ANNEX 2:

GENERAL PESTICIDE ANALYSIS:
Relevant to USAID Environmental Procedures Title 22, CFR 216.3 (b) (2) (iii)

Prepared by: Dr. A. D. Brock[1]

Pesticide Application at the Lamego Research Station
FHI/M/Mozambique

Background

The primary role of the adaptive research component of the FHI/M/Mozambique agricultural program is to develop sustainable and simple crop production techniques.
In order to achieve this goal, carefully monitored field experimentation and post-harvest testing are conducted in an approximately 3-ha research farm supervised by well-experienced and trained staff

At the research station, the application of any form of pesticides, either chemical or botanical, is limited to two cases. First, pesticide is applied when the threshold level has been reached at which a trial may be severely damaged due to a high degree of disease infection or increased pest population. In this instance, the least toxic and most effective of a range of recommended pesticides is selected. Secondly, pesticide is applied as part of an experimental trial in small, carefully controlled plots of $27m^2$ (replicated 4 times).

The following general pesticide analysis is presented according to the Pesticide Procedures, per 22 CFR 216.3 (b)(1)(a-l). Please see the tables annexed to this document for a list of chemicals used by FHI/M including botanical pesticides.

Analysis

USEPA's registration status of the requested pesticide

Table 1 shows the list of pesticides, chemical and botanical, for which authorization is being requested. All chemical pesticides are currently registered with USEPA with a low level of toxicity (WHO classification). Malathion and Trichlorfon, both organophosphates, are known to control a broad spectrum of destructive insect pests effectively. Perimophos-methly is a quick acting insecticide that is widely used to control insect pests in stored products. Mancozeb, a dithiocarbamate, is widely used as a foliar protectant for a variety of diseases. All of these chemical pesticides, except for Trichlorfon, are found to have low to moderate effects to beneficial organisms.

Of the six botanical pesticides, only neem is registered with USEPA. Three plant species (mango, groundnut and turmeric), which are unregistered with USEPA, are reported to be sources of

[1] A. D. Brock is the Coordinator for Agricultural Research of FHI/Mozambique. She earned her Ph.D. in Crop Science from the University of Reading in 1991. Before joining FHI/Mozambique, she has worked in the areas of crop production management and post-harvest technology in potatoes, sweet potatoes, wheat and maize for 14 years in the Philippines, Canada and the USA. She also has done agricultural consulting in countries like Burkina Faso and Vietnam.

botanical pesticide products and are edible to humans and animals. These are, thus, assumed safe for application as pesticides.

Bases for selection of the requested pesticide

The chemical pesticides are chosen because they are proven to be some of the most effective chemicals against the pest and diseases identified at the research station. Moreover, their level of toxicity to humans and hazards to the environment are known to be low to moderately low. All of the chemical pesticides are currently registered with the USEPA and with the Mozambican Government. The Supplementary Environmental Assessment of the USAID/Mozambique PVO Support Project also identifies all of the aforementioned chemical pesticides as acceptable for use.

Of the botanical pesticides, neem is selected because it is widely-tested for its effectiveness as a pesticide and is not hazardous to humans and the environment. The tree is known to grow in this climatic regime and provides many uses for the farmers. Neem is a registered botanical pesticide source with USEPA. Mango is a common tree in Sofala. It is recommended that only unproductive or old mango tree limbs are cut for use (burnt to ash) as mango is an important source of cash. The use of mango wood ash is not known to cause any hazards to humans or beneficial organisms. Groundnut and turmeric are likewise common crops in the province of Sofala. Nsequesse and goye, are indigenous trees growing in many parts of Sofala. They have been reported by farmers to control insects in stored grains. These plant species, therefore, will be tested as a possible insect pest control in small amounts of stored grains.

Extent to which pesticide is a part of an IPM

FHI/M affirms and supports the principles of integrated pest management (IPM) and will follow the management practices and strategies of IPM in dealing with any pest and disease problems that arise in the project. The identification of key pests and monitoring of pest population are vital elements of an effective IPM system. FHI/M is staffed with research station personnel who have training and experience in this field. At the research station, various methods and options will be considered and evaluated in order to come up with the most economical, sustainable and environmentally safe system. The following techniques will be integrated in order that chemical pesticides are applied judiciously (at the "threshold level of action at which chemical application is taken to prevent losing the plots to severe damage due to the disease or pest"): use of rat traps or scarecrows; proper time of planting and harvest; hand picking of pests ; good crop sanitation; the use of border or trap rows; and intercropping or relay cropping. Also,
FHI/M is continuing its efforts to screen for botanical pesticides using indigenous plant species.

Proposed methods of application, including availability of appropriate application and safety equipment

The method of application will depend on the type of formulation. Malathion is in emulsifiable concentrate form and Mancozeb is a wettable powder. In either case, the recommended amount of chemical will be mixed with water. Upon mixing, it will be sprayed directly to the affected crop using a knapsack sprayer. Application will only be made early in the morning when it is calm (not-windy). The following protective equipments will be used during the preparation and application of the chemical: gloves and boots, protective dust masks and respirators and overalls.

Trichlorfon, as Dipterex granules, will be applied directly to the whorls of maize and sorghum at the recommended rate and time of application. The applicator will be required to wear protective outfits (gloves; boots; overall and masks).

Actellic powder (at the recommended rate of 50g/100kg seeds) will be mixed with grains of maize, cowpea or sorghum in the storage trial building. Some replicated trials will involve applying actellic in big quantities (about 40-50 kgs) and some in small quantities (5 kgs) of seeds. After treatment, both (big and small quantities) will be separately bagged and tied. They will be regularly monitored (ie. by weight, in order to check the damage caused by weevil) over a period of time. The applicator will be required to wear masks, gloves, boots and overalls.

All of the botanical pesticides listed in Table 1 will be applied in small packs of maize, cowpea or sorghum (5 ks) to evaluate their effectiveness to control weevil (*Sitophilus* sp.). Neem is extensively reported for its pesticidal properties. The use of mango wood ash, groundnut oil and turmeric as insect protectants have been previously reported elsewhere (Stoll, 1992).

For the purpose of the trials, seeds of neem will be collected, dried and crushed until powder. Powdered neem will be mixed with the grains at 2% by weight. Cooled mango wood ash will be applied to the grain samples at 10 g per kg of grains. Turmeric powder will be mixed with the grains at 2% by weight. Oil of groundnut will be extracted and will be used to coat the grains at 15 ml/kg grains. Leaves of nsequesse and goye will be dried and powdered. Both materials will be applied at 2% by weight.

FHI/M Lamego research station is staffed with an agronomist, field supervisor and field technicians who have the training and experience in the preparation and application of chemical pesticides. They are also trained in the correct storage of chemicals and disposal of their containers and first-aid, in case of exposure to the chemical.

Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use and measures available to minimize such hazards

All chemical pesticides listed in Table 1 are classified to be low in toxicity (Classification III based on WHO). The corresponding lethal acute oral dosage (rats) for each chemical pesticide is given in Table 1. Not one of the listed chemicals is known to be allergenic (PAN and CTA, 1995). In cases of inappropriate use, however, Malathion is reported to be toxic to bees and fish, and Trichlorfon is toxic to fish. Only Trichlorfon is reported to be harmful to some beneficial organisms.

FHI/M Lamego research staff is well trained in the proper preparation and application of chemical pesticide. They are also knowledgeable in the hazards they may cause to humans and the environment. Therefore, appropriate measures will be applied. Among these measures: wearing the protective clothing and using the necessary gadgets; application of chemicals at the recommended rate, application at the right time and weather (early and not-windy), no smoking nor eating during the preparation or application of the pesticides; washing up hands or bathing immediately after pesticide application, keeping children or animals off the vicinity where the pesticides are being mixed and applied; posting “no-entry” signs at the area of application after spraying; proper disposal of the containers and proper cleaning up in case of accidental spillage.

Soap, towels and water are available for washing up after handling the pesticides. Moreover, the station has some antidotes in case of poisoning. The staff is also aware of first-aid techniques in the event that accidental poisoning occurs.

Procedures for the proper disposal of pesticide containers

FHI/M takes care to assure that the bottles, jugs and packages previously containing pesticides are properly disposed and are not handled or used by anyone but qualified individuals. The packaging is collected and buried in a one meter deep pit at least one kilometer from the nearest surface water. The pit is currently located in an old mango grove adjacent to the Lamego Research Station. Since the grove is not cultivated, there is little risk of farmers coming in contact with the containers. The pit is far enough away from the mango trees as to not effect the trees through leakage in or around the pit.

Effectiveness of the requested pesticide for the proposed use

The chemical pesticides being requested are listed as acceptable for use in the USAID/Mozambique PVO Support Project on cereals (maize, sorghum), leguminous (cowpea) and solanaceous crops (tomato) (Table 2). Moreover, the same chemicals are registered to effectively control specific pests and diseases on specific crops by the Government of Mozambique (Direccao Nacional de Agricultura).

Neem has been extensively reported for its effectiveness as a botanical pesticide (PAN and CTA, 1995). Seeds of neem are known to have a stronger pesticidal property than the neem leaves. Thus, seeds of neem will be tested to control weevil damage in maize and cowpea grains. Likewise, groundnut oil, turmeric and wood ash have been previously found to be effective protectants against weevil in stored products like maize and legumes (Stoll, 1992). The use of nsequesse and goye as effective sources of pesticide was primarily based on local farmers' experiences and observations.

The conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology and soils

At the FHI/M Lamego research station, there are two types of field crop management activities: first, replicated plots, some trials of which may include plots that are being tested for a chemical or botanical pesticide as a treatment; second: multiplication plots.
In the first case, application is normally made on small 15-20 m^2 plots, replicated four times (eg. evaluation of botanical pesticides to control stalk borer in maize). Multiplication plots normally range from 100 to 500 m^2. In both cases, application of the pesticide will be done early in the morning when the wind is calm to avoid spray drift.

The research station is situated away from a populated village and is enclosed by barbed wire and wind breaks (*Leucaena* sp.). These factors keep passers-by and any animals out of the research area, especially during and after chemical application. Also, no-entry warning signs are staked on the sprayed plots/ trials soon after application. The station is right next to a deep running river, however, FHI/M strictly prohibits any type of activity related to the use of chemical pesticides that would result to water contamination. The soil at the FHI/M Lamego research station is considered fertile and well-managed. FHI/M consistently practices crop rotation and green manuring with leguminous cover crops (eg. crotolaria) to enrich the soil and improve the soil structure.

The availability and effectiveness of other pesticides or nonchemical methods

The pesticide chemicals listed in Table 2 are found to be the least toxic and most effective against the insects and diseases affecting the crops on station. (FHI/M is continuing its efforts to identify botanical pesticides using indigenous plant species.) The station consistently practices crop rotation (particularly leguminous species after cereals) in order to disturb the disease or pest cycle, thus, reduce the severity of pest infestation or disease infection. This technique is likewise practiced in order to improve the fertility level of the soil. Other techniques practiced are: use of traps and baits, planting border rows as trap crops, right time of planting and harvest, good crop sanitation and fertility management (eg. green manuring).

The requesting country's ability to regulate or control the distribution, storage, use and disposal of the requested pesticide

Mozambique has had a pesticide legislation in the past, however, pesticide law enforcement has been difficult for many reasons (eg. security situation, lack of trained personnel, fragmented responsibility among government agencies). The responsibility for safe and effective use of chemicals, therefore, lies on the PVO's themselves and the PVO Support project.

Provisions made for training of users and applicators

Chemical application will be applied by a staff member who have about six years of experience on pesticide use and application in research plots. He will be directly supervised by an expatriate Agronomist (about 30 years experience as a researcher; commercial farm producer and an agricultural development expert).

It is planned that research technicians, extensionists and agronomists will participate in some short-term training on pest identification, pest and disease control and concepts of IPM system. This is hoped to update the staff of the latest findings in this field, upgrade their skills and to reinforce the relevance of proper methods of handling chemicals both to humans and the environment.

Provisions made for monitoring the use and effectiveness of the pesticide

A monitoring pesticide use and application logsheet will be kept at the research station. The sheet will include the following information: what pestides are in storage; what quantity, on what crops the pesticide was applied, what are the target pests and diseases; when was the application made, who prepared the pesticide solution or mixture, who applied the pesticide.

Trained staff will also monitor the treated crop or plots for pest population as soon as it is safe to enter the area.

Because here in Mozambique the PVO Support Project and PVO's themselves are responsible for the proper use of the pesticides, the Agronomist and Research Coordinator will monitor that the following are implemented: proper storage of chemicals, maintenance of an inventory of chemicals and their application, appropriate pesticide application practices (eg. wearing protective outfit), right time of application and recommended dosage of the chemical and proper disposal of chemical containers.

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