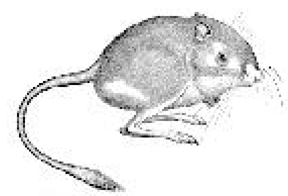
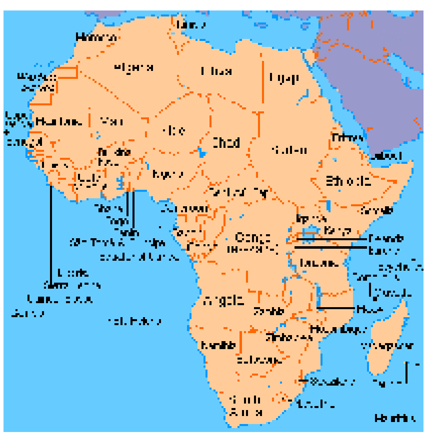
United States Agency for International Development

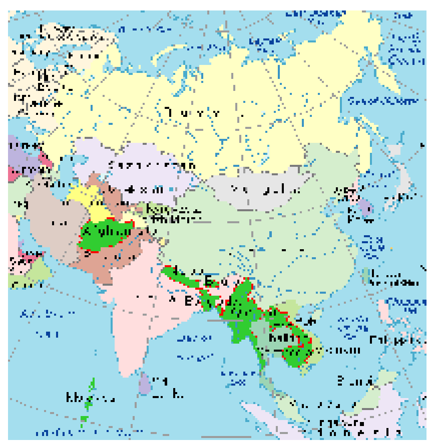
Emergency Transboundary Outbreak Pest Management in Africa and Asia



Revised Programmatic Environmental Assessment

Executive Summary and Recommendations





United States Department of Agriculture
Animal and Plant Health Inspection Service
Riverdale, Maryland
November 2001

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Executive Summary

This document updates and supplements the 1989 Programmatic Environmental Assessment (PEA) for locust and grasshopper (l/g) control in Africa and Asia and also addresses two other emergency transboundary pests-armyworms and rodents but- it does not replace it by its entirety. The 1989 PEA responded to the United States Agency for International Development's (USAID) environmental procedures and has played an important role in protecting human safety and the environment in USAID-sponsored activities to control l/g in Africa and Asia.

Since the 1989 PEA was published, country-specific Supplementary Environmental Assessments (SEAs) have been prepared for 19 countries in Africa, two countries in southwest Asia and one country in the Middle East. There have also been six amendments to those original SEAs. The SEAs and amendments provided specific information on l/g programs in individual countries and assisted in the implementation of new technologies. The SEAs also meet the requirements contained in the USAID Environmental Procedures for foreign assistance.

The purpose of this document is to update the 1989 PEA, reflecting the current best and safest practices and techniques for management and control of l/g and other emergency or outbreak pests of crops and pasture such as armyworms and rodents. Portions of the 1989 PEA pertaining to l/g that are still relevant and require no revision have not been changed. However, those portions of the 1989 PEA where additional information have been made available through the SEAs and in the scientific literature have been revised in this document.

Locusts and Grasshoppers in Africa and Asia

Locusts and grasshopper (l/g) swarms, or plagues, can inflict devastating damage on agricultural crops and pasture that residents of Africa and the Middle East depend upon for sustenance as many SEAs described. Some developing countries do not have the financial resources to reliably control l/g plagues or replace food lost to l/g.

Governments that request USAID assistance are expected to maintain an ongoing insect management program during periods of normal pest levels. During outbreaks, USAID may choose to support a control/management program that is coordinated with other donors and the recipient country's government. Programs should emphasize the principles of Integrated Pest Management (IPM). Before any assistance is implemented USAID thoroughly analyzes of the need for assistance.

Should a substantial and widespread l/g outbreak occur, a large-scale operation may be needed as a last resort to protect crops and reduce l/g levels. In this situation all safeguards must be instituted to protect crops without jeopardizing human population and environmental safety. Aerial application of pesticides is viewed as a control strategy only after preventative measures and other management techniques have failed to yield expected results and the magnitude of the threat exceeds the response capacity of the national governments.

As described in the country-specific SEAs, l/g management should involve preventative intervention as the first line of defense against l/g outbreaks. Obtaining information on areas where past outbreaks have occurred, locations where populations are building, and habitat conditions that help determine when and where l/g breed are all important in determining whether conditions are conducive to widespread l/g outbreaks. Numerous mathematical models have been developed to forecast l/g population dynamics. Other prevention methods rely on monitoring information and surveys. Ideally preventative intervention will suppress l/g populations so that widespread outbreaks requiring large-scale pesticide applications will not occur.

The Africa Emergency Locust/Grasshopper Assistance (AELGA) program's three-phase training helps strengthens capacities of head farmers that can, and do, play a key role in Village Brigades. Both USAID and FAO have used village brigades since 1987 in areas of Africa where l/g infestations are endemic, but the number of village brigades varies considerably across Africa.

As part of its long-term capacity building and institutional strengthening strategy, the Africa Emergency Locust/Grasshopper Assistance (AELGA) Project is actively involved in training national staff in various fields of l/g management and control. AELGA's training courses are offered at two levels: country-specific (bilateral) and regional (multilateral). In general, the AELGA trainees have indicated that the training course was useful and should be conducted on a regular basis.

AELGA's also conducts regional/multilateral training courses that are specialized, highly technical courses offered to scientists, researchers, and senior technical staff from participating countries. The overriding objectives of the regional biocontrol and other training courses are to promote preventive approaches in locust and grasshopper control as an alternative to the expensive and environmentally damaging reactive approach which has been commonly practiced, and to develop and strengthen capacities to implement this approach at the national and regional levels.

Biological Control

Biological control, or the use of natural enemies, in the reduction of pests is major components of IPM. The use of classic biological predator and parasite/parasitoids control of migratory locust swarms is complicated by the nomadic nature of swarms, especially locusts. Naturally occurring predators, parasites, and diseases require stable environments over time to establish population equilibriums with pest species. Conservation of naturally occurring enemies of locusts/grasshoppers through habitat modifications can also be considered as an alternative means to enhance effectiveness of biocontrol agents.

Of the natural l/g enemies identified, only some have potential for practical augmentive development and use as biological control agents. Such a biological control agent is one that can be humanly produced or augmented. Despite the prodigious efforts to discover an effective and economic biological control agent, the SEAs did not describe a single agent that has proven to be efficacious in the wide range of environmental conditions encountered in Africa and Asia.

Chemical Control

A list of USAID-approved anti l/g pesticides was contained in the 1989 PEA, Review of Environmental Concerns in A.I.D. programs for Locust and grasshopper Control (Louis Berger and Associates, 1991), and in a cable (State 1187601, April 13, 1993) which provided an alphabetical listing of nine insecticides that are approved by A.I.D. for use against locusts and grasshoppers. The current document provides information on the insecticide fipronil and insect growth regulators (IGRs) that were not addressed in the PEA, but that may be considered for use in USAID-sponsored l/g control activities.

Fipronil, a phenyl pyrazole compound, is a broad spectrum, stomach poison and contact insecticide whose stomach action is far more potent than its direct contact action. The mode of toxic action of fipronil occurs through potent blocking of the chloride channel regulated by gamma-amino-butyric acid (GABA). Technical grade fipronil's effects are greatest on locusts, grasshoppers and other invertebrates which possess similar chloride channels. Fipronil is slightly to severely toxic to birds, severely toxic to terrestrial invertebrates, highly toxic to fish, and highly toxic to aquatic invertebrates. It should be noted that in addition to the inherent nature of the chemical agent, toxicity is also influenced by the dose rate and the duration of exposure to the agent. Although fipronil does not seem to pose a serious threat to the general public when used as recommended and in accordance with label instructions, those who handle the productC either through transporting, mixing, formulations, as applicators or are otherwise directly exposed to the productCshould always wear protective gear including face shields, respirators, hats, gloves, overalls, and heavy PVC boots.

Compounds referred to as insect growth regulators (IGRs) are relatively recently developed insectides that affect insect development and differ greatly from conventional insecticides in their mode of action. The most widely studied IGR is the chitin synthesis inhibitor diflubenzuron, (DFB). DFB is primarily a stomach poison insecticide and is effective when ingested by insect larvae feeding on vegetation but, has no effect on adults or pupae. DFB disrupts the synthesis and formation of chitin, a substance that is the major component of the tough outer covering (exoskeleton) of insects and other arthropods. DFB has a pronounced effect on l/g larval stages with death often occurring in the next molt following exposure to DFB spray under field conditions. DFB has low toxicity to mammals, does not concentrate through vertebrate food chains or absorption from water, remains stable on foliage, and seldom persists for extended periods in soil or water. Other insects, especially aquatic insects, as well as crustaceans, can be adversely affected by DFB. However, these effects are most pronounced in the developing stages of those organisms, and affected populations may recover quickly.

Cultural and Mechanical/Physical Control

Cultural, mechanical, a physical control measures are often attempted by farmers and nomads to protect their crops or pasture from locust/grasshopper attack. Quite frequently, out of desperation and due to lack of effective control alternatives, farmers resort to digging trenches in the direction of marching hopper bands, beating swarms and hoppers with tree branches and sticks, driving cattle and letting chickens into marching hoppers and roosting swarms, building fire and smocks to deter swarms and/or hoppers, making noise, and even consulting a voodoo doctor, but none of these yield any meaningful results in controlling the pests.

Integrated Pest Management

Integrated pest management (IPM) approaches pest control in an economically and ecologically sound manner using a variety of techniques to reduce and keep pest populations at acceptable levels. Most IPM programs survey, monitoring and forecasting components that strive to prevent and reduce, if not eliminate, the need for widespread, reactive, control measures. Despite the best efforts of IPM programs, insect pests can build into outbreaks that severely threaten agricultural production. In these situations, pesticides may be the only control option available. However, an IPM perspective stipulates that the chemicals be used as effectively, safely, and efficiently as possible and in combination with other means.

USAID has been promoting IPM as its policy regarding l/g and other pest control efforts in Africa and other regions. Although it is difficult to implement such a program to the fullest extent when controlling l/g outbreaks, few would argue that l/g control by nonchemical means is preferable to a sole reliance on pesticides. However, despite the best research efforts, a cost-effective biological control agent that can effectively, rapidly, and reliably reduce and control l/g populations over widespread areas has yet to be developed. Despite the obstacles that IPM programs confront, it remains important to continue investigating a wide range of ways to improve l/g control. Certainly, developing IPM further will require a substantial commitment in areas such as research, training, and coordination of all those involved with l/g control.

One aspect of IPM that has been researched and used for a number of pests and may be applicable to l/g control in Africa is reduced agent-area treatments (RAATs). RAATs is an IPM strategy/tactic that has been known and practiced for many years in other crop systems such as cereals, and is a form of barrier treatment that has also been developed for use against rangeland grasshoppers in the United States. In the RAATs method, the rate of insecticide is reduced from manufacturer recommended levels (often by more than 50%), and untreated swaths, or refuges, are alternated with pesticide-treated swaths. The object of this approach is to achieve a more economical, effective, and environmentally sound pest management strategy compared to traditional blanket, high-rate pesticide applications. RAATs is a promising method for grasshopper control in the U.S., however, research is needed to demonstrate how this approach can be applied to l/g control in Africa and Asia.

Pesticide Storage and Disposal

Not all pesticides donated or procured for use against l/g and other pests are exhausted in a given year, thereby requiring storage and/or disposal. Suitable pesticide storage and disposal facilities are very often lacking in most developing nations, and improperly stored pesticides, that have long past their shelf-life and as a result, lost their effectiveness, can cause economic, human health, social, environmental problems. In many developing countries in Africa and Asia, large stocks of obsolete pesticides have accumulated to dangerous levels and require to be properly cleaned-up and removed.

Pesticide storage and disposal options have been documented by FAO over the past few years and have included specific plans and pilot projects for pesticide disposal implemented in several developing countries. There are various technologies and methods which can neutralize (which is most applicable for small quantities), destroy, or otherwise render pesticides and related waste materials harmless. The techniques for pesticide disposal include: transhipment and incineration in Europe, local incineration, chemical treatment, lined landfill disposal, and long-term controlled storage. Due to lack of technical, logistical, and financial resources, obsolete pesticide disposal operations in most developing countries in Africa and Asia focus on the transhipment of these products for incinerations overseas countries in Europe where appropriate technologies exist provided there are donors to support such options.

Armyworm

The African armyworm, *Spodoptera exempta,* (Walker, Zimmerman 1958) (Lepidoptera: Noctuidae) is a pest of pastures and cereal crops in Africa south of the Sahara, parts of Arabia, Asia, Australia, and the Pacific, including Hawaii. This noctuid moth is a migrant and in African plague years, and can infest many thousands of square kilometers in eastern, central, and southern Africa may be infested at densities up to and occasionally exceeding 1,000 larvae per square meter (m^2), which often occur as noncontiguous outbreaks.

USAID has described the effects of armyworm outbreaks and infestations in Malawi and Namibia, Ethiopia, Eritrea, and Tanzania. In Malawi, the African armyworm is very destructive to maize, rice, wheat, sorghum, and millet and is endemic, resulting in annual losses. The decision has been made to control armyworms only in crop-producing areas, and not on rangeland in both Malawi and Tanzania. In Namibia, the armyworm can also be very destructive to maize, sorghum, and millet. This pest is able to survive in marginal grasslands where seasonal drought conditions prevail because of its rapid development, high reproductive capacity, and migratory ability. Outbreak occurrence is associated with inland topography and seasonal weather.

Only the larvae of *S. exempta* cause crop and pasture damage. The eggs are not easily found and they pupate in the ground. The moths cannot easily be controlled because they are dispersed as they fly downwind at night, unlike the cohesive day-flying swarms of the desert locust that can be sprayed directly by aircraft.

There are two forms of armyworm larvae: solitary (solitaria), which are green, and gregarious (gregaria), which are black. Solitary larvae, especially in the early instars or stages, are difficult to distinguish from the larvae of other Noctuidae species. Solitary larvae have little resemblance to the gregarious African armyworm larvae usually seen by farmers during outbreaks. The full grown larvae seek soft, damp soil at the base of plants or sandy banks in which to burrow and pupate. This is a critical period for survival. If the soil is too dry and hard, many larvae will perish. If there is rain at this time, farmers may report that all larvae have been killed, whereas they have entered pupation.

After 7 to 12 days, the moths emerge from the pupal case and push their way to the soil surface. Once out of the ground, the moth climbs the nearest grass stem or other available vertical surface to expand its wings. The moths are 14 to 18 millimeters (mm) long and have a wing span of 29 to 32 mm. Adults survive for 7 to 16 days. There are typically 6 to 8 generations per year in eastern Africa and 4 to 5 in southern Africa, with an Aoff season@ of 3 to 5 months when outbreaks are not reported. In areas favorable for low-density populations to persist throughout the year, there is the potential for up to 13 generations to occur. Although low densities often cause less damage, there is the potential for rapid population increases and outbreak due to the number of generations when conditions are favorable. An armyworm Aoutbreak@ is when larvae occur in such large numbers that the majority are in the black (gregarious) phase.

The direction and speed of winds when the adults fly play a major role in determining the distances traveled by the moths. Their flight speed and behavior may also influence where they settle to mate and lay eggs. Because moths disperse downwind from their emergence sites, outbreaks occur when moths are subsequently concentrated by persistent wind convergence, such as associated with rainstorms or mountains. The resulting moth concentrations mate and lay eggs, and outbreaks may subsequently occur. Moths that are not concentrated by wind convergence remain dispersed and produce scattered, low-density populations of solitary larvae. At the end of the migration flight, *S. exempta* moths settle in trees where mating takes place either on the same night or during the following night.

Damage to cereal crops results principally from direct attack on young plants by larvae hatching or dispersing into the crop as first instars and by invasion of the crop by older larvae from adjacent wild grasses. These invasions caused by late-instar larvae moving from heavily infested grasslands can totally destroy maturing crops. Damage to pasture and rangeland can be both severe and extensive. The resultant change in swarm composition can persist for many years if armyworm damage to grasses gives dicotyledons (broad-leaf plants) a growth advantage, which is likely in lower-rainfall areas. This effect is reinforced by drought and overgrazing by cattle, sheep, and goats. Small farmers are particularly vulnerable to the effects of infestation as they rarely have the resources for effective control or seeds for replanting. Infestations frequently affect large areas, eliminating the possibility of assistance between farmers. Government crop protection and extension services may only be able to provide limited assistance as a result of financial and logistical constraints.

It is also known that cattle feeding on armyworm infested fields could become sick, and perhaps die from a cyanide poisoning. It is believed that moncotylidon plants, such as grasses, produce a chemical that contains cyanide when foraged by insect larvae, such armyworm. An elevated level of cyanide produced by grazed grasses could thus, become a serious toxicant to animals such as cattle. Under such circumstances, it is advisable that farmers avoid cattle grazing of larval infested fields.

USAID's Environmental Policy requires that any USAID-supported project activities that may involve pesticide procurement, transport, applications and/or use must be done in accordance with USAID Environmental Procedures for Foreign Assistance, 22 Code of Federal Regulations (CFR) Part 216, Section 3(b) which emphasizes that any foreseeable adverse impacts a given pesticide product may have on humans and the environment must be minimized. This report provides information on the pesticides used for armyworm control programs, summarizes the current U.S. Environmental Protection Agency (USEPA) registration status of those chemicals, and presents the environmental effects associated with those pesticides.

Armyworm Control and Integrated Pest Management

Integrated pest management (IPM) is a comprehensive approach to African armyworm control. It involves a variety of methods and minimizes the potential for adverse effects on health and the environment. IPM control of *S. exempta* is based on regular inspections, surveillance or monitoring, forecasting outbreaks, identification of pest species, delimiting the areas infested, and establishing economic or other thresholds above which infestations become intolerable. The control strategy has been to eliminate as many larvae as possible early in the outbreak season to minimize crop loss and reduce the number of moths subsequently available to initiate new outbreaks downwind in areas of agricultural production or livestock grazing. The aim of controlling these primary outbreaks is by destroying the largest, oldest, and most dense outbreaks first, whether they are on crops, rangeland, or pasture, to minimize the downwind spread of emergent moths and minimize the damage they could inflict on these habitats.

Control of armyworm outbreaks is based on rapid reporting of their occurrence and monitoring moth populations and their movements. In eastern Africa, armyworm control operations are managed and co-ordinated by the Desert Locust Control Organization for Eastern Africa (DLCO-EA). Further south, the International Red Locust Control Organization for Central and Southern Africa (IRLCO-CSA) assumes this role. These organizations coordinate the exchange of information among their member countries, thus providing an overview of reported and expected population developments and movements of moths within and between countries. Such regional cooperation is essential for effective monitoring, survey, forecasting, and control of migrant pests.

Accurate monitoring and prompt reporting of armyworm outbreaks are essential for forecasting and control. Surveys are important for understanding the population dynamics and the control options available. The most effective way of monitoring armyworm populations is through networks of moth traps such as pheromone traps, light traps, sticky traps, etc., in each vulnerable country. Pheromone traps are the most effective trap of all for monitoring armyworm moth populations since they are synthetic analogs of the pheromones that are produced by the male armyworm moth.

The use of established population thresholds for treatment have been estimated to prevent a 15% crop loss from armyworms. However, this strategy requires that control operations be mounted against infestations of *S. exempta* larvae, even if they are of no immediate economic importance, but because their progeny pose a potential threat to crop areas downwind. The tentative threshold for treatment of maize has been determined to be 200 second, 80 third, or 20 fourth instar larvae per 100 plants at the early whorl or 4- to 6-leaf stage of plant development. In sorghum, millet, rice, and tef, yield losses may be small if the damage occurs before the grain filling stage has been reached. Since damage to pastures and rangeland can be heavy, livestock production can also be affected.

Chemical Control

Only the larval stage is accessible to control by insecticides. Eggs are difficult to find, pupae are underground, and moths fly at night at low aerial densities. Armyworms are susceptible to a wide range of insecticides and there is no record of resistance so far. Insecticides are effective means of controlling armyworm pest outbreaks, either in the form of baits or sprays. The organophosphate (OP) and carbamate insecticides used for armyworm control are neurotoxic cholinesterase inhibitors. Synthetic pyrethroid insecticides are generally less acutely toxic than organophosphates and carbamates, but are usually more costly and, as a class, are known for fish and aquatic invertebrate toxicity at low levels of exposure. Like OPs and carbamates, synthetic pyrethroids are broad spectrum insecticides and can affect beneficial insects such as honeybees, other pollinators, predatory and parasitic insects. Insect growth regulators are usually low in mammalian and bird toxicity, but some affect beneficial nontarget invertebrates at very low dose rates; and they are also usually more costly to use than commonly available OPs and carbamates.

Bait formulations of insecticides or some biological control agents are a means of strategically delivering the active ingredient to the target insect while reducing many of the human and nontarget organism exposure risks. Baits usually also require smaller amounts of active ingredient per hectare than topical spray applications. Development of bait formulation that are particularly attractive to African armyworm larvae would be a possibe approach to control while reducing risks. However, such baits may be attractive to birds and other wildlife, or may be even inadvertently consumed by domestic animals, livestock, and humans. The unique risks associated with use of baits should be carefully weighed against benefits.

Biological Control

African armyworm pheromones have been well characterized, manufactured, and successfully used in pheromone traps to monitor male moth populations to predict outbreaks. Other Lepidoptera pheromones have been used in area-wide applications to successfully disrupt mating where the pheromones in the ambient air are at a level that makes the males unable to locate females. This pheromone-confusing technique may be useful for *S. exempta,* as well. Straight-chain aliphatic Lepidoptera pheromones have been exempted from many EPA regulatory toxicology testing requirements because they, as a class, are practically nontoxic to mammals, birds, and nontarget invertebrates. There are 57 such Lepidoptera pheromones registered by EPA and they include two for the beet armyworm, *S. exigua*, which is closely related to the African armyworm. Of the six pheromones known for the African armyworm, two are EPA registered for the beet armyworm .

Leaves and especially oil of the neem tree *Azadiracha indica,* have insecticidal properties which disrupt insect molting by antagonizing the insect hormone ecdysone. It may also function as a feeding deterrent in some insects, including desert locusts and can reduce their ability to fly. At least 13 pesticides derived from azadirachtin, a purified active ingredient from neem-seed oil, are EPA registered and are of low acute oral and dermal toxicity. One product based on dihydroazadirachtin is EPA registered. Neem trees are common in Africa, especially West Africa and the sahelian region, easily propagated, and, therefore, a potential source of indigenous sustainable botanical insecticides for control of African armyworms

The major cause of disease-induced mortality is a *S. exempta* species-specific nuclear polyhedrosis virus (NPV). The first armyworm outbreaks of the season may be virus free because of lack of transmission in low-density populations, but later outbreaks may be almost eliminated by this virus. Nuclear polyhedrosis viruses (NPV) have been used to control armyworms and cutworm infestations by collecting diseased larvae from the field and using them in a spray preparation. The African armyworm NPV is slow acting and the larvae may not be killed until considerable crop or pasture damage has occurred. Therefore, it is important to identify outbreaks and apply the virus suspension to early stage larvae before serious crop damage occurs.

The most common fungus found attacking armyworm larvae is *Nomuraea rileyi*. Once infected, a larva climbs to the top of a grass blade where it becomes covered with mycelium. This fungus requires conditions of high humidity and temperature in order to survive. The potential for solid culture fermentation and biopesticide use of this fungus is of interest for development. The biological control agents identified for African armyworms have virtually no environmental or human adverse effects potential. Costs for biocontrol agents may also be higher than conventional chemical insecticides, at least at the initial stage of production, if their production is labor, material, or technically intensive. The *S. exempta* nuclear polyhedrosis virus may be effective, but no NPV has become a successful insect biopesticide for use on a regular basis because in-vitro tissue culture production is prohibitively technical and costly. However, the NPV lends itself to cottage industry production by field collections of diseased larvae, mixing with water, and filtering through cloth, and spraying.

There were a number of Programmatic Recommendations in the 1989 USAID Locust and Grasshopper Control in Africa/Asia Programmatic Environmental Assessment. Some of these recommendations may also apply to African armyworm control due to nomadic behavior and sporadic outbreaks of both insects, as well as their status as the most damaging agricultural insect pests in Africa. Those recommendations that have been revised for armyworms follow later in this section. The primary recommendations of this report are providing informal education, training of extension and field agents, and research to develop effective and safe control options. An important component of an agricultural assistance program for African armyworm control is conveying practical information to farmers to help them identify the pest, know its basic biology, anticipate and prepare for outbreak control, be able to organize among themselves to prepare for such an emergency, and know how to use cost effective and minimum adverse human and environmental risk pest management materials and methods. Crop protection services that focus on delivery of this practical applied information to farmers, either directly or through train-the-trainer-type activities, are essential for crop protection development programs to be effective and sustainable.

Rodent Control

For centuries rodents have been a problem for humans. Rats have found human civilization to be ideal environmentsCa source of abundant food, shelter, and convenient transportation to new territories. Many rodent pest situations occur in urban, agricultural, and other environments throughout the world.

Historically, vertebrates and vertebrate pest problems have not received as much attention as other agricultural pests perhaps because public health significance and the economic aspects of rodent infestations have, in many instances, overshadowed the public health significance associated with rodents. Rodents are reservoirs for many different types of infectious organisms that if transmitted to human and domestic animal populations, may cause disease outbreaks with high morbidity and some mortality.

Nearly all agricultural food crops grown on farms are susceptible to rodent damage from the time of planting until consumption. Intensified agricultural operations and diverse cropping patterns allow vertebrate pest species to move from one feeding area to another when a particular crop is harvested. Global damage by vertebrates is estimated to be hundreds of millions of dollars annually. Loss of agricultural production is not only loss of yield, but also includes the loss of a corresponding proportion of all other inputs such as labor, fertilizer, pesticides, water, harvesting, and processing. To the economic cost in providing health care and prevention of rodent-borne diseases in Africa, one must add the effect on nutrition of humans which results from rodent depredations on foodstuffs.

USAID has supported, since 1967, a vertebrate pest research and management project within the International Programs Research Section (IPRS) at the Denver Wildlife Research Center (DWRC) (now the National Wildlife Research Center), under participating agency service agreements which ended in 1991. Funds were provided to DWRC by USAID missions and the regional programs, particularly AELGA project, to maintain a core group of international vertebrate pest specialists to implement cooperative agreements. The program goal is to evaluate vertebrate pest situations and, when circumstances warrant, develop environmentally acceptable methods to reduce their damage. This has been accomplished by taking an active role in providing aid to countries requesting assistance for vertebrate pest control.

Between the years of 1967 and 1993, DWRC scientists conducted about 450 international consultancies around the world at the request of USAID missions and the regional projects. These research projects were funded mostly by USAID. The consultants assessed vertebrate pest problems; reviewed, evaluated, conducted, and coordinated vertebrate pest management research programs; and participated in workshops and conferences. In a cooperative effort, USAID has continued to fund numerous vertebrate pest research projects throughout the continent of Africa in order to monitor and assess rodent problems. In 1996, AELGA, in collaboration with Kenyatta University, in Nairobi, conducted a very successful regional training course on rodent pest management and control in which twenty senior crop protection technicians and researchers from nine Anglophone African countries participated.

Rodent pest outbreaks or Aeruptions@ occurring in Africa at national or regional levels have been reported as early as 1905. Most countries that experience rodent outbreaks normally undertake steps to control the pest. Unfortunately, control measures are only initiated when the first signs of damage are observed. Therefore, strategies that predict the likelihood of damage must be developed so that the risk of useless expenditures on control will be minimized. There are two main types of prevention: organizational prevention, which tries to forecast high rodent densities in advance so that necessary steps to prevent damage are taken in time; and ecological prevention, which interferes with the population to prevent the development of later outbreak numbers.

There are a number of rodent pests, including rats and mice, that affect agricultural crops, household products, and other produces in Africa and Asia. Among these are the multimammate rat, *Mastomsy natalensis*, and the Nile rat, *Arvicanthis niloticus* account for most of the damage to cereal crops throughout western and eastern Africa, south of the Sahara. In North Africa, rodents of the genus *Meriones* are widespread pests of agriculture, particularly in sandy areas where they attack cereal, grains, vegetables, and ground nuts, often storing large quantities underground. The roof rat, *Rattus rattus*, is almost universally present in towns, villages, and even remote farms throughout the African and other regions and is a serious pest in commercial and domestic premises. The Norway rat, *R. norvegicus*, tends to occur mainly in ports and highland towns in tropical Africa, although it is distributed more widely in North Africa where it is considered as a troublesome pest.

Control Alternatives and Methods

Many methods for rodent control have been suggested, tested, or used in attempts to control or manage rodents or rodent damage. Pesticides registered for use against rats and mice are known as rodenticides. Most rodenticides, depending upon their mode of action, are administered as poisoned baits, liquids, contact dusts, and poisonous gases. No matter how they are applied, rodenticide active ingredients are normally classified as either (1) acute or fast-acting compounds, or (2) the chronic, exclusively anticoagulant compounds with a relatively slow mode of action.

A number of acute chemicals are available for use, however most of these chemicals have been replaced by anticoagulants primarily due to a preference for a lower risk product to the acute toxicant. The discovery of anticoagulant rodenticides was the most important step ever taken towards establishing a more effective and safe rodent control program. Their chronic mode of action is the key to their success. Based on their chemical structure, all anticoagulant rodenticides are either hydroxycoumarins or members of a related group, the indandiones. The first generation anticoagulants are generally effective against most rodent species when used with surplus baiting, although longer periods of feeding may be required. Second generation anticoagulants were developed to use against rodent species that are resistant to warfarin anticoagulant rodenticides.

Fumigants are used for rodent control in situations where conventional methods, such as baits and contact poisons, are normally ineffective or impractical. Usually, sites treated with fumigants are enclosed in a gas-tight tarpaulin or covering such as buildings, ships, warehouses, grain silos, and rodent burrows in the soil. Fumigants are available and formulated as powders, pellets, and tablets, and as gases in steel cylinders. Caution and great care should be exercised when using this method of rodent control and should only be performed by a person trained in their use.

Some methods of controlling rodents without using chemicals have been used for centuries and proven to be effective. Trapping can be very successful when carried out correctly. Inspections and evaluations of proper placement of traps or poison, should be included in the planning process for proper effective control. Some of the more modern methods, such as the use of ultra sound, electromagnetic waves, attractants, repellants, and chemosterilants have been less successful.

Cultural control of rodents involves changing agricultural practices from those currently practiced to new ones that will evade or minimize crop loss and crop damage. Clean farming practices discourage rodent infestations and make it easier to detect and deal with the problem when it occurs. The main idea is to eliminate areas that contain excess vegetation, such as weeds, grasses, and shrubs, which serve as food and cover for rodent populations.

The biological control of rodents through natural predators is a very common topic when rodent control is discussed. The use of animals such as cats, dogs, and snakes are ineffective measures for the economic control of field rodents. Another form of biological control is through the introduction of diseases that kill rodents, although there is a general concern that these diseases may be passed on to humans and domestic animals and that maximum precautions must be practiced while attempting to implement this method. Also, some biological control methods, involving altering rodent fertility, use immunosterilants delivered by a virus vector. However, the success and side-effects on humans, domestic animals, and other non-target and beneficial organisms of this interesting approach has yet to be fully evaluated and determined.

Development of Integrated Pest Management approaches to reduce or prevent crop damage by rodents presents some special problems that require a careful consideration. The general population dynamics of rodents are well-known from studies conducted in temperate countries, but few basic ecological data exist for common rodent pest species in tropical agriculture. Rodents are highly responsive to changes in environmental conditions, making it essential to develop a thorough understanding of the specific ecological, phenological, and climatic factors that influence rodent population behavior in particular crop situations. The same rodents often damage a variety of crops in the same area, shifting from one field to another as crop cover develops or matures. Seasonal movements from crop fields to dwellings or storage structures are common for some problem species. Consequently, more broadly-based integrated programs involving the overall rodent problems in the community would be more practical than a specific crop-oriented approach.

Environmental Effects of Rodenticides

Care should be taken to reduce the exposure of humans and nontarget organisms to rodenticides. In general, rodenticides are highly toxic to birds and mammals. Small pellets and whole grain baits are attractive to birds and nontarget vertebrates. Rodenticide formulations in wax blocks decrease the risk of primary poisoning of non-target species. Toxicity to aquatic organisms ranges from moderate to very high. In addition to direct toxicity, rodenticides may also be a secondary hazard to predators feeding on poisoned rodents. Some rodenticides are not persistent in animal tissues and must be eaten over a period of several days to cause mortality. Other rodenticides are more persistent and a single dose may post a greater risk when poisoned rodents are consumed.

Because rodents inhabit human residences, rodenticides in domestic dwellings pose a risk to human health and safety. The USEPA has recently proposed an approach to minimize rodenticide exposure, particularly to infants and children. Under this approach, rodenticides must incorporate an indicator dye to help identify whether a child, pet, or domestic animal has actually consumed the pesticide. In addition, a bittering agent is incorporated into the formulations to make it less likely that the pesticide would be consumed by children.

Signs of anticoagulant poisoning in all species, including humans, are associated with an increased bleeding tendency. Because the mode of action of the anticoagulant rodenticides is known, vitamin K is an effective antidote and available for either intentional or unintentional incidents. Training in the safe handling and application of rodenticides is essential for persons who use them.

Programmatic Recommendations

The 1989 Programmatic Environmental Assessment (PEA) contained 38 Recommendations pertaining to locust/grasshopper control in Africa and Asia. When proposing those recommendations in the 1989 PEA, it was realized that as experience is gained the recommendations would become outdated. Indeed, much new information has been published in the Supplemental Environmental Assessments, the scientific literature, and a wealth of experience has been gained since 1989. Therefore, there is a need to review those 38 Recommendations and revise them based on the current understanding of transboundary pest prevention and control.

In this section, the 1989 PEA Recommendations are reproduced and a revised recommendation is presented. Changes to the original recommendation are italicized. In many cases the original recommendation has been broadened to include armyworms and rodents. Comments and supporting information are provided for those recommendations that have been changed. Some of the original recommendations are still pertinent and have not been changed. The previous groupings of the recommendations are retained to maintain clarity of the document and consistency between the original PEA and the revised version.

PRE-CONDITION FOR ALL OTHER RECOMMENDATIONS

1989 PEA Recommendation 1.

> It is recommended that AID continue its involvement in Locust and Grasshopper Control. Operationally, the approach to be adopted should evolve toward one of Integrated Pest Management (IPM)

Revised Recommendation 1.

> It is recommended that USAID continue its involvement in Locust and Grasshopper Control *as well as the control of other transboundary pests such as armyworms and rodents.* Operationally, the approach to be adopted should evolve toward one of Integrated Pest Management (IPM). *It is also recommended that an assessment [environmental] and/or monitoring be conducted, especially when pesticides that are not included in the USAID-approved list for l/g, armyworm, and rodents are intended to be used. Currently, such list only exists for l/g and a similar list needs to be developed for armyworm and rodents as well.*

Comment.

The original recommendation has been broadened to include armyworms and rodents. Integrated Pest Management remains the approach that should be adopted for locusts, grasshoppers, armyworms, and rodents. Environmental monitoring would document the efficacy and the actual environmental consequences of those programs.

INVENTORY AND MAPPING PROCEDURES

1989 PEA Recommendation 2.

It is recommended that an inventory and mapping program be started to determine the extent and boundaries of environmentally fragile areas.

Revised Recommendation 2.

It is recommended that an inventory and mapping program be started to determine the extent and boundaries of environmentally fragile areas. *Such activities should be continued and completed in areas where they have been initiated.*

Comment.

Many environmentally fragile areas in Africa and Asia have not been adequately inventoried and mapped, and in those areas a systematic assessment program should be started. However, many governments and nongovernmental organizations in Africa have begun valuable mapping and inventory programs, and some of the information generated by these efforts is contained in the country-specific Supplemental Environmental Assessments for locust/grasshopper control operations. Future revisions of SEAs as well as any new SEAs should include the most recent information available on environmentally fragile areas.

1989 PEA Recommendation 3.

It is recommended that a system for dynamic inventory of pesticide chemical stocks be developed.

Revised Recommendation 3.

No revisions needed

Comment.

The need for a dynamic inventory system of pesticide chemical stocks, including viable and obsolete, is as great as ever. Pesticides that may be provided by USAID for armyworm and rodent control should also be included in these inventories.

1989 PEA Recommendation 4.

It is recommended that the AID take an active role in assisting host countries in identifying alternate use or disposal of pesticide stocks. Refer to Recommendation 14.

1989 PEA Recommendation 5.

It is recommended that FAO, as lead agency for migratory pest control, be requested to establish a system for the inventory of manpower, procedures, and equipment.

Revised Recommendations 4 and 5.

No revisions needed.

Comment.

There continues to be a need for responsible and cost-effective pesticide disposal or alternative uses. While an inventory of manpower, procedures, and equipment is not complete, FAO has made great strides in this area, especially regarding obsolete pesticide stocks. Such inventories should be regularly updated to determine host country capacity and the level of assistance that may be needed in case of emergency.

MITIGATION OF NON-TARGET PESTICIDE EFFECTS

1989 PEA Recommendation 6.

It is recommended that there be no pesticide application in environmentally fragile areas and human settlements.

Revised Recommendation 6.

It is recommended that there be no application of broad-spectrum synthetic chemical or biological-based pesticides in environmentally fragile areas and human settlements *except to control rodent populations that are a threat to human health and food security*. Even under such circumstances, maximum precaution should be exercised.

Comment.

The most common buffer zone specified in the SEAs for locust and grasshopper control is that protected areas should be surrounded by a buffer zone at least 2.5 km wide. A similar buffer should be observed for armyworm control programs, especially when pesticides are applied aerially. However, it will be necessary to apply pesticides within human settlements and man-made structures to control rodents. All rodenticides should be applied in a manner that minimizes human exposure.

1989 Recommendation 7

It is recommended that pesticides used should be those with the minimum impact on non-target species.

Revised Recommendation 7.

It is recommended that pesticides used should be those with the minimum impact on non-target and beneficial species.

Comment.

Pesticides examined in this report all have some potential to adversely affect non-target and beneficial organisms. The use of these pesticides may require buffers or other mitigating measures in order to reduce the direct and indirect impacts on non-target organisms. It is very important that good pesticide application practices are exercised to the fullest extent possible whenever and wherever pesticides, be it synthetic or biological-based, are involved.

1989 Recommendation 8

It is recommended that pre- and post-treatment monitoring and sampling of sentinel organisms and water and/or soils be carried out as an integral part of each control operation.

Revised Recommendation 8.

No revision necessary.

Comment.

Transboundary pest control programs should not be considered finished until samples of critical environmental parameters have been collected and analyzed to assess the impacts of program activities. Monitoring can also determine the need for and effectiveness and efficiency of control programs and operations.

APPLICATION OF INSECTICIDES

1989 Recommendation 9.

It is recommended that one of the criteria to be utilized in the selection of control techniques should be a minimization of the area to be sprayed.

Revised Recommendation 9.

It is recommended that one of the criteria to be utilized in the selection of control techniques should be a minimization of the area to be sprayed, *and an approach such as a Reduced Agent/Area Treatments (RAATs) be considered as a means to economically and effectively control grasshopper and perhaps locust and armyworm populations prior to gregarization.*

Comment.

A combination of reduced insecticide application rates and a reduction in the treatment area (RAATs) has been shown to be an effective and economical approach to grasshopper control on rangelands in the United States. There is no single application rate or determination of areal coverage that defines a RAATs treatment. Yet, in many cases, insecticides applied at half the EPA labeled rate results in grasshopper mortalities that are only slightly less than the mortalities under the recommended full rate applications. The amount of pesticide can be reduced even further by Askip swathing@, or leaving parts of the treatment area untreated. The non-target organisms in these Aislands or refuges@ are conserved by not being exposed to insecticides, unless they move out into treated areas, while target pests may be controlled when they migrate from the untreated area to the treated area. The RAATS approach should only be used after effective dose rates and optimum dimensions of untreated strips (areas) are determined. Such operations are also best implemented by experienced personnel to assure that an acceptable level of control can be reached.

1989 Recommendation 10.

It is recommended that helicopters should be used primarily for survey to support ground and air control units. When aerial treatment is indicated, it should only be when very accurate spraying is necessary, such as close to environmentally fragile areas or localized treatment.

Revised Recommendation 10.

It is recommended that helicopters should be used primarily for survey to support ground and aerial control units. When aerial treatment is indicated, it should only be when very accurate spraying is necessary, such as close to environmentally fragile areas or localized treatment, or where treatments by ground equipment or fixed-wing aircraft are ineffective, e.g., rugged terrain, mountain sides, narrow valleys, etc.

1989 Recommendation 11.

It is recommended, that whenever possible, small planes should be favored over medium to large two or four engine transport types. In all cases, experienced contractors will be used.

Revised Recommendation 11.

It is recommended, that whenever possible, small planes should be favored over medium to large two or four engine transport types. In all cases, experienced contractors will be used, *and all spray aircraft should be equipped with computer-assisted agricultural navigation systems based on Global Positioning System (GPS) technology to ensure accurate and detailed locations of treated areas.*

Comment.

Global Positioning System (GPS) technology uses signals from an array of satellites to determine geographic locations that in many cases are accurate to within a meter. Using GPS will allow program managers, survey and operation staff to accurately map the movements of spray aircraft to ensure that the desired area was treated.

1989 Recommendation 12.

It is recommended that any USG-funded locust/grasshopper control actions, which provide pesticides and other commodities, or aerial or ground application services, include technical assistance and environmental assessment expertise as an integral component of the assistance package.

Revised Recommendation 12.

It is recommended that any USG-funded locust/grasshopper, *armyworm, or rodent* control actions, which provide pesticides and other commodities, or aerial or ground application services, include technical assistance and environmental assessment expertise as an integral component of the assistance package.

Comment.

Armyworm and rodent control have been addressed in this document and should be included in all general statements regarding USAID transboundary pest control activities.

1989 Recommendation 13.

It is recommended that all pesticide containers be appropriately labeled.

Revised Recommendation 13.

No revision is necessary.

DISPOSAL OF PESTICIDES

1989 Recommendation 14.

It is recommended that AID provide assistance to the host governments in disposing of empty pesticide containers and pesticides that are obsolete or no longer usable for the purpose intended.

Revised Recommendation 14.

It is recommended that USAID provide assistance to the host governments in disposing of empty pesticide containers and pesticides that are obsolete, or no longer usable for the purpose intended, or cannot be reformulated and used, or preferably, if the original source can be liked to USAID, or if these products are considered serious public health hazards, or if these products put USAID's initiatives/programs in the country or the region at risk. Under such circumstances, USAID should provide training courses on proper disposal and management of obsolete pesticides. It is advisable that the responsible Bureau Environmental Officer (BEO) be contacted in the event such technical assistance is provided.

Comment.

Proper disposal of obsolete pesticides and pesticide containers remains a critical need in developing countries. Training courses based on the FAO, EPA, and USAID guidelines would help implement disposal of pesticides and pesticide containers in an efficient, effective, and environmentally safe and sound manner.

PUBLIC HEALTH AWARENESS

1989 Recommendation 15.

AID should support the design, reproduction, and presentation of public education materials on pesticide safety (e.g., TV, radio, posters, booklets). This would include such subjects as, safely using cost effective pesticides, ecology, pest management of locusts and grasshoppers and the hazards of pesticides. The goal would be to help policy-makers and local populations recognize potential health problems related to pesticide applications.

Revised Recommendation 15.

USAID should support the design, reproduction, and presentation of public education materials on pesticide safety *and first aid techniques for pesticide poisoning* (e.g., TV, radio, posters, booklets). This would include such subjects as, safe use of cost effective pesticides, ecology, pest management of locusts and grasshoppers, *armyworm, and rodents* and the hazards of pesticides. The goal would be to help policy-makers and local populations recognize potential health problems related to pesticide applications and to promote and encourage completion of safety procedures.

Comment.
The simple techniques of first aid are usable by almost anyone who has access to first aid information. There is a potential for pesticide poisonings associated with locust, grasshopper, and armyworm programs to occur far from health care personnel, and basic training in first aid can help prevent serious injury or death. Human contact with rodenticides, especially baits, is likely because these chemicals are most commonly deployed within human settlements. First aid training is recommended as part of a larger public education effort on the management of transboundary pests.

1989 Recommendation 16.
It is recommended that training courses be designed and developed for health personnel in all areas where pesticides are used frequently.

Revised Recommendation 16.
It is recommended that training courses be designed and developed for health personnel in all areas where pesticides, including rodenticides, are used frequently.

Comment.
See comments for Recommendation 15.

1989 Recommendation 17.
It is recommended that each health center and dispensary located in an area where pesticide poisonings are expected to occur should be supplied with large wall posters in which the diagnosis and treatment of specific poisonings are depicted. The centers and dispensaries should also be provided, prior to spraying, with those medicines and antidotes required for treatment of poisoning cases.

Revised Recommendation 17.
It is recommended that each health center and dispensary located in an area where pesticide poisonings are expected to occur should be supplied with large wall posters in which the diagnosis and treatment of specific poisonings are depicted. The centers and dispensaries should also be provided, prior to spraying, with those medicines and antidotes required for treatment of poisoning

cases *such as atropine and vitamin K for use as an antidote for some insecticide and anticoagulants used in insect and rodent control.*

Comment.

A major consideration when using anticoagulant rodenticides is the safety of personnel, families, and domestic animals. In case an accidental poisoning should occur from the use of anticoagulants, vitamin K is an effective antidote and should be included in safety kits.

1989 Recommendation 18.

It is recommended that presently available tests for monitoring human exposure to pesticides should be evaluated in the field. This includes measurement of cholinesterase levels in small samples of blood as a screening test.

Revised Recommendation 18.

It is recommended that presently available tests for monitoring human exposure to pesticides should be evaluated in the field. This includes measurement of cholinesterase levels in small samples of blood as a screening test for OPs and Carbamates.

Comments:

It should be noted that AchE testing is not relevant to pesticides other than OPs and Carbamates, including the newer pesticides. This method of blood AchE monitoring is not suitable for pyrethroids, GABA-channel blockers and other products whose modes of action are different from OPs and carbamates.

SPECIFICATIONS FOR PESTICIDE FORMULATION AND PACKAGING

1989 Recommendation 19.

It is recommended that the specifications developed for AID purchase of locust/grasshopper insecticides be adapted for all insecticides.

Revised Recommendation 19.

It is recommended that the specifications developed for USAID purchase of locust/grasshopper *and armyworm* insecticides be adapted for all pesticides, including rodenticides.

Comment.
Purchase specifications should be also be developed for insecticides used for armyworms and rodenticides used for rodents.

1989 Recommendation 20.

It is recommended that pesticide container specifications be developed.

Revised Recommendation 20.

No revision is necessary.

Comment.
The UN Packaging standards for the transport of dangerous chemicals should be referenced for transport of pesticides. Specifications should clearly state in native languages that the re-use of pesticide containers for unintended purposes is strictly prohibited.

BIOLOGICAL CONTROL

1989 Recommendation 21.

It is recommended that *Nosema* and other biological agents such as Neem be field tested under African and Asian conditions in priority countries.

Revised Recommendation 21.

It is recommended that *biological control agents continue to be developed and field tested* under African and Asian conditions in priority countries.

Comment.
The full potential of biological control agents for locust, grasshopper, and armyworm control has yet to be fully realized. A number of once promising biological control agents including Nosema and Neem have not proven to be completely efficacious and/or cost effective under field conditions in Africa and Asia. However, the research on the development and field testing of other biological control agents, including fungi, bacteria, viruses, protozoa and others should continue to be a high priority.

TRAINING FOR USAID [FIELD] STAFF

1989 Recommendation 22.

It is recommended that a comprehensive training program be developed for AID Mission personnel who have responsibility for control operations. This will involve a review of existing materials and those under development, in order to save resources.

Revised Recommendation 22.

It is recommended that *comprehensive training programs be developed for USAID Mission personnel and host country staff who have the responsibility for monitoring, survey, and control operations. Activities that have been initiated should be continued, strengthened and expanded to countries and regions in which they have not yet been done*. This will involve a review of existing materials and those under development, in order to save resources.

Comment.

USAID-AELGA, and FAO have successfully developed training programs that have been delivered in individual country and at regional/inter-region levels. These training programs should be expanded to include those countries and regions that have not yet received training. Future training courses should also include aspects associated with monitoring, preventing, and controlling other emergency, transboundary pests such as armyworm and rodents, pesticide applications, management, and disposal options. The regional/inter-regional training courses should also address new techniques and strategies for emergency, trans-boundary outbreak pest management .

1989 Recommendation 23.

It is recommended that local programs of training be instituted for pesticide storage management, environmental monitoring and public health (see Recommendation 16).

Revised Recommendation 23.

It is recommended that local and regional training programs be instituted to address safe storage, use, and management of pesticides as well as monitoring public health and environmental safety. Training programs on obsolete pesticide management and safe disposal should also be put in place in countries that have such problems (see Recommendation 16).

Comment.

All training programs involving pesticides should include information on old and new chemicals that are used for l/g, armyworm and rodent control.

1989 Recommendation 24.

It is recommended that when technical assistance teams are provided, they be given short term intensive technical training (including language, if necessary) and some background in the use and availability of training aids.

Revised Recommendation 24.

It is recommended that when technical assistance teams are provided, they should be selected based on their technical capacity, prior experience, knowledge of countries and regions where they will be deployed to, language competency, previous overseas experience and some background in the use and availability of training aids.

ECONOMICS

1989 Recommendation 25.

It is recommended that field research be carried out to generate badly needed economic data on a country-by-country basis.

Revised Recommendation 25.

It is recommended that field research be carried out and those initiatives that have already begun be continued to generate badly needed economic data on a country-by-country basis or at a regional level.

Comment.

Considerable amount of data on economic implications of locust/grasshopper infestations and control operations have been generated through a study co-sponsored by USAID-AELGA and in forums such as FAO/EMPRES Workshops that strongly substantiate the need for transboundary pest control programs. These types of information gathering efforts should be expanded. Similar studies should also be conducted for other emergency outbreak pests.

1989 Recommendation 26.

It is recommended that no pesticide be applied unless the provisional economic threshold of locusts and grasshoppers is exceeded.

Revised Recommendation 26.

It is recommended that no pesticide be applied *without a clear and demonstrated need to protect agricultural production, human welfare, or ecosystem integrity. Commonly there will be an economic threshold that will be exceeded, but there are also aspects of human* *health and welfare, as well as protection of the environment, in general, and fragile habitat and biodiversity in particular, must also be considered.*

Comment.
There is no clearly defined threshold that can be applied to each pest outbreak in every country to control the damage caused by transboundary pests. The decision to apply pesticides is complicated by many inter-related factors, and the threshold to apply pesticides may be different for locusts, grasshoppers, armyworms, and rodent control efforts. Economic damage should be an important, but not the sole, threshold in the decision to apply pesticides.

ENVIRONMENTAL POLICY

1989 Recommendation 27.

It is recommended that AID provide assistance to host countries in drawing up regulations on the registration and management of pesticides and the drafting of environmental policy.

Revised Recommendation 27.

No revisions are necessary.

Comment.
FAO, in collaboration with other agencies, is assisting West African countries in harmonizing their pesticide management and regulations. Programs such as these are useful especially in those countries that lack a fully developed pesticide policy.

PESTICIDE USE POLICY

1989 Recommendation 28.

It is recommended that a pesticide use inventory covering all treatments in both agricultural and health programs be developed, on a county-by-country basis.

Revised Recommendation 28.

It is recommended that a pesticide use inventory covering all treatments in agricultural and health programs be developed, on a county-by-country basis.

Comment.
Pesticides should include insecticides and rodenticides.

PESTICIDE HANDBOOK

1989 Recommendation 29.

It is recommended that AID produce a regularly updated pesticide handbook for use by itself.

Revised Recommendation 29.

No revisions are necessary.

Comment.

A pesticide handbook document has yet to be produced. Such a document can be produced in collaboration with the United Nations' Food and Agriculture Organization, (UNFAO). However, a number of documents that have relevance to this topic have been written such as Pesticide Users' Guide: A Handbook for African Extension Workers (Overholt and Castleton, 1989), SEAs' on pesticide use and written guidance regarding approved chemicals for use in locust/grasshopper programs. While these documents have been valuable, the need for pesticide handbook that can be regularly updated remains. It should also be noted that the a series of guidelines and procedures on pesticide handling, use, transport, and disposal of obsolete products have been prepared by the FAO. These documents are available in hard copes as well as electronic files, in CD-ROM and also on the organization's web site. Although the importance of such documents is undisputable, they cannot replace the need for technical assistance from USAID/W at least for the near future. These documents can also be used is conjunction with other existing relevant publications.

SUPPORT AND TRAINING FOR HOST COUNTRY CROP PROTECTION UNIT

1989 Recommendation 30.

It is recommended that technical assistance, education, training and equipment be provided to crop protection services of host countries with a view to making the services eventually self sustaining.

Revised Recommendation 30.

No revisions are necessary (see recommendation # 22)

PESTICIDE STORAGE FACILITIES

1989 Recommendation 31.

It is recommended that more pesticide storage facilities be built. Until that occurs, emergency supplies should be pre-positioned in the United States.

Revised Recommendation 31.

It is recommended that more pesticide storage facilities *continue to* be built. *Pre-positioning supplies in the United States should be considered as only one of the many possible alternatives for pesticide storage.*

Comment.

Pesticide storage facilities have been built or improved by USAID in a few countries such as Mali and Niger. This work needs to be continued. Pre-positioning pesticides in the United States poses a number of problems including access to those supplies in crisis situations, high cost, and ownership responsibilities. Other alternatives to pesticide storage, including storage at properly constructed and maintained sites in Africa that are accessible in times of emergency outbreaks, may be preferable and more cost effective than pre-positioning these pesticides in the U.S.

FORECASTING

1989 Recommendation 32.

It is recommended that AID make a decision as to whether to continue funding forecasting and remote sensing or utilize the FAO's early warning program.

Revised Recommendation 32.

No revisions are necessary.

Comment.

USAID has continually supported early warning programs administered by FAO and other agencies. AELGA uses this and other sources of information for its monthly emergency pest updates. USAID can strengthen existing early warning systems through the FAO and/or the AGRHYMET Center which were originally supported by the Agency.

PUBLIC HEALTH MONITORING AND STUDY

1989 Recommendation 33.

It is recognized that a series of epidemiologic case-control studies, within the countries involved in locust and grasshopper control, should be implemented in areas of heavy human exposure to pesticides.

Revised Recommendation 33.

It is recognized that a series of epidemiologic case-control studies, within the countries involved in locust, grasshopper, armyworm, and rodent control, should be implemented as necessary and when possible, in areas of heavy human exposure to pesticides. Nevertheless, it should be realized that, due to the nature of the studies involving human subjects, such studies will require careful analysis and planning and can only be done on a limited scale, under strict supervision.

Comment.

Epidemiologic case-control studies of human exposure to pesticides should remain a goal, however, the difficulty in obtaining such information should be recognized. These studies may be more readily obtained by regional or local organizations that have the capacity to undertake the task.

RESEARCH

1989 Recommendation 34.

It is recommended that applied research be carried out on the efficacy of various pesticides and growth retardants and their application.

Revised Recommendation 34.

It is recommended that applied research be carried out on the efficacy of various pesticides and growth retardants and their application *for the control of locusts, grasshoppers, and armyworms*.

Comment.

New approaches to locust, grasshopper, and armyworm control that reduce reliance on synthetic chemical pesticides should be given a high priority.

1989 Recommendation 35.

It is recommended that applied research be carried out on the use of Neem as an anti-feedant.

Revised Recommendation 35.

No revisions are necessary.

Comment.

Extracting neem oil from local neem tree seeds may be done by indigenous companies or organizations. It should be noted that to date, neem and neem extracts have not demonstrated a significant potential for locust/grasshopper control. Nevertheless, satisfactory results have been achieved when neem extracts are used against routine vegetable pests. It is possible that neem and other botanical agents may be tried against armyworm as part of an IPM program.

1989 Recommendation 36.

It is recommended that research be carried out to determine the best techniques for assessing the impacts of organophosphates used for locust and grasshopper control "in relation" to the use of these and other chemicals for other pest control programs.

Revised Recommendation 36.

It is recommended that research be carried out to determine the best techniques for assessing the human health, environmental, and non-target impacts of pesticides used for locust, grasshopper, armyworm and rodent control "in relation" to the use of these and other pest control programs.

Comment.

Environmental and human health risk assessments for some pesticides that are used against locusts, grasshoppers, armyworm, and rodents may be researched from the USEPA resources. Some are already available and others may require further investigations.

ACTION PLAN AND COORDINATION

1989 Recommendation 37.

It is recommended that AID, on the basis of the previous Recommendations, develop a plan of action with practical procedures to provide guidance in locust/grasshopper control to missions in the field.

Revised Recommendation 37.

It is recommended that USAID, on the basis of the recommendations that are listed above, develop a plan of action pertinent to a request from the field missions, with practical procedures to provide guidance in locust/grasshopper*, armyworm and rodent* control to missions in the field.

1989 Recommendation 38.

It is recommended that detailed guidelines be developed for AID to promote common approaches to locust and grasshopper control and safe pesticide use among UN Agencies and donor nations. Coordination of efforts is becoming increasingly important because of the increasing number and magnitude of multilateral agreements and follow up efforts in subsequent years by various donors.

Revised Recommendation 38.

It is recommended that detailed guidelines be developed for USAID to promote common approaches to locust/grasshopper, *armyworm, and rodent* control and safe pesticide use among UN Agencies and donors that wish to participate in this task. USAID should continue its collaborations with and support for the EMPRES and EMPRES-like programs to strengthen national and regional capacities to monitor, prevent, and respond to any emergency pest operations that may be required by the host countries. Coordination of efforts among donors, affected countries, and others that may be involved in emergency trans-boundary pest operations have come a long way and shown improvement. This becomes evermore increasingly important when more and more nations are, on their own will, participating. This becomes increasingly important when bilateral agreements are signed between donor and recipient nations.

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