Visible and Hidden Costs of Human-Elephant Conflict on Smallholders in Peninsular Malaysia

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*"**Vakratunda Maha-Kaaya Surya-Kotti Samaprabha
Nirvighnam Kuru Me Deva Sarva-Kaaryeshu Sarvadaa ||**"*

"O Lord Ganesha, who has a huge body, curved elephant trunk and

whose brilliance to billions of Suns,

May always remove obstacles that come my way and pave my path"

Surrounded by the burgeoning human population, Asian elephants have to contend with the spread of settlements and farming and the demand of rapidly developing nations: plantations, mines, railways and irrigation canals have carved up former wilderness."

Mark Shand

ABSTRACT

Human-elephant conflict (HEC) is an ongoing issue of concern in all elephant range countries including Peninsular Malaysia. The clearing of forest land for agricultural expansion and urbanisation has reduced available habitat for elephants and other wildlife. The competition for space, that results in forest further fragmentation, leads to conflict which adversely affects communities living next to forest with elephants. Since smallholder community's land represents about 38% in total planted area of oil palm and 93% of the planted rubber area in Malaysia, understanding the impact of human-elephant conflict on them is crucial when designing HEC mitigation approaches and in promoting human-elephant coexistence for the agriculture sector. The smallholder community in Malaysia is categorised into two groups, namely: i) Independent smallholders – those who grow their crops without help from external agencies and ii) Organised smallholders – farmers who are supported by government or any organization either through technical assistance, finance, or agricultural inputs. Following a participatory research approach, and a snowball sampling technique I assessed the *Visible cost* (e.g., either monetary or by considering the cost of seedlings, fertilizers, and pesticides) and *Hidden cost* (e.g., worry and exhaustion from guarding crops, loss of work opportunities, etc) for both independent (n=142) and organised (n=27) smallholders and examined their perception of insurance schemes as a financial tool. Respondents perceived elephants, wild boars, and macaques as top conflict animals. Yearly crop loss suffered by 137 respondents on oil palm, rubber, durian, and banana that included seedling, labour, fertilizer, and pesticide cost, due to conflict with elephants, was reported to be RM 2,962,475 for an area size of 11,460.51 acres. Mitigation cost (covering 5 years) that included installation of measures and repair cost amounted to RM 3,593,449.32 as reported by the smallholders during the survey. The smallholders admitted that factors such as lack of knowledge (58%), high cost (82%), and failed past attempts (66%) prevented them from deploying mitigation methods. But they were willing to try insurance as a financial mitigation tool to secure their crops against damage. In all, 35.5% (60) smallholders were willing to invest in insurance premium with majority opting for an amount below RM 200, which reflects the range they are willing to invest monetarily. Aspects of hidden cost that comprised of psychological stress (92.47%), fatigue due to guarding crops (84.56%) in the night and being vigilant (89.47%) were also reported. Opportunity loss was reported to be lower than expected. Attitudes of smallholders were found to be influenced by age, level of education, and past experience of property damage. These results can help support management recommendations to promote human-elephant coexistence for the agriculture sector in Peninsular Malaysia, such as the development of smallholder insurance scheme and helping conservation agencies understand grievances and challenges faced by smallholders in implementing conflict mitigation measures.

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ACRONYMS AND ABBREVIATION

Initial	Description
BM	Bahasa Melayu
CBO	Community-based Organisation
CWCCC	County Wildlife Conservation and Compensation Committees
DWNP	Department of Wildlife and National Parks
FELCRA	Federal Land Consolidation and Rehabilitation Authority
FELDA	Federal Land Development Authority
FFB	Fresh Fruit Bunch
HACSIS	Human Animal Conflict Self Insurance Scheme
HEC	Human-elephant Conflict
HWC	Human-wildlife Conflict
IUCN	International Union for Conservation of Nature
KNP	Kibale National Park
MCO	Movement Control Order
MEME	Management and Ecology of Malaysian Elephant
MPOB	Malaysian Palm Oil Board
MSPO	Malaysian Sustainable Palm Oil
PHRF	Patharia Hills Reserve Forest
RA	Research Assistant
RI	Respondent Id
RISDA	Rubber Industry Smallholders' Development Authority
RM	Malaysian Ringgit
RSPO	Roundtable on Sustainable Palm Oil
SACRA	Sarawak Land Consolidation and Rehabilitation Authority
SLDB	Sabah Land Development Board
SOP	Standard Operating Procedure
SPOC	Sustainable Palm Oil Clusters
WCS	Wildlife Conservation Society
WWF	World-Wide Fund for Nature

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1.0 INTRODUCTION

Asian elephants (*Elephas maximus*) are listed as endangered on the International Union for Conservation of Nature (IUCN) Red List due to the rapid decline of their habitat range and estimated reduction of the population in the past three generations (Menon, Amin and Wangdi, 2020; Nayak and Swain, 2020). The relationship between humans and elephants has changed over time in multiple dimensions (Nayak and Swain, 2020). Elephants transformed from being the beasts of burden helping to carry heavy loads in the past to being a "burden" to the farming communities in present day. From representing the strength of ancient nations as beasts of war to a symbol representing peace, friendship and family. From being revered as equivalent to the Hindu God - Ganesha, and yet being poached for tusks or harmed because of their association with crop depredation and disrupted livelihood. Despite these changes, elephants continue to live with humans either free roaming or in captivity. But their survival in the wild has been a matter of concern due to habitat fragmentation which disrupts movement passage increasing mankind conflict with elephants (Santiapillai et al., 2010).

Definitions of human-elephant conflict (HEC) have also evolved over time - being defined as a complex relationship between humans and elephants with detrimental impacts both species have on each other (Desai and Riddle, 2015) to an expanded definition looking at human-dimensions of conflict devised by the IUCN SSC Human-Wildlife Conflict and Coexistence Specialist Group that examines human-dimensions of conflict which includes "struggles that emerge when the presence or behavior of wildlife poses actual or perceived, direct or recurring threat to human interests or needs, leading to disagreements between groups of people and negative impacts on people and/or wildlife" (IUCN, 2020). The last definition of conflict with wildlife not only circumscribes conflict as being only negative interaction but also elaborates on the possibility of actual and perceived sense of conflict between groups of people under which conflict may arise. My thesis attempts to capture both visible cost and hidden cost of conflict while taking into account the human dimension aspects of human-elephant conflict, which in in line with the definition proposed by IUCN.

With the growth of human population, the need for agricultural land surged at the expense of forests, resulting in the reduction of elephant habitat (Santiapillai et al., 2010). Also loss of biodiversity in their natural habitat and loss of corridors for movement have left elephants with no alternative but to migrate to a new one causing conflict on the way (Mukherjee, 2016). When local communities live close to elephant landscapes, ramifications of HEC brings costs borne by both the stakeholders of conflict – elephants and humans, which generates antagonism among local communities (Desai and Riddle, 2015) and between different groups

of stakeholders (e.g. conservationists versus developers). The frequency and the negative nature of the interaction further deteriorates the relationship between local communities and elephants (Nayak and Swain, 2020).

Elephants being mega-herbivores, need to fulfill their daily food requirement - approximately 150 – 300 kg which is 10%of their body weight (Eisenberg, 1980; Sukumar, 2006; Liyanage et al., 2021). In order to meet their food requirement they have evolved into generalist herbivores consuming a wide range of vegetation (Fernando, 2015) including palms, grasses, early succession plants and others, but which inevitably includes crops like oil palm, rubber, durian, banana and other vegetables and fruits (Ong, 2020). Conflict arises as a part of the elephant's optimal foraging strategy (Belovsky, 1986; Stephens and Krebs, 1986) by which they adapted a feeding behaviour that optimizes their food intake by choosing to encroach into nearby human-governed plantations which are abundant in energy-rich food. Agriculturally grown crops are found to be preferred by elephant than their wildly grown counterparts because humans select and grow crops that are palatable, digestible, non-toxic and high in nutrient which makes it attractive to the elephants (Sukumar, 1990). This may help to explain the proclivity of elephants entering commodity crop plantations like oil palm and rubber (Sukumar, 1990; Berliani et al., 2018) resulting in human-elephant conflict.

Conflict with elephants result in economic loss like crop depredation, property damage, and loss of life or injury to humans. Studies across elephant range countries revealed that local communities are forced to absorb these costs (Ogra and Badola, 2008). The locals not only endure loss of livelihood, infrastructure damage, physical harm or injury during crop raids but also suffer from fear, anxiety and post-traumatic stress (Barua, Bhagwat and Jadhav, 2013; Bond and Mkutu, 2018).Type of cost that originates as a consequence of conflict and includes non-monetary cost is known as *intangible/hidden/indirect costs* (Jadhav and Barua, 2012; Barua, Bhagwat and Jadhav, 2013; Bond and Mkutu, 2018). It manifests into situations like individual's inability to apply for other jobs owing to conflict, children missing school attendance because of assisting parents in guarding crops, additional costs faced in attempts of securing claimed compensation (Jadhav and Barua, 2012; Barua, Bhagwat and Jadhav, 2013; Bond and Mkutu, 2018). Hidden cost also includes fear, psychological stress and anxiety associated with visible and other intangible costs (Jadhav and Barua, 2012a; Barua, Bhagwat and Jadhav, 2013; Bond and Mkutu, 2018; Saif et al., 2019a). Although prevalent policies in India include compensation to offset the visible losses that include infrastructure damage, crop loss and human fatality (Kansky, Kidd and Knight, 2016a; Saif et al., 2019a), recent studies are focusing beyond the scope of economic outcomes and concentrating on hidden cost, that involves disruption of the psychosocial well-being of the people involved (Bond and Mkutu, 2018). Unlike visible cost, the hidden cost is difficult to quantify and may sometimes outweigh

the economic damages (Saif et al., 2019b; Thondhlana et al., 2020). It also plays an important role in shaping the perception of conflict among local communities (Hoare, 2000). Researchers like Ruth Kansky, Maan Barua and Gladman Thondhlana, who have worked extensively on hidden cost of conflict expressed hidden cost as an unaccounted driver of HEC that needs equal inclusion while mapping mitigation procedures (Barua, Bhagwat and Jadhav, 2013; Kansky, Kidd and Knight, 2016a; Thondhlana et al., 2020).

Compensation, defined as reimbursement in cash or in kind is offered to the bereaved based on direct economic loss, that considers damage to crops and property caused by wildlife conflict to promote cohabitation with affected people without much consideration for hidden costs (Nyhus, 2016; Johnson, Karanth and Weinthal, 2018; Sampson et al., 2019; Manoa et al., 2020). Compensation schemes are sometimes productive in certain cases like in Amboseli elephant research project where compensation was disbursed to the farmers for loss of livestock due to conflict with elephants inside the national park where they earned their livelihood (Bulte et al., 2008). The goal of compensation is to instill positive attitude in people towards wildlife and increases their tolerance towards elephants by offsetting their loss with monetary compensation. However, some studies suggest that compensation do not necessarily improve tolerance towards wildlife because of problems related to evaluation of claims for damage, determination of fair values of losses, transparency, and issues of fraud and corruption (Naughton-Treves, Grossberg and Treves, 2003; Ogra and Badola, 2008). There are other factors involved in the process of successful execution of compensation as a mitigation type – such as fair and timely disbursement of compensation amount and accurate measurement of the cost of damage due to conflict, whose failure can result in higher level of conflict (Ogra and Badola, 2008). Simultaneously compensation may promote exaggerated claims by farmers that raise concerns about sustainability of the schemes (Guru and Das, 2021). These issues would only increase intolerance towards the concerned wildlife species (Thondhlana et al., 2020). Insurance, on the other hand is a tool that involves monetary contribution from individuals, households, or communities to insure people against loss of life, injury, crops, and property damage (Desai and Riddle, 2015). Compared to compensation schemes, insurance schemes are independent and when there are sufficient people using the scheme it can be sustainable, as it is not dependent on availability of government budget every year. Insurance is audited and have check and balance system, that if facilitated well, are more transparent in nature.

Malaysia too experiences HEC. Human-elephant conflict in Peninsular Malaysia was prevalent even before the mass conversion of forests began (Zafir and Magintan, 2016) but was found to have intensified after forest conversion in 1800s as elephants became attracted to plantations and fruit orchards (Kathirithamby-Wells, 2006). In the early 1900s elephants

were recorded destroying banana and coconut crops (Maxwell, 1907). Encroachment of natural forests for expansion of rubber plantations in Peninsular Malaysia has increased conflict with elephants (Olivier, 1978; Saaban et al., 2011a; Shevade and Loboda, 2019). Crop depredation was not limited to rubber, durian, banana, or coconut. Oil palm, which was introduced to Peninsular Malaysia in 1930s, too was predated upon by elephants (Kathirithamby-Wells, 2006). The introduction of several government agricultural schemes such as Federal Land Development Authority (FELDA,1956), Federal Land Conversion and Rehabilitation Authority (FELCRA,1966), and Rubber Industry Smallholding Development Authority (RISDA,1973) in the 1970s to accommodate agricultural schemes opened more lowland forests that intensified human-elephant conflict during the early days (Saaban et al., 2011a; Zafir and Magintan, 2016). The objective of the schemes was to eradicate poverty in rural areas in addition to developing and rehabilitating the land, had also resulted in forest habitat loss and fragmentation (Saaban et al., 2011a).

Plantations in Malaysia have experienced extensive economic loss due to crop raiding by elephants. The human-elephant conflict induced monetary losses for FELDA, FELCRA and other private companies that was reported to be over RM78 million between 1975 and 1978. Monetary loss due to HEC declined only in the early 1980s with the installation of electric fence (Zafir and Magintan, 2016). However, the effectiveness of electric fence in mitigating HEC has varied response. Considered to be last resort (Daim, 1995) to mitigate conflict without causing harm to elephants, translocation has been attempted by a number of countries like Kenya, Zimbabwe, South Africa, Malaysia and India. While in some countries translocating the elephants served its purpose and reduced conflict like in Kenya, Zimbabwe, South Africa and Malaysia, in India, Sri Lanka and Indonesia it did not (Janaki and Raman, 2011). Translocation requires specialist skills and equipment apart from causing heavy expenses (Parker et al., 2007). In India, only 22% of the elephant range consist of Protected Areas which could have reached its capacity leaving only few suitable sites for release. Landscape with sufficient holding capacity of translocated elephants is required without which large scale translocation could cause adverse effects to elephant conservation (Janaki and Raman, 2011). Visible costs due to HEC in Sime Darby plantation has been quantified and documented in Quilter (2019)'s Master's dissertation which reported that out of 94 insurance claims submitted between 2009 and 2018, HEC was the highest in number (33%), with wild boar and cattle damage claim to be 13% (Quilter, 2019). However, the highest amount of claim disbursed between 2009 and 2018 was, for flood (RM 2,157,112.88) which consisted of 60% of the monetary value, followed by 32% of the claim for elephant damage (RM 1,171,436.36), 4% for wild boar (RM 151,491.98) and others (Quilter, 2019). Although insurance schemes are available for

plantations in Malaysia but currently the scheme is too expensive for the smallholders to invest in it (Quilter, 2019).

Smallholder communities are important stakeholders that own around 38,8% (2,294,721 ha) of oil palm planted hectarage (Ghulam Kadir et al., 2020) and an estimated 93.22% (1,009,530 ha) of rubber planted hectarage (Malaysian Rubber Board, 2019). Smallholder community in Malaysia is divided into two categories i) *Independent smallholders* and ii) *Organised* smallholders. Independent smallholders are those who own or lease 100 acres of land or less (40.46 ha) and manage the holding themselves or employ workers (Senawi et al., 2019). Organised smallholders are those who are managed by government agencies like FELDA, FELCRA, RISDA in Peninsular Malaysia and Sarawak Land Consolidation and Rehabilitation Authority (SACRA) in Sarawak, Sabah Land Development Board (SLDB) and other state agencies (Senawi et al., 2019).

Smallholders face various challenges due to fluctuating price of oil palm in global market, increased cost of fertilizers and pesticides and inability to meet labour requirements for harvesting and Fresh Fruit Bunch (FFB) collection due to lack of field workers (Azman et al., 2018; Rahman, 2020). Issues faced by smallholders in Peninsular Malaysia is documented by Azman (2018) and Rahman (2020) but not much is known about the impact of HEC on smallholders and quantification of losses due to crop raiding in Malaysia. Conservation projects advancing coexistence with elephants need to identify the extent of the HEC cost – both visible and hidden faced by smallholders.

Plate 1: Crop-raiding by a herd of elephants in May 2020 in Chepor where around 300 oil palm trees were damaged overnight. Photo credit: Sinchita Sinha

1.1 Rationale of the Study

Malaysia, a hot spot of mega-diversity has been experiencing human elephant conflict since the 1800's with the onset of agricultural expansion resulting in habitat loss and fragmentation. While lands were cleared for expansion of oil palm and rubber plantation, habitat fragmentation further increased the interaction between man and elephants that led to conflict. Common losses of HEC faced by the local people usually includes crop raiding, property damage and injury or life loss. With the plantation sector being segregated into estates and smallholdings, type of losses and HEC impact varies considerably between the two. Research has been undertaken to account for the losses sustained by the estate plantation based on the availability of the past HEC records and voluntary reports. Research papers on smallholders in Malaysia have mostly focused on the labor requirements and challenges faced by them during cultivation leaving costs suffered by smallholders owing to HEC undocumented (Azman et al., 2018; Arshad et al., 2020; Tambi et al., 2021). Countries that encounter high human-elephant conflict incidents like India, Sri Lanka, Bangladesh, and Africa, temporal dimensions of unresolved financial and psychological concerns lead to directing their

grievances towards the elephants (Jadhav and Barua, 2012b). In order to bring in effective mitigation methods it is essential to bring into perspective, not only the visible cost (purchase of saplings, fertilizers, pesticides and employment of labor and setting up or repairing mitigation machinery) that smallholders have to bear on account of an elephant raid but also the hidden loss (Jadhav and Barua, 2012b). Kansky (2016) found that hidden or visible or both could impact tolerance and eventually conflict. Understanding and comparing the visible and hidden costs suffered by smallholders will help to understand the type of cost that drives conflict in Peninsular Malaysia.

The range of HEC mitigation methods used in Peninsular Malaysia are usually traditional methods (firecrackers, burning tires at the gate, patrolling, night-guarding, bamboo canons, carbide canons) or physical barriers (electric fences and trenches) or a combination of both. Meanwhile crop insurance as a means of coping with HEC losses has been opted by few countries, and by large plantations like Sime Darby Plantation Berhad, but insurance for smallholders has not been attempted in Malaysia. Assessing the willingness of the smallholders (independent and organized) to invest in insurance for crop protection would help to determine their perspicacity and foresightedness to secure crops. It is important to scale the effectiveness of the mitigation methods employed by the smallholders and try to determine if the smallholders would consider paying a premium in exchange for insuring their crops against damage wild animals, extreme weather, insect infestation or crop diseases.

Hence this MRes thesis focuses on understanding the type of HEC losses, both visible and hidden, experienced by independent and organised smallholders in Peninsular Malaysia, in particular the state of Johor and some communities in Perak. Specific questions on smallholders' willingness to pay insurance premium has also been incorporated and to ascertain barriers in implementing HEC mitigation. Understanding the stakeholders' perception and attitude (in this case the smallholders) regarding living in proximity to elephants, including their ability to accept elephants in the same landscape, whether they think there are benefits to having elephants and so on, is essential in providing insight for designing communication and engagement approaches in communicating about conflict management.

1.2 Aim & Objectives

The aim of this study is to understand the visible and hidden costs suffered by the smallholder community directly or indirectly due to HEC in Peninsular Malaysia and how this affects their attitude towards elephants.

Therefore, the following objectives are established:

1. To estimate visible and hidden cost incurred by smallholders in their plantations after elephant raids.
2. To understand how these visible and hidden costs influence the attitude of smallholders towards elephants.
3. To assess the willingness of smallholders to pay for Insurance as a means of protecting their crops against damage caused by elephant raids.

1.3 Review of Literature

1.3.1 Concept of Conflict

The interactions between wildlife and people can be negative (crop damage, attacks on people, livestock depredation), neutral (wildlife passing by without damages or disruption) or positive (income from recreational, educational, psychological and ecosystem services) for the community (Soulsbury and White, 2015; Frank, 2016; Nyhus, 2016). Conflict often focuses on the negative aspects and has myriad viewpoints that gathers its quintessence and structure from the changes of human and societal nature. Conflict can be considered as a natural consequence of different groups of people with different values and beliefs, incongruous perceptions, and attitude that may manifest its presence in various strata of the social, economic, and political niche in conservation which illustrates contrasting trends of human culture, society, rituals and traditions (Nyhus, 2016; Punjabi, 2020).

1.3.1.1 Dimensions of Conflict

Conflict arises when numerous issues occur between two or more parties (multiparty conflicts) on varying levels and at least one of the participants attempts to aver its interests at the expense of the other party's interest (Scialabba, 1998). To examine conflict, it is important to understand multi-faceted natures, its intricate relationships that keep evolving and how it impacts the people involved. The different components of conflict are A) Actors B) Resources at stake C) The stake and D) The time dimension (Scialabba, 1998).

A) *Actors* – Apart from the usual disputers like government departments, private companies and local communities, there are other parties who are involved, like the state government, who may be inclined towards peaceful resolution of social conflicts. The effect the actors have on each other becomes a critical determinant in understanding the conditions under which conflict could be resolved. The factors influencing interaction are:

a. *the level at which the conflict occurs* – e.g., international, national, or local level.

b. *the status of the disputants* – conflict occurs in two scopes – horizontally and vertically.

Horizontal conflict is when conflict occurs between opponents on the same level such as within local communities or within government but there is no inter-conflict between the two involved. *Vertical conflict* is when conflict occurs between opponents of different level such as between government and local communities.

c. *the relative power of the disputants* – For example, despite being at the same level, some ministry might wield more power than the other government ministries, as they may be generating more revenue and is contributing relatively more to the national economy.

The actors involved with regards to HEC are the elephants, the locals, and the government or state agencies.
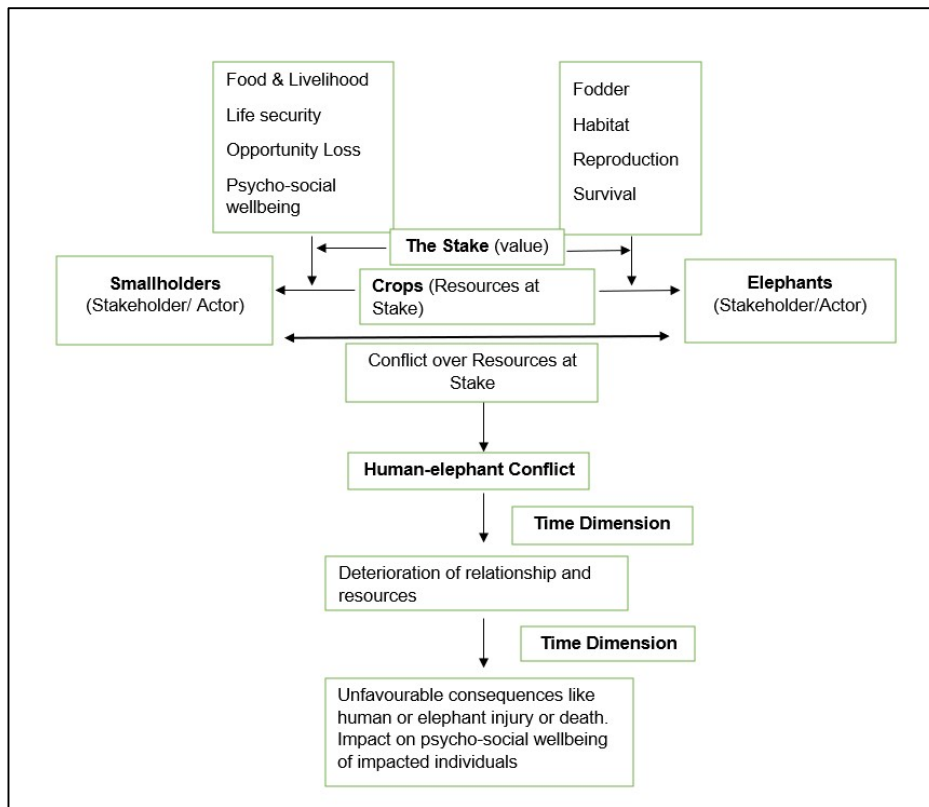
Figure1: Relationship among different dimensions of conflict (Scialabba, 1998).

B) *Resources at Stake* – In most cases conflicts emerge in response to either competing or claiming over allocated natural resources or accesses to them (Scialabba, 1998; Sukumar, 2006). Conflict mitigation might be physical (e.g. barriers electric fences), biological (using bees as effective deterrent against crop raiding by elephants) (King, Douglas-Hamilton and Vollrath, 2011; Digun-Aweto, Van Der Merwe and Saayman, 2020), social (e.g., Avoid walking or riding bicycles in the night in areas with elephant presence especially under the influence of alcohol), or economic (e.g., insurance or compensation scheme). Striving to save their livelihood, the farmers risk their lives to guard their crops. Their efforts are often enormous

with real risk of injury or fatality to them or their family and workers and likewise to the elephants (Saaban et al., 2011b; Hariohay, Munuo and Roskaft, 2020; Talukdar and Choudhury, 2020). In Sri Lanka, it is estimated that annually 50-60 people and 225 elephants are killed because of HEC (Jayewardene, 2014). In Malaysia, seven elephant attacks were reported over a period of five years (2006 to 2011) which resulted in four human casualties and three human injuries (Saaban et al., 2011b).

C)*The Stake*– The stake refers to the value, use and the interest the actors have for the resources from the resource pool. The stake could be economic, political, environmental, religious, or socio-economic. The stakes that actors place on the resource is based on the subjective evaluation of the relationship they share with the resource. The higher they value the relationship the greater they will pronounce their interests in their resource (Scialabba, 1998). With regards to HEC both elephants and farmers are dependent on crops – one perceives it as fodder and the other considers it livelihood. Crops grown for human consumption are selected primarily on sensory quality, digestibility, absence of toxins and nutritive value, elephants are naturally attracted to the cultivated crops (Sukumar, 1990). For example, iodine, a key nutrient for reproduction and a nutrient that is directly or indirectly essential for brain growth is likely to be deficient in wild plants (Milewski, 2000; Sach et al., 2019) while several species of cultivated plants have sufficient iodine to meet the iodine requirement for humans who are prone to be iodine-deficient (Sauchelli, 1969). When nutritious and palatable crops like sugarcane, oil palm, paddy, coconut are cultivated, crop-raiding becomes inevitable (Santiapillai and Ramono, 1993; Sukumar, 2006) as it reduces foraging time and enables elephants to optimize their nutrient intake (Santiapillai and Ramono, 1993). This behaviour is known as the *optimal foraging strategy* (Stephens, 1986). While crops are viewed by the elephants as only a source of food, to the farmers it is their source of income, at times their sole source of livelihood. The conflict with elephants in India is influenced by seasonal cultivation and includes minor crops like sorghum, maize, major crops like finger millet, paddy and fruits like coconut, banana, mango, sugarcanes, and jackfruits (Sukumar, 1990). With the elephants' natural preference for plants of Palmae family inclusive of the cultivated variety (Sukumar, 1990), oil palm and also rubber plantations in Malaysia experience severe economic impact owing to crop raiding by elephants (Sukumar, 2006; Saaban et al., 2011a).

D) *Time Dimension* – The time dimension is linked to the stage where the conflict has reached (Scialabba, 1998). Conflict intensifies over time that influences the method suitable for stakeholders to engage and deal with conflict (Scialabba, 1998). If the conflict has been ongoing then it is likely to have intensified and become confrontational. The state of the

resource and relationship may deteriorate over time, which makes conflict difficult to resolve with increasing pressure from all quarters and hasty decisions (Scialabba, 1998). The conflict between humans and elephants have been a never-ending battle over crop raiding, human injury, and death - the consequences have been severe, ending in retaliatory poisoning or gunfire, and also electrocution of the elephants (Dublin et al., 2006; Fernando et al., 2011). Although illegal, 10 retaliatory killings of elephants by poisoning was reported in Peninsular Malaysia between 1974 to 2002 (Saaban et al., 2011b).

1.3.2 Classification of Costs of Conflict

Conflict between humans and elephants engendered costs that includes crop and property damage, raiding of food stores, occasionally injuring or killing humans in the process (Hoare, 2000; Ogra and Badola, 2008). These costs are absorbed by the locals who live in the same landscape as elephants. Cost that includes serious injuries and fatality to both humans and elpehants, crop depradation, loss of livelihood and property damage is known as *direct/ visible or economic cost* (Ogra, 2008; Barua, Bhagwat and Jadhav, 2013). Referred also as *tangible cost* which means monetary cost (Kansky, Kidd and Knight, 2016b). On the other hand cost that includes diminished state of psychosocial well-being resulting from loss of livelihood, injury or fatality, disruption of family and food security through conflict is known as *indirect cost* (Barua, Bhagwat and Jadhav, 2013) or *intangible cost* that also refers to non-monetary cost (Kansky, Kidd and Knight, 2016b). Kansky's research found *tolerance could not always be determined by tangible cost* (Kansky, Kidd and Knight, 2016a). The study highlights the need to focus on intangible costs under certain circumstances, despite most strategies concentrating on visible cost to alleviate conflict, such as compensation schemes (Kansky, Kidd and Knight, 2016a). Tolerance could be explained with tangible cost when the livelihood of a household was impacted by the cost (Kansky, Kidd and Knight, 2016a). In her study monetary loss only comprised of approximately 0.5 to 1% of annual income but intangible cost had more impact on human-wellbeing (Kansky, Kidd and Knight, 2016a). Following Guru and Das (2021) approach, I grouped the direct/economic/tangible cost as *visible cost* that can be quantified in monetary terms and the other indirect/intangible cost as *hidden* because of its inconspicuous nature. I constructed a chart based on literature gathered from prominent research papers (Ogra, 2008; Kansky, Kidd and Knight, 2016a; Thondhlana et al., 2020), to categorise the costs of conflict and further elaborate on the hidden costs of conflict (*Figure 2)*.

1.3.2.1 Tangible/Visible/Direct or Economic Cost

Tangible/Visible/Direct costs of HEC are immediate and monetary in nature i.e., crop loss, property loss, injury or fatality (Ogra, 2008; Saif et al., 2019a). Human injury and deaths can

increase negative attitude towards elephants. Human life lost due to HEC is an emotional affair which makes valuation of life difficult and even considered immoral (Manoa et al., 2020). Across elephant range countries and even intra-country the extent of visible loss is never consistent. It varies depending on fragmentation of the forests in that region, on the type of crops grown, the accessibility of the crops, the type of preventive measures used to avoid loss and the distance of the fields from protected areas (Hariohay, Munuo and Roskaft, 2020). The various types of visible cost suffered by the smallholder community in elephant-range countries are listed below.
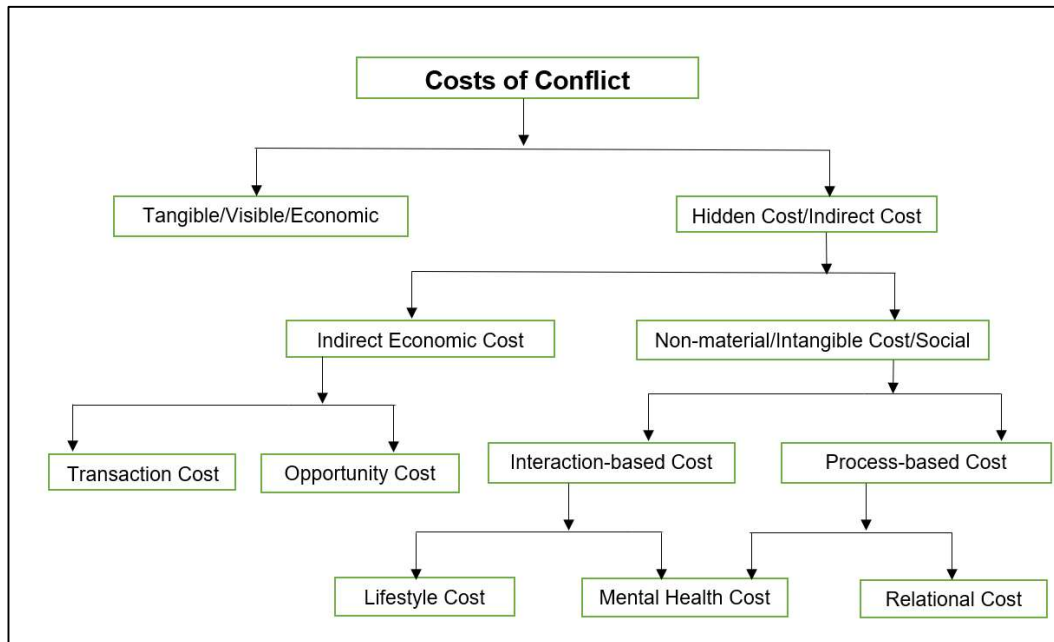
Figure 2: Classification of Costs of Conflict. Reproduced from (Ogra, 2008; Kansky, Kidd and Knight, 2016a; Thondhlana et al., 2020)

Visible costs suffered in Africa

In Africa crop raiding is an economically damaging form of human-wildlife conflict where frequent raiders were redtail monkeys but raids by elephants were fatal although infrequent and localized (Naughton, Rose and Treves, 1999; Hoffmeier-Karimi and Schulte, 2015). A study conducted in Marsabit National Reserve, Kenya between August 2004 to July 2005 (excluding December 2004 and April 2005 due to rains), a total of 414 farms were raided by elephants which caused a loss of KES 15,034,610 (US$139,792)** (Ngene and Omondi, 2008). A questionnaire-based survey in central Tanzania (Rungwa, Kizigo, and Muhesi Game Reserves), carried out during June to August of 2015 estimated annual total loss as a result of elephant damage to be 437.5 ha of crops (Hariohay, Munuo and Roskaft, 2020). Financial cost associated with crop raiding by elephants was studied by Mackenzie and Ahabyona (2012) in 25 villages around Kibale National Park, Uganda. The study, conducted over a period of 6 months in 2009, reported that elephant remained the top conflict animal in terms of total

area of damage despite baboon-damaged incidents occurring more than twice the number of elephant incidents. Despite elephant raids causing damage to 87,183 sq.m of area and baboon damaged area was 78,714 sq.m, monetary loss caused by baboons (US$3,809.20) were slightly higher than that of elephants (US$3,515.21) (Mackenzie and Ahabyona, 2012). This goes to show that although economic damage by baboons were more than elephants, yet the area of damage by elephants preceded the monetary loss and regarded elephants as the top predator by the farmers. There are instances of loss of human life due to elephant attacks. In a span of seven years (2000 to 2007), 200 people were reportedly killed by elephants in Kenya and 10 people were killed in Ghana over a period of five years (Lamarque et al., 2009).
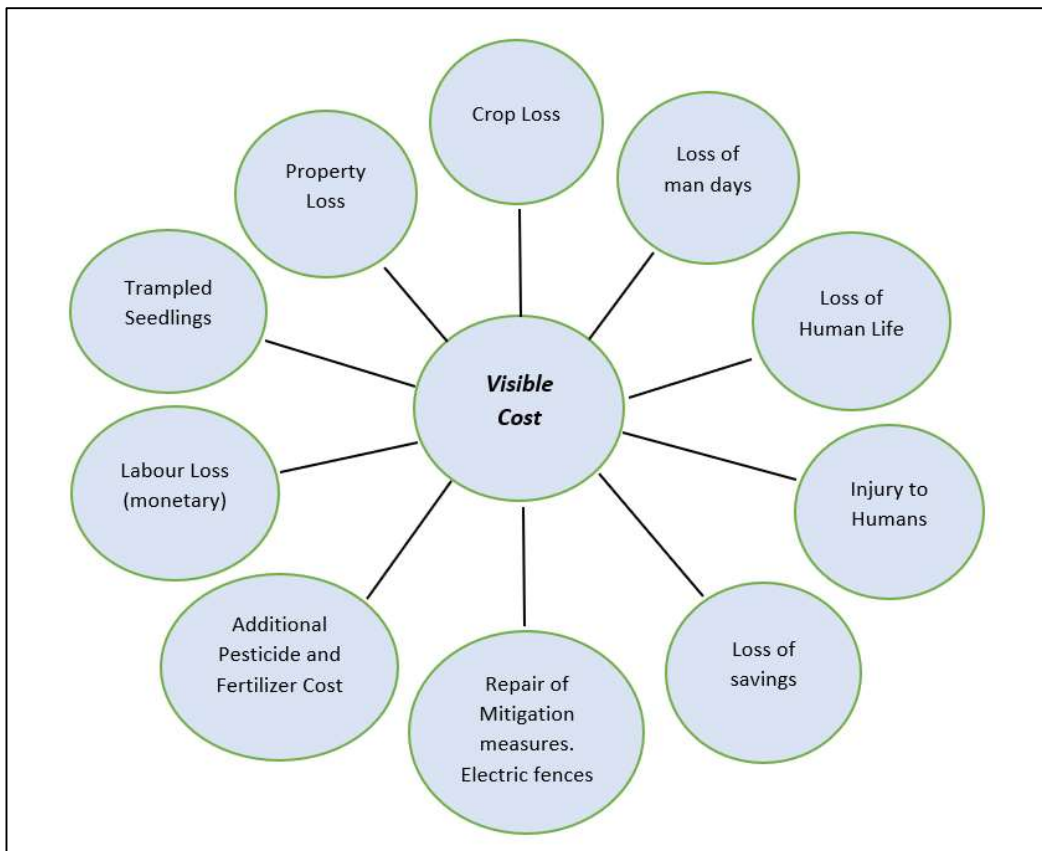
Figure 3: Various Visible Costs of Human-elephant Conflict. Reproduced from (Ogra, 2008; Manoa et al., 2020; Thondhlana et al., 2020; Guru and Das, 2021)

Visible costs suffered in India

In India, estimates show that every year elephants damage round 10,000-15,000 houses and 800,000-1,000,000 ha of crops (Chakraborty and Mondal, 2013) and the costs remain inconsistent across the different parts of the country which has elephant presence. Survey conducted between March 2006 to February 2009 in the Northeastern part of India, Assam was carried out in Goalpara and Sonitpur districts where a total of 1,761 conflict incidents was

recorded over a period of 3 years across the 2 study sites. Total area of crop damage amounted to 359 hectares which was estimated at INR 3,599,809 (US$48,274.23)** as per local market value (Davies et al., 2011). Another state in India - West Bengal, located on the eastern part of India, has HEC confined to 2 geographical locations – the western plateau fringe that comprises of Bankura, Purulia and Midnapur and the other is *duars* region of North Bengal comprising of Darjeeling, Jalpaiguri and Coochbihar (Chakraborty and Mondal, 2013). Chakraborty and Mondal, (2013) conducted a survey in Bankura to review crop damage by elephants and subsequent economic loss. The monetary loss displayed disproportional distribution of crop damage across 7 *mouzas* or districts ranging from 6.74 ha to 80.94 ha. Information shared by the forest officials placed the estimated total crop loss up to three lakhs per year (Chakraborty and Mondal, 2013). Karanth et al. (2013) surveyed 1,972 households, from 1371 villages surrounding 5 reserves in the Western Ghats (Dandeli-Anshi, Bhadra, Nagarhole, Bandipura and Biligiriranganatha Swamy Temple Wildlife Sanctuary) over a period of five months (February 2012 to June 2012) to determine the influence of wildlife species and type of damage on compensation (Karanth et al., 2013). Across the five locations in Karnataka, 64% of the surveyed households reported crop damage which ranged from INR 0 to INR 800,000. In all the five locations, wild boar remained the top crop raider, apart from one location – Nagarhole. Dr. Karanth observed people were more inclined to report damage or incidents caused by high value wildlife species like tigers or elephants than wild boars, macaques, smaller canids or felids (Karanth et al., 2013). A study in the Buxa Tiger Reserve of West Bengal revealed paddy fields raided by elephants worth INR 872.6 lacs (US$1,359,190). The damage was distributed unevenly across study villages. Out of several studies carried out in Odisha, one study carried out between 2000 – 2012 around Mayurbhanj Elephant Reserve reported 2045 incidents of HEC, of which crop raiding consisted of 70% of the cases and involved damage to 3,248.29 acres (Palei, Rath and Kar, 2013). A total of 74 human lives were lost, 25 humans injured, and 945 houses damaged, out of which 734 houses were partially destroyed and 211 houses completely destroyed (Palei, Rath and Kar, 2013). Data obtained through Right to Information (RTI) from Principal Chief Conservator of Forests, Wildlife Division, Odisha (2015) disclosed damages caused by elephants from 2001 to 2015 (Guru and Das, 2021). Over this period of 15 years HEC had claimed lives of 785 people and damaged 2,809.143 hectares of crops, a cost which was largely borne by the marginalized section of the society (Guru and Das, 2021).

Visible costs suffered in Thailand

Survey carried out in Chong Sadao district in Thailand between October 2015 and March 2016 consisted of 2 sections. The first section aimed at households and the second sections aimed at plantation owners since they endured elephant-induced damaged. Results of the survey

divulged that more than half the plantations were raided by elephants daily. Nearly all plantation owners experienced crop raiding once a month while the sugarcane plantations owners stated that elephants visit their farms weekly. Plantation owners estimated losses to be between THB 10,000 - THB 20,000 annually (van de Water and Matteson, 2018). Apart from crop damage due to elephant raids, property damage was reported to 71.7% and human injury was reported to be 2.2% (van de Water and Matteson, 2018).

Visible costs suffered in Sri Lanka

In his paper, de Silva (1998) mentioned almost always human deaths and injuries observed were due to negligence of humans. Most of the human fatality occurred while guarding the crops against elephant raids or while walking or cycling along the road or footpath (de Silva, 1998). According to Santiapillai between 1995 to 2002, around 500 people lost their lives owing to human-elephant conflict (Santiapillai, 1998). Jayewardene estimated the range of crop loss between Rs 10,000 (US$134.10)** and Rs 30,000 (US$402.30)** per farmer per annum in Mahaweli region where farmers predominantly grew paddy during both the cropping seasons in north-western and Mahaweli regions (Jayewardene, 1998) whereas de Silva estimated crop damage by elephants between Rs 5,000 (US$67.05)** and Rs 10,000 (US$134.10)** per cropping season per farmer during Maha season (major season that coincides with the rains) in the southern region of Sri Lanka (de Silva, 1998).

Visible costs suffered in Bangladesh

Study carried out by Aziz, (2016) to assess loss caused by elephants in the Northern territory of Bangladesh consisted of focus group discussions, interviews and data obtained from secondary sources like Forest Department records which were later validated by susequent visits (Aziz et al., 2016). Records for a period of 14 years (2001 to 2015) reported 78 human casulties and 68 human injuries. Of the casualties 42% died in the crop fields and 38% during property raids and 90% of the victims were males, indicating they lost their lives protecting their crops and houses from elephants (Aziz et al., 2016). Crop and house damage incidents between 2013 and 2014 across Northern Bangladesh were 82 and 228 respectively, along with trampling of stored grain and other household material (Aziz et al., 2016). Evaluation of monetary cost associated with crop and property damage was not reported in this paper.

Visible costs suffered in Malaysia

In a period of three years (1975 to 1978) over RM 78 million in losses were reported due to HEC by FEDLDA, FELCRA and other private companies (Monroe and England, 1978) while between 2005 to 2010 economic losses reported was approximately RM 18 million. These losses were assessed and estimated aby DWNP officials (Saaban et al., 2011a). In Malaysia,

eight estates under Sime Darby Plantation Berhad reported total loss of oil palm depredation by elephants to be RM 24,227,234.70 during 2011 to 2018 for damage to 200,242 oil palm trees which is equivalent to 381 hectares considering 1 hectare consisted of 145 trees (Saaban et al., 2011a; Quilter, 2019).

1.3.2.2 Hidden Costs

Hidden impacts or costs are defined as costs that are characterized by *any one or more* of the following traits that could be either be uncompensated or temporally delayed or psychological or social in nature (Ogra, 2008). The term hidden is synonymous with "indirect" or secondary (Hunter, Hitchcock and Wyckoff-Baird, 1990) because many critical causes and antecedents it encases slips elaborate analysis when the focus lies on visible impacts of human-wildlife conflict (Barua, Bhagwat and Jadhav, 2013). Crop-raiding that has earlier been mentioned as being the primary visible cost suffered by the famers, leads to a series of hidden costs (Ogra, 2008). Hidden costs include the diminished state of psycho-social well-being, opportunity, and transaction loss. Costs that are associated with losing out on possible opportunities that includes jobs and school attendance (in case of children), while engaging in guarding activities are known as *opportunity cost* (Hoare, 2000; Barua, Bhagwat and Jadhav, 2013). Costs that are associated with effort while pursuing for compensations already applied are known as t*ransaction costs* (Hoare, 2000; Barua, Bhagwat and Jadhav, 2013). The indirect cost manifests in the form of increased workloads, diminished well-being, reduction of food supplies, loss of income, sleep loss and fatigue due to nocturnal crop guarding, poor school attendance as children often accompany parents in guarding crops in the night (Ogra, 2008; Jadhav and Barua, 2012a). Loss of life, although considered under visible/direct cost, has hidden effects as well as it affects the psychological framework of family members (Jadhav and Barua, 2012a; Barua, Bhagwat and Jadhav, 2013). Myriad circumstances with variety of species influence costs of conflict differently in different households or communities (Kansky, Kidd and Knight, 2016a).

1.3.2.2.1 Indirect Economic Cost

The cost incurred due to time and money spent to prevent wildlife damage is known as Indirect Economic Cost (Ogra, 2008). These are economic losses that are concomitantly associated but indirectly. There are two types of cost that can be included under Indirect Economic Cost – a) *Opportunity Cost* and b) *Transaction Cost*.
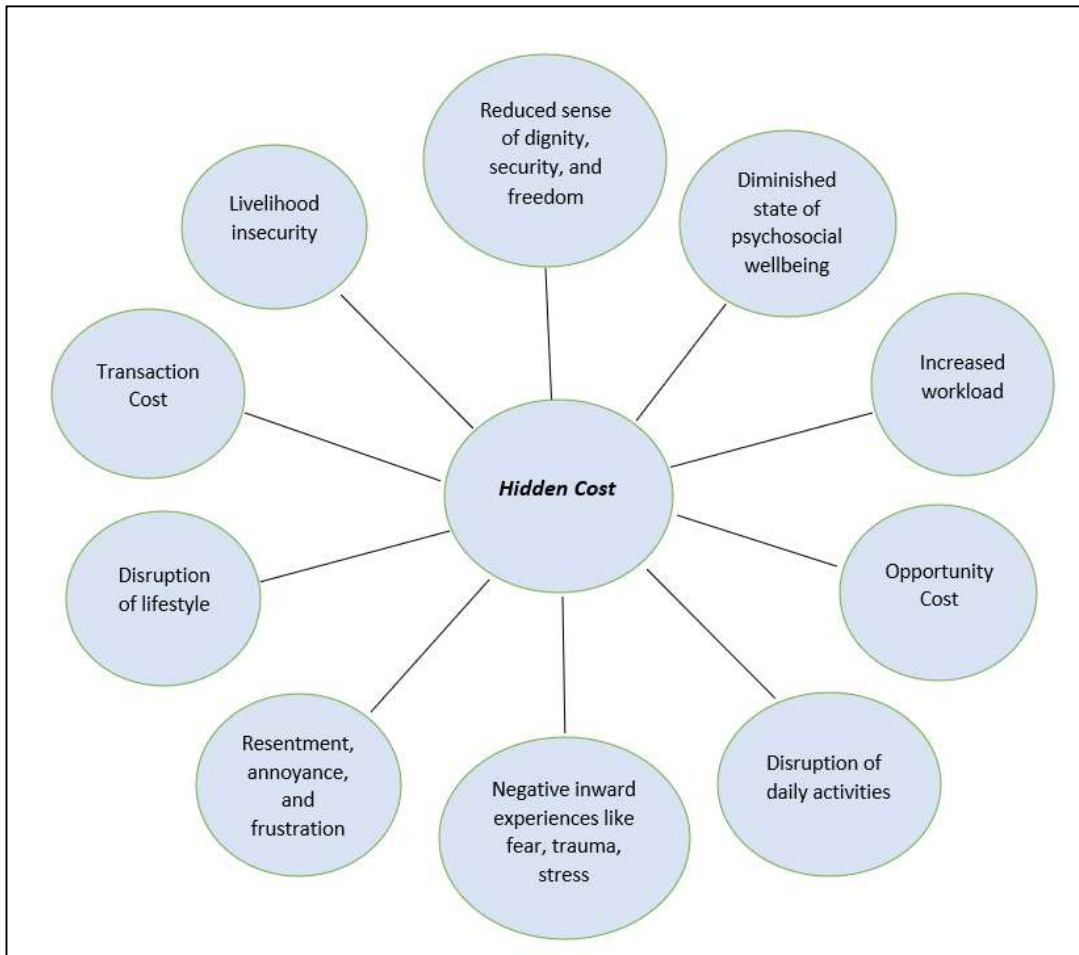
Figure 4: Various Hidden Costs of Human-elephant Conflict. Reproduced from (Barua, Bhagwat and Jadhav, 2013; Thondhlana et al., 2020; Guru and Das, 2021)

1.3.2.2.1a Opportunity Cost

Income-generating activities or lifestyle choices that people forgo in which they could have otherwise participated but were deprived of, due to the presence of wildlife and certain activities associated with their existence around human settlement, is known as *opportunity cost* (Ogra, 2008; Mackenzie and Ahabyona, 2012). The opportunity cost includes loss of sleep, disrupted school attendance (Hoare, 2000), loss of job opportunity (Barua, Bhagwat and Jadhav, 2013; Thondhlana et al., 2020). Crop guarding leads to loss of opportunity for individuals due to time and effort required. In some parts of Asia and Africa, men frequently engage in other wage earning activities which gets affected because of their responsibility of guarding the crops (at times along with family) against wildlife in the night or lose out on job opportunities due to guarding (Barua, Bhagwat and Jadhav, 2013; de Silva and Srinivasan, 2019). The responsibility of guarding the crops in the morning falls on children (Barua, Bhagwat and Jadhav, 2013). Teenagers are found to drop out of school to help assist in guarding the crops at night during harvest season (Barua, Bhagwat and Jadhav, 2013).

Guarding also leads to children missing school and consequently poor performance. This jeopardizes the prospect of future employment. Mackenzie and Ahabyona,(2012) carried out interview-based survey and physical examination of damage to collect data on the social impact of crop raiding around Kibale National Park (KNP) between July and August 2009 with households that were located between 15 and 3300 m from the park boundary. Their study revealed that the local population perceived that crop raiding led to lost opportunity lost, while the reason for fewer employment opportunities was indicative of strained local economy than crop raiding. The claim was suggested to be invalid because crop raiding could reduce income generation but was not restricting households from engaging in income-generating activities. Studies also found that scholastic achievement of village students staying closer to the park were affected than those who stayed further from the park due to the involvement of the former in guarding crops along with their parents(Mackenzie and Ahabyona, 2012).

1.3.2.2.1b Transaction Cost

Cost that is suffered due to the bureaucratic inadequacies in processing and applying for other forms of economic compensations is known as transaction cost (Barua, Bhagwat and Jadhav, 2013; Thondhlana et al., 2020). The cost incurs due to institutional inability to verify and determine the equitable value of losses and payment in a timely and transparent manner. This might be due to prevalent fraud and corruption at the bureaucratic levels (Jadhav and Barua, 2012a). Sometimes the costs occur while preparing and filing for the paperwork. Often rural farmers end up sacrificing their day's paid labour and spending money and time to travel long distances to government offices to register complaints. Evidence from some parts of India suggests that the deprived and marginalized sections are less likely to file claims and receive compensation (Ogra and Badola, 2008). Some smallholders might lack social capital, borrowing money at higher rate of interest while trying to mobilize compensation. These transactions costs seem material or economic at first glance but ends up affecting the well-being of individuals over a prolonged period of time and adds to their suffering (Jadhav and Barua, 2012a).

1.3.2.2.2 Non-material / Intangible / Social Cost

The part of hidden cost that relates to fear, anxiety, trauma, other negative feelings and insecurities like loss of self-esteem and identity (Bond and Mkutu, 2018; Thondhlana et al., 2020) is known as *social cost*. Intangible cost that is referred as a cost with non-monetary value such as feeling of fear or stress due to a species can also be known as social or non-material cost (Kansky, Kidd and Knight, 2016b; Thondhlana et al., 2020). Loss of family member/members due to elephants leads to disruption of family. With the loss of bread winner

of the family, particularly a male member, entire responsibility of the household shifts to the women or children (Jadhav and Barua, 2012a; Barua, Bhagwat and Jadhav, 2013). From their case study Jadhav and Barua, (2012) attempted at addressing how psycho-social consequences of human-elephant conflict impacts people's mental well-being (Jadhav and Barua, 2012a). Three subjects were chosen based on elephant fatalities between 2009-2011 and the fourth one had visited for consultation at the local mental health services following an elephant attack. The author suggested that conflicts aggravated pre-existing issues such as poverty and fatality from elephant attacks resulting in domino effect that burgeoned extant family conflicts. It was propounded from the case studies that mental health and psycho-social dimensions of HEC is complex and needs inter-disciplinary dialogue (Jadhav and Barua, 2012a). Crop raiding often leads to reduced food supply to a family, particularly women who sacrifice their nutrition intake for children (Ogra, 2008). This leads to plummeting of physical well-being of women and childcare (Barua, Bhagwat and Jadhav, 2013). Displacement of families from their traditionally cultivated lands are followed by social ruptures in family and increased stress (Barua, Bhagwat and Jadhav, 2013). In their paper, Chakraborty and Mondal (2013), mentioned that matrimonial settlements were called off in Dakaisini in Barjora block of Bankura district (West Bengal), owing to the presence a herd of elephants in Barjora forest for over a month. When the possibility of having family is disrupted by elephant invasions it creates a strong influence on the psychological set-up and behavioural space (Chakraborty and Mondal, 2013).

1.3.2.2.2a Interaction-based Cost – The cost that arises when there is actual or perceived cost on human wellbeing on account of direct or potential interaction between people and wildlife is known as *interaction-based cost*. The interaction-based cost is sub-divided into lifestyle cost and mental health cost (to be discussed later).

i. *Lifestyle Cost* – In case of wildlife conflict, the change in lifestyle usually relates to the loss of the bread winner of the family due to animal attack, in most cases a male member or head of the family. The surviving members resort to more labor-intensive livelihood activities. The spouses and children find the change in the circumstances stressful. The increase in the workload also causes disturbance in family bonds. Loss of or injury to parents to animal attacks results in the vulnerability in family demography and give rise to dysfunctional families (Thondhlana et al., 2020). In India, smallholders abandon their traditionally cultivated farms due to frequent elephant attacks. This causes social cost that can continue a lifetime but is hardly taken into consideration.

ii. *Mental health Cost* – Loss resulting from injuries or fatalities, disruption of family lifestyle and livelihood because of wildlife interaction may lead to a diminished state of psychosocial wellbeing including a feeling of negativity towards them (Jadhav and Barua, 2012b). Effort and time spent in chasing wildlife while protecting crops or property and attending to the damaged crops after a raid by elephants adds to the woes, causing diminished mental well-being especially for those who are responsible for their family's welfare (Thondhlana et al., 2020). Crop raids by elephants mean after field work in addition to their daily work, families protecting the crops at night, which results in loss of sleep and increased mental fatigue. Additionally, constant fear for the safety and welfare of loved ones and the stress of crop and property damage by wildlife leads to mental health cost (Jadhav and Barua, 2012b). Negative feelings also stem from the possibility of being confined indoors due to wildlife attacks. The incessant stress, fear and worry causes lower level of tolerance towards wildlife (Thondhlana et al., 2020).

1.3.2.2.2b Process-based Cost – The cost that is associated with the human wellbeing owing to the conservation processes like PA establishment or extension, ban on access to the PA or using resources from the PA, as well as protecting threatened wildlife which might be problematic like tigers, wolves, rhinos or elephants is called *process-based cost* (Thondhlana et al., 2020). Processed-based cost is further divided into relational cost and mental health Cost. Since Mental health cost stems from both interaction-based and process-based costs.

i. *Relational Cost* – The cost on human wellbeing that manifests as negative perception experienced by the exclusion of the local communities from decision making processes and non-inclusion of their priorities, preferences and expectations that may lead to feelings of loss of dignity, voice, freedom and personal fulfilment is known as relational cost (Thondhlana et al., 2020). It has often been observed that the local communities experience relational cost due to disproportionate distribution of power dynamics within societal framework – they become spectators or direct victims when their priorities and predicament remain unaddressed (Thondhlana et al., 2020).

ii. *Mental health Cost* – Resentment, hostility, frustration not only generates from interaction-based processes but is contributed by restrictions to movement due to presence of wildlife like elephants, rhinos or tigers, which in turn disrupts the social fabric of communities whose livelihood depends in and around PA's (Thondhlana et al., 2020).

1.3.3 Classification of Mitigation Methods

In mitigation, there is no "stand alone" method that acts as an universal solution and requires integrated approach (Fernando et al., 2008; Janaki and Raman, 2011). Various traditional methods like crop guarding, creating noise and hurling objects, and lighting fire, chili bombs are employed by smallholders to protect crops (Chakraborty and Mondal, 2013). These methods are supplemented with early warning devices set-up on the periphery of the crop fields (Fernando et al., 2008; Janaki and Raman, 2011). Long-term effective measures to address wildlife related losses would require integration of post hoc compensation with application of early warning systems and incorporation of insurance schemes (Karanth, Gupta and Vanamamalai, 2018). Adding to their frustration are the delayed payments from the government and the time they invest while pursuing compensation (Ogra and Badola, 2008). Apart from the preventative and non-preventive measures, occasionally the locals are recommended to relocate from severe conflict areas to other places with nil or reduced conflict which would act as a permanent solution for conflict (Mohanarangan et al., 2021). And though from time to time, there have been few instances of successful voluntary relocation of entire village – like in Bhadra Tiger Reserve, Nagarhole National Park and Corbett Tiger Reserve (Ramesh et al., 2019), often, the residents refuse to abandon their land, even if it means experiencing conflict continually. The reasons behind the few success stories are good governance, efficient coordination between forest department, non-government organizations and villagers and coherent compensation schemes (Lasgorceix and Kothari, 2009). When people voluntarily relocated within tiger reserves, they received resettlement package as per National Tiger Conservation Authority (NTCA) guidelines (Mohanarangan et al., 2021).

The effectiveness of mitigation measures is dependent on identification of key elements of conflict that influences individual or community's perception, feelings, attitudes, values and mindset. Visible costs rendered due to HEC exacerbates the hidden impact on the affected people. But only visible impacts predominantly configure in the compensation set-up thus causing incomplete evaluation of the hidden costs of the HEC on people's well-being. Various preventive mitigation methods like electric fence, elephant trenches, capture and translocation, bee-hive fence, chili bombs, firecrackers, and other local methods are usually employed to alleviate conflict in most countries, while non-preventive mitigation measures like ex-gratia payments, implementing financial compensation for livelihood losses and insurance are also employed as reactive measures in some countries.

Comparing various literatures (Fernando et al., 2008; Janaki and Raman, 2011; Wilson-Holt and Steele, 2019; Montgomery et al., 2021), the broad classification of mitigation measures has been fabricated in *Figure 5*.
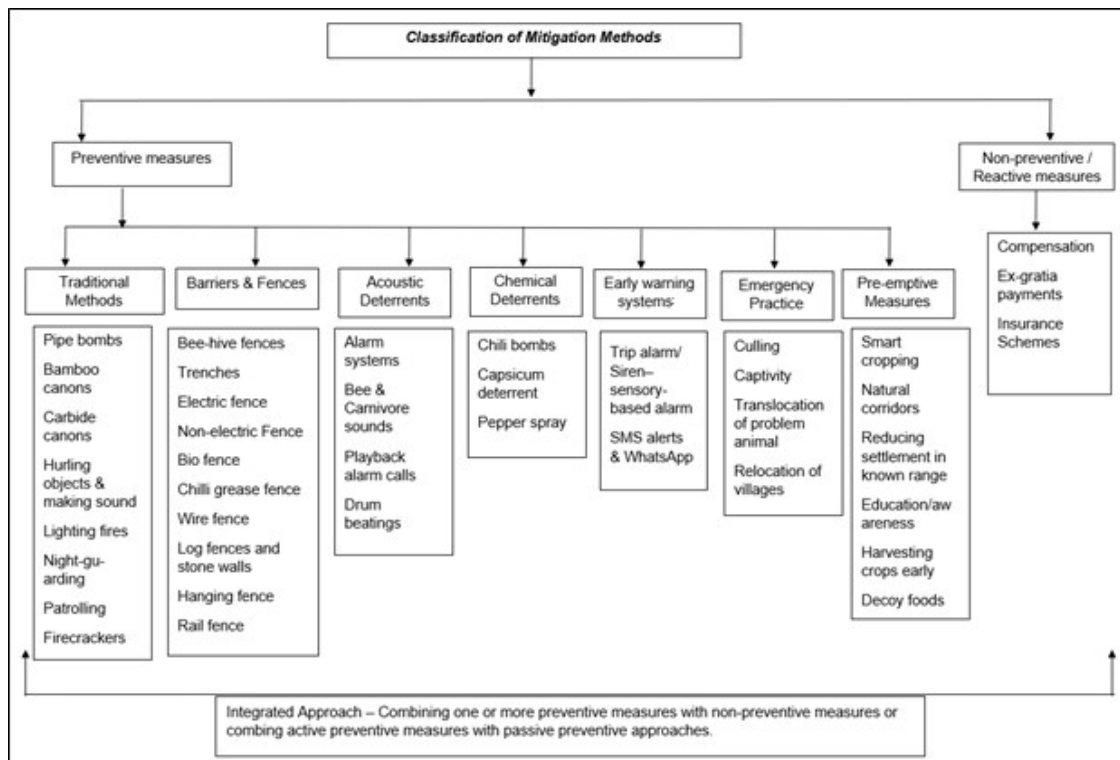
Figure 5: Classification of Mitigation Methods. Reproduced from (Fernando et al., 2008; Osei-Owusu, 2018; Panda, Thomas and Dasgupta, 2020; Montgomery et al., 2021)

1.3.2.1 Compensation

Compensation payments, a form of non-preventive method, is a scheme under which an individual or household is recompensed for the damage cause by elephants (injury and/or loss of life, damage to property/crops)as per extant rules and regulations (Desai and Riddle, 2015). No financial contribution is expected from the affected individual or household. The compensation schemes that run in Asian elephant range countries are generally funded by the government or could be managed and funded by a host of agencies such as government, private sectors like NGO's and local communities (Desai and Riddle, 2015).

Most compensation scheme covers the visible loss suffered by smallholders. Based on Kenya's WCMA (Wildlife Conservation and Management Act) 2013 compensation for loss of life and injury is KES 5 million (US\$ 46,490)** and KES 2-3 million (US\$ 18,596 – US\$27,894)** respectively (Manoa et al., 2020). A state in Western Ghats, India, that experiences HEC is Kerala. In a study examining 17,216 compensation cases by Kerala Forest Department in all 14 districts of Kerala (2009 - 2015), conflict animal was specified in 16,312 instances, while in 642 records, the generic term of "wild animal" was used. Out of these 16,954 cases, compensation was paid to 16,948 cases that amounted to INR 217,756,915 (US\$ 2,920,167.83). Out of the total compensation paid 13% was paid due to elephants, out of which 84% (14,246 cases) accounted for crop damage and human death

accounted for 2.2% (373) of these cases (Sengupta, Binoy and Radhakrishna, 2020). In another study (Karanth, Gupta and Vanamamalai, 2018) 78,656 conflict incidents reported across 18 states of India were analyzed to identify the cost incurred and associated compensations paid to the affected. The study revealed eight states listing elephant in compensation policy.

Compensation packages given out by the West Bengal Forest Department were assessed by Chakraborty and Mondal, (2013) in Barjora block of Bankura district and they observed that compensation for death due to HEC was limited to INR 100, 000 (US$ 1,341.02)**. Half of the amount of compensation was disbursed to the victim's family or individual upon receiving reports by the Forest Department and the rest was paid out after the completion of inquiry. The compensation in case of injury depended upon the doctor's prescription. Property damage compensation relied on the extent of damage. If the house was completely destroyed then INR 3000 was paid and for partial damage ex-gratia payment varied between INR 1000 to INR 1500 (Chakraborty and Mondal, 2013). In Sri Lanka, the highest amount paid to members at the loss of head of the family was Rupees 50,000 (US$ 253.14)**, loss of a family member who was not the head, the maximum amount paid Rupees 35,000 (US$ 177.20)**(Bandara and Tisdell, 2002). In Kenya, the compensation amounts prevalent from 2006 to 2013 changed when Constitution of Kenya was implemented in 2013 (Bond and Mkutu, 2018). Since 2013 the counties were delegated in the decision-making process in matters of wildlife (Bond and Mkutu, 2018). With the formation of County Wildlife Conservation and Compensation Committees (CWCCC) (Section 18-20) the compensation increased considerably (Bond and Mkutu, 2018). For human death compensation increased from KES 50,000 (US$ 465)** to KES 5 million (US$ 46,490)**, for injuries it increased from KES 200,000 (US$ 1,860)** to KES 2 million (US$18,596)** and for human injury with permanent disability it was KES 3 million (US$ 27,894)**(Bond and Mkutu, 2018). Compensations on injury depends on the extent of injury while the crop loss or crop damage remuneration or damage to property is valued at market price (Bond and Mkutu, 2018). Sometimes compensations are successful in meeting the expectations of the farmers while in some occasions they are ineffective (Saif et al., 2019a). Reasons for failure comprises of inadequate compensation, lack of understanding of individual's perception of loss or over-reporting of losses (Naughton-Treves, Grossberg and Treves, 2003; Chen et al., 2013). Although wildlife managers anticipate an increase in the tolerance level of individual through direct compensation payment, more often than not these direct compensation programs have been criticized because of its limitations to include indirect factors (Naughton-Treves, Grossberg and Treves, 2003; Ogra and Badola, 2008).

Compensation, being a non-preventative mitigation method does not lead to any reduction in crop damage. It is complex and not always effective. It disincentivized preventive measures like building defenses against animal attack and there is a tendency to exploit compensation payments by not attempting to prevent damages caused by elephants or other wildlife (Bulte and Rondeau, 2005). On the other hand deserving individuals/ households/ communities may miss out on compensation due to several obstacles like lack of awareness of schemes, time-consuming process, logistical complications, gender-based restrictions and unclear property ownership (Desai and Riddle, 2015). Delayed compensation payment would erode the trust in authorities to manage the conflict, aggravating tension between groups of people which may lead to deep-rooted conflict (Bulte and Rondeau, 2005; Thondhlana et al., 2020). In Barjora, West Bengal, victims of HEC, had applied for compensation but not received any (Chakraborty and Mondal, 2013). The delay was in assessing the damage after the ex-gratia payment claims which questions the bureaucratic inadequacies of the forest department and the government. Their futile efforts at demonstrating their dissatisfaction of failure to receive timely and proper compensation would eventually force them to take extreme measures for survival, even if it meant killing elephants (Bulte and Rondeau, 2005; Chakraborty and Mondal, 2013). Compensation schemes only cover a small part of the economic loss suffered by the smallholders. In an attempt to claim higher compensation figures, people often name elephant as the conflict species (Gubbi, 2012; Sengupta, Binoy and Radhakrishna, 2020). Gubbi (2012) observed that in Nagarhole National Park, complaints of only elephants were reported as opposed to wild boars or sambars As a mitigation measure, compensation should be considered a short-term approach, which should be eventually be replaced by other effective, long-term strategies and should only be used to support severely affected people to overcome their crisis situations (Desai and Riddle, 2015).

*(As per current rates 1 USD = Rs 74.57, KES 107.55)

1.3.2.2 Insurance Schemes as Compensation

Insurance is another type of non-preventive mitigation method where an individual, household and/or a community pays a monthly, quarterly, half-yearly or yearly premium in exchange of reparation of loss (e.g. loss of life, injury, crop and property damage) from HEC under previously agreed terms of protection and payment (Naughton-Treves, Grossberg and Treves, 2003; Desai and Riddle, 2015). On the upside, insurance may help to increase tolerance by alleviating animosity towards elephants as the insured smallholders may feel secure of being compensated of any loss they suffer. Insurance schemes are less likely to be abused by the applicants because of better transparency in terms set prior to offering the schemes. The assessors of damaged should be well-trained and non-biased in their approach while validating claims (Desai and Riddle, 2015). This method of compensation is gaining

momentum as an upgrade as opposed to the traditional method of compensation for various reasons – if actuarial analysis is the basis, then insurance can promote fair market value of insured goods by incorporation of risk factors encompassed spatially (Chen et al., 2013). Also, the net present value (NVP) could be incorporated to provide an estimate of the potential cost of losing an animal or sapling, for example, rubber, oil palm, etc. (Chen et al., 2013). Lastly, compensation based on insurance, would be sustainable if supported by multiple stakeholders, like community funds or locally generated wildlife revenue like ecotourism. Local communities can come together to raise funds that would help reduce dependence on funds from external sources (Chen et al., 2013; Desai and Riddle, 2015). Insurance-based compensation was introduced in Xishuangbanna, China in the year 2009 to compensate for losses incurred by elephant raids. The process included reporting once the crop damaged was identified so that the insurance agents can verify and compensate the loss (Chen et al., 2013). In India, state-led insurance schemes are in place while market-based options like the private insurance schemes largely remain unexplored (Ogra and Badola, 2008). Past and present insurance-based schemes, invested by countries were reviewed and found that the schemes mostly covered livestock loss and few suffering from HEC also included crop depredation, property damage, human injury and death (Wilson-Holt and Steele, 2019). However, three countries, namely Sri Lanka, Italy and Russia discontinued the insurance-based program. Insurance Corporation made a huge loss on insurance in Sri Lanka (Bandara and Tisdell, 2002), in Italy the scheme failed to augment tolerance for wolves amongst farmers and in Russia, there was a lack of interest with increasing depredation rates that ran the program into bankruptcy (Wilson-Holt and Steele, 2019). Community-based organizations (CBO) contributed directly to the pay-outs in the scheme that started in Namibia, implemented as Human Animal Conflict Self Insurance Scheme (HACSIS) in 2003, because of which it came to be known as "*self-insurance*" (Wilson-Holt and Steele, 2019). Although termed as insurance-based scheme it could neither be categorized under a strict compensation scheme nor a traditional insurance scheme as it aligned with payment for ecological services that required fulfilling some constitutional requirements (Diggle et al., 2012). The scheme included the funeral expenses and compensation for livestock death caused by lions, cheetahs, hyenas, buffaloes, crocodiles, hippos, and elephants as well as livestock loss. In case of crop depredation, damage by elephants were considered for compensation, but damage by buffaloes and hippopotamus' were only acknowledged, with the motive of incorporating them in the scheme after its success(Diggle et al., 2012). One of the requisites for applying for the scheme was measures taken by participating members to protect their crops that encouraged a robust performance-based payment and adherence to strict payment conditions. Currently Namibian government is in the process of developing a human-wildlife conflict insurance scheme that would pay for deaths or injury cause by wildlife as well as offsetting costs for

livestock loss (Wilson-Holt and Steele, 2019). In Canada, the producers do not need to pay premium to receive compensation. Payment for crop and livestock loss is administered by insurance corporations (Wilson-Holt and Steele, 2019). An insurance program, to mitigate the effects of HEC was introduced in China in 2009, funded by the government that facilitated the premium to the Yunan branch of China Pacific Property Insurance Company to cover the damage in Xishuangbanna (Wilson-Holt and Steele, 2019). From the review of all the insurance-based schemes prevalent, in only Pakistan farmers paid the premium towards their insurance fund, which was co-financed through eco-tourism activities (Wilson-Holt and Steele, 2019). Although at times, the insurance-based schemes and compensations were effective, at other times they were ineffective due to delayed payments, not offering incentives for damage prevention, and ineffective institutional arrangements to verify claims (Wilson-Holt and Steele, 2019).

As per Wilson-Holt and Steele (2019) there are four general challenges to the success of effective insurance schemes.

a. *Cost-effective insurance administration* – Verification of insurance claims are often costly and require an expert to analyze the cost. The most common method of verification across schemes is to employ a ranger or a damage expert to assess extent of damage. In Canada, assessment and the disbursement of claims is carried out by the same company which streamlines the process. In Pakistan, verification process is locally managed by the village insurance committee, which verifies the damage as well as approves the payment claims to the affect individuals. Community members are actively involved in the process and resolution of issues are quick and efficient because of local accountability. On the contrary, other countries with insurance schemes have several layers of administration through which verification must pass through, in order for claims to clear, which results in delayed payments and subsequent mistrust among communities (Hussain, 2000).

b. *Timely and fair disbursement of insurance payments* – Studies carried out by Wilson-Holt and Steele (2019) concluded local dissatisfaction towards schemes is often because of payment related issues where reduced payments are disbursed instead of actual claimed amounts. For example, in Sri Lanka, compensation for loss of life of the head of the family is capped at Rs 50,000. Payments disbursed were found to be less than 8% of the actual loss suffered (Bandara and Tisdell, 2003). Apart from disbursement of lower compensation payments, schemes also suffer long delays and inconsistencies in payments (Bandara and Tisdell, 2003). Swift verification of financial damages and timely payments are necessary to ensure lower resentments of locals towards wildlife (Nyhus et al., 2009). Success of insurance schemes was found to be dependent on adequate payments and inclination of villagers to

contribute towards the programs that would fully compensate them for their loss and any future losses incurred (Dickman, Macdonald and Macdonald, 2011). Another probable reason for inadequate payments is the non-utilization of appropriate metrics to calculate the premiums or payments (Chen et al., 2013). Research on appropriate methods of calculating premium and the subsequent claims revealed that comprehensive study on various aspects of human wildlife conflict, and in this case, human-elephant conflict like hotspots and community behaviour should be collected and organized over time to analyze the pattern of conflict and prepare reports of associated costs (Chen et al., 2013).

c. *Incentives offered for damage prevention* – A recommended method in designing insurance is to make compensations conditional on adoption of damage prevention methods that would encourage farmers to adopt measures to reduce the risks of future conflict (Boitani, Ciucci and Raganella-Pelliccioni, 2010; Ravenelle and Nyhus, 2017). A reward program for anti-predatory measures was introduced to protect livestock in case of India's snow leopard program which led to its success. The reward introduction led to better safeguarding measures, reduced attacks and an increased sense of ownership (Mishra et al., 2003).

d. *Financial sustainability of premium payments* – One of the challenges faced by insurance of human-wildlife conflict is that the affected smallholders find it hard to afford the insurance premiums so there is a need for alternative partners to co-finance schemes (Wilson-Holt and Steele, 2019). For example, in India, insurance premiums are supported by funds from NGOs and development of both local handicraft market and wildlife tourism partnership (Wilson-Holt and Steele, 2019). Financial sustainability is dependent on extensive study of conflict trends with wildlife such as the incidents rates and intensity. This information helps in apprising policy makers in assessing the level of finance required to fund a scheme (Wilson-Holt and Steele, 2019).

Like compensation schemes, insurance schemes are also expensive and complex, requiring coverage over large areas, training of assessors, education for smallholders on the schemes, and finances management. Often funds are inadequate to cover all complaints. Insurance schemes are also vulnerable to abuse where inflated damage costs are quoted, and crops grown in areas where they are more likely to get damaged. Apart from these drawbacks, substandard administration processes and corruption prevent fair and timely insurance-based compensation, and payments to few applicants can cause disputes among communities (Desai and Riddle, 2015). In Asian elephant range countries like Bangladesh, Cambodia, Lao PDR, Malaysia, Myanmar, Thailand, and Vietnam, currently has no existence of insurance schemes. While in countries like Sri Lanka it failed and in China insurance scheme was financially unstable because the company lost a lot of money in 2010 and 2011 (Wilson-Holt

and Steele, 2019). In Sri Lanka, the compensations disbursed to members of family who lost their family head or other members were financed by Insurance Corporation of Sri Lanka. The Ministry of Home Affairs paid Rs 2 million (US$ 10,125.56)** as annual insurance premium to the Insurance corporation from its budgetary allocation (Bandara and Tisdell, 2002). In 1999 the insurance company paid Rs 2.9 million (US$ 14,682.06)** as compensation to farmers in HEC affected areas (Bandara and Tisdell, 2002). However, when the compensated amount was compared to the estimated annual elephant damage by Jaywardene and de Silva, it was found that the compensation paid out by the company only covered 3-8% of the actual economic loss caused by elephants. This established the inadequacy of the scheme amount paid out to cover the actual loss (Bandara and Tisdell, 2002). A crop insurance scheme trialed in Aceh (Sumatra) failed because of non-participation of smallholders due to high premiums. The countries with crop insurance in existence are India, where it is state-led, China, where it is handled by an insurance company but the premium is supported by the government (Chen et al., 2013; Desai and Riddle, 2015; Wilson-Holt and Steele, 2019) and Malaysia where insurance schemes for tree protection are offered by insurance companies and opted by large companies but deemed too expensive for (Quilter, 2019).

From the literature above it can be observed that most countries did not introduce insurance as a method of reactive response towards human-elephant conflict, while the countries who introduced witnessed both failure and successes (Desai and Riddle, 2015). With no wildlife conflict-based schemes for smallholders (there are available schemes for large plantations) or government compensation schemes in Malaysia for smallholders, it remains to be seen whether smallholders would choose insurance as a means of protecting their crops along with preventive measures. Despite the limitations of insurance-based schemes, like it is with any other means of mitigation, smallholders should be provided an opportunity to select their preference.

1.3.4 Attitude and Tolerance Towards Elephants

Attitudes are defined as "*dispositions or tendencies to respond with some degree of favorableness or not, to a psychological object, the psychological object being any discernible aspect of an individual's world, including an object, a person, an issue or a behaviour*" (Fishbein and Ajzen, 2011). Although behaviours not always partake in predicting attitudes but positive attitudes towards an object are necessary conditions for behaviours (Kansky and Knight, 2014). Also, the concept of tolerance in the studies of human-wildlife conflict has been used interchangeably with attitude (Naughton-Treves, Grossberg and Treves, 2003), although tolerance can take both attitudinal and behavioural forms (Bruskotter and Wilson, 2014). The definition of tolerance according to Oxford English Dictionary is "*the action of bearing hardship,*

or the ability to bear pain and hardship", which can be described in terms of wildlife research as *the proportion of individuals who have a positive attitude towards a species group despite suffering damage by that species group* (Kansky, Kidd and Knight, 2014). In conflict management of wildlife, research on attitude provides insight on stakeholder's preference for managing options. Kansky, Kidd and Knight (2014) conducted meta-analysis of English peer-reviewed journals that were published from 1 January 1990 through March 2011, quantifying the attitude of stakeholders who had experienced direct conflict with medium and large-sized carnivores, elephants, primates, and ungulates. Publications that concerned attitude of individuals without any direct conflict with wildlife were excluded because general population would have positive attitude towards wildlife as they are not directly affected (Kansky, Kidd and Knight, 2014). Study revealed that the respondents' were more tolerant towards elephant damage than carnivore damage while tolerance remained proportional to the damage caused by primates and ungulates (Kansky, Kidd and Knight, 2014). The positive attitude towards elephants could be because of the positive cultural symbolism of elephants. Communal farmers (small-scale crop and animal producers who produce for either sale or subsistence) were found to be more tolerant towards elephants, ungulates and primates and less positive towards carnivores but a section of them were open to adapting to living with damage causing wildlife (Kansky, Kidd and Knight, 2014). Another meta-analysis by Kansky and Knight (2014) where individuals with no direct contact with wildlife were excluded to reduce risk of sampling bias found that intangible costs were ten times more significant than tangible costs in explaining attitude (Kansky and Knight, 2014). Five tolerance indicators were identified – 1) *Spatial* – tolerance to spatial proximity(the acceptable distance of wildlife within the bounds of the space that humans and wildlife share), 2) *Damage* – tolerance to accept monetary cost due to a species, 3) *Killing* – tolerance to killing under circumstances to remove wildlife from property, 4*) Population size* – acceptable population size of a species, and 5) *Prevention* – ability and willingness of individuals to undergo costs to engage in mitigation measures that are effective, sustainable, legal and conforms to welfare norms (Kansky, Kidd and Knight, 2016a).

Malaysia has witnessed a positive shift in the overall attitude of the population over the past 80 years from being generally lethargic and apathetic towards biodiversity conservation because of rapid urbanizations and socio-economic transformation (Guérin et al., 2017). Study survey carried out by Tan et. al (2020) between June 2016 and December 2017 in Malaysia divulged that overall rural tolerance towards megafauna species was relatively low, with less than 10% of the rural participants willing to accommodate their existence within 10 kms of their homes , which suggest that urban citizens did not associate the costs of living with megafauna while the rural population have to bear it, which highlight the cost of conflict as one of the key

drivers that influences people's attitude towards conflict-prone species (Tan et al., 2020). Factors affecting attitude also include social influences, cultural norms, expectations, and beliefs. Animals have always been part of folk-lore and their representation in good or bad light plays an important role in determining attitude of people towards them and towards conflict or damage caused by them (Dickman, 2010). From the field study on assessment of attitude of the villagers in Viharamahadevipura village, located adjacent to Yala National Park (YNP), Sri Lanka, disclosed a general idea of tolerance with unanimous opposition towards any extreme retaliatory action against elephants (de Silva and Srinivasan, 2019). Despite experiencing significant impacts of HEC, villagers in this area were sympathetic towards elephants, stemming from awareness that these majestic creatures inhabited the landscapes way before humans (de Silva and Srinivasan, 2019). Elephants have also been religious and cultural symbols through India, Sri Lanka, and Thailand where they are revered. In his study area in West Bengal, Kulandaivel (2010) had shared that the communities were initially tolerant towards the elephants because their presence was considered auspicious and signified prosperity (Kulandaivel, 2010). But frequent crop raiding left the community members agitated. However, Chowdhury (2004) in his case studies from the Northeastern India mentioned locals were more tolerant towards elephant because they attracted tourists (Choudhury, 2004). The study carried out in five villages within a 2km periphery of Patharia Hills Reserve Forest (PHRF), Assam, India showed polarized views on attitude towards elephant conservation (Talukdar and Choudhury, 2020). Respondents from villages in the northern part of PHRF were positive about elephant conservation because they never experienced HEC and elephants never visited their side (Talukdar and Choudhury, 2020). Responses were different for those who faced HEC and were fearful of the consequences of increased elephant population due to conservation. Crop loss was also the sole factor for increased intolerance against elephants (Talukdar and Choudhury, 2020). Various social, economic, cultural and behavioural factors are responsible in influencing tolerance and eventually affecting the attitude of individuals or communities towards elephants (Dickman, 2010).

1.3.5 Smallholders in Peninsular Malaysia
Generic definition of a smallholder is a farmer who derives his/ her income from a holding of an area that is subjected to the type of crop that the growers choose to grow as well as own 10-20 heads of livestock (Narayanan and Gulati, 2002). The area of land considered to be under smallholders' ownership varies between 2 to 5 ha worldwide (or 4.94 – 12.36 acres) ('Water Resources Research', 1969; Narayanan and Gulati, 2002; Panichvejsunti et al., 2018) (*Table1*). However, the oil palm and rubber industry in Malaysia is categorized into *i)*

plantations owned by large businesses or conglomerates, *ii*) smallholders and *iii*) state-scheme or government-owned plantations (Azman et al., 2018; Rahman, 2020).

Table 1: Comparison of area allocated to smallholders in different countries based on various research papers (Narayanan and Gulati, 2002; Jayne et al., 2003; Shajaat Ali, 2005; Lowder, Skoet and Raney, 2016; Aznie et al., 2018)

Country	Smallholder Farm Capacity (ha)
India	< 2 - 5, sometimes < 0.2
Bangladesh	< 0.5
Africa	2.7 ha in Kenya and Zambia to 0.71 ha in Rwanda
Worldwide	72% - <1 ha 12% - 1-2 ha 10% - 2-5 ha 3% - 5-10 ha 2% - over 20 ha 1% 10-20 ha (The figures are based on the estimate of each country from the World Agricultural Census 1990 and 2000 rounds)
Malaysia	< 40.46

In Malaysia, oil palm smallholder estates are frequently family-owned that depend on generations of family and migrant labour. It remains widely known that the independent smallholders are relatively old and need work force for harvesting and Fresh Fruit Bunch collection so they resort to hiring illegal foreign workers (Rahman, 2020). For many families oil palm is the primary source of cash income, while supplementary crops are grown or consumption and subsistence (Azman et al., 2018; Rahman, 2020). Many of the smallholders also belong to the indigenous communities who may or may have land title but have lived on and used the area through generations. Smallholder sector in Malaysia is split into 2categories into *i) organized* and *ii) independent* smallholder (Figure 2), differentiated by the support extended to them either by the government or different agencies (Aznie et al., 2018).

i)Organized smallholders are growers who are supported and supervised by the agencies like FELDA, RISDA, FELCRA and State Land Schemes by providing technical assistance and agricultural inputs or financing. The support includes supplying saplings, fertilizers, and pesticides to the growers at the time of planting and during replanting. The number of organised smallholders in Malaysia as calculated in 2019 was 315,293 (Senawi et al., 2019)

ii)Independent smallholders are growers with land title or customary rights, who own or lease 100 acres (40.46 ha) of land or lesser and manage it themselves or employ workers (Senawi et al., 2019). They are not assisted directly by the government or private agencies (Awang et

al., 2016; Yew et al., 2016). They tend to be self-organized, self-managed, self-financed and have more autonomy over land usage, choice of crops to cultivate and its management (Nagiah and Azmi, 2012). As of December 2019 there were 187,188 independent smallholders in Peninsular Malaysia (Rahman, 2020)

In general, rural and other indigenous smallholders find it difficult to access the mills and markets given their distant locations (Rahman, 2020). Despite independent smallholders being better placed at bargaining for best price for their crops because they tend to sell their yield directly to the traders of the local mills as they are not contractually bound, there is still uncertainty over the price offered to them by the traders which may not be as much as they would expect. Since they are not a part of an extensional scheme, they are offered limited institutional, technical, and financial support and knowledge of best practices and new technologies are not extended to them (Nagiah and Azmi, 2012). With restricted or no access to the wider market and millers they have to depend on the middlemen to collect their harvests (Nagiah and Azmi, 2012). They may receive some support in terms of seeds, fertilizer, and manpower or extension services from the government agencies (RSPO, 2010). Although financial and agronomic assistance are extended to the organized smallholders and also to independent smallholders who are grouped into Sustainable Palm Oil Clusters (SPOC) under MPOB Malaysian Sustainable Palm Oil (MSPO) certification, only a small section of independent (24.82%) and large proportion of organized (99.07%) smallholders are certified as of 31st May 2020.

Independent smallholder community, being a small-scale production entity is often perceived to be inefficient and unproductive as compared to the large estate plantations (Rahman et al., 2008). However, they play a significant role in the development of the palm oil industry by overall supply chain as their cumulative size is comparatively large (Rahman et al., 2008). Independent smallholders of Malaysia and Indonesia together contribute substantially towards the production of world's palm oil, which is about 85% of the total output and accounts for about 40% of the total planted area (Senawi et al., 2019). However, Hiyadat (2015) emphasized on the vulnerability of the smallholders is due to their lack of knowledge in maintaining their farm, lack of financial support and uncertainty about accessible market price (Hidayat, Glasbergen and Offermans, 2015). Apart from the usual challenges faced by the smallholders like maintenance, logistics, point of sale, lack of financial support and affordability to acquire seedlings and fertilizers, reliance on the dealers for selling products, vulnerability to highly volatile market price and weather factor (Aznie et al., 2018), there is another challenge that is faced by smallholders but that has not been explored in any research – crop raids by elephants and subsequent loss sustained by them.

1.3.6 Expansion of Oil palm and Rubber Plantations in Malaysia

The area of oil palm and rubber in Malaysia is estimated to be at 5.9 million hectares and 1.083 million hectares respectively (Malaysian Palm Oil Board, 2019; Malaysian Rubber Board, 2019). While the planted area of oil palm has peaked over the years, the planted hectarage of rubber has reduced over the years due to the fall in prices in the global market since 1965 so the profitable oil palm production was given priority. From a mere 4% of Peninsular Malaysia's total land area covered by oil palm in 1975, it increased to 15% by 2000 (Abdullah and Hezri, 2008). Because of its importance as one of the significant tropical crops, its contribution to world economy and owing to its use in multiple industries, there is a growing demand to meet the extensive consumption of oil palm (Aznie et al., 2018; Tanuwidjaja, 2020). Due to the need for cash income many smallholders switched to oil palm cultivation from the cash crops (Rahman, 2020). Even RISDA offered replanting subsidies to farmers who opted to switch to oil palm (Rahman, 2020). As per MPOB reports in 2017 the area of oil palm in Malaysia was 5.8 million ha, out of which 979,758 ha (16.9%) was run by independent smallholders. Their planted area in 2017 was 538,490 ha, of which 30.7% was in Johor, followed by Perak (17.8%), Sarawak (15.3%), Sabah (14.2%), and Selangor (8.7%), while the remaining 13.3% accounted for the rest of the states (Azman et al., 2018). In Peninsular Malaysia itself 175,630 independent smallholders were present in 2017. Looking at the MPOB report for the past 19 years (2000-2019), it can be deduced that the cultivated area of oil palm has been growing steadily due to demand of the product. Forest loss first occurred with the expansion of rubber in the early mid-20th century and then by oil palm from 1960s onwards (Miyamoto et al., 2014). According to Koh and Wilcove (2008), during a span of 15 years, from 1990 to 2005, around 55%-59% (1,040,000 ha – 1,109,000 ha) of oil palm expansion in Malaysia can be attributed to conversion of forests and 41%-45% (765,000 ha - 834,000 ha) of oil palm expansion was due to pre-existing cropland (Koh and Wilcove, 2008). MPOB report in 2019 states that the planted area of oil palm increased from 5.85 million ha in 2018 to 5.90 million ha in 2019 which inferred that the area of oil palm plantation increased steadily by 0.05 million ha in a span of 2 years from 2017 to 2019.

**Category of Oil Palm Producers
(December 2019)**

RISDA 72,444 million hectares

State schemes/goverment agencies 327,396 million hectares

FELCRA 185,005 million hectares

FELDA 723,545 million hectares

Independent smallholders 986,331 million hectares

Private estates/Plantations 3,605,436 million hectares

- Private estates/ Plantations - 61.1%
- Independent smallholders - 16.7%
- FELDA - 12.3%
- FELCRA - 3.1%
- RISDA - 1.2%
- State scheme/Government agencies - 5.5%

Figure 6: Category of Malaysian Oil palm Producers as of December 2019
FELDA – Federal Land Development Authority
FELCRA – Federal Land Consolidation and Rehabilitation Authority
RISDA – Rubber Industry Smallholders' Development Authority
Data Source: MPOB 2020 (Kadir, 2020)

But the expansion came at a cost – deforestation. First, with the expansion of rubber (in the early mid-20th century) and then oil palm (1960s onwards) (Miyamoto et al., 2014).
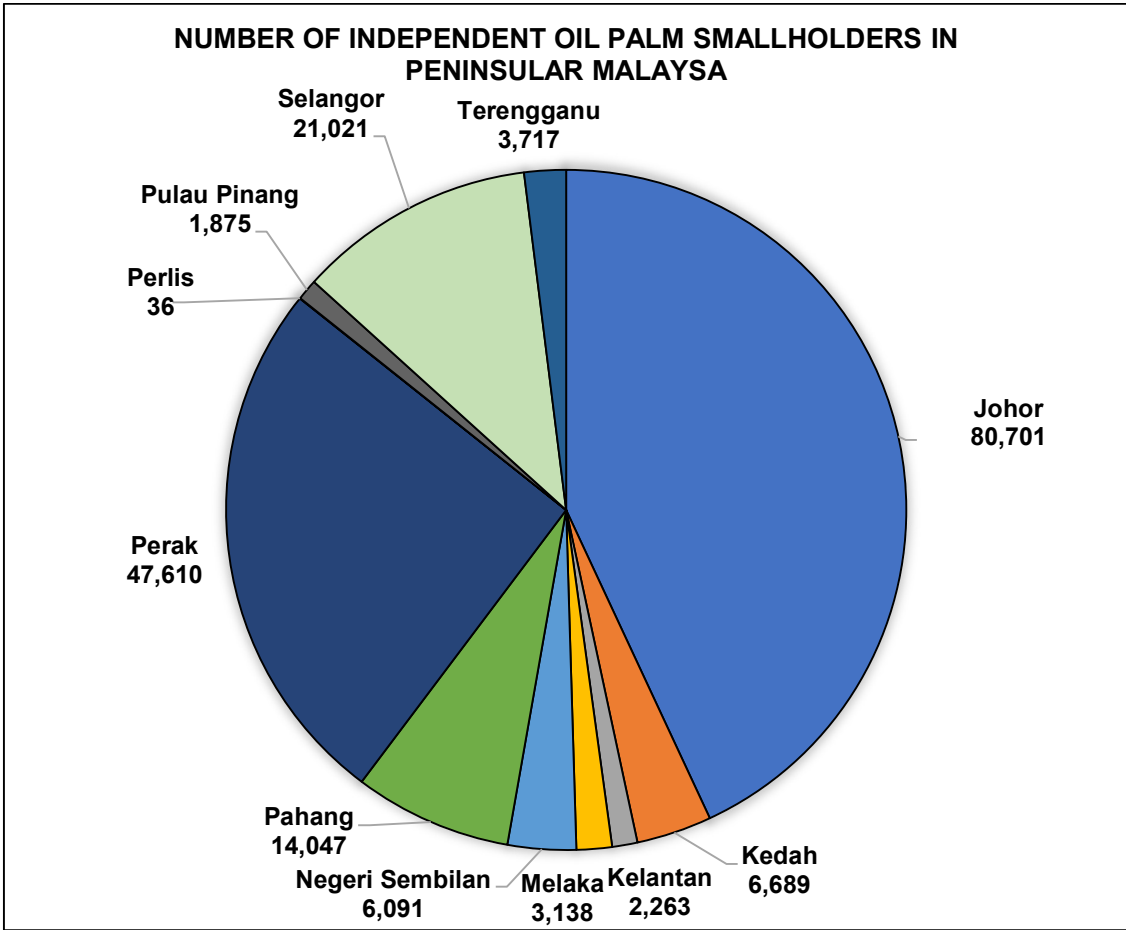
Figure 7: Population of Independent Oil Palm Smallholders in different states of Peninsular Malaysia;
Data Source: MPOB (2020)(Rahman, 2020)

2.0 METHODS

2.1 Study Sites

The selection of the sites to conduct survey was based on the presence of smallholders in the area where Management & Ecology of Malaysian Elephants are conducting their research work and where human-elephant interaction had been observed by the smallholders. There are six states within Peninsular Malaysia with reported HEC cases (Kedah, Perak, Terengganu, Kelantan, Pahang, and Johor) and three states for this study. Perak, Pahang, and Johor were selected representing the northern, east coast and southern regions of Peninsular Malaysia, respectively.

Perak, located on the western part of Peninsular Malaysia, covers an area of 21,035 km² and among its major towns Kuala Kangsar, Ipoh and Taiping. The area of Sungai Siput (4º57'21.6"N, 101º8'13.2"E) in Kuala Kangsar district and Chepor (5º6'10.8"N, 101º0'28.799"E) in Lenggong district were selected to conduct the survey. We obtained responses of 41 respondents from Perak. The villages - Kampung Padang (Kuala Tahan), Kampung Pagi and Kampung Paya Garuk in Jerantut, the largest district is the state of Pahang, were chosen as the place for survey in the east coast. In the state of Pahang, the villages – Kampung Padang (Kuala Tahan), Kampung Pagi and Kampung Paya Garuk in the district of Jerantut were chosen as the place for survey in the east coast.

The state of Johor has 80,701 independent smallholders and approximately 113 elephants (census 2008-09) (Zafir and Magintan, 2016), with high incidents of HEC, so four districts of Johor were selected to conduct the survey, namely, Kluang, Kota Tinggi, Mersing and Segamat.

During the tenure of my stay, Covid-19 pandemic broke out in Malaysia because of which Malaysia went under lockdown so inter-state travel was banned. Part of the data was collected in Perak when travel restrictions were partially lifted. By the time we were supposed to start data collection in the third phase lockdown was announced in October 2020, which restricted our movement. The irregular number of respondents across the three states was due to inter-state travel restrictions imposed by the government to curb Covid-19 outbreaks. I am thankful to our collaborators from Wildlife Conservation Society (WCS) who were able to complete the data collection in Johor and few smallholders they were able to contact in Pahang on our978+ behalf.
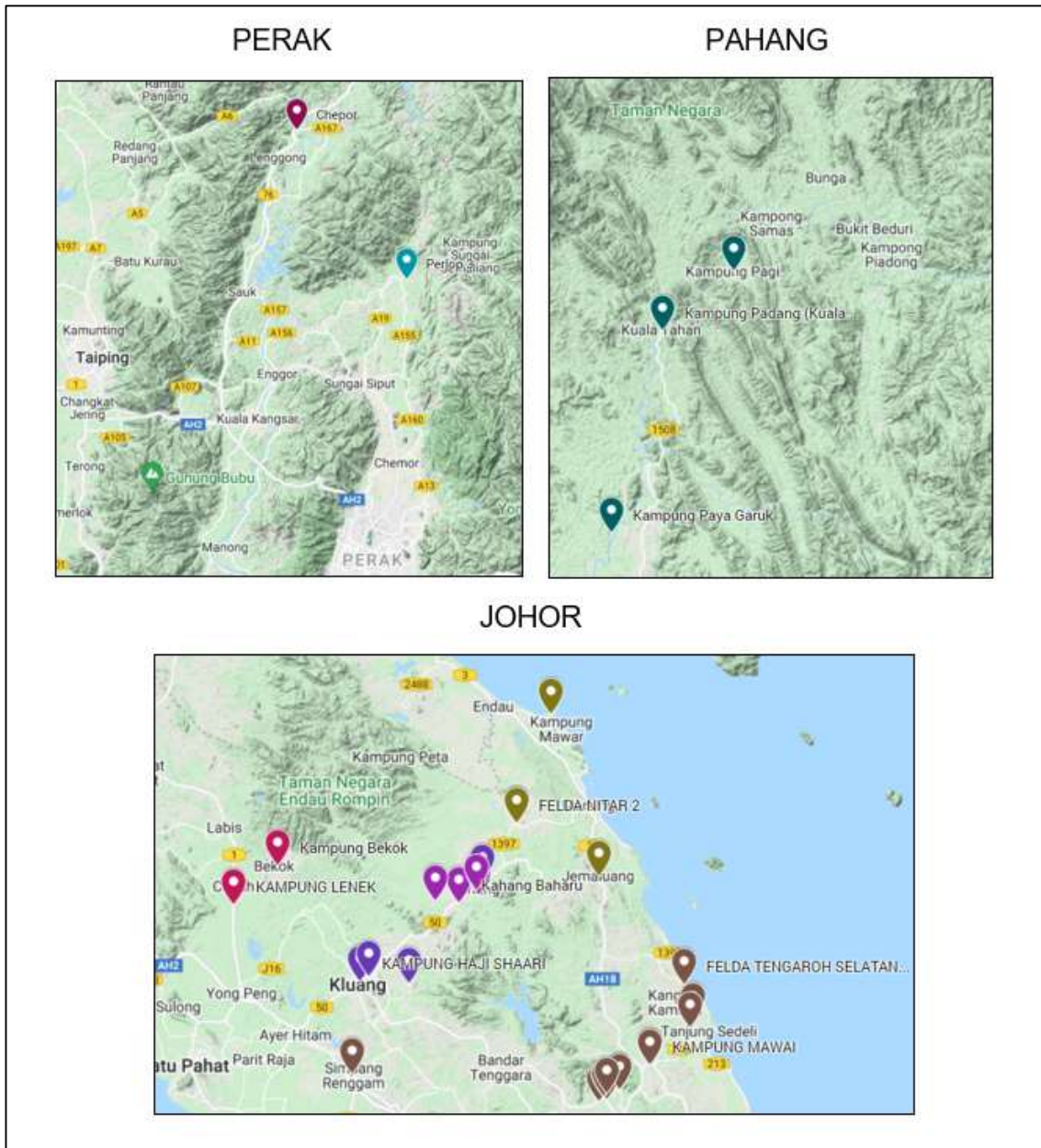
Figure 8: Map of the survey sites

2.2 Development of Questionnaire

The questionnaire was developed based on the information required to assess visible and hidden cost of human-elephant conflict and the feasibility of insurance as a financial tool. A section of hidden or intangible cost was adapted from Saif et al.(2019a). The validity of the questionnaire was ascertained by internal experts (supervisor and co-supervisor) and external experts (i.e., Wildlife Conservation Society, Dr. Ahimsa Campos-Arceiz).

The questionnaire was initially written in English, and later translated to Bahasa Melayu (BM. We initially conducted a pilot test for the questionnaire in the field to test the flow of the questionnaire and the understanding of the questions before conducting the large-scale interviews. Based on the responses received from the pilot interviews we adjusted few questions to avoid ambiguity and phrases which could be misinterpreted.

Questionnaire was designed with mostly close-ended questions to make self-administration easy. However, most smallholders were assisted in filling the questionnaire as they were not confident of filling the questionnaire on their own. Participants were encouraged to share their comments and experiences in the "Comment" section of the questionnaire. The benefit of self-administered questionnaire was the ability to cover a substantial number of people in a relatively short span of time. The respondents were questioned about their household demography, their socio-economic characteristics (information like gender, age, level of education, marital status, number of children, ethnicity, religion, income, and land size) and the mitigation measures that are employed by them. Respondents were asked of conflict instances in the past two years (2019 and 2020) related to crop depredation. In addition to requesting for socio-demographic information, the participants were requested to fill questions on visible loss like costs involving purchase of seedlings, fertilizers, pesticides, or employment of labourers to work on the farm after elephant raids. Few other important variables on hidden cost, willingness and attitude included "*The reason smallholders find it difficult living with elephants*", "*Are smallholders willing to pay premium to insure your crops against damage?*", "*If smallholders are willing to pay, how much are they willing to invest?*", "*If guarding crops in the night leave them exhausted which prevents them from applying for other jobs*", "*If children are involved in guarding crops which affects their attendance in school*" and "*If there are benefits to having elephants*".

2.3 Sampling and Recruitment

The snowball technique, also known as Chain-referral-sampling is a method by which contact is made with the initial subject of convenience who serves as "seed" through which wave 1 subject is recruited, who in turn recruits wave 2 subjects (Etikan, 2016). This method is practised when potential participants are difficult to find. My study required travelling to distant villages to interview smallholders to comprehend the extent of the losses they face. Because of the ongoing Covid-19 crisis along with the implementation of Movement Control Order (MCO) frequent travel to other states was restricted and the best available method of sampling was snowballing technique. Contact was established through emails with MPOB managers who extended their assistance by providing few smallholder contacts in Sungai Siput, with whom we connected over calls. Only after the lockdown was partially lifted, arrangements

were made for conducting questionnaire on the ground. In Gerik, I was accompanied by a PhD candidate who volunteered to assist in eliciting information from villagers of areas which suffered from frequent elephant raids. The visits to the villages were dependent on the contacts shared by MPOB. One focus group discussion was held during the interviews in Gerik. A potential respondent introduced a FELCRA manager who offered to organize the interview and gather the willing smallholders. With locations in Perak confirmed, we moved to Johor to conduct the questionnaire where Wildlife Conservation Society (WCS) members offered to assist in collecting data and even collected few responses from Pahang.

2.4 Study Ethics

Ethics Approval – The study required us to conduct face-to-face interviews with smallholders, so ethics approval for research studies involving human participants from the Science & Engineering Research Ethics Committee (SEREC) under University of Nottingham was obtained (*Application identification number – SS041218*). Due to the ongoing pandemic, necessary Standard Operating Procedures (SOP) to enforce social distancing, putting on masks to prevent spread of Covid-19 were followed during interviews. Before we began the interview, the participants were read their right to withdraw at any given time.

Participant Consent Forms & Participant Information Form – Two Participant Consent Forms and a Participant Information Form were distributed among all. The Participant Form explained their rights, while the Participant Information sheet included the title of the project, a short description of the project, the benefits of the research and risks if any, along with my and my supervisor's details. Both the forms were translated in Malay for easy reference. Those smallholders willing to partake in the survey were requested to provide their consent by signing the "Participant Form" before initiating the survey.

2.5 Data Collection Technique

Mixed research approach, a method that comprises of collecting, analysing, and integrating quantitative data (e.g., survey) and qualitative data (e.g., interviews) was used for data collection as relying on either quantitative or qualitative method alone would not have yielded the appropriate data.

The qualitative approaches used were face-to-face interviews. Quantitative methods included numerical comparisons between types of financial loss, extent of agreement or disagreement to statement, statistical analysis to determine correlations between attitude and visible and hidden cost variables.

Both quantitative and qualitative data collection was carried out over a period of five months, from July to November 2020 with intermittent breaks due to Covid lockdown. A lot of information regarding types of crops smallholders grow, crop raids by different wildlife, if any kind of support is received from the government or other agencies after crop raids, if they are willing to pay to secure their farm and their feelings about elephants were collected during in-depth interviews with villagers. Quantitative data collection was limited to the structured questionnaire. Most of the interviews were conducted in office spaces since we had coordinated and planned with the concerned contacts. The ones conducted in Orang Asli villages were usually at the headman's house or a space dedicated for gatherings where the headman informed the members of the community to attend on their own free will. There were also instances of door-to-door interviews conducted by WCS. During the interview schedule, a research assistant (RA) and some interns helped with translating the responses that were in Malay. Interviews were conducted by MEME staff/members, RA and interns, while in Johor and Pahang WCS also assisted. Refreshments were offered to the participants during the interviews. No payments were given to the respondents.

2.6 Data Analysis

Descriptive analysis covering the value of frequency, percentage, median and standard deviation of monetary damages (purchase cost of sapling, fertilizer, pesticide, employment of labour, establishment, and repair of mitigation methods) incurred by the smallholders was analysed using Microsoft Excel and IBM SPSS *version 27*. Median is the value located on the second quartile representing the middle-positioned value, when the responses were ordered from small to large. Bar graphs were also used to depict values.

Before running the ordinal analysis, correlation between the independent variables were examined and Chi-square was conducted on SPSS to check for significant effect of the independent variables. But running only chi-square would not indicate the level of significance of the independent variables on the response variable, so ordinal regression was conducted to obtain those particulars.

Since the number of "Disagree" and "Strongly disagree" were relatively fewer in number hence "Agree" and "Strongly agree" was collated under agreement and "Disagree" and "Strongly disagree" was collated under disagreement.

Ordinal Logistic Regression

To examine the possible associations between dependent and independent variables ordinal regression analysis was carried out. And only the ones with significant values ($p > 0.05$) were

included in results. A list of response variables (*Table 2*) was tested against a list of explanatory variables (*Table 3*)

Table 2: List of response variables

	Response Variables
Reason why smallholders find it difficult living with elephants in the area	Need to be always vigilant
	Exhausted guarding crops
	Worry about safety of my children
	Worry about my safety
Opportunity Loss	Plan to apply for another job
	If children or young siblings miss school
Reason why smallholders find it difficult to deploy mitigation measures	Mitigation Cost is high
	Lack of knowledge
	Need support to set-up
	Failed past attempts
	Mitigation not Needed
Attitude	37b. As more forests are fragmented, elephants will move closer to human habitat
	Q37c. My tradition and culture from my grandparent's days until now, encourage me to live harmoniously with elephants.
	Q37e. Protecting elephants will only make conflict worse
	Q37k. The law is not fair to planters
	Q37m. My family and I will feel happy if there are no elephants in this area.
	Q37n. If given an option, are you willing to relocate (move from one place to another) to another village where the villages experience less or no elephant raids
	Q37r. I feel pity for the elephants sometimes
	Q37s. I feel there are benefits to having elephants.
Willingness to invest in crop insurance	Q27. Investment in life insurance
	Q31. If insuring crops will help to protect against any damage

Table 3: List of explanatory variables

	Explanatory Variables
Socio-economic characteristics	Gender
	Age
	Income
	Ethnicity
	Religion
	Marital Status
	Highest Level of Education
	Number of children in a household
Age and parts of damaged trees	Q12a_AgeOfOPDamage_Years
	Q12a_PartsOfOPDamaged
Visible Loss	Q12a_OP_TotalLoss_Seedling_RM
	Q12a_OP_TotalLabourLoss_RM
	Q12a_OP_TotalFertilizerCost_
	Q12a_OP_Pesticide_
Type of tree damage	Q12a_Permanent
Types of damage due to conflict	Q9_KindOfConflict_CropRaid_DamageByTrampling
	Q9_KindOfConflict_PropertyDamage
	Q9_KindOfConflict_InjuryToHumans
	Q9_KindOfConflict_CausingHumanDeath
Distance of the farm and house	Q19_LocationSameAsHouse
Types of mitigation methods	Q14d_NightGuarding
	Q14e_Firecrackers
	Q14_BambooCanons
Loss of labour time due to crop raiding	Q26_DuringElephantRaids_AmountOfLabourTimeLost
Attempt of mitigation in the past	Q13_MitigationINPastYears
Support received by smallholders	Q29_ReceiveAnySupport
Reason why smallholders find it difficult living with elephants in the area	Need to be always vigilant
	Exhausted guarding crops
	Worry about safety of my children
	Worry about my safety

3.0 RESULTS

3.1 Socio-economic characteristics of respondents

The study took place across 3 states, mainly in Johor (*n=123*) with few respondents in Perak (*n=41*) and Pahang (*n=9*) due to the ongoing pandemic. In total, we were able to obtain 173 responses from independent and organised smallholders, but we had to remove four respondents who did not mention their gender and left most of the questionnaire unanswered, reducing the total number to 169. Out of 169 respondents, 84% (142) consisted of independent smallholders while the rest were organised smallholders (27). Social class denotes one's position in the society measured by subjective indicators of resources such as income, and level of education (Diemer et al., 2013). Respondents were predominantly male (83% of the total number of participants) with 53% (75) having completed their secondary education, 35% (50), completing primary education, and few with no formal education (6). Most of the participants attending the interview were married (133), among them 87% (116) had children, out of whom 70% had children who were over 18 years of age (81). Household members averaged to 6 members (SD=±4) with an average of 3 children (SD=±3) per household. The age of the participants ranged from 23 years to 90 years (median=56, mean+SD=53±16.13). Three-quarter of the respondents (N=169) practised Islam, followed by Buddhism. Majority of the ethnic group were Malays (74%), followed by Chinese (18%). Farming was cited as the primary source of income for 62.72% (106) of the respondents, while it was not the only source of livelihood for 37.28% (63) of the respondents. The additional means of income varied from fishing, contractor jobs, patrolling, running a food stall, and pursuing other jobs. The income bracket (in RM) of most of the participants varied between "< RM 1000 per month" (31%) and "RM 1001- RM 2000 per month" (36%). However, there were 6 participants who earned more than RM 5000 per month.

3.2 Land size and types of crops cultivated by the smallholders

More than 50% (97) of the growers cultivated only oil palm, while the rest harvested rubber, durian, banana, and other vegetables or combination of these (*Table 5*). The average land size of the smallholders was calculated at 7 (SD = ±0.48) acres.

3.3 Conflict with wildlife

Out of 160 participants 93.75% (150) mentioned experiencing conflict in the past 5 years (the timeline to be considered - 5 years from the time interview was conducted). The list of conflict animals in the questionnaire provided to the smallholders had wild boars, elephants, macaques, civets, tigers, and porcupines – all collated from the pilot survey. But options were provided to respondents to add others and there were additional records of goats, cows, buffaloes, rats, pythons, and dogs.

Table 4: Socio-economic characteristics of the respondents. Percentages given within parentheses.

Variable	Factors	Independent Planters (142)	Organised Planters (27)	Both (N=169)
Gender	Male	117 (82)	24 (89)	141 (83)
	Female	25 (18)	3 (11)	28 (17)
Age (years)	< 40	29 (20)	15 (56)	44 (26)
	41 - 60	58 (41)	5 (18)	63 (37)
	> 60	53 (37)	7 (26)	60 (36)
	No Response	2 (1)	0 (0)	2 (1)
Education	None	8 (6)	0 (0)	8 (5)
	Primary	57 (40)	3 (11)	60 (36)
	Secondary	51 (36)	15 (56)	66 (39)
	Tertiary	10 (7)	5 (19)	15 (9)
	Graduate	8 (6)	2 (7)	10 (6)
	No Response	8 (6)	2 (7)	10 (6)
Religion	Buddhism	27 (19)	0 (0)	27 (16)
	Islam	100 (70)	27 (100)	127 (75)
	Hinduism	2 (1)	0 (0)	2 (1)
	Christianity	1 (1)	0 (0)	1 (1)
	None	9 (6)	0 (0)	9 (5)
	No Response	3 (2)	0 (0)	3 (2)
Ethnicity	Chinese	31 (22)	0 (0)	31 (18)
	Malay	98 (69)	27 (100)	125 (74)
	Indian	3 (2)	0 (0)	3 (2)
	Orang Asli	9 (6)	0 (0)	9 (5)
	Other	1 (1)	0 (0)	1 (1)
Marital Status	Married	118 (83)	15 (56)	133 (79)
	Single	13 (9)	9 (33)	22 (13)
	Divorced	3 (2)	1 (4)	4 (2)
	Widowed	6 (4)	1 (4)	7 (4)
	No Response	2 (1)	1 (4)	3 (2)
Income	<1000	44 (31)	8 (30)	52 (31)
	1001 - 2000	49 (35)	12 (44)	61 36)
	>2000	36 (25)	5 (19)	41 (24)

Out of the 12 conflict animals, Asian elephant (*Elephas maximus*) ranked first among the top-ranking conflict animals, while 33% (55) selected wild boar (*Sus scrofa*). Choices for types of damage as provided to the smallholders were not restricted to only one option, so few selected more than one. Crop depredation and trampling remained the most common damage type caused by elephants (67%), followed by crop damage together with property damage (20%), crop damage together with human injuries (2.5%), and crop damage together with human deaths (2.5%). Between 2019 and 2020 an average of 6.4 conflict incidents/year.
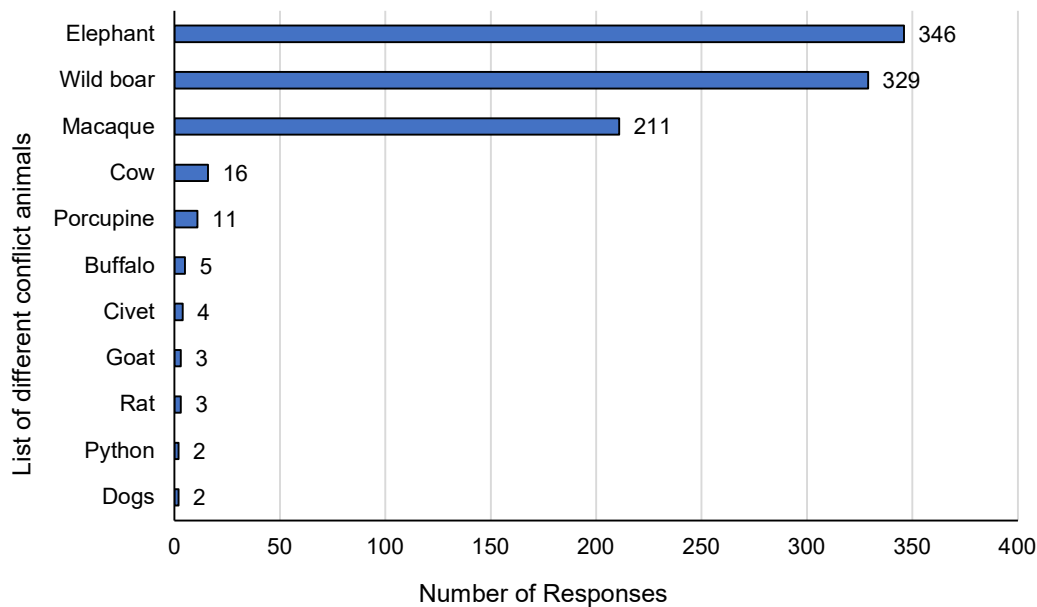
Figure 9: Top ranking Conflict Animals

There were 140 respondents who experienced conflict with a median value of 5 (min=1, max=365), of which 101 respondents mentioned elephants raided farms 10 times or less in two years. Conflict did not follow a pattern and remained unpredictable (78%).

Table 5: The type of crops grown by the smallholders. Frequency denotes number of participants who grew the crops, and the percentage signifies the section of smallholders growing single or combination of crops (169).

Type of crops grown	Frequency	Percentage of growers (%)
Oil palm	92	54.44%
Rubber	8	4.73%
Oil palm + Rubber	6	3.55%
Oil palm + Others	34	20.12%
Rubber + Others	7	4.14%
Others	22	13.02%

3.4 Types of Visible Cost

While range for age and part of crops most likely to be damaged by elephants was provided as categories for both oil palm and rubber, for durian and banana the section was left blank for the respondents to complete. We received different responses on the age of the damaged crops. However, the preference of elephants for "<3" years and "6-10" years of age crops were common among all the 4 variety (*Table 6*).

A.   B.
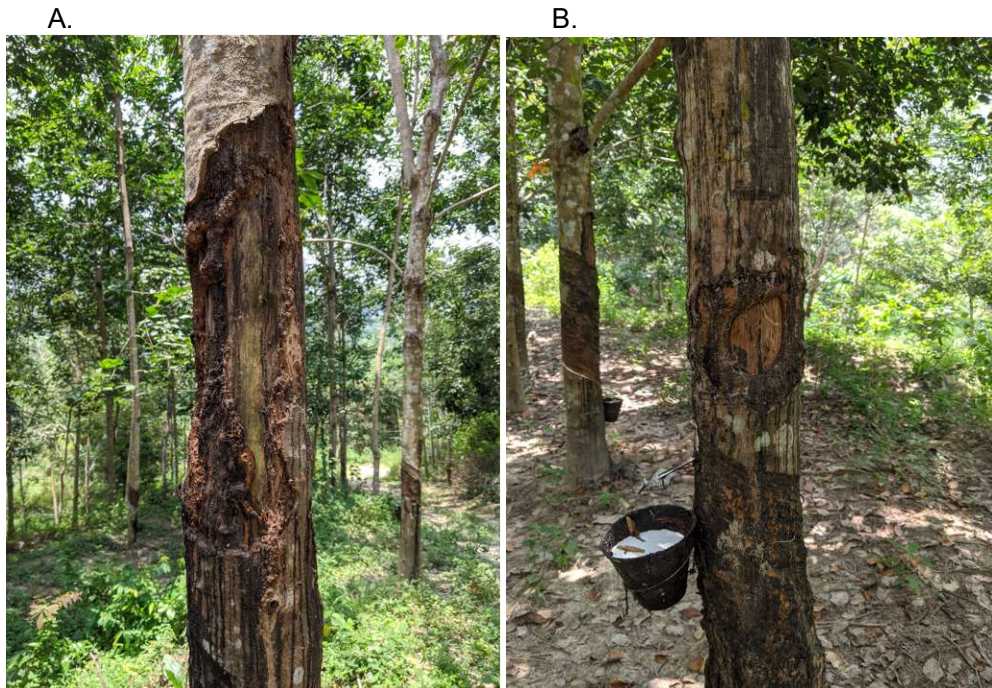
Plate 2: (A) shows rubber tree permanently damaged by elephants and (B) rubber tree temporarily damaged by elephants (B). B shows that latex can still be tapped from the rubber while in A the tree is completely damaged due to debarking. Photo credit: Sinchita Sinha

The parts of oil palm preferred by elephants were shoot, leaves and palm heart, while for rubber it remained bark, shoot and leaves (*Table7*). The type of damage common to all four crop varieties was "*Uprooting trees*" that caused the most damage, except for oil palm, where "*Palm heart*" was the most damaged part of the plant. Major damage was sustained by palm oil (permanent = 56%, temporary = 24%) than rubber, durian and banana put together.

Cost of seedling loss per year in RM for oil palm was estimated to be at a median of RM 585 (min=RM5.00, max=RM11000.00) with two outliers that were more than RM 15,000. Median of labour cost per year for oil palm was RM 80 (min=RM1.00, max=RM76837.95) with 10 outliers that were >= RM 3,000.

Table 6: Frequency distribution of "Age" of the four crops that are likely to be damaged by the elephants after removing all missing data

Age of Crops Damaged	Oil palm (180)	Rubber (36)	Durian (17)	Banana (19)
<3	41 (22.78) [2]	12 (33.33) [2]	4 (23.53) [2]	15 (78.94) [1]
3 to 6	87 (48.33) [1]	15 (41.67) [1]	3 (17.65) [3]	2 (10.53) [2]
6 to 10	30 (16.67) [3]	4 (11.11) [3]	5 (29.41) [1]	2 (10.53) [2]
10 to 15	11 (6.11)	3 (8.33)	2 (11.76)	0 (0)
>15	11 (6.11)	2 (5.56)	3 (17.65) [3]	0 (0)

Table 7: Frequency distribution of "Parts" of the four crops that are likely to be damaged by the elephants

Part of Crops Damaged	Oil palm (328)	Rubber (59)	Durian (25)	Banana (77)
Shoot	78 (23.78) [2]	14 (23.73) [3]	2 (8.00)	9 (11.69)
Leaves	63 (19.27)	8 (13.56)	1 (4.00)	9 (11.69)
Fruits	10 (3.04)	2 (3.39)	4 (16.00) [3]	-
Fruits & flowers	-	-	-	11 (14.29)
Palm heart	95 (28.96) [1]	-	-	-
Branches	-	-	5 (20.00) [2]	-
Bark of the tree	5 (1.52)	15 (25.42) [2]	4 (16.00) [3]	-
Tree trunk	-	-	-	14 (18.18) [2]
Banana pith	-	-	-	12 (15.58) [3]
Uprooting trees	77 (23.48) [3]	20 (33.90) [1]	9 (36.00) [1]	22 (28.57) [1]

Median of fertilizer cost for oil palm per year was RM 70 (min=RM1.00, max=RM3600.00) with 5 outliers which were>= RM 1,600. Median of pesticide cost for oil palm in a year was RM 77.50 (min=RM1.00, max=RM3600.00) with eight outliers considering all values which were >= RM 1,000. Because of considerably less data on rubber, durian, and banana than oil palm the costs of seedling, labour, fertilizer, and pesticide of the three crops were calculated together to estimate the median RM 200 (min=RM2.00, max=RM10000.00).

Crop loss that included seedling, labour, fertilizer, and pesticide cost of all the four types of crops (oil palm, rubber, durian, and banana) suffered due to HEC in a year amounted to a total of RM 2,962,475.00 for 137 respondents (excluding those who suffered from conflict with other animals) for an area size of 11,460.51 acres, with an estimated cost per smallholder using median of RM 6000 (min=RM12.00, max=RM554400.00). Mitigation measures that included setting up cost and repair cost over a span of five years totalled to RM 3,593,449.32 with a median of RM 6050 (min=RM30, max=RM700000). I also projected the total cost that encompassed crop loss and mitigation cost for five years that added up to RM 18,405,824 for all 137 respondents, with an estimated cost per smallholder of a median of RM 27,300 (min=RM39.32, max=RM2772000.00).

Table 8: Types of financial crop loss and their average as subjected during crop raiding by elephants. Value of mean and SD has been calculated without the outliers

Segregation of Loss	Mean (RM)	Std. Dev	No of Outliers	Median (RM)	Minimum value (RM)	Maximum value (RM)
Seedling Loss (*n=86*)	1108.78	1160.26	2	585	5	11000
Labour Loss (*n=58*)	198.97	332.68	10	80	1	76837.95
Fertilizer Loss (*n=86*)	169.73	178.22	5	70	1	3600
Pesticide Loss (*n=62*)	78.31	69.69	8	77.5	1	3600

Table 9: Crop loss in RM suffered due to HEC per year and per acre in a year

Monetary loss suffered by smallholders due to HEC	Mean (RM)	Std. Dev	Median (RM)	Minimum value (RM)	Maximum value (RM)
Crop Loss due to HEC/ year (RM) (n=115)	25760.65	75457.95	6000	12	554400
Crop loss/ acre due to HEC in a year (RM) (n=108)	5781.21	23990.14	570.83	1.2	221760

Table 10: Overall loss that includes crop and mitigation cost in RM suffered due to HEC in a span of five years including per acre cost

Monetary loss suffered by smallholders due to HEC	Mean (RM)	Std. Dev	Median (RM)	Minimum value (RM)	Maximum value (RM)
Total mitigation cost in 5 years (RM) (n=74)	48560.13	123731.7	6050	30	700000
Crop loss + Mitigation cost in 5 years (RM) (n=123)	149640.9	379261.6	27300	39.32	2772000
(Crop and Mitigation Cost)/acre in 5 years (RM) (n=115)	28964.82	116966	2937.5	6	1108800

3.5 Mitigation Measures Deployed by Smallholders

To assess the smallholders on the difficulties they face trying to deploy mitigation to protect their crops, the responses were categorised under "Strongly disagree", "Disagree", "Neither agree nor disagree", "Agree" and "Strongly disagree". There were 152 smallholders who responded out of 169 participants for this section, of which 76.97% (117) had employed in mitigation techniques in the past and 23.03% (35) never attempted at applying any mitigation technique to protect crops against elephant raid. Among those who attempted mitigation, 87.18% (102) acknowledged needing support to set up mitigation followed by 82.05% (92) mentioned cost of mitigation being high and 66% (77) acknowledged failed past attempts.

Among those who did not attempt preventive measures in the past (35), majority pointed high cost (69%) and requirement of support (69%) and a smaller percentage agreed that failed past attempts (29%) is a barrier– which is largely presumed to be by observing failed attempts by others and 14% believed mitigation is not needed. By differentiating respondents from those who tried mitigation measures and those who did not, we were able to gain more informed reasons for barriers in setting up HEC mitigation, rather than without distinction between the two groups.

Among the different mitigation options that were used by the respondents, included electric fence, chilli and grease, bee-hive fence, night-guarding, etc. .It was found that out of 169, one or two or more than two types of mitigation methods were deployed by those 117 smallholders while 35 smallholders did not deploy mitigation measures (*Figure 10 A & B*).

The respondents were given the opportunity to select which methods they attempted and found effective against elephant raids. The popular and deemed effective methods of mitigation were night-guarding (34.87%) and firecrackers (34.21%). It was followed by patrolling (29.61%) and electric fence (25.66%). Patrolling was considered an activity done collectively by a group of people requiring movement around the area, while night-guarding requires the guard/s to stay at the location the whole night to protect the crops. Least effective methods among all were bee-hive fence and application of chilli and grease (*Figure 11*). Overall, 67.12% (98) of the smallholders responded that elephant raids do not follow a pattern with respect to foraging crops in specific reasons or months; however, 23.97% (35) believed that they do follow a pattern perhaps depending on their own perception or crop types. Out of 41 smallholders who mentioned the times of the year elephants raided crops, 12.2% (5) misunderstood the question and answered that elephants raided in the night.

A.

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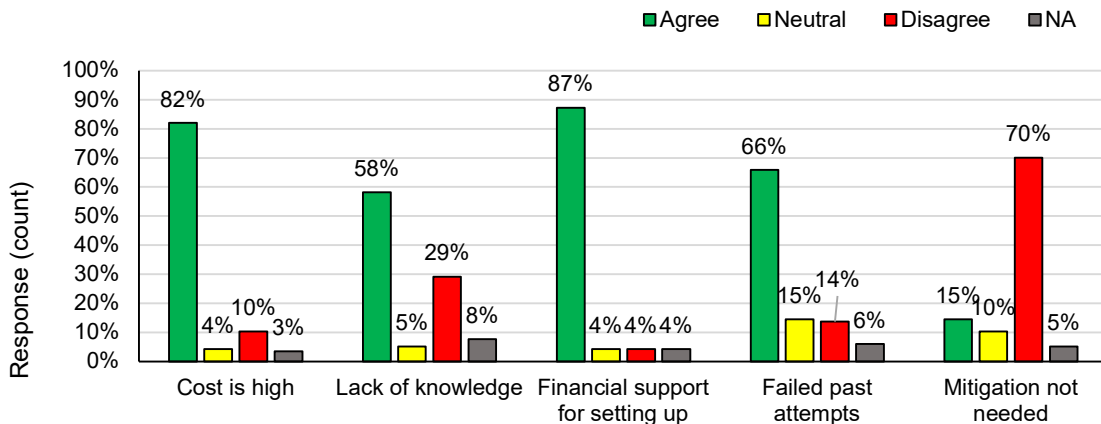
B.
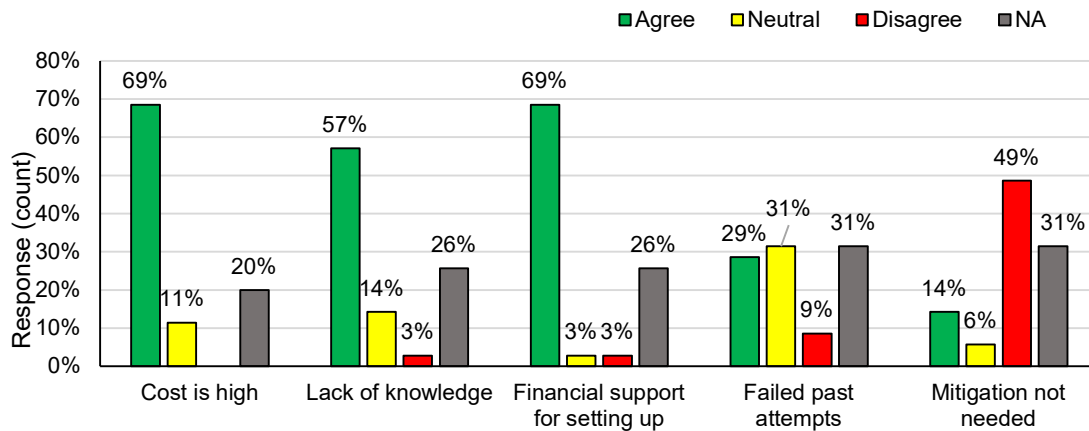
Figure 10: Bar graphs (A & B) displaying the percentage of agreement and disagreement on reasons that make it difficult for smallholders to engage in mitigation between groups that tried measures earlier (A) and those who never attempted (B).
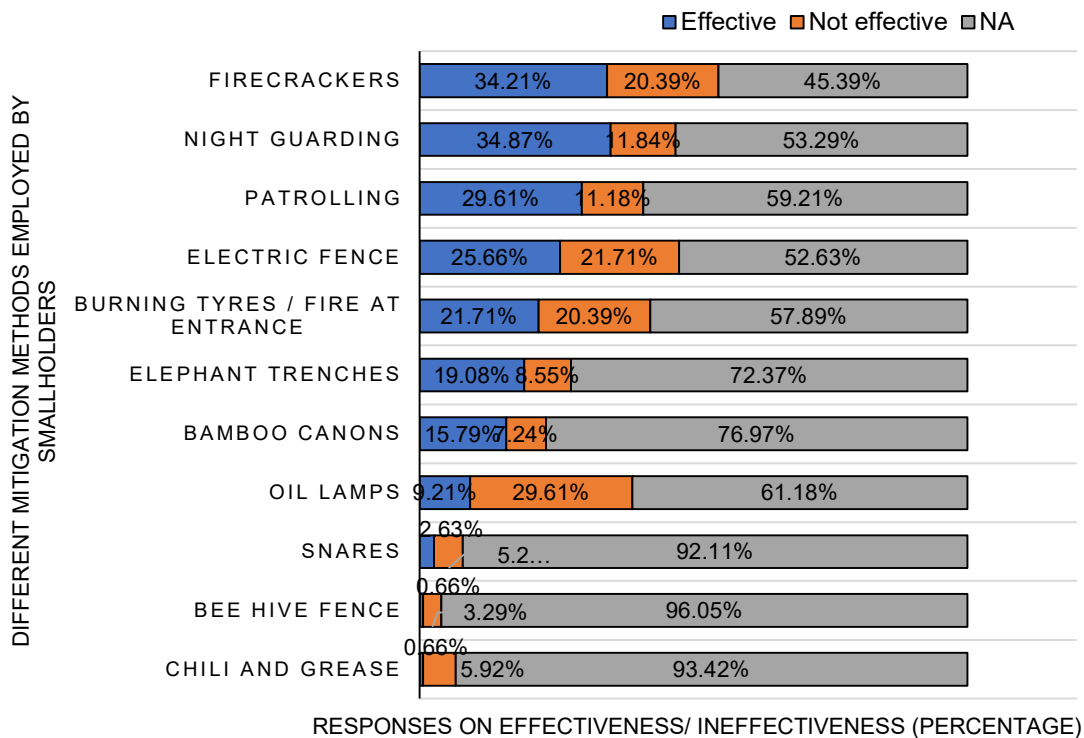
Figure 11: Effectiveness of different elephant deterrence methods used by smallholders (n=152)

3.6 Willingness to Pay for Crop Insurance

When assessing their perception of insurance and if they thought insurance will help to protect crops, it was found that there were no significant differences in the attitude towards insurance

between independent smallholders and organised smallholders (*Figure 12*). Hence, we combined their data for subsequent analysis.
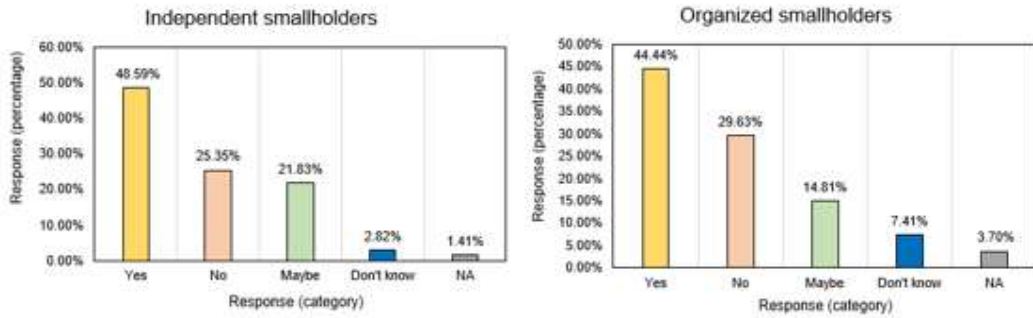
Figure 12: Comparison between the perception of independent and organised smallholders on the efficacy of insurance towards crop protection (independent = 142, organised = 27).

Overall, 40.27% (60) of the smallholders, that included the independent and organised smallholders, were willing to pay for premium towards crop insurance. Of the 60 smallholders, 71.67% (43) had engaged earlier in mitigation measures and 21.67% (13) never attempted. The rest 59.06% (88) were not willing to invest towards crop insurance. Out of the 88 respondents, 72.73% (64) mentioned engaging in mitigation methods earlier, 16 (18.18%) did not and the rest did not provide information.
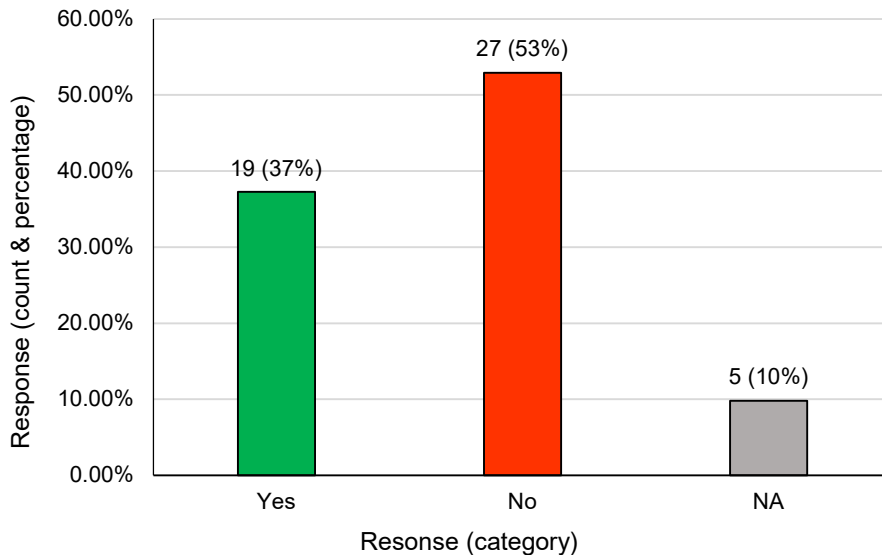
Figure 13: Willingness of those smallholders to invest in crop insurance who had already invested in life insurance schemes (n=51).

Of the 169 participants, 51 of them had invested in life insurance schemes while the rest 118 did not. In an attempt to compare their willingness to contribute towards crop insurance, it was

found that among those who had earlier invested in life insurance schemes, 37% (19) were willing to invest in crop insurance, while 53% (27) did not wish to invest (*Figure 13*).
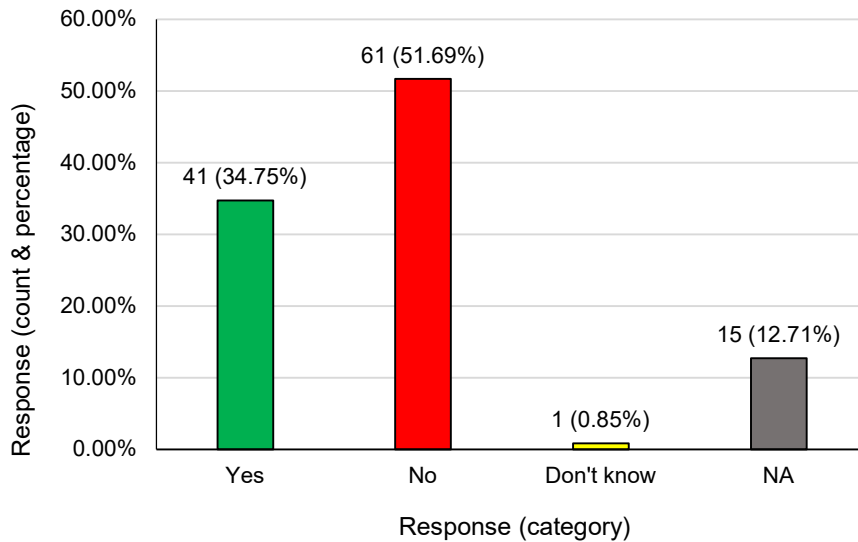
Figure 14: Willingness of those smallholders to invest in crop insurance who did not invest in life insurance schemes (n=118).

It was observed that, out of 118 smallholders who did not invest in life insurances policies 34.75% (41) were willing to invest in crop insurance while 51.69% (61) did not want to (*Figure 14*). Out of 54 smallholders who received support either from private agencies, NGO's or subsidies from government, 37% (20) were willing to pay premium and 63% (34) were unwilling to pay. Out of 92 smallholders who did not receive support from any agency 42.4% (39) of the smallholders were willing to contribute towards premium payment while 57.6% (53) did not want to (*Table 11*). There is no difference between these two groups of smallholders ($x^2 = 1.3356$, p-value > 0.05, df = 1).

Out of 51 respondents claimed to receive support from either government or private agencies or NGOs. Among them 49.02% (25) mentioned receiving support at the beginning of setting up the plantation, while 39.22% (20) mentioned receiving yearly support.
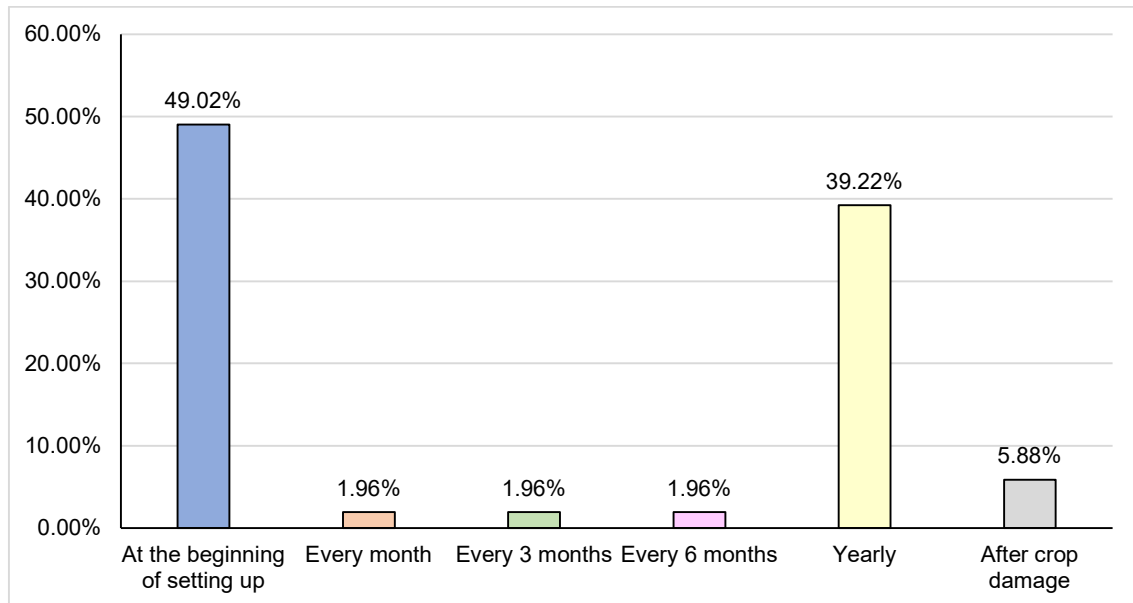
Figure 15: Support or subsidies received by smallholders from government or private agencies or NGOs (n=51)

Despite being identified by the size of land which is anything less than 100 acres (*40.46 ha*), around 66% of the independent smallholders owned less than 10 acres of land for farming and income of 73.38% (113) were less than RM 2000 which is below the Poverty Line Income in Malaysia. In all, 48.8% of the respondents (81) believed that insurance would be an effective tool to protect livelihoods of the smallholders of which 55.56% are willing to invest. While out of 26.51% (44) disagreed. Out of 44 smallholders who did not believe insurance would be effective tool, 4 of them were ready to invest less than RM 200 towards crop insurance, and out of 9 smallholders who were unsure of insurance as an effective mitigation tool, 8 were ready to invest less than RM 200 and one was ready to invest between RM 500 to RM 1000.In all, 60 respondents were willing to invest in crop insurance, of which 86.67% (52) were ready to pay below RM 200 and 6.67% (4) were willing to pay between RM 200 to RM 500 (*Figure 17*).
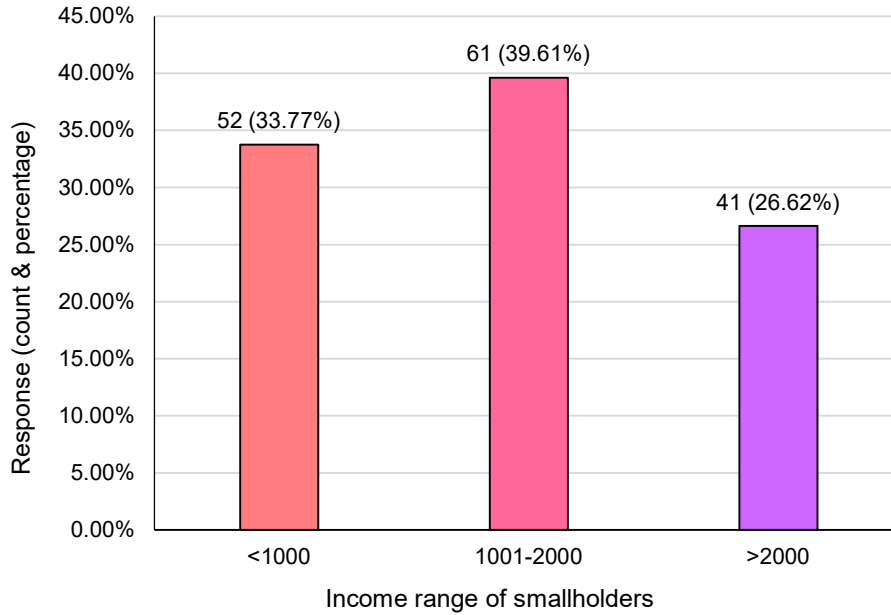
Figure 16: Income range of the smallholders that would help to access their ability to contribute towards insurance premium.
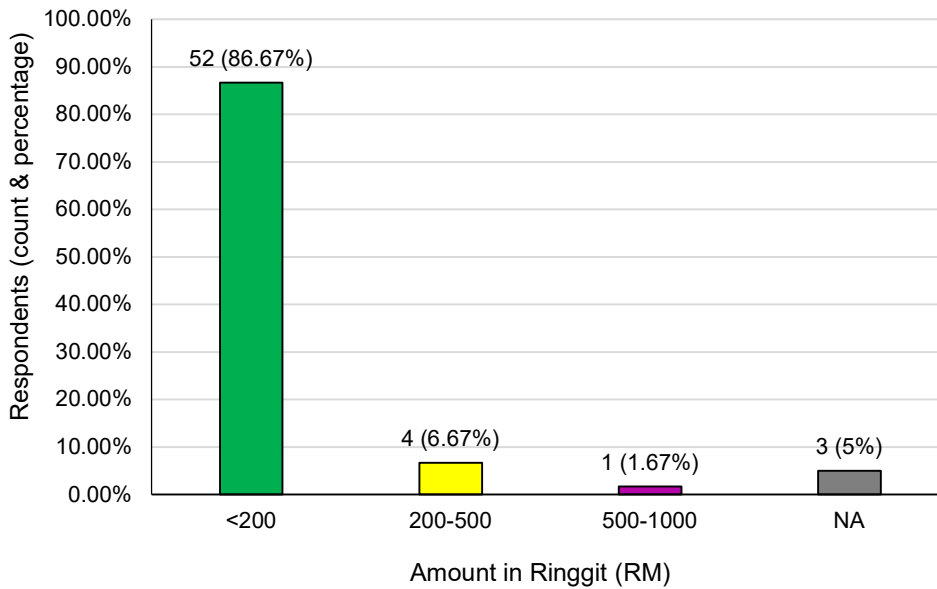
Figure 17: Amount of Premium payment smallholders are willing to pay towards protecting their crops (n = 60)

There were 123 responses who advocated for the government to be responsible while 94 responses opted for self. Other responsible parties recognized by the smallholders included private agencies like FELDA, FELCRA, etc., smallholder farmers living with elephant in their vicinity, village heads, environmental NGOs and general public (*Figure18*).
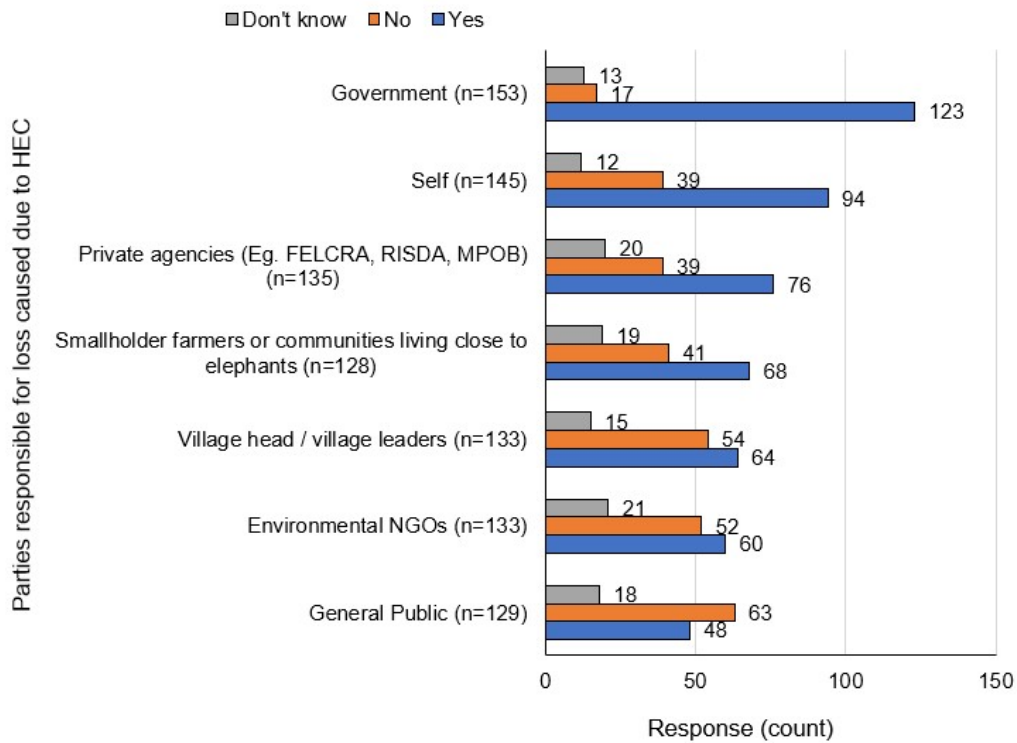
Figure 18: Stakeholders responsible for loss incurred due to human-elephant conflict.

On the possible types of damage smallholders wanted to insure their crops against, elephant raids were considered 3.7 on a scale of 1 to 5 (5 = most important, 1 = least important) followed by raids carried out by other animals like livestock, wild boar, and macaques (3.44) (*Figure18*).
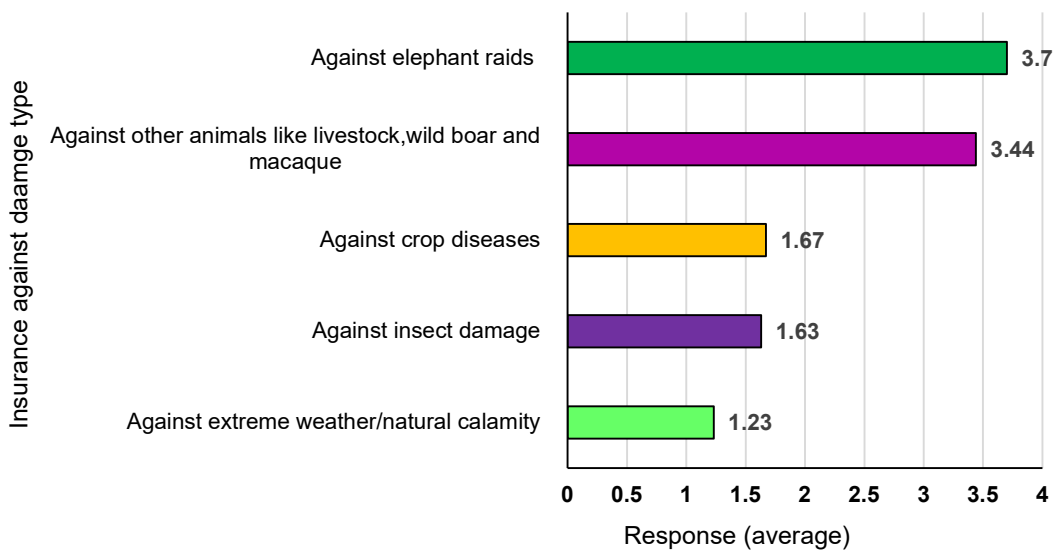
Figure 19: Averaged responses on the most recurrent damage against which smallholders would prefer to insure their crops (closer to 5 – is more important, while close to 1 is least important)

3.7 Types of Hidden Loss caused by human-elephant conflict

Majority of the respondents admitted that they found living in proximity to elephants difficult. Most of the smallholders were concerned over their own safety (92.47%) and constant vigil they had to keep (89.47%) when elephants frequented their area. Exhaustion due to guarding the crop (84.56%) to protect from elephant raids was also raised as a matter of concern which made life difficult. Among 83 smallholders, 21.3% (36) employed people to guard their crops. While, out of 89 smallholders who answered the question on guarding with the community, 80% (71) were involved in community guarding and 18 smallholders were not, and this group does not overlap with those who employed people to guard crops. However, out of 169 smallholders, only 57 participants responded to number of days they spend guarding crops in the night in a month after the most recent conflict incident, which averaged to 3.2 days (SD=±7.3, min=1 and max=31). This included those who employed paid guards and those who guarded the crops themselves. Crop guarding was limited to the adults, however, two participants mentioned that children helped in guarding the crops. After every crop raid the participants usually lost 4 to 8 hours or full day of their usual labour hours at the field (*Figure 23*). There were 72% (96) of smallholders who stated the reason for not applying for jobs was because of old age, or for the love for their farm and kampung (village), or disinterest in city jobs. There were also those who applied for other jobs (37), among whom few succeeded (41%) and the rest could not (49%) because of limited job opportunities and insufficient educational qualifications.
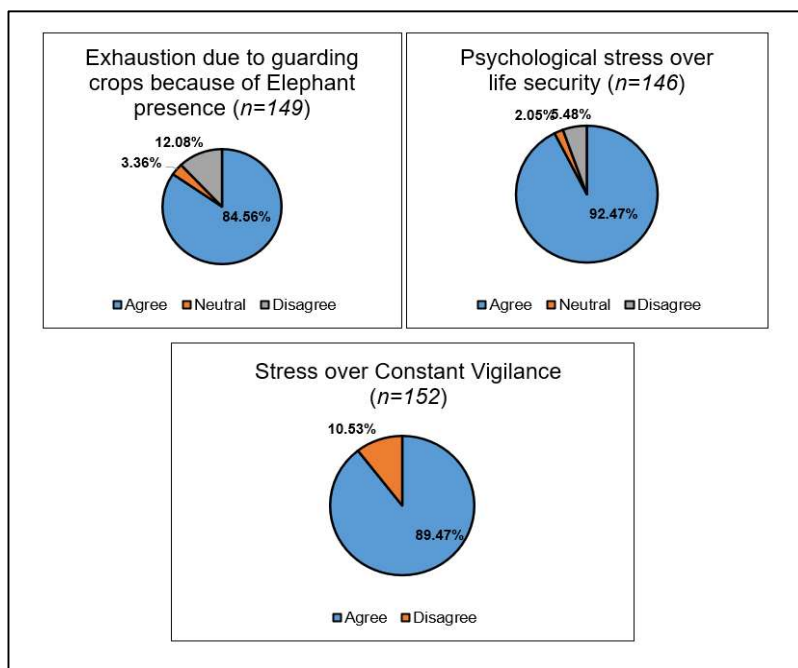
Figure 20: Pie charts indicating the percentage of smallholders who suffer from exhaustion due to crop guarding because of elephant presence in the vicinity and stress over life security of self and family.

A.
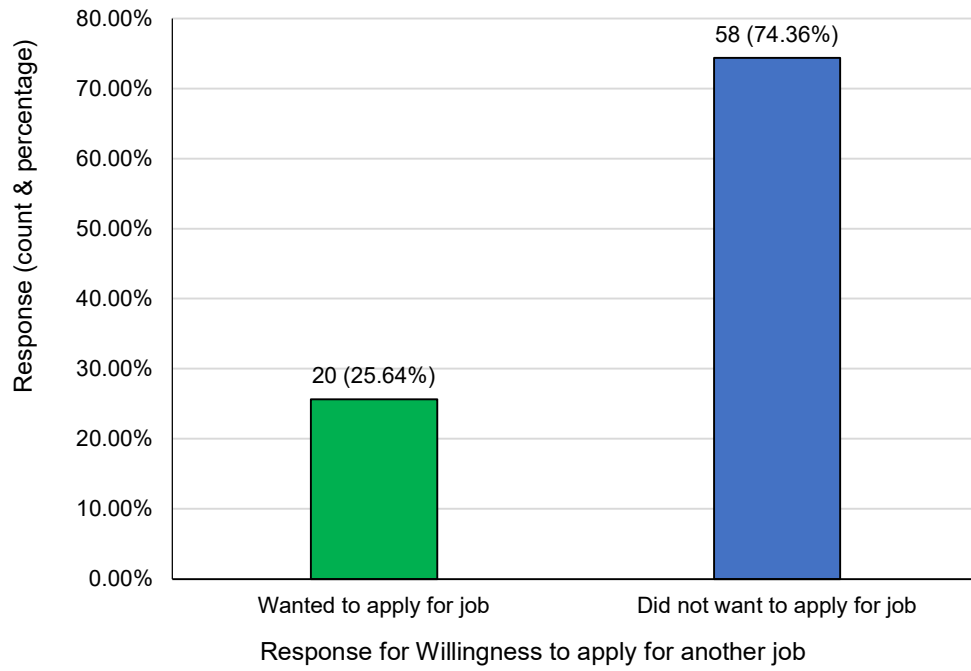
B.
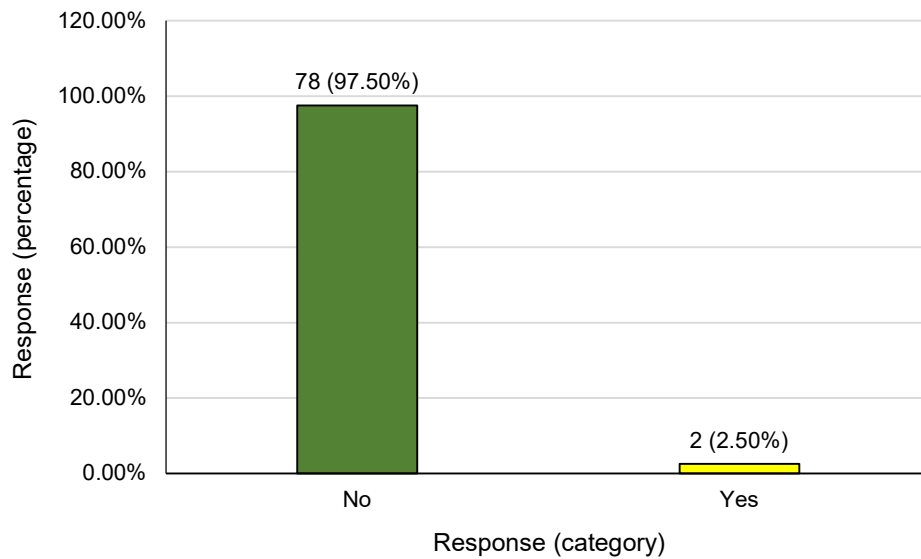
Figure 21: Analysis of Opportunity loss – A. Willingness of smallholders to apply for secondary jobs (n=78)
B. Crop guarding by children which affects their school attendance (n=80).
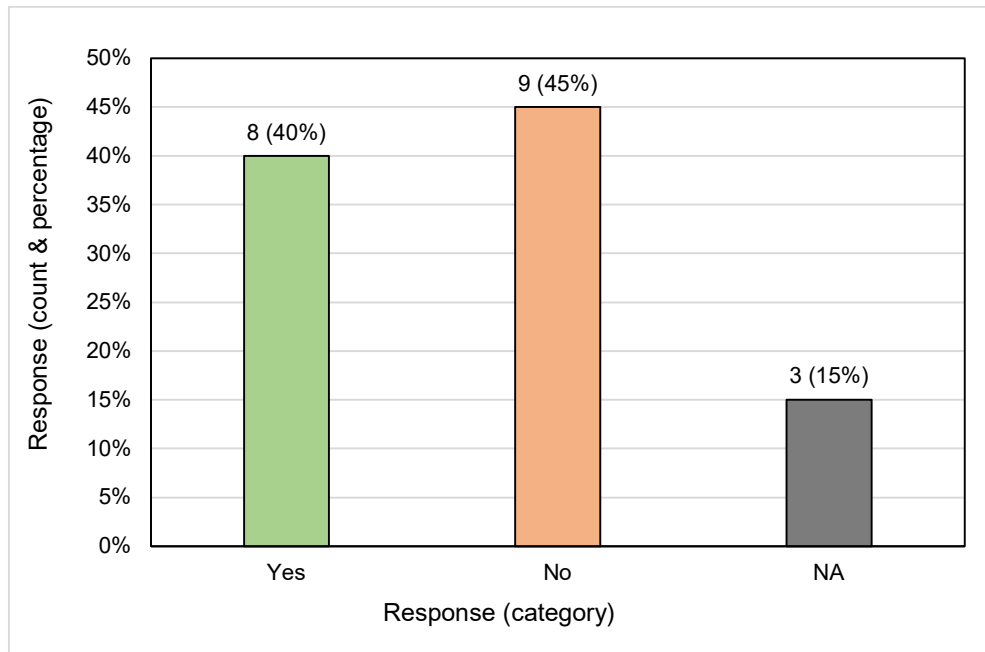
Figure 22: Analysis of secondary job application – success at obtaining jobs, those who had planned on applying (n=20)
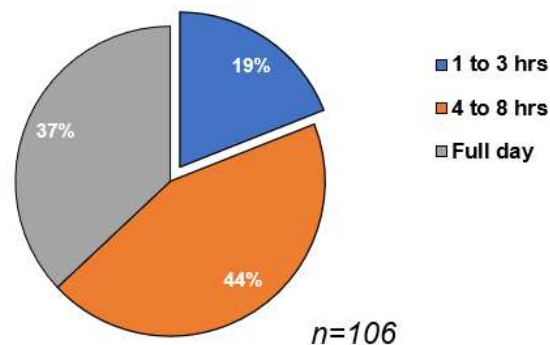
Figure 23: Labour time of smallholders lost from normal field work due to elephant raids.

3.8 Perception and Attitude towards Elephants

3.8.1 Forest and human activities on HEC

Forest fragmentation led to elephants moving into human habitat – 91% of the smallholders (152) agreed that fragmentation of forest was the cause that pushed elephants to venture into human habitats, while 6% (10) disagreed. *Scarcity of food in the forest forces elephants to venture out* – More than 90% of smallholders concurred that limited food resources in the forest compel elephants to venture out for food. *Human activities disturbing elephant habitats are forcing them to move into villages* – A vast majority (91%) admitted that human activities are disturbing elephant habitat which is compelling the elephants to move into villages.

3.8.2 Potential conflict between smallholders and other stakeholders

Protecting elephants would make conflict worse – 45% (73) believed protecting elephants would worsen the situation of conflict. *Law is unfair to planters* – 50% of the participant population (80) believed that the law is unfair to the smallholders, followed by 31% (50) who chose to remain neutral. *Welcoming attempts that would help smallholders in addressing conflict with elephants* – 97% of the participants (160) agreed to welcoming any attempts that would help them in addressing the issue of human-elephant conflict while, only a small section disagreed to welcoming any efforts (1.82%)

3.8.3 Culture and traditions

Influence of traditions and cultures passed on living with elephants – Around 48% (79) believed that the traditions and culture that were passed on by their forefathers motivated them to live with elephants harmoniously. However, 31% disbelieved those traditions encouraged them to live with elephants in harmony. *Talking about elephants is considered a taboo* – 77% of the smallholders reported that talking about elephants was a taboo.

3.8.4 Laws and enforcement

Death of an elephant in neighbour's plantation would place the neighbour in trouble – Only 23% (38) agreed, while majority disagreed (57%). *Penalty for injuring or killing elephants is severe* – Larger population of the participants (73%) believed that the penalty for injuring or killing is severe and 18% remained neutral.

3.8.5 Elephant population

Elephant population is too large in Malaysia – More than 50% of smallholders believe that the elephant population in Malaysia is large, while 27% disagree. *Perception of elephant population increasing in their area* – 70% of the smallholders believed that the elephant population in their area is increasing.

Out of 169 respondents, there were 153 smallholders who experienced conflict with elephants while 16 did not. It was observed that only 14% (2) of the smallholders who did not experience conflict believed elephant population to be large in Malaysia and 33% (5) believed that elephant population is increasing. While the section of smallholders who had experienced conflict with elephants believed that the elephant population is large in Malaysia were 57% (85) and 74% (110) believed elephant population is increasing.

3.8.6 Coexistence

Sufficient space for humans and elephants in Malaysia – 53.94% of the participants (89) admitted that there is adequate space for both elephants and humans in Malaysia. *Living with elephants in the past was never a problem* – 66% of the interviewees concurred that during their grandparents' time, living with elephants was never a problem. *Benefits to having elephants* – 49.36% of the participants (77) acknowledged that having elephants is beneficial while 31% disagreed and 19% remained neutral. *Willingness to relocate to another village with less or no human-elephant conflict* – 80% (132) of participants were unwilling to relocate to a village with less or no human-elephant conflict, although a small section (27) was willing to relocate.

When examined further the response for adequate space for humans and elephants to coexist, 87% (13) of smallholders who did not experience conflict with elephants agreed, while for smallholders facing elephant conflict, there were 51% (76) agreed and 24% (36) disagreed.

3.8.7 Emotions

Feeling of pitifulness for elephants at times – 87% of the smallholders (144) sympathised with elephants, 7% did not and 6% remained neutral. *Sense of relief if no elephants in and around the human habitat* – 87% of the smallholders disclosed that they and their family would be happy if there are no elephants in their vicinity.
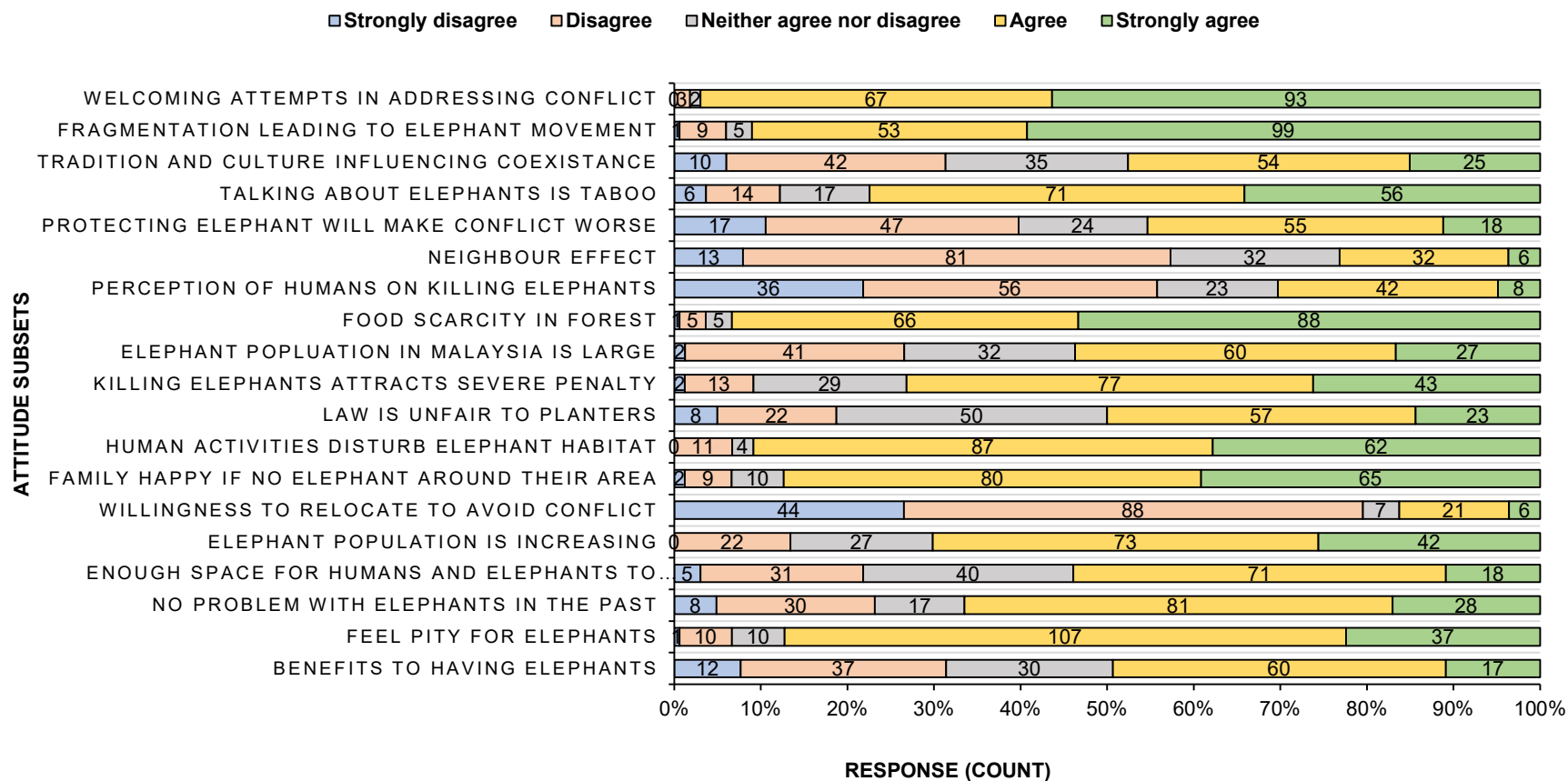
Figure 24: Responses of the smallholders on the Attitude section of the questionnaire

Regression

Model 1*:* Model comparing fertilizer cost with age and parts of oil palm preferred by elephants.

Table 11: Model 1 comparing fertilizer cost with age and parts of oil palm preferred by elephants

Pseudo R-square	Test Parallel of Lines-General			Parameter Estimates							
McFadden	Chi-square	df	Sig		Estimate	Std. Error	Wald	df	Sig	Lower Bound	UpperBound
0.063	9.659	5	0.086	Shoot	-1.929	1.093	3.114	1.000	0.078	-4.072	0.213
				Leaves	-3.850	1.499	6.596	1.000	0.010*	-6.787	-0.912
				Palm heart	-2.370	1.172	4.107	1.000	0.043*	-4.671	-0.078
				Uprooting trees	0ᵃ			0.000			
				Less than 3 years	0.717	0.636	1.270	1.000	0.260	-0.530	1.963
				3 to 6 years	0.637	0.608	1.099	1	0.295	-0.554	1.829
				More than 6 years	0ᵃ			0			

The expenditure for fertilizer is significantly lower by 97.88% when damaged parts are leaves (p = 0.010, 95% C.I. [0.001, 0.402]) and by 90.65% if damaged part is palm heart (p = 0.043, 95% C.I. [0.009, 0.925]), when compared to trees are uprooted. Age of tree was found to have no significant effect on fertilizer cost.

Model 2: Model comparing respondents' perception that living with elephants is difficult due to exhaustion from guarding crops score 5-point Likert scale (strongly disagree to strongly agree) with three types of mitigation methods deployed that required physical presence to prevent raids and location of farm.

Table 12: Model 2 comparing respondent's perception on exhaustion due to guarding while living around elephants with three mitigation methods and location of farm

Pseudo R-square	Test Parallel of Lines-General			Parameter Estimates							
McFadden	Chi-square	df	Sig		Estimate	Std. Error	Wald	df	Sig	Lower Bound	UpperBound
0.183	0.592	4	0.964	Location of house same as farm	0.245	1.277	0.037	1	0.848	-2.257	2.747
				Location of house not same as farm	0ᵃ			0			
				Bamboo canons are effective	3.100	1.660	3.490	1	0.062	-0.152	6.353
				Bamboo canons are not effective	0ᵃ			0			
				Night guarding is effective	13.897	2.056	45.694	1	0.000*	9.868	17.926
				Night guarding is not effective	0ᵃ			0			
				Firecrackers are effective	-17.939	0.000		1		-17.939	-17.939
				Firecrackers are not effective	0ᵃ			0			

Night guarding has a statistically significant effect on the Likert scale for exhaustion in guarding crops. It could signify. But the readings of Model 2 cannot not be considered for analysing exhaustion due to night-guarding because of the high beta (13.897), which happens when the data is insufficient. In this table, the number of respondents who mentioned night-guarding to

be ineffective was 18 which is a low number for analysis (18) hence the significance outcome of the analysis is not reliable.

Model 3: Model comparing respondents' cultural and traditional affiliations encourages them to live with elephants in harmony on a 5-point Likert scale (strongly disagree to strongly agree) with age and religion.

Table 13: Model 3 comparing respondents cultural affiliations influencing attitude with age and religion

Pseudo R-square	Test Parallel of Lines-General			Parameter Estimates							
McFadden	Chi-square	df	Sig		Estimate	Std. Error	Wald	df	Sig	Lower Bound	UpperBound
0.013	14.363	9	0.110	Religion is Islam	0.109	0.334	0.107	1	0.744	-0.545	0.763
				Other religions	0ᵃ			0			
				Age is below 40 years	0.867	0.367	5.597	1	0.018*	0.149	1.586
				Between 41 years to 60 years	0.297	0.332	0.802	1	0.371	-0.354	0.948
				Above 60 years of age	0ᵃ			0			

Age group has a statistically significant effect on the response to "My tradition and culture from my grandparent's days until now, encourage me to live harmoniously with elephants ". Smallholders in the age group below 40 score 2.38 times odds higher, in agreement with this statement (p =0.018, 95% C.I. [1.160, 4.884]) when compared to those who were more than 60 years of age. Religion has no significant effect on the response if traditions and culture from forefathers encourages smallholders to live in harmony with elephants.

Model 4: Model comparing respondents' perception on laws of land being unfair to smallholders on a 5-point Likert scale (strongly disagree to strongly agree) with level of education, income, and number of children per household.

Table 14: Model 4 comparing respondents' perception on unfair laws with level of education, income and number of children per household

Pseudo R-square	Test Parallel of Lines-General			Parameter Estimates							
McFadden	Chi-square	df	Sig		Estimate	Std. Error	Wald	df	Sig	Lower Bound	UpperBound
0.020	7.725	12	0.806	Income less than RM 1000	-0.627	0.442	2.015	1	0.156	-1.493	0.239
				Income between RM 1001 to RM 2000	-0.602	0.412	2.133	1	0.144	-1.410	0.206
				Income more than RM 2000	0ᵃ			0			
				Below secondary level of education	-0.754	0.340	4.907	1	0.027*	-1.421	-0.087
				Above secondary level of education	0ᵃ			0			
				Household with children	-0.144	0.488	0.087	1	0.768	-1.101	0.813
				Household without children	0ᵃ			0			

Level of education has a statistically significant effect on the response to "The law is not fair to planters". An increase in a step on the Likert scale in agreement with this statement for

those with above secondary level of education is associated with a decrease of 52% in the odds for those with below secondary level of education (p = 0.027, 95% C.I. [0.241, 0.917]). Average income or number of children in the household do not have any significant effect on the response.

Model 5: Model comparing respondents' prerogative on their feelings on elephant presence around them on a 5-point Likert scale (strongly disagree to strongly agree) with level of education.

Table 15: Model 5 comparing respondents' feelings of elephant presence around them with level of education

Pseudo R-square	Test Parallel of Lines-General			Parameter Estimates							
McFadden	Chi-square	df	Sig		Estimate	Std. Error	Wald	df	Sig	Lower Bound	UpperBound
0.019	6.997	3	0.072	Below secondary level of education	-0.804	0.315	6.491	1	0.011*	-1.422	-0.185
				Above secondary level of education	0ᵃ			0			

Level of education has a statistically significant effect on the response to "My family and I will feel happy if there are no elephants in this area". An increase in a step on the Likert scale in agreement with this statement for those with education above secondary is associated with a decrease of 55.24% in the odds for those with below secondary level of education (p = 0.011, 95% C.I. [0.24, 0.83]).

Model 6: Model comparing respondents' views on laws of land being unfair to smallholders on a 5-point Likert scale (strongly disagree to strongly agree) with crop depredation, property damage, human injury, and death.

Table 16: Model 6 comparing respondents' views on unfair laws with crop and property damage, human fatality, and injury

Pseudo R-square	Test Parallel of Lines-General			Parameter Estimates							
McFadden	Chi-square	df	Sig		Estimate	Std. Error	Wald	df	Sig	Lower Bound	UpperBound
0.022	18.556	12	0.100	Damage by crop raid	-0.438	0.557	0.618	1.000	0.432	-1.529	0.653
				No damage by crop raid	0ᵇ			0.000			
				Damage by property destruction	0.751	0.379	3.926	1.000	0.048*	0.008	1.494
				No damage by property destruction	0ᵇ			0.000			
				Damage by injury to humans	-1.830	0.935	3.830	1.000	0.050	-3.663	0.003
				No damage by injury to humans	0ᵇ			0.000			
				Damage by human death	0.605	0.932	0.422	1.000	0.516	-1.221	2.432
				No damage by human death	0ᵇ			0.000			

Property damage has significant effect on the response law being unfair to planters. Smallholders suffered property damages scored 2.11 odds higher in agreement with the statement when compared to smallholders who don't suffer property damage (p = 0.048, 95%

C.I. [1.008, 4.454]). Other types of conflict - crop damage, injury to humans and death of humans have no significant effect on the response law being unfair to planters, although injury to humans is on the margin of significance. Note that the number of cases of human injury and human death are very few, and a bigger dataset or a more specialised study in this area of research will allow more in-depth assessment.

4.0 DISCUSSION

I conducted a social questionnaire assessment of visible and hidden costs of human-elephant conflict on independent and organised smallholders in Peninsular Malaysia. Due to the Covid-19 pandemic, I was only able to obtain 169 respondents.

Malaysia ranks second in the global production of oil palm and its smallholder communities help to contribute significantly to its cultivation. Malaysia is also home to the endangered Asian elephants. Like in other Asian elephant range countries, wherever the range of elephants and agricultural activities meet, human-elephant conflict (HEC) is likely to occur, and this results in visible and hidden costs for communities.

4.1 Socio-economic characteristics of the respondents

Independent smallholders in Malaysia are defined as growers who own or lease 100 acres (40.46 ha) of land; however, from our study in Peninsular Malaysia around 68% of the independent smallholders owned less than 10 acres of land for the farming. Interviewed participants were largely independent smallholders, with most (41%) falling under 41 to 60 years of age (58) and income of 65% (93) falling below Poverty Line Income (PLI) that was increased from RM 980 to RM 2,208 in 2019 (Jamaluddin and Hanafiah, 2020) (with most respondents earnings were in the categories of below RM 1000 and RM 1001 to RM 2000) (Department of Statistics Malaysia, 2020).

4.2 Costs of Conflict experienced by smallholders in Peninsular Malaysia

Costs incurred due to HEC are of varying nature. Visible costs such as loss of life and monetary losses that are easily quantifiable (e.g., crop livestock or property loss) are often examined in HEC studies. However, alongside visible costs there are hidden costs that includes feelings of anxiety and fear and others such as loss of productive hours due to the need of guarding.

4.2.1 Visible Loss

The main animals involved in conflict were found to be elephants, wild boars and macaques which corroborated with smallholders' priority to insure their crops against elephant raids as their topmost, followed by raids against other wildlife like wild boars and macaques (*Figure 19*). Smallholders identified that elephants consumed crops, damaged crops by trampling, and destroyed property while wild boars and macaques were also found to responsible for conflict with smallholders (*Figure 9*). My study dealt with human-elephant conflict hence the questionnaire concentrated on the types of conflict experienced by smallholders due to HEC.

However, this finding is similar to conflict situation in India where crop raiding is a prominent form of conflict between humans and wildlife like wild boars (*Sus scrofa*), elephants (*Elephas maximus*) and macaques (Gubbi, 2012; Karanth et al., 2013) Since my study is more of a perception assessment than actual quantification of damages by different wildlife there could be species bias as human mortality and injury are more of concern during elephant raids (Naughton, Rose and Treves, 1999; Gubbi, 2012) and hence conflict with elephants are perceived to be more concerning than wild boars. Smallholders perceived that crop raiding by elephants to be the most prevalent type of conflict (67%) followed by property damage (20%), human injury (2.5%), and human death (2.5%). The order is similar to reports of human-elephant conflict received by the Wildlife Department in Malaysia, Kenya, India Sri Lanka (Bandara and Tisdell, 2002; Fernando et al., 2011; Saaban et al., 2011a; Palei, Rath and Kar, 2013; Manoa et al., 2020). However, instances of human injury or death due to elephants in Peninsular Malaysia are not as high as India, Sri Lanka, and Africa where the numbers range from 70-80 (Sri Lanka), and 400-450 (India) human deaths per year (Menon, Amin and Wangdi, 2020). There are only handful human injury or mortality incidents recorded annually in Malaysia numbering around four cases per year (Saaban et al., 2011a). The cause of the few deaths that occurred due to elephants was not explored in detail in this study, but perhaps future studies can examine factors influencing human injury and mortality cases throughout the Asian elephant range countries.

A raid on the plantation means the owner will need to employ labour to help clear the land conduct maintenance. In case of permanent damage where trees are uprooted and incapable of bearing fruits, those trees need to be replaced with new seedlings for which labour, fertilizer and pesticide are needed. From the regression Model 1, damages to palm heart and to leaves had significant lower fertilizer cost compared to uprooted trees. Fertilizer is not utilized when shoot, leaves or palm heart is damaged but they are applied during replanting. When trees are frequently uprooted by elephants, that would cause the need for replanting. Raids by elephants on oil palm, rubber or any other fruit-bearing trees like cassava, banana, jackfruit, or coconut trees could also be temporary where the trees are partially damaged but can still produce fruits or latex. Permanent damage in case of rubber is caused when the bark of the tree is completely pulled out by elephants, then the tree is useless and cannot be tapped for latex. In my study it was found that the cost of setting up and repairing mitigation methods was exorbitant (RM3,593,449.32). This expense could be due to installation of electric fence as a mitigation tool. Traditional methods are inexpensive but installing, maintaining and repairing electric fences are expensive (Hoare, 2003). Study elsewhere found that smallholders may exaggerate the amount of loss they incur due to wildlife damage on crops (Hoare, 1999). The HEC reports received by the Wildlife Department in Malaysia are usually verified by their

officers on the ground (Saaban et al., 2011b) but further evaluation of the actual crop loss suffered by smallholders and the findings from this study can be carried out in future studies to ascertain the economic loss to further support application for monetary relief for smallholders due to HEC.

The age of oil palm affected by HEC that has been reported by smallholders can be compared with the plantation records from Quilter (2019) which found 99.99% of over 200,000 depredated oil palms were six years and below. While from my survey the smallholders perceived that 79% (95) of the trees depredated by elephants were less than 6 years old. Parts of oil palm preferred by elephants were shoots/leaves and palm heart which concurred with previous studies that elephants are known to be selective of the plant parts (Quilter, 2019). Seldom trees above 15 years of age were damaged by elephants. The age of rubber plants preferred by elephants were also less than 6 years old and parts desirable were shoot/leaves and bark. By assessing the age of the plants preferred by elephants, smallholders can take necessary mitigation measures during the period when the trees are at a higher depredation risk.

4.2.2 Hidden costs of human-elephant conflict

Hidden costs are often finely interspersed with visible costs. The need to minimise visible cost encourages the deployment of mitigation measures, of which crop-guarding remains the most popular and effective choice. The activity of crop-guarding may be perceived to be effective (34.87%) in deterring elephants from raiding farms and alleviate monetary loss but simultaneously involves a lot of effort resulting in exhaustion. The respondents in our study found it difficult to live with elephants due to constant vigilance (89.47%), exhaustion due to guarding (84.57%) and fear over own (92.47%) and family's safety (76.05%). The need to constantly monitor and guard the crops against elephant raids, in places, where the smallholders share landscape with elephants, can cause disruption in their lifestyle and unwarranted psychological stress (Thondhlana *et al.*, 2020). However, in my study, I observed that despite the high percentage in agreement on the night guarding causing exhaustion was a cause of concern on staying with elephants, only 42% (71) were found to engage in guarding their crops. The percentage who perceived that exhaustion and constant vigil is a matter of concern was found to be higher than those who were physically involved in guarding, but this percentage could also include those who couldn't be involved in guarding the crops due to age or health considerations. However, their experience of guarding in their younger days cannot be negated. For standardisation my questionnaire limited the days of guarding to the most recent HEC incident and may not be able to reflect all spectrum of the stakeholders' experience.

On the other hand, most of the smallholders were not interested in applying for other jobs, with some already engaged in secondary jobs. The reasons stated include love for their farm, they remain unaffected even if unable to secure a job, and preference to work in kampung (village), but none of the respondents stated their ability to apply for another job due to guarding. However, most respondents were from older age group, which could contribute to why the respondents were not eager to apply for other jobs. Out of 37 smallholders who wanted to apply for a job, some were successful (41%) and few were not (49%) due to inadequate education and comparatively less job opportunities. R16 stated "*No qualification*", while R26 mentioned "*Hard to get a job in current time and academic qualification do not meet job requirement*".

This otherwise is contradictory to other countries with high opportunity loss like India and Africa. Smallholders in India and Africa lost out on job opportunities while safeguarding their families and guarding crops in the night against elephant raids and children lose school attendance to help their parents in guarding crops (Naughton, Rose and Treves, 1999; Hoare, 2000; Ngene and Omondi, 2008; Manoa et al., 2020; Guru and Das, 2021). Smallholders in Botswana were compelled to interrupt or abandon their livelihoods tasks owing to few crop raiding incidents during the dry post-crop harvest season (Mayberry, Hovorka and Evans, 2017). In parts of Asia like India, Bangladesh, Sri Lanka and also in Africa children assist elders in guarding crops during daytime that leads to poor school attendance and performance (Ogra, 2008; Jadhav and Barua, 2012b; Barua, Bhagwat and Jadhav, 2013; Manoa et al., 2020), however in Peninsular Malaysia children neither assisted their parents in guarding crop nor were they involved in guarding alone apart from two instances mentioned. Hence, they did not even miss out on their attendance in school.

In Malaysia houses are usually located together in a more accessible area than that of their crops (spatial separation between house and plantation), and the housing areas are often connected by road systems to nearby schools. Additionally, the Malaysian government invests millions in educational aids. Students from low-income families are offered funds by the Department of Social Welfare under the Schooling Assistance (Bantuan Sekolah) programme for a variety of expenditures that includes uniforms and bus fares. One of the most popular education aids is the Poor Student's Trust Fund (PSTF) (Patel, 2014). Also, as per FELDA's land settlement scheme, they had introduced a share system where the settlers they selected and brought were given the house lot along with 10 units of share in the Land Development Corporation which was equivalent to 4 ha of plantation. However, the settlers are not only paid wages, but also dividends and bonuses from profits made by the Corporation (Sutton, 1989). While RISDA provides subsidy towards rubber tree planting (Sutton, 1989) and MPOB for oil palm planting (Senawi et al., 2019).

4.2.3 HEC Conflict Pattern

An important revelation by 67.12% of smallholders (98) was that crop raiding did not follow any pattern and was unpredictable. This admission by the smallholders differed from other elephant range countries where crop raiding was found to be higher during rainy or harvesting season (Sukumar, 1990; Webber et al., 2011; Gubbi, 2012). However, in case of Peninsular Malaysia, crop raiding was found to be a random event which meant constant crop protection is required throughout the year. Both oil palm and rubber are perennial crops and cover expansive areas because of which the elephants might not be raiding in specific seasons as food is available throughout the year. In fact, one of the participants mentioned that "*sometimes elephants stay close-by the oil palm and rubber plantation and wait for replanting saplings to reach three to four years to consume it*". Most of the smallholders interviewed in this study, primarily cultivated either oil palm or rubber and grew alongside other fruit trees like banana or durians, making it challenging for the smallholders to ascertain the patterns of conflict. However, the patterns of conflict could change if the smallholders have grown only seasonal crops on their land like durians or paddy In India crop raiding follows a pattern based on the seasonal crops (Sukumar, 1990) which differed from the outlook of most smallholders in Peninsular Malaysia. Since this was a self-reported study we were unable to ascertain the minor subset of respondents with positive claim (number of respondents) on seasonal patterns but for those who had elaborated their answers, most reported general patterns such as crop raiding occurring at night instead of day time. Hence it is most probably due to misinterpretation of the questions.

4.3 Mitigation methods employed by smallholders

Although organised smallholders are supported by government-linked agencies in terms of plantation management, but they still suffer from economic losses (i.e., less harvest or income loss) linked to HEC. While some countries affected by HEC do provide monetary support to the victims based on the extent of crop damage, in Malaysia, government compensation schemes focus mostly on human injury or loss of life due to human-wildlife conflict. Only large plantations can invest in insurance, but smallholders find it difficult to invest due to high premium (Quilter, 2019).

Extant mitigation strategies emerged to redress the visible loss suffered by smallholders in Peninsular Malaysia. Most of the methods deployed by smallholders in Peninsular Malaysia were found to be traditional, inexpensive, measures like night guarding, patrolling, bamboo canons, carbide canons, lighting tyres in the middle of the field, oil lamps at gates and firecrackers which are similar to practices elsewhere (Sitati et al., 2003; Chakraborty and Mondal, 2013). Not much has been researched on the types of mitigation methods deployed

by smallholders in Malaysia, except for electric fences and elephant trenches (Saaban et al., 2011a; Ponnusamy et al., 2016). In this study, smallholders perceived night-guarding and the use of firecrackers as effective to prevent raids and these methods are more popular. When comparing with other studies, crop-guarding was found to be effective for smallholders and electric fence have varied results (Nyhus, Tilson and Sumianto, 2000; Sitati et al., 2003; Sitati, Walpole and Leader-Williams, 2005; Dublin et al., 2006). Noise, generated from the bamboo canons and firecrackers is another deterrent method, that is popular among elephant-range countries. Noise from bamboo canons lose its effectiveness over time. Since these methods were used quite often, it could lead to eventual habituation (Davies et al., 2011). Among other traditional methods that were used as a standalone method, including burning tyres or lighting fire at the entrance, while there were too few cases of bee-hive fence and application of chilli grease to conclude on its effectiveness.

Most smallholders engaged in some measure or the other to prevent crop raid. Smallholders who had attempted to deploy mitigation in the past (117), mentioned requiring financial support (87%), cost of mitigation being high (83%), lack of knowledge (58%) and failing in their previous attempts (66%). On the other hand, the remaining smallholders who had not attempted mitigation in their past (35), 69% mentioned requiring financial support, the cost being high (69%), lack of knowledge to set up mitigation was 57% and failed past attempts was 29%. I assume that the responses of failed past attempts mentioned by those who had not deployed mitigation in the past could be influenced by neighbours or family who had experienced it earlier. When implementation of mitigation methods entails high cost that could indicate smallholders were setting up electric fence because traditional methods are not exorbitantly priced. Smallholders should be advised on efficient and cost-effective methods that would allow them an opportunity to protect their crops.

Department of Wildlife and National Parks (DWNP), which is under the Malaysian Federal Government is responsible to control threats against wildlife or non-governmental organizations (NGOs) and academia could conduct short programs on empowering smallholders with different mitigation techniques for HEC affected area, that would provide an opportunity for smallholders to choose from the techniques best suitable for them. My questionnaire assessed smallholders' perception on the effectiveness of different HEC mitigation methods and included an option to state that mitigation is not necessary to differentiate respondents who have tested mitigation methods and those who did not. Indeed, a small section of the smallholders did not believe in the need to apply mitigation method. A reason could be that elephants passing through their fields without disturbing the crops. Like RI55 mentioned "*Elephant comes alone, passes by, doesn't bother. Used to come with a herd. Came three weeks ago.*". In fact, smallholders in one of the villages or *kampungs* called

Kampung Bekok mentioned two friendly wild male elephants – one adult and one young who often visit the farms of smallholders without causing any damage. Often the smallholder's family accompanied to see the elephants. But the elephants never charged at them despite sensing their presence. While RI34 mentioned "*MPOB always pays attention and is considerate*" which could mean the smallholders are coexisting with elephants in peace because MPOB helps them with replanting or compensation. And RI114 mentioned "*Usually didn't chase away elephants. The more they are chased away, the more aggressive they become. Old folk's tip – don't insult. Didn't guard at the field. HEC isn't too bad.*" The respondents had mixed reactions on their attitude towards elephants and since majority of the respondents agreed that mitigation is necessary, this further emphasised that smallholders needed some support with HEC mitigation methods.

4.4 Smallholders' Willingness to Pay for Insurance to protect their crops from damage

Monetary compensation to offset visible loss caused by elephants have always been considered in the framework to increase tolerance. But smallholders never mentioned being compensated for loss, although few stated receiving support occasionally from various agencies like FELCRA, FELDA, MPOB and RISDA. Apart from preventive mitigation measures, introducing financial instruments could play an important role in increasing tolerance between humans and elephants. Insurance scheme, which had proven to be efficient in some cases (Mishra et al., 2003), provided there is an established process and timely compensation can offer smallholders an alternative financial tool to secure some compensation for their crops. This study assesses smallholders' willingness to invest in insurance as a financial instrument. It was observed that less than one-third of the population invested in life Insurance schemes that indicated some smallholders were well-informed of the policies and benefits of insurance. It was surprising to note quite a few of them expressing doubt on the effectiveness of insurance in helping to recoup losses from crop damage despite having invested in life insurance, possibly because of trust issues in insurance schemes or their inability to afford the premium amount, or possibly the need to socialise the idea to the smallholders. Organised smallholders in Malaysia receive financial, technical, and agricultural support from FELDA, FELCRA, RISDA, MPOB and other government and private agencies. However, similar support is not extended to independent smallholders. Independent smallholders are supported once a while by MPOB (oil palm) and RISDA (rubber) or any of the other government or private agency. Support is often given by providing saplings or fertilizers or pesticides at the beginning of setting up a farm, or once in six months, or after crop depredation by elephants or at the time of replanting. The cost of insurance is a barrier

as insurance premiums are high and smallholders are reluctant to invest in schemes because they risk losing money to secure their crops for events that are not certain to occur (Wilson-Holt and Steele, 2019). Those who were willing to pay premium to secure their crops from damage could only afford to pay less than RM 200. In accordance with ranking elephant as the most conflict-prone wildlife, the smallholders wanted to insure their crops against elephant raids, followed by damage against other animals like livestock, wild boar, and macaque. I speculate that a possible reason that made smallholders uncomfortable to invest in crop insurance could be their belief that these costs should be covered by the government, state, or wildlife department.

Smallholders attributed the responsibility of absorbing the loss caused by human-elephant conflict to mostly government (80.39%) and themselves (64.83%). Smallholders also named private agencies (56.3%) and smallholders' communities (53.12%) living in proximity to elephants to take the responsibility for loss. Some mentioned general public (37.2%) should be responsible to bear the loss while majority agreed that they shouldn't be held responsible. The role of government in absorbing the loss caused by HEC is similar to other studies carried across elephant range countries like Botswana, Congo, Kenya and Myanmar (Mayberry, Hovorka and Evans, 2017; Nsonsi et al., 2018; Kinyanjui *et al.*, 2020; Tan *et al.*, 2020). On one hand, as laws to protect elephants and penalties charged to perpetrators who inflict harm to elephants are established by the government, which in the eyes of the smallholders and public, makes them responsible for elephants' actions. On the other hand, smallholders are aware that they, themselves are better placed at accepting ownership and sharing responsibility at achieving co-existence with the elephants (Tan et al., 2020).

This information gathered from this study can help insurance companies to assess the smallholders' ability and willingness to invest in premium to insure their crops and accordingly set-up insurance schemes for them.

4.5 Smallholders' Perceptions and Attitudes Towards Elephants

Model 2 to Model 6 of regression analysis examined factors influencing smallholder's attitude. It was found that types of damage, level of education, and age group were responsible for influencing few aspects of smallholders' attitude, not all. Smallholders who suffered property damage due to elephant raids were found to likely perceive that the laws of the land were unfair to smallholders as also those smallholders whose educational qualification was above secondary level. Damage to property causes monetary loss to the Level of education also played a part in influencing their attitude towards sharing landscape with elephants. It was found that smallholders with level of education below secondary level were likely to agree that

they would be happy if there are no elephants in their area. Age also played a part in influencing the attitude of the smallholders wherein, those below the age of 40 years perceived that the age-old traditions of living harmoniously with elephants which were passed on by their grandfathers encourages them to follow the same traditions.

Laws that encompass the well-being of elephants may garner antipathetic emotions from those whose remain powerless victims whose lives are affected by elephants (Madden, 2004). Smallholders held the laws responsible for their plight with elephants. Smallholders' perception on fairness of laws was found to be influenced by level of education and property damage, while injury to humans was found to be insignificant (*Model 6*). When the smallholders' level of education is lower than secondary school, smallholders are less likely to question the laws that protect elephants and may accept it as a way of life. On the other hand, when properties are damaged by elephants, then the feelings of unfairness towards the laws protecting elephant festers. Possibly property damage often involves electric fences which is expensive (Saaban et al., 2011b) and is a matter of concern for the smallholders as it involves financial loss and most of the respondents belonged to "below poverty line". Possibly, compensation or insurance could help offset their loss and help reduce the negative attitude (Thakur, Yadav and Jhariya, 2016; Manoa et al., 2020; Guru and Das, 2021).

Cultural heritage has always been an integral part of shaping one's individual perception and attitude (Dickman, 2010; Nayak and Swain, 2020). This study found that younger generation of smallholders are more likely to agree that their tradition and culture promotes coexistence with elephants compared to older generations which is similar to other studies (Khatun, 2012). This could mean an opportunity to develop projects on the ground that engages with the younger generation of smallholders to establish coexistence efforts with elephants.

An ideal scenario would be to manage conflict with elephants to a tolerable level for smallholders while taking into account both visible and hidden cost of conflict. This entails as well, the need to increase the sense of safety for people in order to promote coexistence with elephants in the same landscape, instead of hoping for the complete absence of conflict.

Level of education also had a statistically significant effect on how smallholders viewed a possible scenario of absence of elephants. Smallholders who had not completed their secondary level of education were more likely to disagree that they and their families will be happy if there are no elephants in their surroundings. Possibly smallholders with less educational qualification found it harder to move to the city or find alternative work to support their family, and hence looking after their smallholding offers the best environment for their family and have accepted the need to live with elephants. Furthermore, majority of the respondents agree (53.9%) that there is enough space for the humans and elephants to

coexist in Malaysia and also the fact 80% of the smallholders were unwilling to relocate to an area with lesser or nil elephant conflict.

Apart from crop raiding, fear of losing one's life or family is another aspect that would alter the smallholder's attitude towards elephants (Kansky, Kidd and Knight, 2016a; Saif et al., 2019b). However, in Malaysia, the residential area and the planted areas are often separated. Possibly, that is why the smallholders in study are more likely to agree that stress over vigilance is more than exhaustion due to guarding crops. Although the number of days a month that the smallholders were engaged in guarding crops averaged to 3.2 days a month, still they mentioned being exhausted due to guarding which could either stem from negative perception towards sharing space with elephants or the fact that vigilance would eventually turn into guarding.

Moving forward, we recommend on ground assessments to record financial costs that entails crop raiding and property destruction suffered either by smallholders, or as a community or by external agencies, that is verified by a third-party. I also recommend expanding the study to examine other human-wildlife conflict and the impact natural disasters such as flood, has on smallholders and plantations. Smallholders are a key component in the production of oil palm and rubber in Peninsular Malaysia and their role in contributing to the economy is substantial. And visible and hidden losses suffered by them due to human-elephant conflict without assistance from authorities can further augment the conflict. So, better and more comprehensive figures of loss suffered by smallholders will help policy makers to determine the financial assistance required for the community. There is continuous scope to conduct in-depth study on various facets of hidden loss that could be affecting the smallholders in Malaysia. Our study found that smallholders feel limited by their lack of knowledge on HEC mitigation methods. There is a need to conduct training programs to empower the smallholders on protecting their crops and managing conflict. Financial compensation through insurance to offset monetary loss should be considered within the purview of mitigation measures, while considering the three challenges of insurance-based compensation schemes – timely assessed, fair and financially sustainable payments. Insurance would offer incentives for damage prevention to encourage smallholders to be responsible and accountable. However, there is a need to socialise the concept of insurance to the smallholders.

5.0 CONCLUSION

This study contributes towards filling critical knowledge gaps the various aspects of visible loss and hidden loss that smallholders in Malaysia faced due to conflict with elephants. Smallholders are important stakeholders of the oil palm industry in Malaysia and potentially one of the important stakeholders to consider when promoting human-elephant coexistence. Since a vast majority of the smallholders cultivate oil palm and rubber, along with other secondary crops research is required to examine ways to support smallholders in managing conflict with elephants responsibly. Despite suffering from heavy losses monetarily, human fatality and injury due to HEC in Peninsular Malaysia was found to be low in comparison to other elephant range countries where the number of human fatalities and injuries are high. Exhaustion due to guarding, the need for constant vigilance and fear for life, remained the reasons why smallholders were unwilling to share the landscape with elephants. Among HEC mitigation methods practised, night-guarding was believed to be the most effective – but no single mitigation measure was found to be entirely 100% effective against elephant raids. Almost half of the smallholders, irrespective of whether they employed mitigation methods in the past or not, thought crop insurance as a potential financial tool for protecting crops, but only some were willing to invest in insurance to secure their crops. Their attitude towards elephants was influenced by age, education level and past experience of property destruction.

This study is the first study examining both visible and hidden cost of human-elephant conflict in Peninsular Malaysia and my findings will hopefully encourage more research to examine the quantification of cost and the human dimensions of HEC faced by the agriculture communities. It is important to note that responsible management of HEC is not an independent procedure by the government. It requires the support of local smallholders and communities for its success. This study is useful for conservation managers when considering challenges faced by the smallholders in managing HEC, factors that promote tolerance for coexistence with elephants and for the development of smallholder insurance scheme.

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7.0 APPENDICES

Respondent ID: _____

Impact of Human-Elephant Conflict on Smallholders in Peninsular Malaysia

My name is Sinchita Sinha and I am a Masters student at University of Nottingham, Malaysia campus. I am conducting a short questionnaire to analyze how tangible (monetary calculation of expenses and cost) and intangible losses (losses that are not economic in nature) of Human-elephant conflict impact the smallholders in Peninsular Malaysia.

This study complies with the requirements of the Ethics Committee of the Faculty of Science of the University of Nottingham.

This questionnaire asks about your experience, knowledge, and ideas. Answering the questions is completely voluntary. You may choose to terminate the interview anytime without having to provide any reason for it. In answering the questions please be honest and frank – there are no right or wrong answers. Identifiable personal details have deliberately been omitted to ensure anonymity of responses. No one apart from the members of the research team will see any of the completed questionnaires.

Thank you for your time and assistance. If you require more information about the study, please contact any member of the research team below.

Names Contact details

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General Info---

1. Date of Interview: _____; 2. Interviewer Name: _____

3. Type of Interview: _____;

A. Tangible Loss:
1. What are the types of crop you grow? (You can select more than one): Oil palm □   Rubber □   Durian □   Banana □   Others (Specify) _____
2. What is the land size of the crops that you grow? _____ acres
3. What is the average income (without the deduction of any cost or expenditure) of your family per month in RM?
   <1000 □   1001 – 2000 □   2001 – 5000 □   5001 – 10,000 □   >10,000 □
4. Do you have any other source of income apart from growing crops: Yes □   No □
5. If yes, please specify _____

__Conflict with animals could mean crop raids, destroying property, animals inflicting injury, animal attacks leading to death.__

6. Have you experienced conflict with animals in the past 5 years? Yes □ No □
7. Select the animals with whom you experience conflict the most? (You can choose more than one answer) - Wild boars □   Elephants □   Macaques □   Civets □   Tigers □   Porcupine □   Others (please specify) □ _____
8. Please mention the top 3 animals with the most conflict:
   a. _____
   b. _____

c. _____

Please continue with No.9 if one of the conflict animal is Elephant, otherwise go straight to Section C.

9. What kind of conflict did you experience? (You can select more than one answer)
    a. Crop raiding and damage by trampling □
    b. Property Damage (house, water tanks, pipes) □
    c. Inflicting injury to humans □
    d. Causing human death □
    e. Others (Please specify) □ _____
10. If you had conflict with elephants, how many times did the elephant raid your farm in the past 2 years? _____
11. If None, when was the last time elephants raided your farm (state the year) _____
12. Please fill the below chart as applicable to the type of crop you grow:

Type of Crop	Age of tree most likely to be damaged	Parts of tree most likely to be damaged	Type of loss (number of trees)	Calculation of the loss
a. Oil Palm □	< 3 years □ 3 years □ 3 - 6 years □ 6 - 10 years □ 10 – 15 years□ > 15 years □	Shoot □ Leaves □ Fruits □ Palm heart □ Bark of the tree □ Uprooting trees □	Permanent damage - the tree is of no use □ (mention the number of trees damaged) _____ Temporary damage - although the tree is damaged it can still bear fruits or be used for tapping resin □ (mention the number of trees damaged) _____	a. Seedling – ____(mention total number of seedling and cost of each seedling) RM_____ b. Labour – RM _____ c. Fertilizer – RM_____ d. Pesticides – RM_____
b. Rubber □	< 3 years □ 3 years □ 3 - 6 years □ 6 - 10 years □ 10 – 15 years□ > 15 years □	Shoot □ Leaves □ Fruits □ Bark of the tree □ Uprooting trees □	Permanent damage - the tree is of no use □ (mention the number of trees damaged) _____ Temporary damage - although the tree is damaged it can still bear fruits or be used for tapping resin □ (mention the number of trees damaged) _____	a. Seedling –_____ (mention total number of seedling and cost of each seedling) RM_____ b. Labour – RM _____ c. Fertilizer – RM_____ d. Pesticides – RM_____
c. Durian □	_____years	Shoot □ Leaves □ Fruits □ Bark of the tree □ Uprooting trees □	Permanent damage - the tree is of no use □ (mention the number of trees damaged) _____ Temporary damage - although the tree is damaged it can still bear fruits or be used for tapping resin □ (mention	a. Seedling – ____(mention total number of seedling and cost of each seedling) RM_____ b. Labour – RM _____ c. Fertilizer – RM_____

			the number of trees damaged) _____	d. Pesticides – RM_____
d. Banana □	_____years	Shoot □ Leaves □ Fruits □ Bark of the tree □ Uprooting trees □	Permanent damage - the tree is of no use □ (mention the number of trees damaged) _____ Temporary damage - although the tree is damaged it can still bear fruits or be used for tapping resin □ (mention the number of trees damaged) _____	a. Seedling – _____(mention total number of seedling and cost of each seedling) RM_____ b. Labour – RM _____ c. Fertilizer – RM_____ d. Pesticides – RM_____

Methods that are usually employed to reduce conflict between wild animals (in this case elephants) and humans are called Mitigation techniques

13. Have you spent in any mitigation techniques in the past years? Yes □ No □
14. If Yes, please select the type of techniques that you have employed and their effectiveness in mitigating conflict with elephants:

	Effective	Not Effective	Not Applicable
a. Electric Fence			
b. Chili and Grease			
c. Bee hive fence			
d. Night guarding			
e. Firecrackers (small balls)			
f. Snares			
g. Elephant trenches			
h. Burning tires / fire at entrance			
i. Oil lamps			
j. Patrolling			
k. Others (please specify) _____			

15. How much money in RM did you invest in preparing mitigation techniques and its repair work in the last 5 years?
    a. Main cost to set-up: RM _____
    b. Repair cost: RM _____
16. Do you think the elephants raid crops at particular months of the year? 1. Yes □   2. No □ 3. Don't know □   4. Unpredictable □
17. If Yes, please specify the months/ seasons of the year: _____

18. It is difficult for me to deploy mitigation to reduce crop damage from elephants because	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree

a. The cost of mitigation is high	□	□	□	□	□
b. I lack the knowledge to set up	□	□	□	□	□
c. I need support to set up	□	□	□	□	□
d. Past attempts has failed/pointless	□	□	□	□	□
e. Mitigation is not needed	□	□	□	□	□

B. Intangible Loss:

19. Is the location of your farm same as that of your house? Yes □   No □

20. Living with elephants in my area is difficult because	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
a. I need to be vigilant all the times	□	□	□	□	□
b. I become exhausted guarding my crops	□	□	□	□	□
c. I worry about the safety of my children	□	□	□	□	□
d. I worry about my safety	□	□	□	□	□
e. Others (Please specify)_____	□	□	□	□	□

Please continue Q20 to Q25 if you use Patrolling as Mitigation technique against Elephants

21. Do you guard your farm together with others in the community after the last elephant raid on your crops? Yes □   No □
22. After the last elephant raid, how many days a month did you guard your crops **at night**? _____ times
23. Did you pay to guard your farm after the last elephant raid on your crops? Yes □   No □
24. Did your children/young siblings miss school and help you guard your farm after the last elephant raid? Yes □   No □
25. If Yes, then how many days of school did your children miss to help you in guarding crops? _____ days
26. During elephant raids, how much of your labor time is lost (in hours) from your normal routine (24 hours)? 1. 1-3 hours   2. 4-8 hours □   3. full day □
    a. Did you ever plan to apply for some other job apart from working on your farm? Yes □   No □
    b. If Yes, have you been able to apply for the job that you wanted? Yes □   No □
    c. If No, why have you been unable to apply for the job? Please explain.
    _____
    _____
    _____

C. Crop Raids & Insurance: Assess organized and independent smallholder's preparedness in managing HEC

Insurance is something that people buy to protect themselves from unexpected losses. People who buy insurance pay a monthly or a yearly fee and promise to be careful. In exchange for this, if something bad happens to

the person or thing that is insured, the company that sold the insurance will provide compensation.

27. Do you have life insurance?
    Yes □   No □
28. Are you satisfied with the services of your life insurance?
    Yes □   No □   May be □   Don't know □   Not applicable □
29. Do you receive any support/ subsidies from gov/ private sectors/ NGOs?
    Yes □   No □
30. If yes, how often do you receive support from the agencies? (Please select one) –
    1 At the beginning of setting up □
    2 Every month □
    3 Every 6 months □
    4 Yearly □
    5 After crop damage □
31. Do you think insuring your crops would be useful in protecting it against any kind of damage? 1. Yes □   2. No □   3. Don't know □   5. Maybe □
32. Have you invested in any insurance scheme that protects your crops from any damage (For eg., fire, flood or crop damage by animals)?
    Yes □   No □
33. If No, are you willing to pay premium (an amount to be paid for a contract of insurance) to insure your crops against damage?
    Yes □   No □
34. If Yes (you are willing to pay) How much are you willing to pay monthly towards insuring your crops in RM? If less than RM 200, then mention the amount you are willing to pay.
    _____ <200 □   200 – 500 □   500 – 1000 □   > 1000 □
35. Please select in the order of most important to least important - Against which damage are you most likely to insure your crops?

1	
2	
3	
4	
5	

    a. Damage against insects'
    b. Damage against crop diseases
    c. Damage against extreme weather / natural calamity
    d. Damage against elephant raid
    e. Damage against other animals like livestock, wild boar and macaque

36. In your opinion who do you think should be responsible for loss due to HEC? Answer as many as relevant:

	Yes	No	Don't know
a. Self	□	□	□
b. Government	□	□	□
c. Smallholder farmers or communities living close to elephants	□	□	□
d. Village head / village leaders	□	□	□
e. General Public	□	□	□
f. Environmental NGOs	□	□	□
g. Private agencies (Eg. FELCRA, RISDA, MPOB)	□	□	□
h. Others (Please specify) _____	□	□	□

D. Attitude towards elephants: Strongly Disagree to Strongly Agree

37. Please indicate the level of your agreement or disagreement with each of the following statements by placing a check in the appropriate box.

	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
a. I welcome any attempts by anyone to help me in addressing conflict with elephants.	☐	☐	☐	☐	☐
b. As more forests are fragmented, elephants will move closer to human habitat	☐	☐	☐	☐	☐
c. My tradition and culture from my grandparent's days until now, encourage me to live harmoniously with elephants.	☐	☐	☐	☐	☐
d. We cannot talk bad about elephants due to taboo	☐	☐	☐	☐	☐
e. Protecting elephants will only make conflict worse	☐	☐	☐	☐	☐
f. If today at my neighbour's plantation a large male elephant dies (for reason unknown), my neighbour may get into trouble with the authorities	☐	☐	☐	☐	☐
g. I think other people/ villages had thought about killing elephants because of conflict.	☐	☐	☐	☐	☐
h. Food is scarce in the forest so elephants venture out for food	☐	☐	☐	☐	☐
i. The elephant population in Malaysia is too large.	☐	☐	☐	☐	☐
j. The penalty for injuring or killing elephants are severe	☐	☐	☐	☐	☐
k. The law is not fair to planters	☐	☐	☐	☐	☐
l. Elephant habitat are disturbed by human activities, that's why they are moving into this village.	☐	☐	☐	☐	☐
m. My family and I will feel happy if there are no elephants in this area.	☐	☐	☐	☐	☐
n. If given an option, are you willing to relocate (move from one place to another) to another village where the villages experience less or no elephant raids	☐	☐	☐	☐	☐
o. I feel elephant population in this area is increasing.					

p. There is enough space for human needs and elephants in Malaysia.	□	□	□	□	□
q. There was never a problem living with elephants in the past (grandparents time) in this area					
r. I feel pity for the elephants sometimes					
s. I feel there are benefits to having elephants. If you strongly agree or agree, please specify_____ _____	□	□	□	□	□

Demographics –

1. Age: _____ years old;   N/A □
2. Gender – 1. Male □   2. Female □   0. N/A □
3. Ethnicity: 1. Malay □; 2. Chinese □;   3. Indian □;   4. Orang Asli □   5. Other □ (Specify) _____;   0. N/A □
4. Religion: 1. Islam □;   2.Buddhism □:   3. Christianity □;   4. Hindu □;   5. None □;   6. Other □ (Specify) _____   0. N/A □
5. Marital Status: 1. Single □   2. Married □   3. Widowed □   4. Divorced □   0. N/A □
6. What is your highest level of education? 1. None □   2. Primary □   3. Secondary □   4. Tertiary □   5. Graduate □   6. Postgraduate (Master or PhD) □   7. NA □
7. Occupation: _____
8. What is the status of the Land Title? Personal □   Lease □   Others (Please specify) □ _____
9. Please mention the land holding years: _____ years
10. Number of members in your household: Adult male _____   Adult female _____   Children _____
11. Age of Child / Children: < 12 □   12 – 18 □   > 18 □
12. Are you the only earning member? Yes □   No □
13. If No, how many others contribute towards income? _____

Comments:

_____
_____
_____