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TRANSFRONTIER CONSERVATION AREA (KAZA TFCA)

A MANUAL for REDUCING and MITIGATING HUMAN-INSECT CONFLICT (HIC)

Migratory locust (*Locusta migratoria*)

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Abbreviations

HIC	Human Insect Conflict
HWC	Human Wildlife Conflict
KAZA TFCA	Kavango Zambezi Trans-Frontier Conservation Area
PA	Protected Areas
DDT	Dichlorodiphenyltrichloroethane

KAZA Mission

"To sustainably manage the Kavango Zambezi ecosystem, its heritage and cultural resources based on best conservation and tourism models for the socio-economic wellbeing of the communities and other stakeholders in and around the eco-region through harmonisation of policies, strategies and practices"

1. Introduction

Kavango-Zambezi Transfrontier Conservation Area (KAZA TFCA), is a transboundary collaborative initiative of five Partner States, Angola, Botswana, Namibia, Zambia and Zimbabwe, in the conservation of shared natural resources and the development of the communities in and around the landscape. The TFCA is a mosaic of multiple land uses composed of:

- Protected areas (PAs) in the form of national parks, game reserves;
- wildlife/game management areas, forest reserves, and conservancies/ community concessions areas, and
- Communal areas (settlement, pastoral, and arable farming).

There are about 3 million people settled across the KAZA landscape. The human population is mainly rural communities that are largely dependent on subsistence pastoral and arable agriculture. The multiple land use status of the KAZA landscape present many development challenges and opportunities for the resident communities.

Humans have been battling insect pests for as long as we have shared this planet. Insects are everywhere and no human being can avoid interacting with insects in all facets of life. In humans' view, any insect that is found in the wrong place becomes a pest and is a source of human insect conflict. Insect pests are those that feed on, compete for food with, or transmit diseases to humans and livestock. Ecosystems modified by human activities have provided opportunities for varied insect species to successfully adapt and thrive as pests. In popular sense, "insect" refers to familiar pests or disease carriers, such as houseflies, ants, locusts, termites, grasshoppers, aphids, mosquitoes, fleas, butterflies, bees, hornets and tsetse flies. Some of the specified insects cause serious problems in people's houses, farms, rangelands, rivers, dams and towns across the world.

The Kavango-Zambezi (KAZA) Transfrontier Conservation Area (TFCA), located in the sub-tropical region, provides favourable conditions for multiplication of many insects that attack people's crops, livestock and products and those that carry disease. Such interaction with human life causes serious human insect conflict (HIC). Massive efforts are required to suppress and manage population densities of the varied and abundant insect species in order to mitigate the HIC. This manual provides information on methods of reducing and mitigating human-insect conflict.

Figure 1: Locusts can cause famine even in years where good rainfall has been received.

1.1 Goal of the manual

The goal of this manual is to:

- Improve the understanding of conflict between humans and insects in order to assist the affected communities in applying best management practice to reduce and mitigate the conflicts.

1.2 Objectives of the manual

- To equip users of the manual with knowledge on human-insects conflicts.
- To assist users of the manual to understand and apply best management practices in reducing and mitigating human-insect conflict.

1.3 Targeted users of the manual

- Farmers (subsistence and commercial) experiencing and affected by human-insect conflict.
- Wildlife managers and extension officers.
- People interested in coexistence of humans and insects.

2 Human Insect Conflict

Insects are essential for the proper functioning of all ecosystems as food for other creatures, pollinators and recyclers of nutrients. Less than 0.5% of the total numbers of the known insect species are considered pests and only a few of these are a serious menace to people. Human-insect conflicts are caused by insect pests which have been defined as any insect in the wrong place. Insect pests inflict damage to humans, farm animals and crops. One example is the tsetse fly that puts millions of people and livestock at risk in sub-Saharan Africa including KAZA TFCA due to the transmission of trypanosomiasis.

Herbivorous insects are believed to be responsible for destroying 20% of the world's total crop production annually. In trying to maximise yields in farms, humans create conducive agro-ecosystems where crops are selected for their size, high yield and nutritional value. This does not only satisfy human demand but provides a highly conducive environment for herbivorous insects at the same time.

Human insect conflict is also seen in vector borne diseases. These are human illnesses caused by parasites, viruses and bacteria that are transmitted by mosquitoes, sand-flies, triatomine bugs, blackflies, ticks, tsetse flies, mites, snails and lice. Every year there are more than 700 000 deaths (globally) from diseases such as malaria, dengue, schistosomiasis, human African trypanosomiasis, leishmaniasis, Chagas disease, yellow fever, Japanese encephalitis and onchocerciasis, globally. The major vector-borne diseases, together, account for around 17% of all infectious diseases. The burden of these diseases is highest in regions like KAZA TFCA that lie in subtropical areas. Poor populations in rural communities are the most affected.

2.1 Behavioural traits of insects

Ecology of terrestrial insects

- Terrestrial insects feed on every sort of organic matter and their methods of feeding and digestion have become modified accordingly. Preventing water loss is another important aspect of life in terrestrial environments. All insects have a waxy (lipid) layer that coats the outer surface of the exoskeleton to prevent water loss from the body wall. In addition, most terrestrial insects also have adaptations to avoid water loss through respiration and waste elimination.

Protection from enemies

- Insects may derive some protection from the horny or leathery cuticle but may also have various chemical defences. For example, some caterpillars have irritating hairs which break up into barbed fragments that contain a poisonous substance that causes intense itching and serves as a protection against many birds. Concealment is an important protective device for insects. For some, this may be accomplished by simply hiding beneath stones or the bark of trees. However, many species rely on some forms of protective coloration. Protective coloration may take the form of camouflage in which the insect blends into its background.

Regulation of population

- It has since become generally thought that the ultimate factor in the control of numbers is competition within the species for food and other needs. Competition within a species is often reduced by wholesale migration to new areas. Migration may occur by active flight or, as in aphids and locusts, largely directed by the wind.

Sensory perceptions

- Insects have an elaborate system of sense organs. Tactile hairs cover the entire body surface. The hairs serve to inform the insect about its surroundings and its body position. Insects can form adequate visual impressions of their surroundings. They have good colour vision, with colour perception extending (as in ants and bees) into the ultraviolet, although it often fails to extend into the deep red. Many flowers have patterns of ultraviolet reflection invisible to the human eye but visible to the insect eye.

Body Structure

- In many insect species the difference in body structure between the sexes is pronounced, and knowledge of one sex may give few clues to the appearance of the other sex.

Reproduction

- Reproductive capacity is generally high in many insects. Usually the male seeks out the female. Some insects advertise their presence to the other sex by flashing lights. In butterflies in which vision is important, the colour of the female in flight can attract a male of the same species. The most important element in mating, however, is odour. Most female insects secrete odorous substances called pheromones that serve as specific attractants and excitants for males. The male likewise may produce scents that excite the female.

Feeding

- Some insects feed only in the immature or larval stage and go without food during an extremely short adult life. Many species imitate other insects in colour and form in order to easily catch their prey. By doing this, they also avoid or minimize attack by predators that feed by day. Behaviour of feeding is diverse, from the almost inert parasitic forms, whose larvae lie in the nutrient bloodstreams of their hosts and feed by absorption, to dragonflies that pursue victims in the air, tiger beetles that outrun prey on land and predaceous water beetles that outswim prey in water.

Instincts

- The insect orients itself by responding to the stimuli it receives. The highest developments of behaviour found in social insects such as the ants, bees, and termites are based on the instinct principle.

Insect societies

- Social insects have developed a division of labour in which the members must do the work required at the proper time. If the society is to succeed, its needs must be communicated to the individual members and those individuals must act accordingly.

Figure 2: Control of mosquitoes through insecticides has been very effective at reducing disease transmission.

2.2 Common problems caused by insects

Damage and destruction of property

When insects that break down dead trees invade structural timbers in buildings, they become pests. This is true of insects such as dermestid beetles and various tineid moths that are ecological latecomers' carcasses and are capable of breaking down the keratin in hair and feathers. When these insects invade skins, furs and wool garments or carpets, they can become problems to humans.

Damage to growing crops

Insects are responsible for two major kinds of damage to growing crops. First is direct injury to the plant by the feeding insect which eats leaves or burrows in stems, fruit or roots. There are hundreds of pest species of this type both in larvae and adults. The second type is indirect damage in which the insect itself does little or no harm but transmits a bacterial, viral or fungal infection into a crop. Common examples include the viral diseases of sugar beets and potatoes carried from plant to plant by aphids.

Figure 3: Applying the right amount of chemical at the right time is a major factor in ensuring successful control.

Damage to humans and livestock

Insect damage to humans and livestock is done directly or indirectly. Direct human injury by insect stings and bites is of relatively minor importance although swarms of biting flies and mosquitoes often make life almost intolerable as do biting sand flies and tsetse flies. Persistent irritation by biting flies can cause deterioration in the health of cattle. Some blowflies, in addition to depositing their eggs in carcasses, also invade the tissue of living animals including humans, a condition known as myiasis. Blowflies infest the fleece and skin of sheep. The infestation is called sheep-strike. It causes severe economic damage which is a manifestation of the conflict between humans and insects.

Figure 4: Spraying is an alternative

Transmission of diseases

Indirect damage is through being vectors of disease causing organisms. Many major human diseases are produced by micro-organism conveyed by insects which serve as vectors of pathogens. Malaria is caused by the protozoan Plasmodium which spends part of its development cycle in Anopheles mosquitoes. Sleeping sickness in humans and a group of cattle diseases that are widespread in KAZA TFCA and other African regions known as nagana are caused by protozoan trypanosomes transmitted by the bites of tsetse flies. Under non sanitary conditions the common housefly Musca can play an incidental role in the spread of human intestinal infections (e.g., typhoid, bacillary and amoebic dysentery) by contamination of food.

Figure 5: Only the Anopheles mosquito is able to transmit the plasmodium into a host.

Figure 5 & 6: Aerial spraying of agricultural chemicals is a useful way to control insects, diseases and weeds.

Figure 7 & 8: Baited traps used to control tsetse flies.

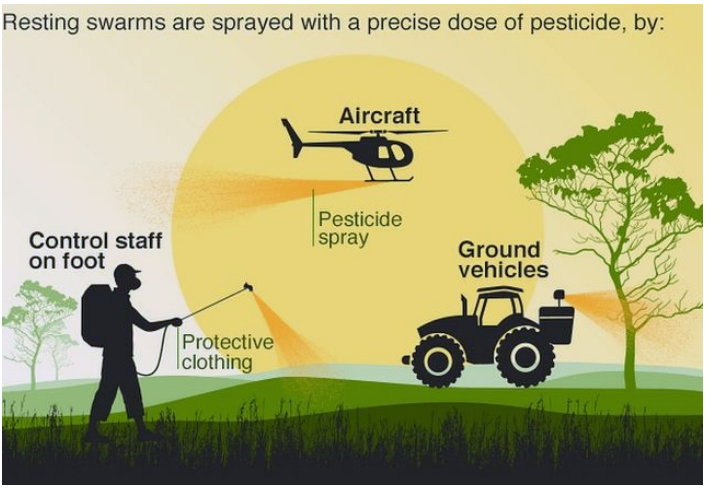

Figure 9: Different ways of spraying swarms of insects such as locusts.

3 Methods of reducing and mitigating human insect conflict

3.1 Chemical mitigation methods (insecticides)

HIC mitigation can be achieved through chemical controls. The method is based on substances that are toxic to the insect pests involved. When chemical pesticides are applied to protect plants from pests, diseases caused by insect pests, they should protect the plants. It is of course important that the plant that needs protection does not itself suffer from the toxic effects of the chemicals. Examples of commonly used chemical substances for mitigating HIC are lime and wood ash to destroy parasitic insects. Nowadays there are hundreds of chemical pesticides available for use in agriculture and horticulture. The commonly used chemicals that are highly toxic to most insects, nontoxic to humans in small quantities are DDT, dieldrin and endrin.

Advantages of use of insecticides are:

- The use of chemical pesticides is widespread due to their relatively low cost, the ease with which they can be applied and their effectiveness, availability and stability and;
- Chemical pesticides are generally fast-acting, which limits the damage done to crops.

The disadvantages of insecticides are:

- They are often not just toxic to the organisms for which they were intended, but also to other organisms. Insecticides can be subdivided into two groups: non-selective and selective pesticides. The non-selective products are the most harmful because they kill all kinds of organisms including harmless and useful species. Selective pesticides have a more limited range. They only get rid of the target pest.
- Resistance of insect pests- Pesticides are often effective for only a (short) period on a particular organism. Organisms can become immune to a substance, so they no longer have an effect. These organisms mutate and become resistant. This means that other pesticides need to be used to control them.
- Accumulation in the food chain - If sprayed plants are eaten by an organism and that organism is then eaten by another, the chemicals can be passed up the food chain. Animals at the top of the food chain, usually predators or humans, have a greater chance of toxicity due to the build-up of pesticides in their system. Gradually, however, this effect is becoming less relevant because pesticides are now required to break down more quickly so that they cannot accumulate. If they do not, they are not permitted for sale.

3.2 Biological mitigation methods

Using natural predators and parasites (microbial)

Biological control assumes that natural predators are able to suppress insect pests. Natural predators are released in small numbers, but once they become established they become effective in the long term. This method is also called inoculation. When the natural predator is introduced periodically, it is known as inundation.

There are two groups of beneficial microbial organisms: predators and parasites. Parasites are organisms that live at the expense of another organism, such as the larvae of, which live in the larva of whitefly and eat them from the inside. Predators are organisms that simply prey on other organisms for food, such as ladybirds which eat aphids.

The advantages are:

- The natural enemy can become established and this will produce long-term results.
- The risk of resistance is also much lower since pests cannot build up resistance to being eaten.
- Natural pest control is much targeted and therefore an effective way to control particular pests.

The disadvantages of biological control are:

- Natural enemies may move away. In greenhouses this problem can be managed, but not in open fields.
- Spreading over a larger plot also takes time.
- In the second place, insect pests are never destroyed completely because the natural enemy needs to stay alive and they will therefore never destroy the entire population.
- Finally, it is not possible to use them before the insect pest has occurred and this means that some damage will be done to crops.

Although these methods are not consistently effective, they are considered to be less harmful to the environment than are some chemicals.

Figure 10: Lady bird beetle and Figure 11: Lady bird beetle eggs respectively. Lady birds feed on plants.

4 Training

Training should be a continuous process for all stakeholders. Various programs of training targeting farmers and extension officers should be executed periodically to improve the technical capacity of the various stakeholders that are responsible to respond to HWC. The understanding of animal behavior and wildlife management, as well as the general awareness programs should be part and parcel of the authorities responsible for wildlife management.

5 Conclusion

It is essential to have accurate spatial and temporal geo-referenced information about when and where the conflict is occurring. This understanding, together with implementation of appropriate mitigation measures, should lead to a better focus on target areas and the most relevant species. Wildlife management and conservation authorities need to understand the HWC hotspots in their respective components and design robust programs for support to the communities against wildlife damages. The support programs should be accompanied by effective support on implementation of mitigation measures, and Monitoring & Evaluation tools. In order to realize positive result in dealing with HWC all stakeholders are requested to ensure that:

- The above interventions are constantly implemented and supported, and not just as occasional campaigns;
- There is greater active participation in the strategic activities by the various parties responsible HWC mitigation;
- There are opportunities to introduce other innovative mechanisms and approaches on dealing with any type of HWC; and
- Adequate capacity in terms of equipment, skills set, technology and financial resources are in place to effectively support HWC mitigation.

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