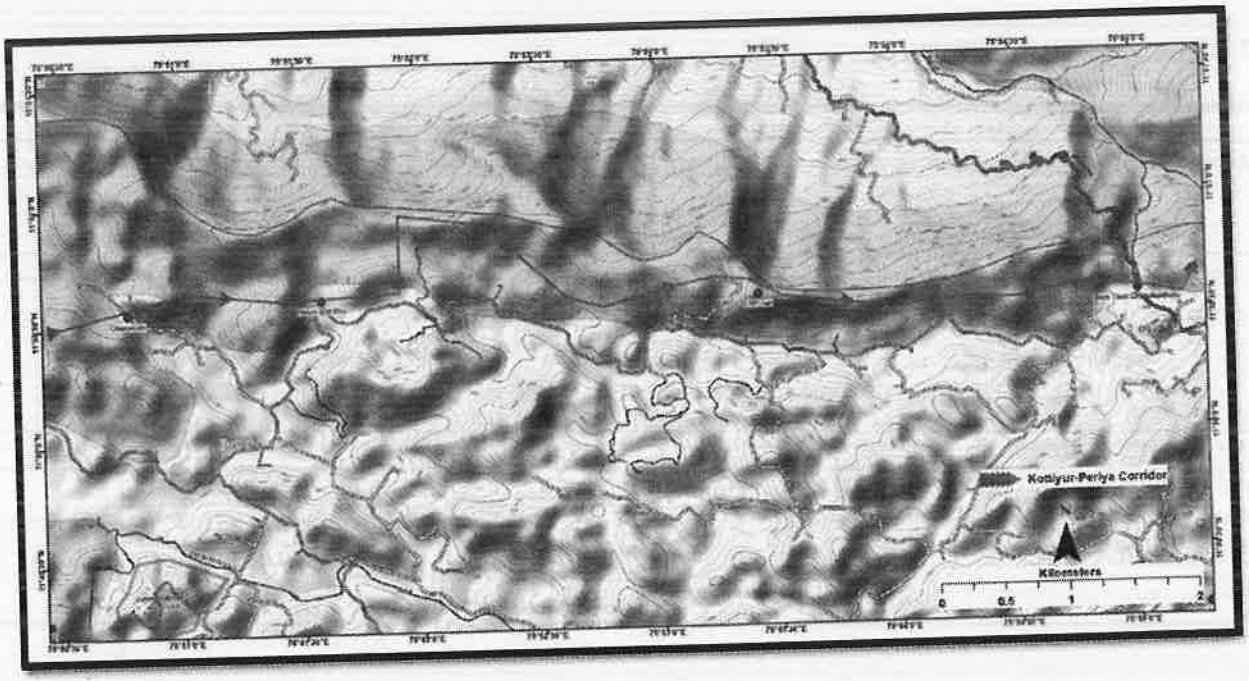
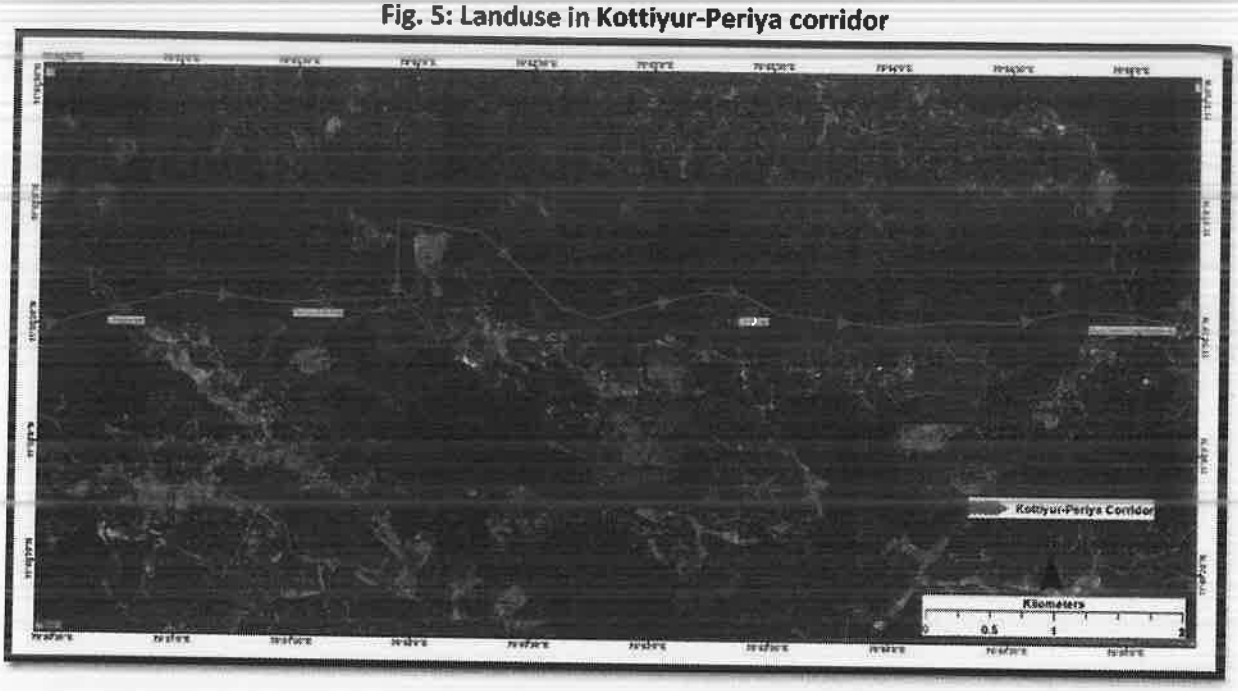


Fig. 5: Landuse in Kottiyur-Periya corridor



The extent of areas in the corridor is as follows: CRP kunnu – 6.856 ha. (with 47 houses); 37 mile – 12.180 ha. (with 73 houses); Chapparam – 8.055 ha. (with 22 houses); Rajagiri estate – 28.33 ha.; Kurisummootil – 5.462 ha. and extent in Kannur FD - 5.43 ha. Hence a total of 66.3059 ha. needs to be secured.

Common crops such as tea, arecanut, plantain, coffee, pepper are found to be chiefly cultivated in the corridor. Grazing, fuelwood collection, exist in the natural forests from the neighbouring human settlement.

The areas such as CRP Kunnu, 37th mile and Chappaaram are power fenced so no elephant is presently crossing the corridor. Solar power fencing in CRP Kunnu (2.5 kms), 37 mile (4.6 kms) and Chapparam (3.0 kms) prevent movement of animals through this corridor. In addition to the above 9.2 km of solar power fencing have been erected between the above areas. North east side – Kottiyur forest – having very steep slopes act as natural geographical barrier. During out visit to field, no animal could be seen or indirect evidence was found. Hence presently the movement of animals is totally prevented.

Cover, water and forage exist in the corridor. In CRP thodu, water availability is upto February. 37th mile stream is perennial. In chapparam, the rivulets are perennial.

Land owners in areas *viz.*, CRP Kunnu, 37th mile and Chappaaram are willing for acquisition. Local forest personnel informed that the remaining area land owners are also willing for acquisition.

Connecting this corridor will ensure free movement of elephants from Chapparam to Thirunelli via 37th mile, CRP Kunnu, Pappananthodu, Boys Town, Chekuthanthodu, 42nd and 43rd mile, Thalappuzha forest area and Thrissleri.

The details of the corridor are given in the following table.

Name of the corridor	Kottiyur – Periya (connects Kottiyur RF of Kannur Forest Division with Periya RF of Wayanad North Forest Division)
Forest Division(s) where the corridor exists	Kannur Forest Division and Wayanad North Forest Division
Forest Range(s) and Forest Section(s)/Station(s)	Varayal Station of Periya Range (exist in five bits *viz.*, 1. CRP kunnu 2. 37 mile 3. Chapparam (upto this point the linear distance is about 2 kms.) 4. Rajagiri estate 5. Kurisummootil
	And one bit exists in Kottiyur Village in Kannur District (in Kannur Forest Division) with an extent of 5.43 ha. belonging to 11 individuals need to be procured. Of the total area of 35.0149 ha. in Kannur District, 29.592 in this region has already been acquired.
Name of Reserved Forests	All bits are mostly surrounded by vested forest.
Dimension of the corridor (length and width)	Among the above, the corridor is highly narrow in the following bits; CRP kunnu - 300 m. x 300 m. 37 mile – 700 m. x 300 m. Chapparam – 1200 m. x 200 m. The average width the remaining bits are 500 meters.
Land use in Reserved Forests with extent of each use with	The vested forests in the surroundings of the corridor is ranging from moist deciduous to semi-evergreen in nature.

type of forests/plantations	
	WTI reported 15 species of trees; 36% shrubs; 33% herbs; 31% grass
Private area/estate/village – extent and number of families, population, etc.	CRP kunnu – 6.856 ha. With 47 houses
	37 mile – 12.180 ha. With 73 houses
	Chapparam – 8.055 ha. With 22 houses
	Rajagiri estate – 28.33 ha.
	Kurisummootil – 5.462 ha.
	Extent in Kannur FD - 5.43 ha
	Boys town village with 12 families (reported by WTI)
Land use in private area/ estate/ village – extent of each use.	Crops such as tea, arecanut, plantain, coffee, pepper are found to be chiefly cultivated in all areas.
Biotic pressure	Grazing, fuelwood collection, exist in the natural forests from the neighbouring human settlement
Development/infrastructure/linear intrusions	A coupe road exists in CRP Kunnu
	37th mile plantation road
	WTI reported as follows:
	Plachuram road between Boys Town and Kottiyur, with steep cuttings prevent movement of animals.
	Mananthavady-Kannur state highway also prevent movement of animals
Willingness for acquisition of estates/ villages	Land owners in all three bits viz., CRP Kunnu, 37th mile and Chappaaram are willing for acquisition.
	Local forest personnel informed that the remaining area land

	owners are also willing for acquisition.
Utilization/movement of animals in the corridor	
• Opinion/view of forest personnel and local community	The areas such as CRP Kunnu, 37th mile and Chappaaram are power fenced so no elephant is presently crossing the corridor.
• Field observation by the investigators	No animal could be seen.
Basic requirements of animals such as availability of cover, water and forage in the corridor	Cover, water and forage exist in the corridor. In CRP thodu, water availability is upto February. 37th mile stream is perennial. Bit 3, the rivulets are perennial.
Land use in adjoining areas of corridor (on either side)	CRP Kunnu - On the north and east Kottiyur vested forest; south and west side vested forest in Periya Range
	37 mile – All side Periya vested forest
	Chapparam – Northern side Kottiyur vested forest and other three sides vested forests of Periya Range
Wildlife damage in the adjoining area of corridor	CRP Kunnu – 2.5 km solar power fencing 37 mile – 4.6 km solar power fencing Chapparam – 3.0 km solar power fencing
	In addition to the above 9.2 km of solar power fencing have been erected between the three bits.
Natural features of the corridor (geographical and other issues)	North east side – Kottiyur forest – having very steep slopes act as natural geographical barrier

This corridor connectivity along with Pakranthalam corridor would ensure free movement of animals between Wayanad South Forest Division on the south and Wayanad Wildlife Sanctuary on the north and further to Nagarhole and Bandipur Tiger Reserves (Figures 6 and 7).

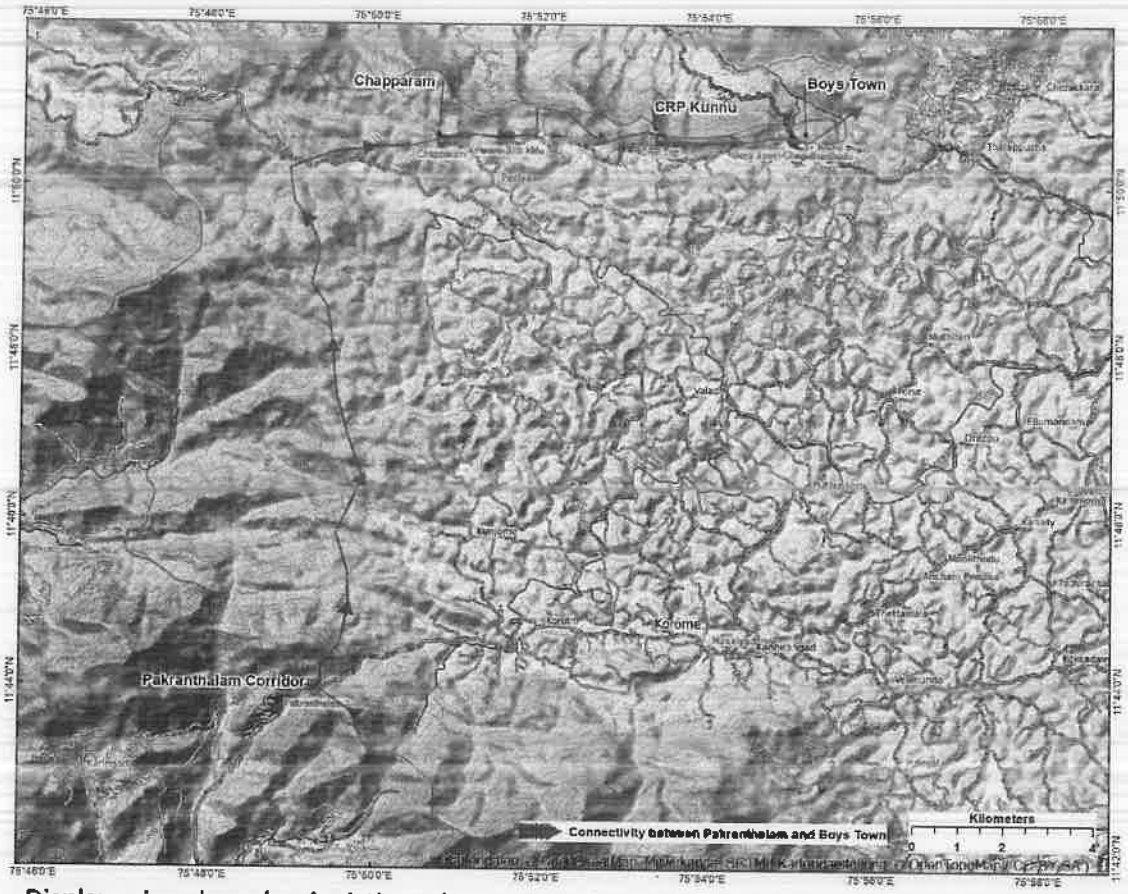
Recommendations

1. The entire private land (with an extent of 66.3059 ha. in Wayanad and Kannur Districts) in the corridor area should immediately be acquired and notified as Reserve Forest under Kerala Forest Act, 1961.
2. The corridor area needs to be declared as Conservation Reserve (under Section 36-A of Wildlife Protection Act, 1972) as recommended by Ramesh et.al. (2003) which states that the area between Periya and Ladysmith (with an extent of 273.71 km^2) as Conservation Reserve. The stakeholders like departments such as road, transport, etc are to be included in the management committee for Conservation Reserve.
3. The corridor area and its surroundings to be notified as eco-sensitive zone under Environment Protection Act, 1986 as decided by the Indian Board for Wildlife held during 2002 (Sharma, 2002).
4. The existing system of erecting physical barrier like solar power fencing should be placed judiciously so as to ensure free movement of animals and access to water sources.
5. Exploring the feasibility elephant crossing by providing appropriate gradient in strategic locations to ease the movement of elephants.
6. A convoy system needs to be implemented along the road between Mananthavady and Kottiyur via Palchuram (Mananthavady-Kannur State Highway) to control the night traffic so as to facilitate free movement of animals at least during night hours.
7. Speed breakers need to be installed in strategic locations along the roads passing through the corridor.
8. Implement night road patrol system to regulate the traffic and protection along the roads passing through the corridor.

Fig.6: Connectivity through Pakranthalam and Periya-Kottiyur

Corridors

Fig.7: Connectivity through Pakranthalam and Periya-Kottiyur Corridors



1. Display sign boards depicting the contact number of forest personnel for sharing the information regarding elephant or any wild animal on the road side in the corridor region to notify the forest officer for reaching the site to control the traffic and facilitate the movement of the animal(s).
2. The maintenance or upgrading of the roads that are passing through forest area especially in corridor region should be done in consonance with wildlife movement and involvement of forest officials concerned so as to avoid physical barriers.
3. Details of wildlife corridors as well as prescriptions and management strategies (including habitat management) for the effective management this corridor need to be incorporated in the Working Plans of Wayanad North and Kannur Forest Divisions and Kottiyur Management Plan.
4. Sensitization of frontline staff, managers including Working Plan Officers and Wildlife Managers and stakeholders on importance of wildlife corridors and landscape management.
5. Surveillance cameras may be placed at strategic locations of animal crossing on the roads in the corridor region.

3. Nilambur - Appankappu Corridor

This Nilambur-Appankappu corridor, located in Pothukkal Station of Vazhikkadavu Range, connects the Nilambur and Vazhikadavu Ranges of Nilambur North Forest Division. Elephants move through a bottleneck forest patch between Appankappu Rubber Estate and Munderi village in Nilambur North Forest Division. Estates in Pothukal Village (Block 102, Resurvey 87), with an extent of 22.8563 ha. (belonging to 6 persons as detailed in the following table) being cultivated with chiefly rubber, prevent the free movement of elephants between the areas.

#	Name of owner	Extent (acre)
1	Sajan, M.K.	2.5667
2	Abdul Salam	0.688
3	Baby	1.261
4	Jins	6.637
5	Paulose	11.4325
6	Jose Mathew	0.2711
	Total	**22.8563**

The Nilambur-Silent Valley-Coimbatore elephant population is connected to the Nilgiris in Tamilnadu through the high-altitude mountainous portions of Silent Valley National Park of Kerala and Mukurthi National Park of Tamilnadu State. It is also distributed within the forests of Nilambur South and North Divisions, Mannarkad Division and Silent Valley National Park in Kerala. There are a few constrictions through which the elephants move either throughout the year or in certain seasons (Figures 8 and 9).

The dimension of the corridor is about 400 m. wide and 500 m. in length. The surrounding forests of this corridor is tropical deciduous and thorn forests and people from neighbouring human settlement depend on these forests for NWFP collection.

Fig. 8: Nilambur-Appankappu corridor in Nilambur North Forest Division

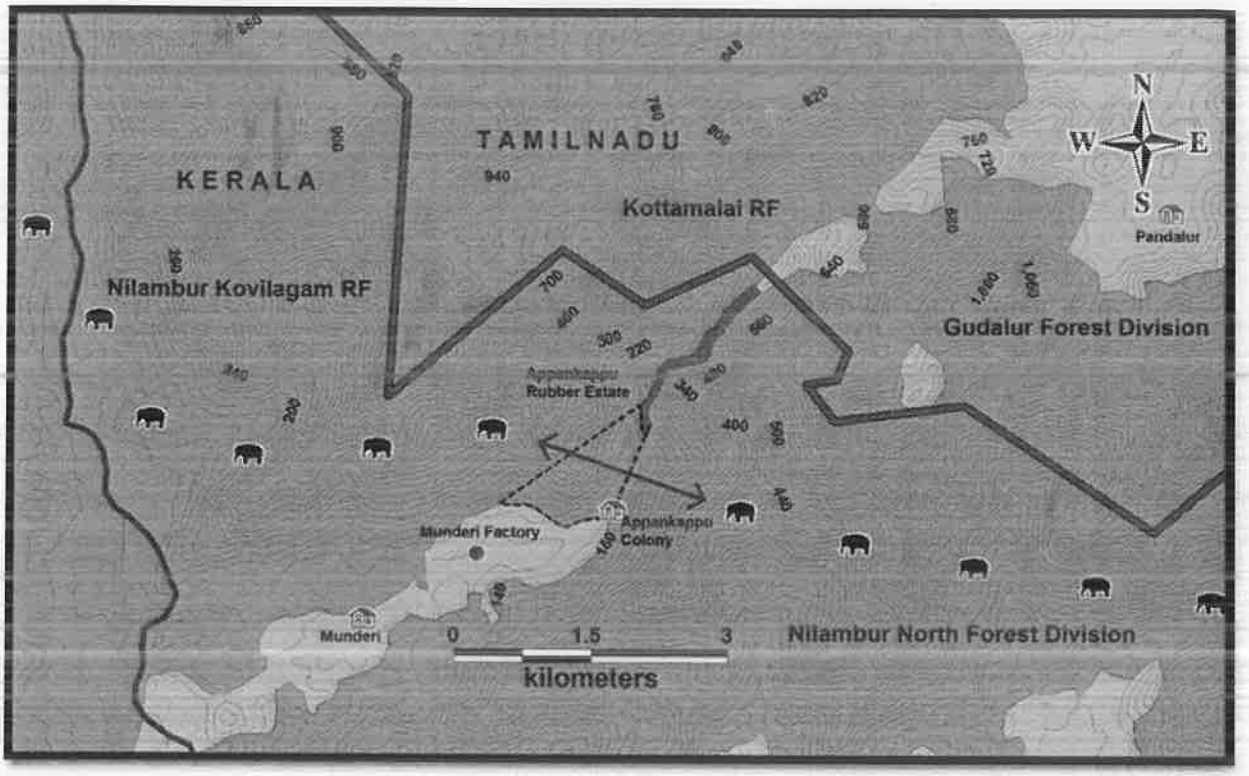
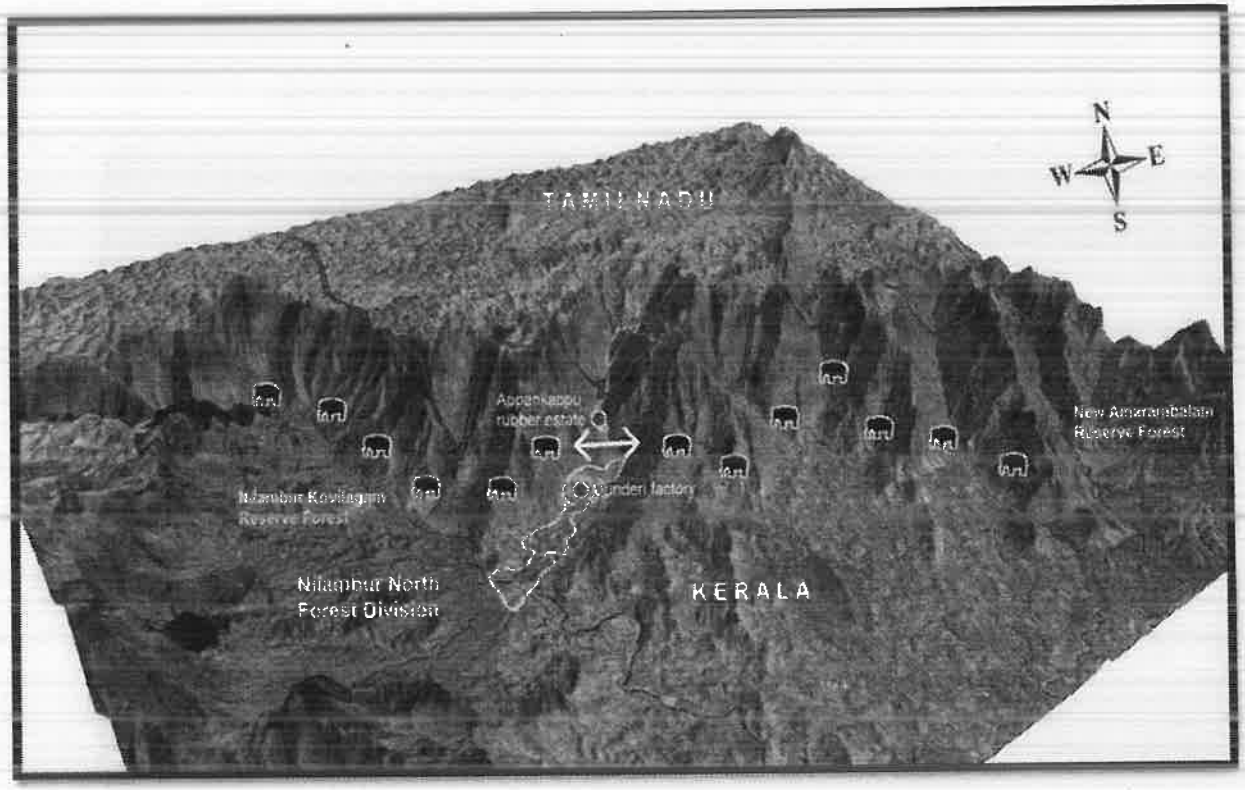


Fig. 9: Three-dimensional view of Nilambur-Appankappu corridor


N
W
E
S
TAMILNADU
Appankappu
rubber estate
Nilambur Kovilagam
Reserve Forest
Nilambur North
Forest Division
KERALA
New Amarambalam
Reserve Forest

Presently animal found to use this corridor as sufficient cover, water and forage exist therein. A rivulet namely Nirpuzha exist in the corridor region.

The details of the corridor are given in the following table.

Name of the corridor	Nilambur - Appankappu (connects Vazhikkadavu Range with Nilambur Range)
Forest Division(s) where the corridor exists	Nilambur North Forest Division Nilambur South Forest Division
Forest Range(s) and Forest Section(s)/Station(s)	Pothukkal Station of Vazhikkadavu Range
Name of Reserved Forests	Vested forest
Dimension of the corridor (length and width)	400 m. x 500 m. (as per WTI report)
Land use in Reserved Forests with extent of each use with type of forests/plantations	Tropical deciduous and thorn forest (as described in WTI report)
Private area/estate/village – extent and number of families, population, etc.	Six private estates exist in this corridor with an extent of 22.8563 ha. The details are as follows:

#	Name of owner	Extent (acre)
1	Sajan, M.K.	2.5667
2	Abdul Salam	0.688
3	Baby	1.261
4	Jins	6.637
5	Paulose	11.4325
6	Jose Mathew	0.2711
	Total	**22.8563**

KFD is proceeding with acquisition of this land.

Land use in private area/ estate/ village – extent of each use.	Chiefly rubber
Biotic pressure	NWFP collection exist in the natural forests from the neighbouring human settlement
Development/infrastructure/linear intrusions	
Willingness for acquisition of estates/ villages	
Utilization/movement of animals in the corridor • Opinion/view of forest personnel and local community • Field observation by the investigators	All animals use corridor regularly
Basic requirements of animals such as availability of cover, water and forage in the corridor	Cover, water and forage exist in the corridor. A river namely Nirpuzha exist in the corridor
Land use in adjoining areas of corridor (on either side)	Forest areas of Pothukkal Forest Station
Wildlife damage in the adjoining area of corridor	Exist in Mundari farm
Natural features of the corridor (geographical and other issues)	

Establishing this corridor would ensure free movement of animals between the Nilambur South and Nilambur North Forest Divisions and further to forests of Tamil Nadu.

Recommendations

1. Six private estates existing in this corridor with an extent of 22.8563 ha. should be acquired and notified as Reserve Forest under Kerala Forest Act, 1961.
2. Details of wildlife corridors as well as prescriptions and management strategies (including habitat management) for the effective management this corridor need to be incorporated in the Working Plans of Nilambur North Forest Divisions.
3. Sensitization of frontline staff, managers including Working Plan Officers and stakeholders on importance of wildlife corridors and landscape management.

4. Begur-Brahmagiri Corridor

This corridor connects Nagerhole Tiger Reserve through Begur Reserve Forest of Tholpetty Range of Wayanad Wildlife Sanctuary, Kerala with Thirunelli Reserve Forests of Begur Range of Wayanad North Forest Division and Brahmagiri Reserve Forest in the Srimangala Range of Brahmagiri Wildlife Sanctuary of Karnataka State (Fig. 10).

The corridor is located on the interstate boundary of Karnataka and Kerala. Elephants from Brahmagiri Wildlife Sanctuary, Karnataka move to Nagarhole Tiger Reserve, Karnataka through the private coffee estates between Tholpetty village and Kutta town. This corridor between Brahmagiri and Wayanad Wildlife Sanctuaries is in addition to the Thirunelli - Kudrakote corridor, which has already been secured. Once secured, this corridor would connect Brahmagiri Wildlife Sanctuary and Nagarhole Tiger Reserve of Karnataka State with Wayanad Wildlife Sanctuary of Kerala, thereby ensuring smooth passage for the elephants in the area. The length of the identified corridor is 1 km. and its width is 0.8 km. The area to be acquired mainly include private enclosures, and the major land-use of the area are coffee plantations and human habitations. The area is having Huvinakadu and Faith coffee estates on Karnataka side and Narikkal and Bargiri Estates on the Kerala side. For securing this corridor, two estates viz. Narikkal estate and Bargiri estates are to be acquired and notified. The details are as follows.

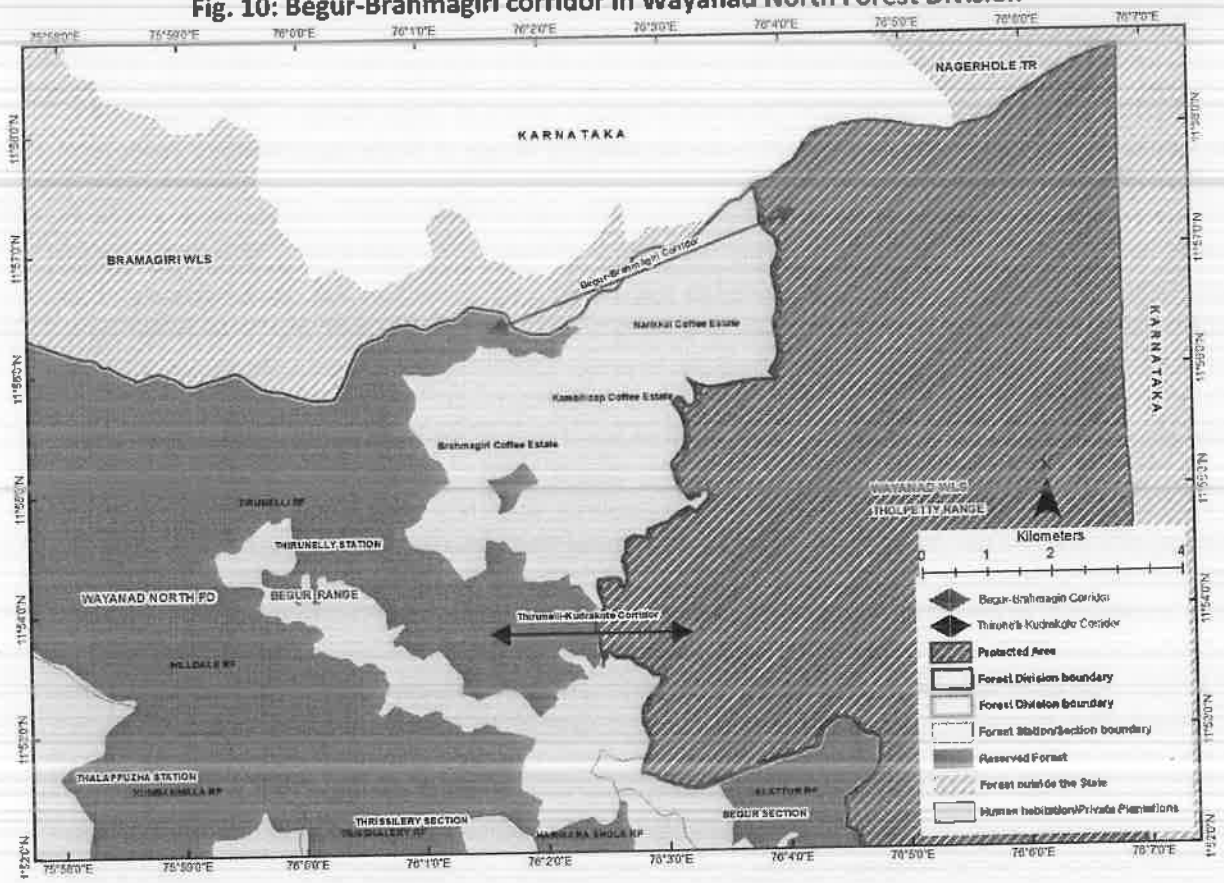
Narikkal Estate: The total area of this estate is 83.8569 Ha. The estate is owned by Pee Vee Plantations Private Limited. The estate is having coffee, pepper and orange as major crops apart from mango, jackfruit and silver oak trees.

Bargiri Estate: The total area of this estate is 163.9209 Ha. existing in three bits. The estate is owned by 5 owners. The estate is predominantly having coffee, pepper and orange apart from silver oak trees, other softwood trees, Venteak, Chadachi etc. The details of the estates to be secured on Kerala side is as follows:

Sl. No.	Name of Estate		Area in Ha
1	Narikkal Estate		83.8569
2	Bargiri Estate – 3 Bits		
	a	Bit 1	85.2987
	b	Bit 2	39.3111
	c	Bit 3	39.3111
	Bargiri Estate - Total		163.9209
		TOTAL	**247.7778**

The road between Mananthavady and Kutta via Tholpetty Range of Wayanad WLS has heavy traffic during day time.

Fig. 10: Begur-Brahmagiri corridor in Wayanad North Forest Division



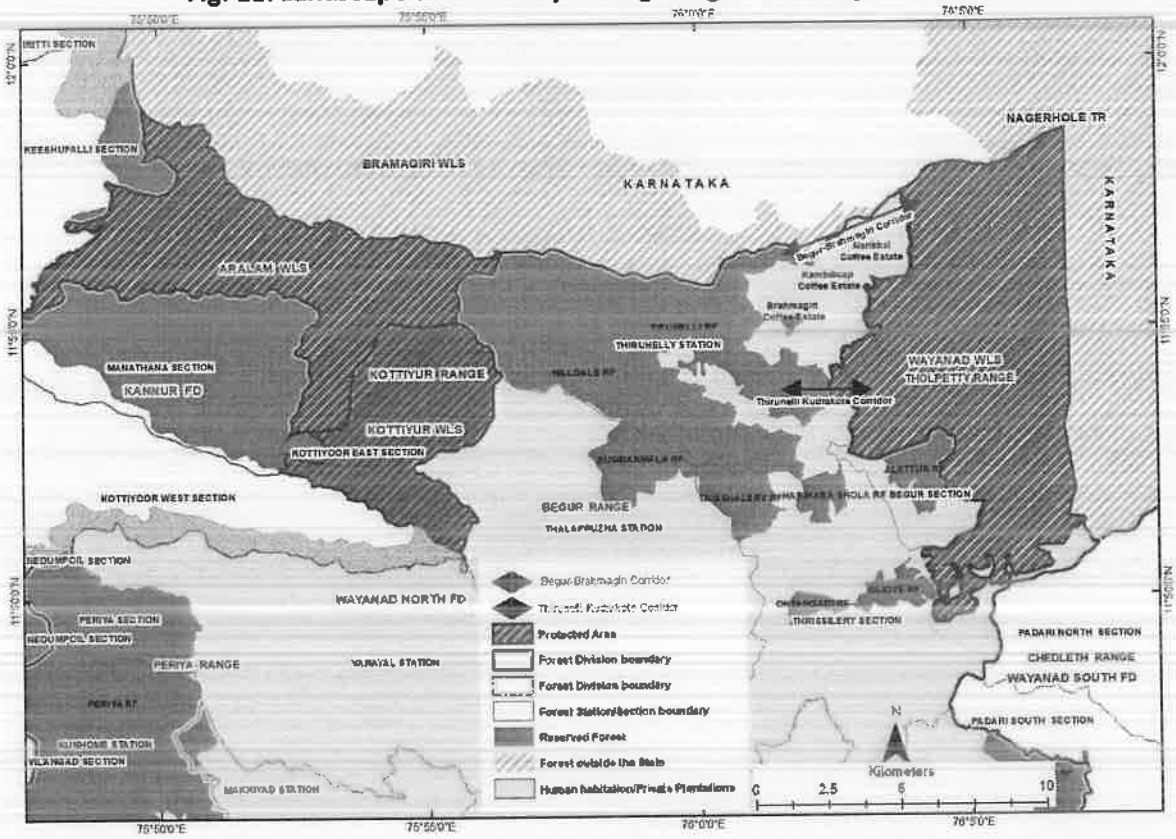
The details of the corridor are given in the following table.

Name of the corridor	Begur - Brahmagiri (connects Begur – Tholpetty - Brahmagiri)
Forest Division(s) where the corridor exists	Wayanad Wildlife, Wayanad North Forest Division
Forest Range(s) and Forest Section(s)/Station(s)	Outside forest
Name of Reserved Forests	Outside forest
Dimension of the corridor (length and width)	1000 m. x 800 m.
Land use in Reserved Forests with extent of each use with type of forests/plantations	Outside forest
Private area/estate/village – extent and number of families, population, etc.	Three private estates exist in Kerala side 1. Narikkal estate – 90.62 ha 2. Bargiri estate – 163.92 ha. 3. Brahmagiri estate (ABC) – 132.12 ha.

	Two estates located in Karnataka side 1. Huvinakadu 2. Faith Coffee
Land use in private area/ estate/ village – extent of each use.	Chiefly coffee with pepper, orange
Biotic pressure	Outside forest
Development/infrastructure/linear intrusions	Tholpetty-Appapara-Narikkal Road – 7 km. Narikkal-Tholpetty road – 2 km.
Willingness for acquisition of estates/ villages	-
Utilization/movement of animals in the corridor	
• Opinion/view of forest personnel and local community	
• Field observation by the investigators	All animals use the estate area and found more in March-April
	-
Basic requirements of animals such as availability of cover, water and forage in the corridor	Cover, water and forage available within the estates. 5 ponds, mango, jack trees exist in the estates
Land use in adjoining areas of corridor (on either side)	North – Interstate boundary East and south – Tholpetty Range West – Thirunelli FS of Wayanad North Forest Division
Wildlife damage in the adjoining area of corridor	Reported
Natural features of the corridor (geographical and other issues)	-

This corridor connectivity along with Thirunelli - Kudrakote corridor would ensure free movement of animals between Nagerhole Tiger Reserve and Aralam WLS through Wayanad WLS (Fig. 11).

Fig. 11: Landscape connectivity through Begur-Brahmagiri corridor



In addition, vide D.O. No. 6-2/2002/WL-I dated 5th February, 2002 of MoEF, GoI (Sharma, 2002) has communicated the decision of Indian Board for Wildlife held under the Chairmanship of Hon'ble Prime Minister of India on 21st January, 2002 as 'to notify the areas within 10 kms of the boundaries of national parks and sanctuaries and the wildlife corridors as eco-sensitive areas'. However, in due course of time, no action is taken to notify areas in the surroundings of wildlife corridors as eco-sensitive zone.

Recommendations

1. The two estates namely Narikkal and Bargiri with an extent of 247.7778 ha. in the corridor area should be acquired and notified as Reserve Forest under Kerala Forest Act, 1961. Since Thirunelli-Kudirakkode Corridor is already secured acquisition of this corridor can be taken up depending upon the financial resources.
2. After acquisition, an eco-restoration plan may be prepared and implemented to improve the habitat parameters.
3. The KFD should initiate mainstreaming co-existence and conservation activities in Brahmagiri estate with an extent of 132.12 ha. located adjoining to Bargiri estate in Kerala.
4. The Kerala Forest Department may take up with the Karnataka Forest Department for exploring the feasibility of acquisition of the two estates namely Huvinakadu and Faith coffee estates on Karnataka side.

5. The corridor area and its surroundings to be notified as eco-sensitive zone under Environment Protection Act, 1986 as decided by the Indian Board for Wildlife held during 2002 (Sharma, 2002).
6. The existing system of erecting physical barrier like solar power fencing should be placed judiciously so as to ensure free movement of animals and access to water sources.
7. A convoy system needs to be implemented along the road between Mananthavady and Kutta to control the night traffic so as to facilitate free movement of animals at least during night hours.
8. The maintenance or upgrading of the roads that are passing through forest area especially in corridor region should be done in consonance with wildlife movement and involvement of forest officials concerned so as to avoid physical barriers.
9. Speed breakers need to be installed in strategic locations along the roads passing through the corridor.
10. Implement night road patrol system to regulate the traffic and protection along the roads passing through the corridor.
11. Display sign boards depicting the contact number of forest personnel for sharing the information regarding elephant or any wild animal on the road side in the corridor region to notify the forest officer for reaching the site to control the traffic and facilitate the movement of the animal(s).
12. Details of wildlife corridors as well as prescriptions and management strategies (including habitat management) for the effective management this corridor need to be incorporated in the Working Plans of Wayanad North Forest Division and Wayanad Wildlife Sanctuary.
13. Sensitization of frontline staff, managers including Working Plan Officers and Wildlife Managers and stakeholders on importance of wildlife corridors and landscape management.
14. Involvement of stakeholders including line departments (in this case, Road Authorities, State Transport Corporation, etc) and estate owners, local dependent communities in planning and management of corridor.
15. Surveillance cameras may be placed at strategic locations of animal crossing on the roads in the corridor region.

Output 2: Review of Kerala Forest Department's existing landscape polices for effective management of corridors

a. Securing Corridors

The Kerala Forest and Wildlife Department (KFD) has already entirely secured two corridors *viz.*, Thirunelli - Kudrakote (State Corridor), and Nilambur Kovilakam- New Amarambalam (State Corridor) and partly one corridor (Kottiyur-Periya Corridor connecting Periya RF of Wayanad North Forest Division and Kottiyur RF of Kannur Forest Division).

(i) **Thirunelli - Kudrakote (State Corridor):**This corridor connects Wayanad WLS and Wayanad North Forest Division and continuity of forest goes upto Brahmagiri in Karnataka. The acquisition of 18 acres of land in this corridor was already completed by Wildlife Trust of India (WTI).

Sl. No.	Government Notification	Section of relevant Act under which notified	Name of Area notified	Extent notified (acre)

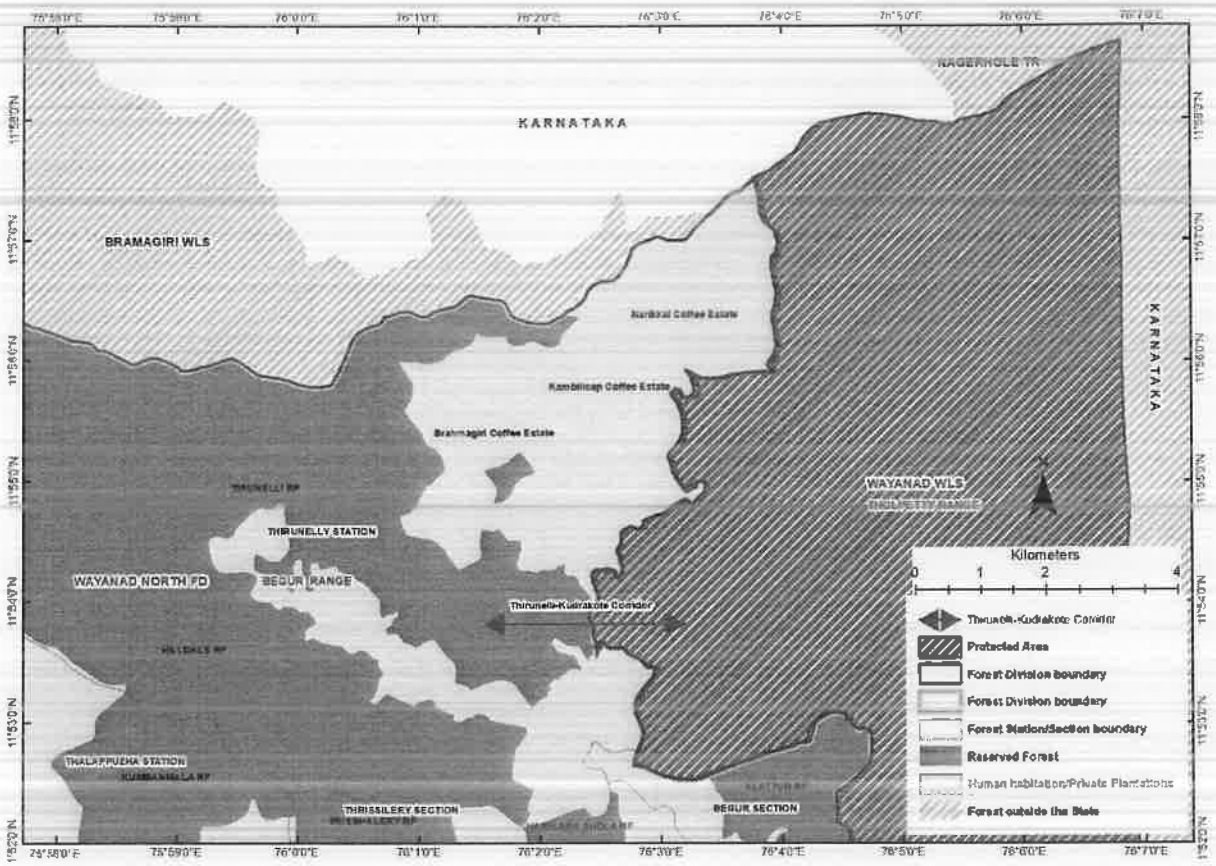
1	G.O.(P) No. 56/2015/F&WLD dated 5th August 2015 (S.R.O No. 507/2015)	Section 18 (1) of W(P)A, 1972 – Declaration of Sanctuary	Thirulakkunnu Addition Bit I – Plot A and Plot B	3.53
2	G.O.(P) No. 57/2015/F&WLD dated 5th August 2015 (S.R.O No. 508/2015)	Section 18 (1) of W(P)A, 1972 – Declaration of Sanctuary	Valiya Emmadi Bit 2	6.10
3	G.O.(P) No. 58/2015/F&WLD dated 5th August 2015 (S.R.O No. 509/2015)	36(2) of KFA, 1961 – Protection of forests at request of owners	Kottappady	8.37
		Total		**18.00**

An extent of 8.37 acres of land is notified under Section 36(2) – 'Protection of forests at request of owners' of Kerala Forest Act, 1961 vide Government Order mentioned in the above table. This should have been notified under Section 4 – of Kerala Forest Act, 1961 as Section 3 – 'Power to reserve forests' of Kerala Forest Act, 1961 clearly states that the Government may constitute any land at the disposal of Government a Reserve Forest. In this case, the WTI has placed the land after procurement at the disposal of Government and requested to notify as a Reserve Forest. This is also mentioned in the explanatory note of the above-said notification.

With the acquisition by WTI and notification by the Government of Kerala, the elephant and other animals have free passage between Wayanad WLS and Wayanad North Forest Division. The landscape map of this corridor is given in Fig. 12.

(ii) **Nilambur Kovilakam- New Amarambalam (State Corridor):** This corridor connects Nilambur North and Nilambur South Forest Divisions in Kerala and further extends to forest areas in Tamil Nadu. The Divisional Forest Officer has done a highly commendable work in securing the corridor for facilitating the movement of elephants and other animals. Approximately, 11 km length of Nilambur-Gudalur road was acting as barrier since both sides had very steep cuts. During renovation and maintenance works inlcuding construction of drainages and retaining walls on either side of the road, the Divisional Forest officer joined hands with the Road Department and requested them for construction of ramps along the road at strategical locations to facilitate the movement of elephants and other animals. The Road Department agreed and constructed 10 ramps on the left side and 11 ramps on right side of Nilambur-Gudalur road. Including these, now there are 33 such locations where elephants can cross the road.

Fig. 12: Landscape connectivity through Thirunelli-Kudrakote corridor



Though the plantations owned by Plantation Corporation of Kerala (PCK) and other private owners were identified as barrier due to solar power fence, the Divisional Forest Officer informed that at present there is no solar power fence in the said location hence these plantations don't act as barrier for the movement of elephants and other wild animals.

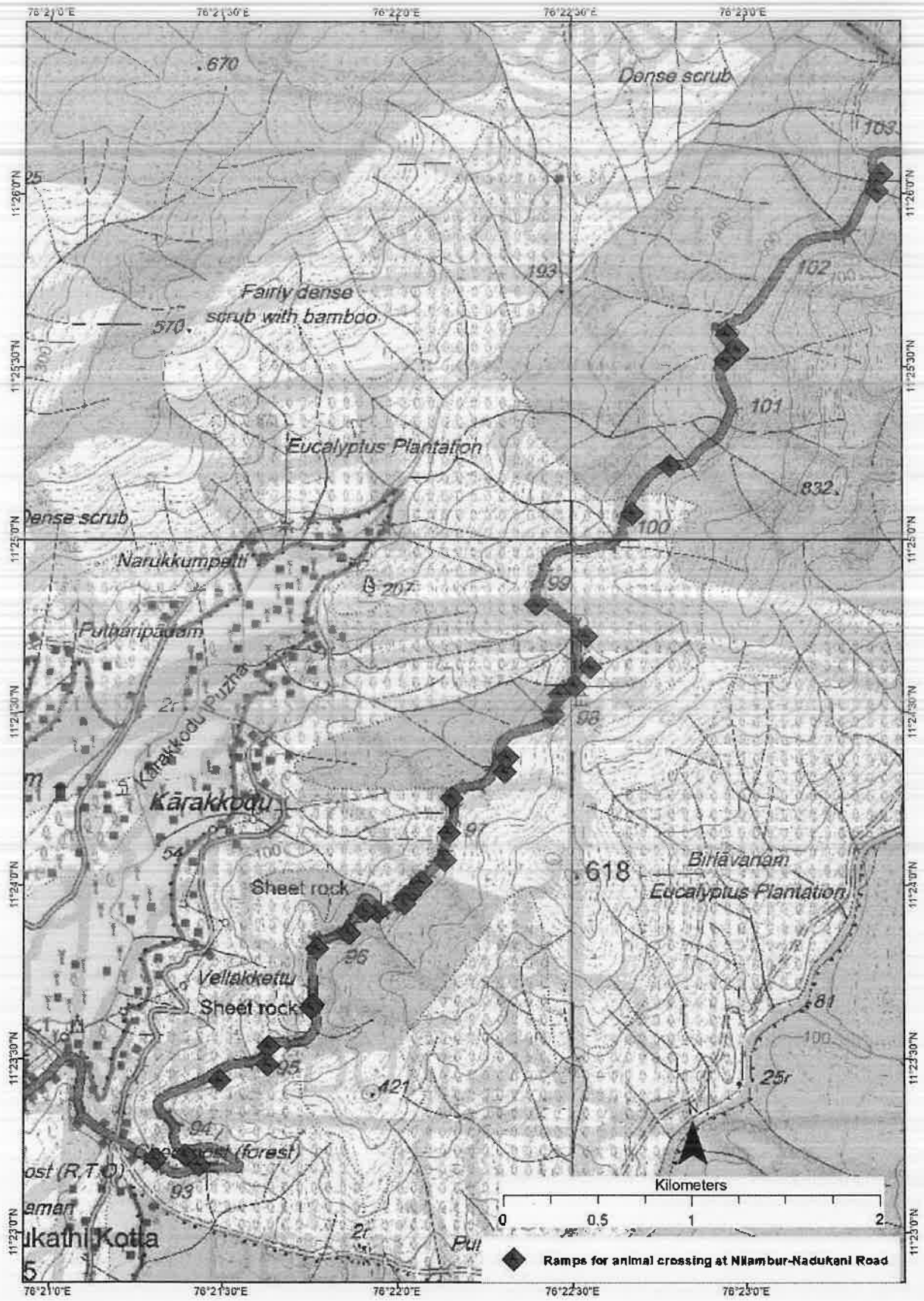
The DFO, also informed that they are planning to introduce 'convoy system' to control the movement of traffic and facilitate the free movement of animals in odd hours.

The DFO has already placed survellience cameras in strategic locations to monitor the movement of elephants along the road between Vazhaikkadavu-Nadukani (Nilambur-Gudalur Highway).

The actions initiated by the KFD, the elephants and other animals have free passage between Nilambur North and Nilambur South Forest Divisions which further extend towards Tamil Nadu.

The landscape map of this region is given in Fig. 13.

Fig. 13: Landscape connectivity through Nilambur-Nadukani corridor


Dense scrub
Fairly dense
scrub with bamboo
Eucalyptus Plantation
Narukkumpetti
Puthanipadam
Karakkodu (Puzha
Karakkodu
Sheet rock
Vellakkettu
Sheet rock
Birlavanam
Eucalyptus Plantation
618
832
421
Kilometers
0
0.5
1
2
Ramps for animal crossing at Nilambur-Nadukani Road

(iii) **Securing part of Kottiyur-Periya Corridor:** The KDF identified 36.5 ha. land in Kottiyur Village in Kannur District and 95 ha. land in Periya Village in Wayanad District in 2007 for acquisition. The KFD could acquire only 29.592 ha. area in 2012.

The details of land still to be acquired for securing this corridor is as follows:

Location	Area proposed for acquisition (Ha)	Area already acquired (Ha)	Area to be acquired (Ha)
Kottiyoor area	35.0149	29.592	5.4229
(Kannur District)			
Periya area	60.883		60.883
(Wayanad District)			
Total	**95.8979**		**66.3059**

The acquisition proceedings for the areas identified could not completed due to insufficient financial resources.

Recommendations

(i) Notify an extent of 8.37 acres of land (secured in Thirunelli - Kudrakote -State Corridor) under Section 4 of Kerala Forest Act, 1961 as Reserve Forest.

(ii) The acquired vayals falling in the jurisdiction of Divisional Forest Officer, Wayanad North Forest Division (secured in Thirunelli - Kudrakote - State Corridor) should be maintained to facilitate the wildlife use and maintain a Vayal Journal for all vayals acquired.

(iii) A convoy system needs to be implemented at the earliest along the road between Nilambur and Nadukani (in Nilambur Kovilakam- New Amarambalam - State Corridor) to control the night traffic so as to facilitate free movement of animals at least during night hours.

(iv) Mainstreaming conservation activities in PCK and other private plantations in Nilambur Kovilakam- New Amarambalam - State Corridor by involving stakeholders.

b. Review of legal provisions related to landscape management

The **Wildlife (Protection) Amendment Act, 2006 (Act 39 of 2006)** has inserted a new chapter IV-B – National Tiger Conservation Authority (NTCA).

The Section 38-O(1)(g) stipulate to 'ensure that the Tiger Reserves and areas linking one Protected Area (PA) or Tiger Reserve (TR) or with another PA or another TR are not diverted for ecologically unsustainable uses, except in Public interest and with the prior approval of National Board for Wild Life and on the advice of NTCA.

The Section 38 V (3)(b) stipulates 'ecologically compatible land uses in TRs and areas linking one PA or TR with another for addressing the livelihood concerns of local people, so as to provide dispersal

habitats and corridor for spill over population of wild an9mals from the designated core areas of the TRs or Tiger Breeding habitats within other PAs.

The Section V (3)(c) stipulates that the 'forestry operations of Regular Forest Divisions and those adjoining TRs are not incompatible with the needs of Tiger conservation.

To implement the provisions of above stated Sections, NTCA has issued guidelines as **Technical Document (NTCA/01/07)** for the preparation of Tiger Conservation Plan for Core, Buffer and Indicative Plan for adjoining areas providing connectivity/corridor for ensuring gene flow and long-term survival of the species. Accordingly, the KFD prepared Tiger Conservation Plans for Parambikulam and Periyar Tiger Reserves for a period from 2011-12 to 2020-21.

Similarly, in the **Wildlife (Protection) Amendment Act, 2003 (Act 16 of 2003)**, two new categories of PA were added to the Wildlife (Protection) Act *viz.*, Section 36-A – Declaration of management of a Conservation Reserve and Section 36-C – Declaration and management of Community Reserves. The purpose of adding these two categories were to 'protect the landscapes and seascapes, flora and fauna, and traditional and cultural conservation values'.

Recommendation

(i) Sensitization of frontline staff, managers in Territorial and Wildlife areas on the legal provisions of landscape management.
(ii) Incorporate legal provisions related to landscape management in the respective Working Plans and Management/Tiger Conservation Plans.
(iii) The Kerala Forest Department may take up with NTCA for providing ration and project allowance to the staff working in territorial divisions falling between Tiger Reserves and other Protected Areas.

c. Review of National Working Plan Code (2014)

The National Working Plan Code para 89 (vii) stipulates the following are mandatory;

- 'the areas of division adjacent to National Parks and WLS shall be managed in consonance with the objectives and management prescriptions of the management plan of the respective protected area'.

In addition, the Working Plan Code also stipulates as follows:

- Mandatory to describe the location of waterholes, suitable habitat for wild animals, measures needed to conserve and improve the same and anything specific and beneficial to wildlife in the division should also be included.
- Status of man-animal conflict, problem of poaching in the division, management of wildlife corridors.

On review of the Working Plan (2015-16 of 2024-25) for Wayanad North Forest Division, Kerala under the light of the above National Working Plan Code, it is found that

(i) The division is not managed on consonance with the objectives of Wayanad WLS which is adjoining to this forest division.

(ii) Although many corridors exist in this division, there is no mention about corridors and their management in the working plan.

(iii) Although check dams and ponds are prescribed, they were not found to be prescribed based on water resource mapping and seasonality.

Recommendation

(i) Ensure management of the territorial forest divisions in consonance with the objectives and management prescriptions of the management plans of adjacent to National Parks and WLSs.

(ii) Sensitization of frontline staff, managers in Territorial and Wildlife areas on the provisions in National Working Plan Code, 2014.

(iii) The Wildlife Circle in Working Plans should be written as provided in the para 89 (vii) of National Working Plan Code, 2014. It is mandatory to describe the location of waterholes, suitable habitat for wild animals, measures needed to conserve and improve the same and anything specific and beneficial to wildlife in the division should also be included. The status of man-animal conflict, problem of poaching in the division, management of wildlife corridors should also be incorporated.

d. Review of National Wildlife Action Plan (2017-31)

The chapter 2 of National Wildlife Action Plan (NWAP) deals with 'landscape-level approach for wildlife conservation' which states to 'identify and set boundaries of the key landscapes and describe land use, assess and evaluate status of all wildlife species and their habitats outside PAs but within landscape.

Recommendation

(i) The Kerala Forest Department may take actions to identify and set boundaries of the key landscapes and describe land use, assess and evaluate status of all wildlife species and their habitats outside PAs but within landscape.

e. Review of studies related to landscape management in Kerala

The review of studies relating to landscape management in Kerala are as follows:

(i) Ramesh *et. al.* (2003), in their study on 'Conservation Review for Rationalization of Protected Area Network in Kerala', proposed five areas *viz.*, (i) Athirapalli-Malayattoor (458.24 km^2), (ii) Attapadi (73.79 km^2), (iii) Attappadi-Chenat Nair (227.19 km^2), (iv) Konni (457.89 km^2) and (v) Periya-Ladysmith (273.71 km^2) as Conservation Reserves.

(ii) Ramesh *et. al.* (2005), in their study on 'Forest Landscape Analysis and Management Plan for Kerala' identified 19 landscapes based on three major criteria as follows:

a. A combination of climate, geology and topography
b. A combination of topography and soil

c. Potential extent of natural vegetation types

The study reveals that

f. The conservation importance of the landscape to meet the local global commitments are not effectively addressed in the existing management/working plans
g. The advancement occurred in knowledge and technology related to conservation and forestry is not reflected in the management of PAs and non-PAs.
h. The creation of PAs was carried out without much emphasize on species ecosystem viz., representation, ecological integrity and contiguity.
i. Biologically rich areas are inadequately represented in the PA system.
j. Although the realization of human as part of the forest management system is reflected in the latest national forest policies, their role and relevance are not reflected in the management/working plans.
k. The prescriptions envisaged in thee plan documents are also incompatible in milieu of ecosystem contiguity.
l. Heterogeneity in land cover, land use and the increasing anthropogenic pressures has made the management of forests a challenging task.

(iii) Johnsingh *et. al.* (2007) in their interim report on 'Habitat quality, connectivity and large mammal distribution in the Western Ghats' submitted to Government of India and a paper on 'Opportunities and challenges for tiger (Panthera tigris) conservation in the southern Western Ghats' in a Workshop on 'Biodiversity Concerns and Human Well Being: Towards Landscape Approach' held on 7th and 8th 2014 at Thiruvananthapuram, identify the following landscapes in the Western Ghats;

a. Sahyadri landscape
b. Nilgiri Biosphere Reserve landscape
c. Anamalai-Kodaikanal-Palani Hills landscape
d. Periyar-Srivilliputhu landscape
e. Agasthyamalai Hills landscape (which inlcudes Ariankavu Pass corridor)

(iv) A Workshop on 'Biodiversity Concerns and Human Well Being: Towards Landscape Approach' held on 7th and 8th 2014 at Thiruvananthapuram, Kerala as part of Biodiversity Conservation and Livelihood Improvement Project (BCRLIP) was conducted by Wildlife Institute of India in association with Government of Kerala and World Bank to sensitize the personnel of KFD. In the same workshop many papers relating the landscape management were presented and discussed. A paper on 'assessing connectivity for large mammals in the Periyar-Agasthyamalai landscape' brought out the quantitative baseline information for monitoring and evaluation of future conservation initiatives in Kerala.

With four notified Elephant Reserves and strict enforcement of Acts and Rules, Kerala has been taking several steps to ensure that the ecosystems of elephants are protected. It is inferred that fragmentation of forests is the major challenge as far as facilitating easy movement of wildlife is concerned.

(v) The Technical Workshop on Elephant Conservation in South Indian States, organized by MoEF, GoI (Anon, 2018), brought out many recommendations related to corridors, connectivity and landscape management for elephant conservation. The important and relevant recommendations in the document are as follows:

a. Management authority in each of the four elephant landscapes needs to be setup to ensure effective planning and management.
b. Establishment of corridors/ interventions in corridor areas should consider the conservation values of the areas. Consolidation/ establishment of connectivity in corridors wherever pending for long time may be expedited.
c. Appropriate legal protection to be made for protection of elephant corridors outside forest areas.
d. Forest Working Plans / Management Plans must be harmonized to integrate wildlife conservation concerns and particularly so in elephant bearing landscapes.
e. Habitat management activities / research must be adequately funded in all elephant bearing landscapes.
f. A comprehensive assessment of invasive in Elephant Ranges and continuous monitoring of habitats.
g. The provisions in various Acts, Policies, Commission Reports, etc which are targeted at ensuring protection and improvement of habitats of elephants and habitat connectivity should be implemented.

Recommendations

(i) In each landscape, Management Authority should be setup to ensure effective planning and management.
(ii) The KFD may take appropriate actions to notify the areas *viz.*, (i) Athirapalli-Malayattoor (458.24 km^2), (ii) Attapadi (73.79 km^2), (iii) Attappadi-Chenat Nair (227.19 km^2), (iv) Konni (457.89 km^2) and (v) Periya-Ladysmith (273.71 km^2) as Conservation Reserves as recommended by Ramesh *et. al.* (2003) to facilitate the management at landscape-level.

Output 3: Study the status of wildlife habitats in one of the high conflict Forest Divisions and suggest broad measures for strengthening/improving the habitat conditions, which could be replicated in other divisions of the State.

The Wayanad North Forest Division, one of the high conflict Forest Divisions in the State, was selected to study the status of wildlife habitats to suggest broad measures for strengthening/improving the habitat conditions, which could be replicated in other divisions of the State. In order to carry out this task the following activities were carried out:

a. Review of Working Plan (for the period from 2015-16 to 2024-25) of Wayanad North Forest Division

The division was reorganized in 1990 and the total extent of the division is 223.897 km^2. The division has an extent of 3335.814 ha. plantations. The land use of the division is as follows:

(i) Forestry use with Department - 21840.42 ha.
(ii) Tribal habitations - 236.86 ha.
(iii) Plantation use, public sector tea plantations under lease of KFDC - 100.67 ha.

(iv) Forest Conservation Act clearance – 10.40 ha.

(v) Encroachments

- Before 01.01.1977 - 67.50 ha.
- After 01.01.1977 - 141.72 ha.

Review of Working Circles in Part II:

- Para 2.4.10.4 **(Protection Working Circle)** stipulate 'maintenance of grassland' but no prescription was seen for maintenance of grasslands.
- Para 3.8 **(Eco-Restoration Working Circle)** states 'reversion of 205.12 ha. of Eucalypts plantations to natural forests'.
- In **Plantation Working Circle**, 'working' of 1734.5 ha is proposed during the plan period which are detailed below:
  - A total of 17 bits of teak plantations with an area of 491.1 ha.
  - A total of 22 bits of teak and softwood plantations with an extent of 1017.03 ha.
  - A total of 5 bits of eucalypts plantations with an extent of 49.64 ha.
  - A total of 15 bits of acacia plantations with an extent of 176.65 ha.
- Para 5.5 **(Participatory Forest Management, Ecotourism and Tribal Development & Welfare Working Circle)**: In the Working Plan, 'Ecotourism' is prescribed in the following locations:
  - Pakshipathalam – Camping and trekking
  - Makkiad-Meenmutty – Waterfall project
  - Muneeswaran Kovil Ecotourism
- Para 7.4.2.1 **(Wildlife Management Working Circle)**: Point 12 prescribe 'construction of 12 numbers of check dams (Table 47 in page 144)' as part of wildlife management.
- Para 8.1 **(General Prescription Chapter)** prescribes 'collection of dead, dying and wind fallen trees' in an interval of five years in an extent of 500 ha. block.
- Para 8.2 (Table 80 – anticipated cost of implementation) propose following activities
  - Construction of ponds (16 numbers@ Rs.2 lakhs/pond) – 32 lakhs during 5 years period
  - Habitat improvement works - 10 lakhs for the entire plan period
  - Planting fruit and fodder trees (500ha. @Rs.10000/ha) – 50 lakhs for the entire plan period
  - Construction of electric fence (15 kms.) – 15 lakhs for only one year during the entire plan period
- Chapter IX **(Summary of Prescriptions)** – prescribe 'Habitat improvement: Improve the wildlife habitat with appropriate scientific interventions such as control burning of grasslands, vayal maintenance, weed removal, waterhole maintenance, construction of new waterholes/checkdams, prophylactic and preventive veterinary interventions, etc. But no budget provision is provided except for waterholes/ponds in the working plan.

b. Review of prescriptions in Wildlife Working Circle in the context of National Working Plan Code – 2014: This is already covered in para _ and Para _ as part of Output B.

c. Guidelines for silvicultural prescriptions for wildlife in managed forests (Reserved Forests):

The suggestions for silvicultural prescriptions in forests managed for timber production that can serve to renew or maintained at least value for biodiversity are detailed below.

(i) Retention of large, well-dispersed, old overstory trees, approximately 2-5 per ha. – These don't have to be teak or the commercial tree species of interest. In fact, often the poorer the grain and bole condition for commercial use, the better it is for wildlife. Examples are trees with deeply twisted boles, furrowed bark, peeling bark, many natural cavities, etc. The indent is to provide a scattered remnant of the original canopy superstructure and large boles.

(ii) Retention of fruit and seed-bearing trees and shrubs not of commercial timber focus and bamboo clumps. Such habitat elements have great value for maintaining biodiversity in managed forests.

(iii) Retention of 3-5 hollow, dead-top, partially dead or fully dead (snag) standing trees per ha, particularly trees >20 cm. gbh and > 5 m. tall. Such trees are used by a variety of specialist wildlife species, particularly woodpeckers, barbets, nuthatches, hornbills, and mammals that den in tree hollows and cavities.

(iv) Buffer protection of local mesic sites: Providing a no-cut buffer of approximately 10 m. surrounding mesic sites of particular character, such as steeps, bogs, wet meadows, or other saturated-soil conditions. Such sites typically have 'azonal' species associated with them, or species not typically found in the general surrounding forest conditions.

(v) Retention of down wood, sizes 20 cm. diameter at the big end and 2 m. long approximately 2-5 per ha. such habitat elements have value for a surprisingly diverse array of life forms, ranging from soil bacteria to fungi, molluscs, arthropods, amphibians, small malls.

(vi) Buffering of species lithic habitats: caves, cliffs, rock shelters, and den sites. Approximate buffers of nonactivity-perhaps 10-50 m. depending on the site and topography -can help maintain special rock habitats within actively managed coupes. Species using such rock sites can include a variety of birds, denning sloth bears, leopards or panthers, and other species.

(vii) Promote diversity of species and spacing in regenerated stands during stand establishment or in cultural treatments. Variable spacing (approximately 2-4 m.) in plantations, within acceptable ranges to meet timber objectives, can provide important structural diversity.

(viii) Protect riparian areas: Habitats along watercourses should be excluded from timber harvesting or used as locations for roads, landings storage yards, or other activities disruptive of the vegetations. Generally, along ephemeral streams, a zone 20 meters wide should be protected. Along intermittent and permanent streams, b roader areas should be included within the protection zone.

Similar silvicultural prescriptions are prescribed in the following documents:

(i) A manual for planning wildlife management in Protected Areas and managed forests, published by Wildlife Institute of India (Anon, 1995)

(ii) A guide for planning wildlife management in Protected Areas and managed landscapes by Sawarkar (2005)

d. Analysis of expenditure for last three years for the management of wildlife habitats:

Expenditure of the last three years (from 2016-17 to 2018-19) were analysed.

- During the year 2016-17 Rs. 578.23 lacks have been spent to implement the prescriptions of the working plan. It was found no expenditure was incurred to implement the prescription related to habitat management in the said year.
- During 2017-18, Rs. 497.52 lacks have been spent to implement the prescriptions of the working plan. Out of which an amount of Rs. 0.95 lakh (which is 0.19% of the total expenditure) has been spent for improvement of waterholes in the division. No other activity related to habitat improvement/ management is found to be carried out during the year.
- During 2018-19, Rs. 319.14 lacks have been spent to implement the prescriptions of the working plan. Out of which an amount of Rs. 1.00 lakh (which is 0.31% of the total expenditure) has been spent for improvement of waterholes in the division. No other activity related to habitat improvement/ management is found to be carried out during the year.

Recommendations:

(i) The Wildlife Circle in the Working Plan of Wayanad North Forest Division needs to be re-written as provided in the National Working Plan Code, 2014. As per the principles described in the Code (as described in Output 2 (para c.).

(ii) Ensure management of the Wayanad North Forest Division in consonance with the objectives and management prescriptions of the management plans of adjacent Wayanad and Kottiyur WLSs.

(iii) The Working Plan Officer should identify the distribution of following habitat elements in the division and include in the prescriptions of Wildlife Circle in the Working Plan of Wayanad North Forest Division

- Retention of large, well-dispersed, old overstory trees
- Retention of fruit and seed-bearing trees and shrubs
- Retention of hollow, dead-top, partially dead or fully dead (snag) standing trees
- Retention of down wood
- Buffer protection of local mesic sites
- Buffering of species lithic habitats
- Promotion of diversity of species and spacing in regenerated stands
- Protection of riparian areas
- Caves and dens
- Cliffs and over hangs
- Gorges
- Talus
- Grasslands and *Vayals* (marshy areas) – location, extent and status
- Waterholes – distribution and seasonality

All the above-mentioned elements may be put in the GIS domain for effective planning and implementation of activities.

(iv) KFD may provide sufficient funds to implement the prescriptions in the Wildlife Working Circle and to manage the division adjoining to PA in consonance with the objective of the PA.

(v) Review of eco-tourism activities to avoid disturbance to wildlife (especially in species specific habitats) and streamline activities accordingly. In such areas, species specific plans to be prepared and implemented.

(vi) Implement a scientific monitoring system for wild animals especially elephants and other flagship species.

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