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FINAL REPORT

STUDY OF PESTICIDE WASTE SITES AND DISPOSAL OF OBSOLETE PESTICIDE STOCKS THAILAND AND WESTERN SAMOA

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	Page No.
Executive Summary	3
Reasons for Undertaking Study	6

PART ONE : THAILAND

Acknowledgements	9
Glossary of Terms and Acronyms	10
I. IDENTIFICATION AND LOCATION OF WASTE SITES	11
1. Study Strategy	11
2. Results of Study	13
a. Port of Bangkok	14
b. Pesticide Formulators	14
c. Repackaging Plants	15
d. Dealers and Warehouses	16
e. Farm Storage of Pesticides	17
f. Waste Sites Due to Fire	17
g. Garbage Dumps	18
II. DISPOSAL TECHNOLOGY APPLICABLE TO THAILAND	19
1. Liquids (Incineration)	19
a. Evaporation Ponds and Lagoons	19
b. Incineration	19
2. Solid Wastes	20
3. Pesticide Spills	21
4. Disposal of Used Containers	22
5. Reclamation of Waste Sites	23
a. Landfill	23
b. Chemical Treatment	23
c. Soil Removal	23
d. Sealing of Surface	23
e. Monitoring	24
III. OTHER ISSUES	25
1. No Labels on Containers	25
2. Occupational and Residential Health	25

Page No.

IV. ORGANIZATIONAL RESOURCES 26

1. Existing Regulations and Legislation 26
2. Existing Environmental Standards 27
3. Other Relevant Studies 27
4. Enforcement 28
5. Hazardous Waste Management 28

V. CONCLUSION AND RECOMMENDATIONS - THAILAND 29

VI. FUTURE STUDIES IN THAILAND 31

REFERENCES 32

APPENDICES

1. Trip to Malaysia 34
2. Site Visits 38
3. Summary of Study Objectives 70
4. Information on Environmental Samples Collected for Pesticide Residue Analysis 70
5. List of Government, Industry and University Representatives Contacted 78
6. Official Report on Pesticide Fire 84

PART TWO : WESTERN SAMOA

I. RESULTS OF STUDY 88

II. CONCLUSIONS AND RECOMMENDATIONS 91

APPENDICES

1. Western Samoa 94
2. Samoa 108
3. Topics for Proposed Training Course on Fighting and Prevention of Chemical Fires and Clean-up of Spills 110
4. Press Release for Visit by Pesticide Expert 113

EXECUTIVE SUMMARY

1. Thailand

No significant stocks of obsolete or abandoned pesticides were found in Thailand. The explanation for these observations lies in the nature of the pesticide business in Thailand and ironically in the possible laxity of enforcement of environmental laws.

Except for paraquat, technical grade pesticides are not manufactured in Thailand and must, therefore, be imported. The main importers are private companies which for obvious economic reasons do not purchase an excess of pesticides which they do not expect to sell. The exception to this was the finding of a large stock of arsenic trioxide at the Port of Bangkok without an identifiable consignee.

The sale and distribution of pesticides in Thailand is mainly controlled by the private sector, and using conservative sales projections, the purchase (i.e. import) of large, uneconomic quantities of pesticides is avoided. The same conservative approach is apparent at the reformulating and repackaging levels of the pesticide industry by limiting the quantities of pesticides processed in order to meet and not exceed the projected market demand. These strategies also prevent the buildup of excess pesticide stocks.

In some African and other Asian countries where pesticide disposal problems have been identified, the public sector was the major importer of pesticides. Pesticide purchases were primarily made through government or donor acquisitions, and market forecasts of pesticide requirements were often inaccurate. As a result, excess stocks of pesticides accumulated and degraded under tropical weather conditions before the pesticides could be used up and often created serious pesticide disposal problems. Such was not found to be the case in Thailand!

According to Thai law, stocks of banned pesticides may be sold until the stocks are used up. Also, there does not seem to be strict enforcement of laws regulating the quality of pesticide products in the market place, so that obsolete and even water-damaged products may be repackaged and sold. Hence, due to these actions, though they may be undesirable, few problems may be expected to occur in Thailand due to product obsolescence or damage.

Although there are environmental regulations requiring that obsolete pesticide stocks and used pesticide containers be destroyed and disposed of by state-of-the-art technology, these regulations are rarely enforced. Drum refurbishing also appears to be a profitable business, and, therefore, the disposal of used pesticide steel drums may not be a serious problem in Thailand. The lack of a program for the disposal of used plastic and glass pesticide containers, on the other hand, does pose a potential

health problem and may be resolved by the imposition of cash container deposits.

At the present time, there is no designated hazardous waste site in Thailand, although there are plans under way for such a waste site to be established in the industrial district of Thonburi, outside of Bangkok. Until this happens, a person or company wanting to get rid of obsolete pesticide stocks will bury or dispose of them on private land. As a result, there may be many small waste sites scattered throughout Thailand but no single site equivalent to the infamous site at Love Canal, near Buffalo, New York.

The farm purchases of pesticides are made in small (100-ml to 1-liter) containers, avoiding the storage of excess stocks of pesticides in large, open containers. Pesticides are also used throughout the year, because distinct growing seasons as in the temperate zones do not exist in Thailand. Even then, we observed that the storage facilities for pesticides on the farm often were untidy and in one case were found within the family one-room living quarters. The improper and unsafe storage of pesticides at the farm level presents a potential health problem, but official standards would be very difficult to enforce due to the large number of farms and the lack of sufficient number of enforcement personnel.

The regional pesticide warehouses owned and managed by the Thai Government may contain an excess of obsolete pesticides for the same reasons that these excess stocks exist in other countries where Governments are the main purchasers and distributors of pesticides. An inventory and inspection of Thai Government pesticide warehouses would assess if a pesticide disposal problem, even on a minor scale, might exist in Thailand.

Pesticide waste sites may result from accidental fires or large-scale spills involving pesticides. Two such pesticide waste sites have been identified, one where a retail pesticide store recently was destroyed by fire, and another one where fire purportedly damaged pesticide stocks in a Government warehouse in 1982. Apparently, no attempt has been made so far to reclaim for human habitation the site of the fire at the pesticide store. Only limited details could be found from the second incident at the government warehouse, where it was estimated that 1.8 million baht (about US$ 72,000) worth of pesticides were damaged or destroyed. The residue from the fire was buried one meter deep in a 25 square meter pit near the site of the fire. There has been no monitoring of this site.

Based on a systematic search of and at pesticide distribution points and discussions held with government and donor agencies in Thailand, we conclude that it is unlikely that large quantities of abandoned or obsolete pesticides exist in Thailand. Though the study time was of short duration, we do not believe that we failed to find such abandoned pesticide stocks if

they do exist. Another reason for concluding that the existence of a significant pesticide dump site is improbable is the strength of the Thai private sector which dominates the pesticide business in this country.

2. Western Samoa

Because of the small population, 160,000, and limited acreage for agricultural crops, the total value of pesticide imports in Western Samoa amounts to less than US$300,000 per year. There are no formulating or repackaging facilities on the two major islands comprising the country of Western Samoa, and all pesticides are imported as formulated products. The major countries of origin are New Zealand and Australia.

At the present time, the Samoan Government exercises almost total control over the import, sales and distribution of pesticides through the Agricultural Store. The Store might lose its monopoly in the future, because several private enterprises have applied and obtained import licenses for pesticides. The oversight of the Agricultural Store is being conducted through a Board of Directors, with the Minister of Agriculture as its Chairman. Recommendations for purchase of specific kinds and amounts of pesticides are made by the Government Agricultural Extension Service and the German-Samoan Project for Crop Protection.

Deficient storage conditions for pesticides were found at the Central Warehouse in Vaitele and to a lesser extent at the Central Store in Apia. Although some improvements for sanitation and ventilation have been attempted in both warehouses, fire and health hazards do exist at both sites. A single fire truck operated by the 12-man National Fire Department is available for an emergency. No training for the prevention and fighting of chemical disasters (fire and spills) have been offered to the personnel of the fire department or the Agricultural Store. AID apparently has funds set aside for conducting such a training course, possibly on a regional basis.

Substantial stocks of obsolete pesticides, leaky metal containers, and open containers without identifying marks were found at the Central Warehouse. Our recommendations will include suggestions for off-site disposal of these stocks.

A site for the disposal of pesticides and containers was recommended by a previous U.S. study team and a Peace Corps volunteer. However, this recommendation was rejected by the Samoan Government, and no authorized disposal site exists at the present time in Western Samoa.

Another warehouse facility with improved safety features is located within the Port of Apia. The proximity of this building to the Central Store and the improved safety features make this a more desirable building for the storage of pesticides than the one presently in use.

INTRODUCTION

REASONS FOR UNDERTAKING STUDY

A serious problem involving obsolete pesticide stocks exists in a number of developing countries in Asia and Africa (Jensen, 1986). For example, it has been authoritatively reported (PAPA, 1985) that 212 lots of pesticides have been identified in Punjab Province, Pakistan, and appear to be abandoned. Among these lots are reported to be 1.5 million kilograms of 5% endosulfan granular formulation, 230,000 liters of 20% EC formulation of Gusathion, 250,000 liters of 27% EC Phosvel, and many more. The first two are examples of persistent chlorinated pesticides and toxic organophosphorus compounds. The third compound, Phosvel, had never been registered in the U.S. and was banned throughout the world due to its delayed effects on the central nervous system of humans, causing temporary and sometimes even permanent paralysis from high exposure.

If large stocks of unattended, obsolete pesticides are left in the open or temporary storage, especially in tropical climates, the containers may corrode, and the contents of toxic pesticides may leak into the environment, endangering man and animals. An additional problem arises if a pesticide is broken down into more toxic degradation product(s) due to exposure to extreme daytime temperatures in the open or unventilated storage sheds. In Pakistan for example, over 2800 persons were reported sick of whom five died due to the presence of an impurity in malathion, isomalathion, which may have been environmentally produced during storage at elevated temperatures. (Aldridge et al., 1979).

In order to find a satisfactory solution to the problem of obsolete pesticide stocks, disposal methods must be developed which are generally suitable or uniquely adapted to the country or region where these stocks might exist. The pesticide disposal problem, for example, in Western Samoa was investigated by an USAID study team (Freed and Krueger, 1983), and their recommendations included the construction of a pesticide waste disposal site for the destruction of excess pesticide stocks and used pesticide containers.

The USAID Office of Foreign Disaster Assistance (OFDA), recognizing that similar problems of obsolete pesticides may exist in other Asian or African developing countries which are users of large quantities of pesticides, has funded this study for Thailand. Thailand uses about US$ 100 million dollars worth of pesticides a year and might be a good candidate for finding large stocks of obsolete pesticides. Since most chorinated hydrocarbon pesticides were canceled in Thailand about ten years ago, it is possible that obsolete stocks of these compounds may still exist.

For budgetary economies it was prudent to include Western Samoa as another study site and to observe if the 1983 recommendations for a pesticide waste site have been implemented.

A side trip by the U.S. members of the team to Malaysia (see Appendix 1) was added to the itinerary with the intention of obtaining information on the latest technology of pesticide and container disposal and to assess if similar technologies might be applicable to disposal requirements in Thailand and Western Samoa.

PART I

THAILAND

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GLOSSARY OF TERMS AND ACRONYMS

ARSAP	-	Agricultural Requisites Scheme for Asia and the Pacific, ESCAP, Thailand
BMA	-	Bangkok Metropolitan Administration
CICP	-	Consortium for International Crop Protection
DIW	-	Department of Industrial Works, Thailand
DOA	-	Department of Agriculture (Research), Thailand
DOAE	-	Department of Agricultural Extension, Thailand
EPA	-	United States Environmental Protection Agency
ESCAP	-	Economic and Social Commission for Asia and the Pacific (United Nations), Thailand
GIFAP	-	International Group of National Associations of Pesticide Manufactures
GTZ	-	Deutsche Gesellschaft fur Technische Zusammenarbeit (German Technical Aid)
IPM	-	Integrated Pest Management
JICA	-	Japan International Cooperation Agency
MOPH	-	Ministry of Public Health, Thailand
MOI	-	Ministry of Industry, Thailand
MOAC	-	Ministry of Agriculture and Cooperatives, Thailand
NEB	-	Office of the National Environment Board, Thailand
NICE	-	National Institute for the Improvement of Working Conditions and Environment, Thailand
OFDA	-	Office of Foreign Disaster Assistance, USAID, Washington, D.C.
PSA	-	Poisonous Substance Act, 1967 and 1973, Thailand
TDRI	-	Thailand Development Research Institute
TPA	-	Thailand Pesticides Association
USAID	-	United States Agency for International Development

PART ONE : THAILAND

I. IDENTIFICATION AND LOCATION OF PESTICIDE WASTE SITES

1. Study Strategy

The value of pesticides imported in 1985 to Thailand amounted to about 4 billion baht (approximate US$ 100 million), not including pesticides spent for the public health sector (Thai Ministry of Agriculture, MOAC/DOA, 1985). With the exception of paraquat which is manufactured in a one-step reaction in two Thai factories (Chia Tai and ICI Asiatic), all other pesticides are imported as technical materials or finished products to be formulated or repackaged in Thailand.

The distribution of pesticides mainly takes place through commercial channels (wholesalers), with less than about 20% (Staring, 1984) of the market going directly through farmers' marketing organizations and the Thai Department of Agricultural Extension (DOAE).

During the preparatory phase for this study, a brainstorming meeting was held in order to get ideas for developing a systematic strategy for finding large quantities of abandoned or obsolete pesticide stocks in Thailand. At this meeting, there were representatives from the Ministry of Industry (MOI), the National Environment Board (NEB), the Thailand Development Research Institute (TDRI) , the Ministry of Agriculture and Cooperatives (MOAC), Ministry of Public Health (MOPH), the Bangkok Metropolitan Administration (BMA) and the US Agency for International Development (USAID).

A rationale for the systematic search of possible sites of obsolete pesticide stocks was developed that was based on the inspection of the following points in the distribution chain for pesticide sales:

1. Port of Bangkok
2. Formulation Plants
3. Repackaging Plants
4. Wholesale and Retail Outlets
   (including central warehouse belonging to DOAE)
5. Farmers' Warehouses

Due to time and budgetary limitations, only a restricted number of sites representing the above distribution points could be visited. They are all within two-hours driving time from Bangkok. This strategy did not appear unreasonable, because the central region around Bangkok consists mostly of agricultural land with the major crops being fruits (guavas, citrus), vegetables, and ornamentals (orchids), and all of them requiring frequent applications of pesticides throughout the twelve months of the year. Also, most of the pesticide formulating and repackaging plants for Thailand are located in this area.

Two garbage dumps were included in the site visits so that the possibility could be investigated if these were used for dumping obsolete pesticides, waste solvents and their empty containers. There is no separate hazardous waste dump site in Bangkok. Included also was a site formerly occupied by a pesticide retail store which was destroyed by fire three months ago (April 12, 1986).

The two U.S. team members were joined by five Thai counterparts: three from NEB; one from the Pesticide Registration Divison of the MOAC, and an academic civil and sanitation engineer associated with TDRI (see Acknowledgements for names of Thai team members). A two-week itinerary was planned in advance of July 7, 1986, the start of the trip, and appointments were made at all places to be visited (see Appendix 2).

At each place visited, the team members were first introduced to the host (usually the plant manager or owner), and the purpose of the study was briefly explained by one of the U.S. team members. A 3-page summary (see Appendix 3) was also handed out to the host. Each interviewee was asked the following questions:

1. "Are you aware or do you know of any site(s) at your location or any other place in the country where obsolete pesticide stocks may be stored?"

2. "How do you dispose of excess or obsolete pesticides?"

3. "How do you dispose of waste?"

After the initial briefing and question-and-answer period, the host would guide the team through the facility, and questions were asked on the spot about specific operations and conditions. With the exception of one formulation plant, photographs were allowed to be taken anywhere on the site. Water and soil samples were also taken at most sites (see Appendix 4).

2. Results of Study

There are no production facilities for technical-grade pesticides in Thailand, with the possible exception of the one-step process for paraquat. We hope to show in the narrative portion of our report, that based on our observations at diverse sites in Thailand (see Appendix 2), we were unable to locate large stocks of obsolete or waste pesticides. We have reason to believe that, unlike Pakistan (Staring, 1984), Thailand does not have such waste sites to any large extent. In Pakistan for about 33 years until 1980, pesticides were distributed free of charge or were highly subsidized by the Government. This giveaway during the 1970's resulted in a large excess of pesticides far above the actual needs of the farmers, leading to stocks of obsolete pesticides which today require remedial action for their disposal.

On the other hand, the Thai economy is based on private enterprise, and more than 80% of all pesticide sales are consummated through commercial channels. Less than 20% of pesticides used in Thailand are distributed by the government and farmers' cooperatives. The profit motivation in private business tends to keep pesticide sales in balance with or even short of demand. Consequently, excess stocks of pesticides are not likely to exist in the private sector.

Minor problems due to stocks of surplus or obsolete pesticide were discovered on some farms and small repackaging plants. Similar minor problems might also exist at regional government warehouses, which due to time limitation, we were unable to visit. These problems possibly existing at scattered points throughout the country do not appear to pose an imminent hazard to the environment or human health. The problem of scattered small waste sites might be exacerbated by creating one or two central collection points, and this option is, therefore, not recommended as a possible solution to the pesticide waste problem in Thailand.

We did discover a number of deficiencies in the way pesticides are handled at different distribution points, and sites where pesticide stocks were damaged or destroyed by fire.

Several specific problems exist at the Port of Bangkok and require immediate attention. Large amounts of arsenic trioxide in fiber drums, captan in plastic bags and organophosphate insecticides in rusty metal drums are stored either under an open roof or just out in the open. These stocks of pesticides should be shipped to their final destination, or in the absence of the identity of the consignee, must be disposed of.

In the narrative which follows, we have examined the distribution chain of pesticides, as discussed in the section on Strategy, beginning with the Port of Bangkok, continuing with

formulators, repackagers, wholesale and retail stores, and ending with the ultimate user of pesticides, the grower. Outside the distribution chain are municipal or private garbage dumps and fire sites, which may require special disposal treatment.

a. Port of Bangkok

The first place where pesticides arrive in Thailand is the Port of Bangkok. Pesticides are mostly shipped by boat and arrive in metal drums, plastic and glass bottles packaged in cardboard cartons, plastic and paper sacks. Pesticide shipments are classified by the resident representative of the Department of Agriculture, and chemicals which are designated as "Dangerous Cargo" are stored in a special warehouse (# 4), provided with automatic sprinklers, carbon dioxide and smoke alarm systems. The residence time of most pesticide shipments appear to be short, with exceptions as noted, so that we did not notice large accumulations of obsolete pesticides at the Port.

Several containers of arsenic trioxide had been stored for a long time, and no consignee has been located. The port authorities spoke about auctioning off the arsenic trioxide, but this chemical has a limited use in agriculture or household pest control. We will obtain the latest EPA-recommendations on the disposal of arsenic trioxide and forward them to the Thai authorities. For the present we are recommending continued storage of this chemical at the port under dry conditions and advise against auctioning.

Tens of used, rusty 200-L steel drums containing methyl parathion and dimethoate and originating in China were stored in the open. The use of old and rusty metal containers poses a safety hazard due to possible leakage of highly toxic organophosphorus compounds.

Several hundred bags of 50% captan WP were stored flat in an open shed, twenty high. One bag had split open, although the inner plastic wrapping prevented the spilling of the contents. These storage and packaging conditions are viewed as a potential hazard and must be corrected.

b. Pesticide Formulators

We visited two pesticide formulators (Chia Tai and Sharp Formulators) who are engaged in manufacturing liquid and dust formulations. No excess technical-grade pesticides or obsolete pesticide stocks were observed in either facility. The manager at Chia Tai related to us that any product to be disposed would be trucked to their Kanganaburi facility where the waste is buried in the ground. This facility is believed to have produced aldrin at one time, and it is possible that a burial site for obsolete pesticides may exist on its property. A member of our study team has visited the Kanganaburi plant site but did not

discover excess pesticide stocks or a waste site. Time restriction imposed on our study precluded a personal visit to the Chia Tai plant at Kanganaburi.

Waste streams at the Chia Tai plant were channeled to an unlined waste pond. Pesticide residue analysis of the water from the waste pond indicated levels of pesticides in the high (28.8) to low (0.1) ppb range. Appendix 4 contains the complete results. Inflammable technical-grade pesticides were stored in an old warehouse with a corrugated roof but with no ventilation, posing a potential fire or explosion hazard.

Sharp Formulators use two serial concrete-lined waste ponds, one as a chemical pond, the next as an evaporation pond. In the first pond, pesticide residue levels as high as 587 ppm (methyl parathion) were detected. In the second pond, residues detected, although still considered high, were about 10 times lower than in the first pond, indicating a limited measure of efficiency in treating the waste water.

The fact that we did not observe any large amounts of excess stock of technical-grade or obsolete pesticides may be due to the commercial operation by these two formulators, trying to maintain a constant flow of packaged materials from the factory to their customers and storing stocks of technical-grade pesticides only at levels consistent with sales projections.

c. Repackaging Plants

We visited four pesticide repackaging plants ranging in size from a plant processing almost 500 tons of pesticides annually to one that utilizes no more than one to two tons per year. A repackaging plant transfers formulated pesticides from large containers (e.g. 200-litre drums) to smaller containers (e.g. one liter). Rodenticide formulations are packaged into small one-time-use packets.

One of the plants we visited had provisions for handling waste streams in an underground waste pond without bottom lining. Such an installation would not prevent leaching of toxic chemicals into groundwater. Analysis of this pond water indicated ppb levels of eight pesticides (Appendix 4). The same plant also had a chemical scrubber for the reduction of gaseous emissions and malodors; this facility was not operating at the time of our visit. None of the other repackaging plants had similar provisions for reducing liquid and gaseous wastes.

We observed in one facility flood damaged paper sacks of the herbicide 2, 4-D awaiting repackaging. The manager of one of the plants told us that obsolete or damaged pesticide goods are removed from her plant by truck to be disposed at a private dump of unknown location. Analysis of the water in a ditch around this plant indicated high levels (up to 197 ppb) of eight insecticides (Appendix 4).

The smaller repackaging plants were devoid of proper safety features, e.g. ventilation around filling equipment, automatic fire alarm or control, fire extinguishers. Some of these operations appeared to be marginal economically as illustrated by our observation that used glass containers were recycled at a repackaging facility which was located on a farm. The glass containers filled at this facility and destined for use on this farm were not labeled, and the contents could only be identified by the color of the plastic bottle cap. Analysis of water collected from a canal around the farm (not near repackaging facility) indicated ppb levels of organochlorine insecticides (Appendix 4).

d. Dealers and Warehouses

Retail and wholesale dealers of pesticides are not easily distinguished from one another. The stores which we visited were neatly kept by displaying packaged pesticide products on open shelves or behind glass cabinets provided with locks. The dealers who were interviewed did not consider outdated pesticide products a serious problem in their operation, although they pointed out that most packaged pesticides did not display an expiration date. One dealer admitted that he had buried some pesticide products for which there was no longer a market, on his private farm property.

The situation of government warehouses, distribution points for subsidized sales or gifts, might be more problematic than that observed in the private sector. On July 27, 1982, there was fire at the major pesticide warehouse of the Department of Agricultural Extension (DOAE), located on the campus of Kasetsart University outside of Bangkok (Dechmani, 1986). According to confidential records, the fire occurred at 11 a m and lasted only twenty minutes. The fire may have occurred because of spontaneous combustion caused by the improper stacking of the pesticides and poor ventilation in the warehouse. Only the chemicals stacked on top were damaged, which amounted to 1.8 million baht out of a 6 million baht inventory (about US$ 72,000 out of 240,000).

A 1-meter deep pit measuring 5 meters wide and 5 meters long was dug outside the warehouse. The residue from the fire filled the pit up to about one-half meter. The pit was then covered over with dirt. There has been no subsequent monitoring. It is worth noting that this area has a high water table and is subject to flooding in the rainy season

The DOAE now owns and manages a newly constructed central warehouse and thirty-one regional storage facilities. The new central warehouse appears to be well-managed, although we did not see facilities for hosing down potential spills, or sprinkler or fire alarm devices. We observed that a truck was being loaded with fertilizers by barefoot workers. No stocks of obsolete pesticides were seen.

We do not know of the existence of obsolete pesticide stocks at regional warehouses. It is probable that the governmental pesticide distribution system results in excess pesticide stocks at some time during the year. It should be noted that this part of the world does not merely have one or two growing seasons, but that crops are grown, and pesticides are being used, all year around. We may assume that stocks of obsolete and excess or outdated pesticides may occur at regional warehouses. One of our recommendations will be to institute a perpetual inventory system of pesticide stocks owned and stored by the Thai Government.

e. Farm Storage of Pesticides

Storage of pesticides on farms and plantations has been identified as a serious problem requiring future attention by appropriate authorities. Without exception, we found that storage sheds on the farms we visited contained full, partially filled and empty pesticide containers stored in a haphazard manner. All kinds of pesticide containers of metal, glass, paper, cardboard, were standing or strewn on the floor of the shed. In one case, pesticides were stored inside a typical one-room dwelling prevalent in the rural areas of the country, where man, animals and pets live under one roof.

Stocks of obsolete and outdated pesticides in the original or unmarked containers, or where the label may have fallen off or may have been removed, exist in storage facilities on the farm. Although specific measures to alleviate these conditions may not be feasible, we will, nevertheless, attempt to make several recommendations.

f. Waste Sites Due to Fire

As mentioned previously under Dealers and Warehouses, there was a fire in 1982 at the main warehouse of the Department of Agricultural Extension, which was located on the campus of Kasetsart University, outside Bangkok. Remains of these pesticide stocks were disposed by burial in the ground.

Another waste site resulted from a fire which destroyed a retail pesticide store in April, 1986. The official report on this incident by the Department of Agriculture is appended to this report (Appendix 6-Thailand). Samples of the ashes, water, and fish from the adjoining waterways were collected and sent to the Toxic Substance Laboratory for pesticide residue analysis (see Appendix 4 for identification of collected samples and results). In the canal water near the fire site, only low ppb levels of dimethoate and carbofuran were detected. In the fish samples, low ppm levels of up to six organochlorine pesticides were detected. These levels probably are more the result of routine environmental pollution than pollution caused by the fire. As expected, the soil and ash samples collected at the fire site had higher ppm level of residues of mainly

organophosphate compounds. This indicates that decontamination of the soil could be accomplished by simple alkaline treatment.

g. Garbage Dumps

No empty pesticide containers or traces of outdated pesticides were found at the Bangkok Municipal Dump or at several private dumps which had been suspected to have been used as dumping ground for pesticide wastes.

II. DISPOSAL TECHNOLOGY

1. Liquid Wastes

a. Evaporation Ponds or Lagoons

Although the volumes of liquid wastes from liquid formulations, solvents, or liquid technical-grade pesticides have not been found to be large, it is nevertheless recommended that each formulation plant build its own lined settling tank, lagoon or pond of appropriate size (UNIDO, 1983). In two plants which we visited, such tanks or ponds were found, although one of them did not have a bottom liner, thus not protecting groundwater from becoming contaminated.

Almost all inorganic soils, such as clay, sand and gravel are suitable for an evaporation pond. However, a clay or synthetic liner is more desirable to prevent leakage into the ground. The recommended thickness of a clay liner is generally about 0.5 m thick. Synthetic plastic liners are manufactured sheets and require installation by trained workers. Concrete linings are recommended for organic soils. The concrete must be reinforced with steel mesh and should have a thickness of about 0.1 m.

The size of the pond or lagoon also depends on the local climatic condition, and must be capable of positive net evaporation (evaporation minus rainfall). Sometimes, it is advisable to cover the pond so that rain water does not intrude into the pond or lagoon. Roofing material might be polyethylene film (inexpensive but only 3-years life expectancy) or corrugated fiberglass panels (more expensive but 20-years life expectancy).

Solids will eventually accumulate on the bottom of the pond or lagoon and must be removed approximately every ten years to a secure landfill. Organic solid matter may also be disposed by high-temperature incineration (see below).

b. Incineration

Commercial incinerators specially adapted for the destruction of organic wastes or other high-temperature machinery built for other purposes (e.g. cement kiln) should be considered for the disposal of waste or obsolete pesticides. The important factors of any successful incineration are the temperature of the combustion chamber (820 to 1500 degrees c) and a residence time of 0.2 to 6.5 seconds for gases and liquid/vapors, respectively (Oberacker, 1985). The proven destruction efficiency of high-temperature incineration for a large number of chlorinated pesticides, organophosphates, triazines and ethylenebisdithiocarbamates (Zineb) has been demonstrated.

A commercial incinerator operated by Shell-Thailand, though of limited capacity, according to Shell personnel, is capable of efficiently destroying pesticides and containers by a batch process or liquid wastes by continuous feeding. The approximate cost of this incinerator was US$ 300,000. Management has expressed interest and willingness to handle pesticide wastes from other companies, if requested by the respective Thai governmental agencies. We recommend that this practice be followed rather than the building of another central incineration facility managed by the Thai Government.

Another, novel approach to utilize existing combustion facilities was demonstrated in Kuala Lumpur, Malaysia (see Appendix 1). A commercial cement kiln with an achievable combustion temperature of 1200 to 1400 degree c was utilized for the incineration of pesticide wastes diluted with kerosene (normal operational fuel for cement kiln) during cement production. The limitation and caution is the upper allowable limit of chloride content of commercial cement.

2. Solid Waste

The disposal of a sizable quantity of arsenic trioxide stored at the Port of Bangkok poses a difficulty. Due to the refractory nature of this inorganic material, none of the disposal methods outlined above for organic liquid wastes apply here. Burial of arsenic trioxide in the ground is also ruled out due to the potential hazard to man and aquatic organisms by the slow solubilization and movement of arsenates into groundwater.

Mechanical incorporation of arsenic trioxide into a solidified matrix may be a possible solution to the disposal problem (USEPA, 1985b). The solidification or stabilization methods which have been found practical for special situations can be categorized as follows:

- cement solidification
- silicate-based processes
- sorbent materials
- thermoplastic techniques
- encapsulation processes
- organic polymer processes
- vitrification

It appears that the first two cement-based solidification techniques may be the recommended technologies for the disposal of arsenic trioxide. There is some evidence, however, that sodium arsenate may cause problems with the setting, curing and permanence of cement. This is not to say that arsenic trioxide necessarily possesses similar unfavorable properties.

The cement-solidification technique involves mixing the wastes directly with Portland cement which incorporates the waste into the rigid matrix of the hardened concrete. The end product may be a standing monolithic solid or may have a crumbly consistency, depending on the amount of cement added. It is recommended that small pilot tests be performed before committing all of the stored quantities of arsenic trioxide for treatment.

Silicate-based processes refer to a very broad range of solidification/stabilization methods which use a siliceous material together with lime, cement, gypsum or other suitable setting agents. There are a number of silicate-based processes which are available either commercially or still in the research stage. Some of these proprietary processes and their manufacturers are the following:

- Chemical Process
- Envirosafe I Process
- PQ Corporation, Lafayette Hill, Pennsylvania

The cost for silicate-cement solidification in the drum has been estimated at approximately US$ 250/ton, but the processing time is almost one year (USEPA, 1985).

It is recommended that the USEPA, Cincinnati, Ohio and the PQ Corporation be contacted before deciding on a final process for the disposal of arsenic trioxide.

3. Pesticide Spills

The primary information which must be available in case of pesticide spills is the chemistry of the spilled material. It is important that plant management be provided with this information by the manufacturer or distributor of each technical-grade or formulated pesticide product. A central government agency may want to keep on file this information for all imported and manufactured chemicals and by means of a hot-line advise the best way to contain and dispose of the spilled material.

Training for first-aid and cleaning up of spills must be provided to workers by the plant management or through a government-sponsored by training program (see "Recommendations"). The first attempt to clean up a site of spillage is the flushing of the contaminated area with water. This may not be a good practice since water may cause the contaminated area to become enlarged and the contaminants to seep into the ground. The use of an absorbing material like attaclay, fine sawdust, soda ash or even dry soil is recommended (Harmer and Wolfe, UNIDO, 1983). Final decontamination must be accomplished with a chemical capable of decomposing the spilled pesticides or solvents. Some of the more readily available chemicals which can be used for such purpose are sodium carbonate, chlorine bleach (sodium

hypochlorite), caustic soda, hydrated lime, water plus detergent, alcohol and trisodium phosphate. Caustic soda is most useful for the decomposition of organophosphate and carbamate pesticides, but as stated before, specific recipes depend on the chemistry of the spilled material. Contaminated absorbents or solutions should be treated as waste pesticides and disposed by suitable techniques as briefly described above.

4. Disposal of Used Containers

Basically there are three acceptable methods for the disposal of used pesticide containers: 1. return to the original source for reuse; 2. recycle for scrap or energy recovery; and 3. disposal by mechanical or thermal methods (Trask, 1985). If the first option is exercised, the containers must be triple-rinsed with a suitable solvent, based on the solubility of the pesticide. As we have seen in one steel drum recycling plant in Thailand, metal drums are being refurbished for uses other than storage and transport of pesticides. The one serious reservation is that these drums might be used for storing drinking water, and no monitoring program exists to determine the safety of this practice to public health. A large commercial operator, like Shell, crushes the used steel drums and disposes of them as scrap.

Recycling metal, glass, and plastic containers as scrap seems to be the most desirable, though not most economic or acceptable option for Thailand. The small amounts of pesticide residues remaining after rinsing are completely destroyed at the temperature of melting steel and glass. Plastic scrap is most easily disposed of by incorporation into plastic products like sewer pipes, agricultural mulch and films.

Energy generated from high-temperature incinerators might be considered an alternate option, but the economics for the capital investment and the potential return are not believed to be favorable at the present time. This option, therefore, is not being considered.

Final consideration may be given to disposing of used pesticide containers, which have been triple-rinsed, in sanitary landfills. Preferably are those which are lined (see above under'Evaporation ponds and lagoons'), but these sites are very expensive to construct. They may cost from US$ 20,000 per acre for unlined landfills to US$ 85,000 per acre for lined sites.

Consideration may also be given to an educational or incentive program for the return of used containers. A program in the U.S. state of Maine (Denny, 1985) for the return of used pesticide containers is being developed and is based on cash deposits at the time of purchase of US$ 5.00 for containers less than 30 gallons and $ 10.00 for those over 30 gallons. Time will

tell how successful this incentive program is for the return of used pesticide containers. Although it involves a great deal of paper work and bookkeeping, such an incentive program may be more successful in Thailand than a mere educational campaign dealing with the hazards of reusing old pesticide containers.

5. Reclamation of Waste Sites

a. Landfill

The specific problem which is being addressed is the reclamation of the site of the pesticide store fire. The site must be carefully monitored laterally and vertically to be able to map out the extent of pesticide contamination. Once the extent of the contaminated area has been determined, the area should be bulldozed and excavated to the depth of the contaminated soil. A synthetic liner, synthetic rubbers or high density polyethylene sheets, are laid down and careful instructions for proper placement and seaming and testing should be followed (Cope et al., 1984). The excavated area is covered with the solid originally removed and compacted. Periodic samples of the soil originally removed and compacted. Periodic samples of the soil and adjoining waterways should be taken to ensure that none of the pesticides are being leached into groundwater.

b. Chemical Treatment

An alternate method for the degradation of residual pesticides from the contaminated site is the chemical treatment with lime or strong base (NaOH). The progress of pesticide degradation must be followed by frequent monitoring and pesticide residue analyses. Instead of chemical treatment, the site might be left fallow for a period of time so that microbial and physical degradation of pesticides might take place. Again, frequent sampling at the site and pesticide analyses should be carried out to follow the progress of degradation.

c. Soil Removal

An effective though expensive technique for decontamination is the mechanical removal of the soil to an authorized landfill. This is only practical if the area of contamination is small and the depth is shallow. Methods and equipment for soil removal have been described in detail by USEPA (USEPA, 1986b).

d. Sealing of Surface

The contaminated surface before or after any of the above treatments should be sealed with a layer of reinforced concrete before attempting to erect buildings for human habitation. It is

important that all utilities, heating and cooling systems be built on top of the concrete liner so that there is no physical contact between the contaminated soil and the building.

e. Monitoring

As has already been mentioned above, frequent monitoring of the soil and surrounding waterways for pesticide residues is very important in order to establish the extent of the contamination and follow the progress of decontamination. Monitoring will also enable one to determine if appreciable amounts of pesticides are escaping from the site into the surrounding environment.

One of our recommendations is that the responsible Thai authorities use the specific fire site as a pilot test for the most practical and applicable technologies for reclamation of contaminated soils. Specific directions should be obtained from USEPA, Cincinnati, Ohio.

III. OTHER ISSUES

1. Labeling of Pesticide Containers

During our site visits, we observed on at least two occasions practices of labeling pesticide containers which might have serious health consequences. In one case, a malathion label had been pasted over the imprint of an old DDT metal container (see photograph in Appendix 2). Another blatant violation of labeling practices was found in a small repackaging plant where the glass containers had no labels and the contents could only be recognized by the color of a removable plastic screw cap. The proprietor of this operation assured us that these pesticides were used by experienced pesticide applicators who knew the color combination of the caps and would not make a mistake by using the wrong pesticide.

We shall recommend that the pesticide laws of Thailand be amended, if not already accomplished, to address the issues of quality control and proper labeling of pesticide products and containers.

2. Occupational and Residential Health

Although outside the scope of our study, we observed that workers and their families, including small children, lived on the premises of several formulating and repackaging plants, and that it would be very easy to enter the processing facilities barefoot and become contaminated with toxic pesticides. This is especially serious for small toddlers whose toys were seen next to pesticide drums. Strict occupational health regulations for involuntary human exposure to pesticides must be considered to improve these adverse situations.

On one plantation where pesticides were applied from a boat, the applicators did not appear to wear any type of protective clothing while spraying liquid formulations. It appeared that little care was taken to pay attention to the direction of the wind. These practices must be improved through stricter enforcement of regulations for farmworker and pesticide applicator's safety and exposure to pesticides.

In a number of bottling operations, it was noticed that the workers on the line wore improper face masks designed for dusts and not liquid formulations, thus affording little or no protection from inhalation of toxic vapors. The working conditions of factory employees comes under the jurisdiction of the Ministry of Industry (see Section IV), but enforcement of these regulations appears to be lax.

IV. ORGANIZATIONAL RESOURCES

1. Existing Regulations and Legislation

This section will briefly address only the major pieces of legislation relevant to hazardous waste management. For a more in-depth discussion of legislation in Thailand, it is recommended that the reader refer to the studies of Manring, 1985, and TDRI, 1985.

a. Poisonous Articles Act (PAA), 1967 amended 1973

The PAA was enacted to control the import, export, manufacture, sales, storage, transport and use of poisonous articles including pesticides. The PAA is jointly enforced by three ministries: Ministry of Agriculture and Cooperatives (MOAC), Ministry of Public Health (MPH), and the Ministry of Industry (MOI). These ministries register a chemical onto a list of poisonous substances. A license must be obtained from the respective ministry to import, export or manufacture a listed chemical. The three ministries are empowered to issue ministerial regulations governing the storage, transportation, manufacture, use, labeling and disposal of both the poisonous substances and their containers.

A Poisonous Substance Board was also created under this act. It is the duty of the Board to advise the respective ministries in registering a particular substance as poisonous and permitting or banning the importation of poisonous substances. It is worth noting here that banning a chemical in Thailand means that no future import licenses will be issued. Existing stocks in-country may be continued to be used until the stocks are gone. This is a major reason why we did not find large stocks of banned pesticides.

The PAA has several weaknesses. The main one is that before any poisonous substance can be regulated, it must first be registered. Substances that have not been officially registered are therefore not subject to control under the Act. This loophole has resulted in many unregistered toxic substances being imported or used freely in Thailand.

b. The National Environment Quality Act, 1975 amended 1978

This Act created the National Environment Board (NEB) and the Office of the National Environment Board (ONEB). This Act authorizes NEB to develop policy and to coordinate with other government agencies in matters involving environmental quality. NEB is not empowered to administer the Poisonous Substance Act.

c. The Factories Act 1969

This Act give authority to the Ministry of Industry (MOI) to control the establishment and operation of factories. Under this Act, MOI can issue regulations limiting waste discharges from factories, air emissions, occupational safety and working environment inside the factories. Government owned factories are exempted from the control of the Act.

2. Existing Environmental Standards

Standards on environmental quality have been compiled in an NEB (1985) publication. The standards are grouped into five categories: air quality, noise, solid wastes, toxic substances and water quality. Only the category on toxic substances will be briefly discussed here.

The standards on toxics substances address the maximum residue level of toxic substances allowed in food, the limits of chemicals allowed in a workplace, and guidelines for the storage, transportation and disposal of toxic substances.

Regarding disposal of toxic substances, the standards are considered official regulations as they have gone through the Royal Government Gazette (vol 99, part 153, dated October 19, 1982) notification procedure. The standards address both toxic chemicals and their containers. Although the standards are useful to show the way toxic substances should be destroyed (by "state-of-the-art technology for the this purpose") or disposed (not in public waterways), it is the authors observation that there is limited enforcement of the standards, especially the standard that says that empty toxic chemical containers must be destroyed. As we observed during our site visits (see Appendix 2 - Drum Recycling Plant), container refurbishing is quite a big business in Thailand.

3. Other Relevant Studies

Hazardous waste management is an emerging issue in Thailand's development agenda. Several studies (Roos, 1985; Manring, 1985; TDRI, 1985) related to the broader toxic substance issues have pointed out the need for improved toxic chemical disposal.

The National Environment Board (NEB) has recently secured funding from the U.S.A. for conducting a national toxic waste inventory which is likely to be started in 1987. This is considered to be a first step in developing a systematic national strategy for dealing with hazardous wastes.

In her report, Ms. Roos developed a Technical Resource Directory for Thailand which includes the following: 1) government agencies and state enterprises that work in connection with toxic substances; 2) chemical testing laboratories; 3) chemical and agricultural chemical industries; 4) agencies involved with heavy metals and pesticides research and testing; 5) clinics performing industrial related medical monitoring of workers; 6) medical toxicologists, toxicologists, and industrial hygienists; 7) environmental consulting firms; 8) technical libraries; and 9) environmental interest groups. The directory is 33 pages long and has already been distributed to relevant government agencies in Thailand. Therefore, it is not included in this report as an appendix. The directory was mentioned only to alert the reader that such a compilation of information exists.

The NEB was pleased to participate in USAID's pesticide disposal study, as this study complemented their short-term goal to identify toxic wastes from all sources.

4. Enforcement

In most developing countries, enforcement of existing legislation and regulations is a problem. This is usually because of lack of adequate budget to hire sufficient personnel and provide them with sufficient funds to carry out routine enforcement.

In Thailand, inadequate funding is a problem. Yet, there is an additional problem which can't be legislated or budgeted. And that is the Thai national characteristics of being polite and non-confrontational. For example, to inspect a factory, it is traditional to make an appointment well in advance. This can give a factory time to "hide" their worst problems.

5. Hazardous Waste Management

Thailand does not yet have a specific site for hazardous waste. In 1985, the Department of Industrial Works (DIW) commissioned the Faculty of Engineering of Kasetsart University to study the siting for industrial waste disposal (TDRI, 1985). DIW plans to establish a toxic industrial waste disposal center for industries located in the Thonburi area. Toxic industrial wastes are to be treated and the settled sludge mixed with cement to form stabilized concrete cubes which will be transported to a dumping site in Ratchaburi province.

The DIW has requested bids three times already for building this site, but to date there are no local companies have bid for the contract (NEB, 1986).

V. CONCLUSIONS AND RECOMMENDATIONS - THAILAND

1. Do stocks of obsolete pesticides exist, and are there pesticide waste sites in Thailand?

Based on our study during a two-week tour of Thailand, we do not believe that large amounts of obsolete or surplus pesticides exist. Also, we do not believe that a large central pesticide waste site will be found in Thailand. The main reason that these potential pesticide disposal problems do not exist in Thailand lies in the nature of the private sector for the import, sales and distribution of pesticides. Countries where pesticide disposal problems exist are those in which the government has a monopoly on the pesticide business, e.g. Pakistan or countries on the African continent.

2. Are there any problems of obsolete pesticides, and what is recommended disposal technology?

One potentially serious problem of obsolete pesticide stock was found at the Port of Bangkok. Probably as many as fifty metal drums of arsenic trioxide (estimated 2.5 tons) are stored without a known consignee. The port authorities have discussed auctioning off this shipment. We do not know of a large-scale use of arsenic trioxide and, therefore, recommend that cement or silicate-based solidification process be considered for the disposal of arsenic trioxide. Details on the technologies are available from the USEPA, Cincinnati, Ohio.

There are one central and thirty-one regional government warehouses for pesticides distributed by the Thai Government. We recommend that a survey of all government warehouses be conducted and inspected for safety infringements, e.g. open or leaking containers, containers without labels, etc.

If a supplier or manufacturer has in his possession waste pesticides which he can no longer sell and wants to dispose of, Shell-Thailand has an incinerator which can be made available to others through a request by the appropriate government authorities. We do not recommend that the Thai Government install its own incinerator or establish a central toxic waste disposal site at this time. Presently, small amounts of obsolete pesticide stocks are disposed by burial on private property. Though this might not be environmentally desirable, a small number of minor waste site problems appears less hazardous than that which would be caused by the establishment of one central toxic waste site. As the chemical industry grows in this country, the establishment of a central waste site may be reconsidered. However, it is imperative that the following factors be carefully studied: site selected, design and planning, installation of equipment, operating procedures, pollution control and monitoring procedures.

3. Strengthening and Centralization of Laws Governing Pesticides and Toxic Substances. Better Enforcement

At the present time, pesticides are largely regulated through import control of poisonous substances. The Poisonous Articles Act is administered by three separate ministries. Disposal of toxic substances and allowable residues in food are regulated through standards developed by the National Environment Board. In addition, the Ministry of Industries administers the Factory Act of 1969 which, among other statutes, includes regulations for occupational safety and the working environment. It appears obvious that enforcement of most of these laws is lax, and that this is due to shortage of inspectors and enforcement personnel, and to the complexities of three ministries enforcing the same law.

We recommend the amendment of the pesticide laws to strengthen provisions for quality control, labeling, environmental and health monitoring. Regulations exist for the destruction of used pesticide containers, but the enforcement arm of the Thai Government must be strengthened so that periodic inspections of commercial, government and farm facilities be conducted for improper handling of pesticides.

4. Pesticide Waste Sites Due to Accidental Fires and Spills

There exist at least two pesticide waste sites as a result of accidental fires. We recommend certain remedial on-site actions for rehabilitating the latest site of a former pesticide store. These technologies are briefly discussed in Section II, and further information can be obtained from USEPA, Cincinnati, Ohio. We further recommend that Thailand participate in a regional training course which is being planned by USAID-Fiji. This course will deal mostly with chemical fire prevention and fighting, and the clean-up of pesticide spills. We further recommend that in the interim, Thailand formulate a plan for handling emergencies like pesticide fires and spills. We also recommend that the appropriate Thai Government Laboratory develop a more comprehensive monitoring program to analyze pesticide residues in environmental samples.

5. Pesticide Container Cash Deposit

A practice which should be discontinued is the reuse of old pesticide containers. Because of the economic value of 200-liter metal drums, it appears unlikely that this practice can be discouraged. However, glass and plastic containers should not be reused especially as food containers. One method which might be considered an effective incentive is the imposition of a relatively large cash deposit for each container at the distributors level and a refund of the deposit upon return of the used container.

VI. FUTURE STUDIES IN THAILAND

1. Detailed guidelines must be drafted for the *in situ* or off-site disposal of pesticides, e.g. burial, chemical decontamination, removal of soil, etc.

2. Criteria for evaluation and setting of priorities are needed for ranking toxic waste sites dump. These criteria must conform to internationally adopted standards.

3. Detailed guidelines are needed for the development of monitoring plans for toxic waste sites to determine if groundwater contamination may be anticipated due to leaching.

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APPENDIX 1

TRIP TO MALAYSIA

APPENDIX 1 (TRIP TO MALAYSIA)

I.C.I AGRICULTURE (Malaysia), Wisma Sime Darby, Jalan Raja Laut, 50350 Kuala Lumpur; tel: 291-9366.

Mr. Iain A. Brown, Manager, Agrochemicals Business Area

Andrew Yap Swee Heng, Public Relations

Khalid Izharbin Dato Mahmood, Marketing Manager

The Malaysian pesticides market is estimated to be about US$ 100 million, with herbicides occupying 75-80% of the market, and the remainder belonging to insecticides and fungicides.

THE PARAQUAT PROBLEM

Paraquat is ICI's major pesticide product in Malaysia. Although safe to use when labelled directions are followed, there have been problems in Malaysia and elsewhere because paraquat appears to be a favored tool to commit suicide, especially among the Indian population. The LD 50 of paraquat is 150 mg/kg. To counter the suicide problem, ICI's paraquat now contains an odiferous agent and emetic. Their present product Gramoxone is dyed green and is no longer dark brown which was known colloquially as "black coffee." The liquid formulation contains 20% (w/v) of the active ingredient, and the final spray solution is a 1:40 dilution (0.5%).

First-aid treatment for paraquat poisoning by ingestion is Fuller's Earth. ICI provides a medical kit containing Fuller's Earth free of charge to doctors, clinics, hospitals and plantations in Malaysia. ICI believes strongly in "product stewardship."

ICI is very much concerned that pesticides be used safely in Malaysia. Therefore, they are involved with several safety programs. In the area of protective clothing, ICI has experimented with a protective garment of rubber which fits over the head of the applicator and especially protects his back from being splashed with paraquat from a leaking backpack sprayer. However, the rubber material makes it unsuitable for hot climates. The ideal material has not been found for rountine use among spray applicators in tropical zones.

Another safety training program involves the use of public media. Radio broadcasts are aired each morning, starting with a cockcrow and followed by a pesticide safety message. A video taped training program, as well as educational and humorous

posters, all of which emphasize the safety aspects of using Gramoxone, have been produced mainly for dealers. The Shell Company has also conducted an active safety campaign (Tan Bokhooy, Manager; tel: 254-3011).

Regarding reuse of containers, the 200 liter drums used for shipping Gramozone to dealers are washed after use, punctured, crushed and then sent to the steel mill as scrap. ICI is thinking about building a commercial incinerator as a separate venture.

Other persons knowledgeable of the Malaysian pesticide market are:

Dr. Sogkingai, Peladang Kimia Petaling; tel: 756-1844.

Mr. Teocheng Hai, Assistant Director of Research, HMPB Research Station (palm oil and rubber); tel: 825-7598.

Malaysia Plant Protection Society (MAPPS)

Dr. N. N. Sabapathy, Doctor of Occupational Health, Dunlop Plantation.

DEPARTMENT OF AGRICULTURE, Crop Protection Branch, Jalan Gallagher, Kuala Lumpur, 01-02 Malaysia; tel: 03-298-3877.

Dr. A. Balasubramaniam ("Dr. Bala"), Secretary of the Pesticides Board

Mr. Zam Abdul Karim, Pesticide Registration

Mr. S. Ramasamy, Bioefficacy Evaluation

Ms. Nursiah Mohammad Tajol Aros, Toxicologist

For Southeast Asia, Malaysia has an exemplary regulatory structure for the control of pesticides. Dr. Bala provided us with a draft copy of rules on the licensing of dealers and applicators. The new legislation will amend the 1974 law to provide rules for highly toxic pesticides, and it specifically names the following 3 compounds: monocrotophos, paraquat, and calcium cyanide (all Schedule 2, Poisons). The other part of the legislation deals with the licensing of pesticide dealers.

We asked Dr. Balla and his staff if the disposal of large quantities of obsolete pesticides was a problem in Malaysia. To the best of his knowledge, he did not think Malaysia has a problem of this sort, mainly because the distribution of pesticides is handled by the private sector, which can forecast pesticide requirements fairly accurately. Hence , it would be unlikely to find large amounts of abandoned pesticides.

GZT, DEUTSCHE GESELLSCHAFT FUR TECHNISCHE ZUSAMMENARBEIT
(German Organization for Technical Cooperation), Jalan Gallagher, Kuala Lumpur, 01-02 Malaysia; tel: 03-983-077.

Mr. Wolfgang Schimpf, Chemical Engineer, GTZ Pesticide Project

Mr. Schimpf discussed the disposal of several tons of diverse pesticide products which had been stored by the Department of Agriculture as a result of companies submitting samples of products as a requirement for registration. A commercial cement kiln in Malaysia capable of achieving temperatures ranging from 1200-1400 degrees c was utilized by diluting the pesticide products with kerosene and feeding the dilute stock together with the normal kerosene fuel into the kiln during cement production. The only precaution in this process is the possible contamination of cement with higher than allowable concentrations of chlorine.

APPENDIX 2

SITE VISITS

APPENDIX 2 (SITE VISITS)

Map of Site Visits

I. Formulators and Repackaging Plants

1. Small Pack
2. The Unico Company
3. Drum Recycling Plant
4. Chia Tai Company
5. VIVA Chemicals and Pesticides Company
6. Sharp Formulators
7. The Shell Company of Thailand
8. Maharerk Limited Partnership

II. Dealers

1. Dealer No.1, Chai Kaset Company
2. Dealer No.2

III. Farms

1. Farm No.1
2. Farm No.2
3. Farm No.3
4. Farm No.4

IV. Private and Municipal Garbage Dumps

1. Waste Site No.1
2. Bangkok Municipal Dump

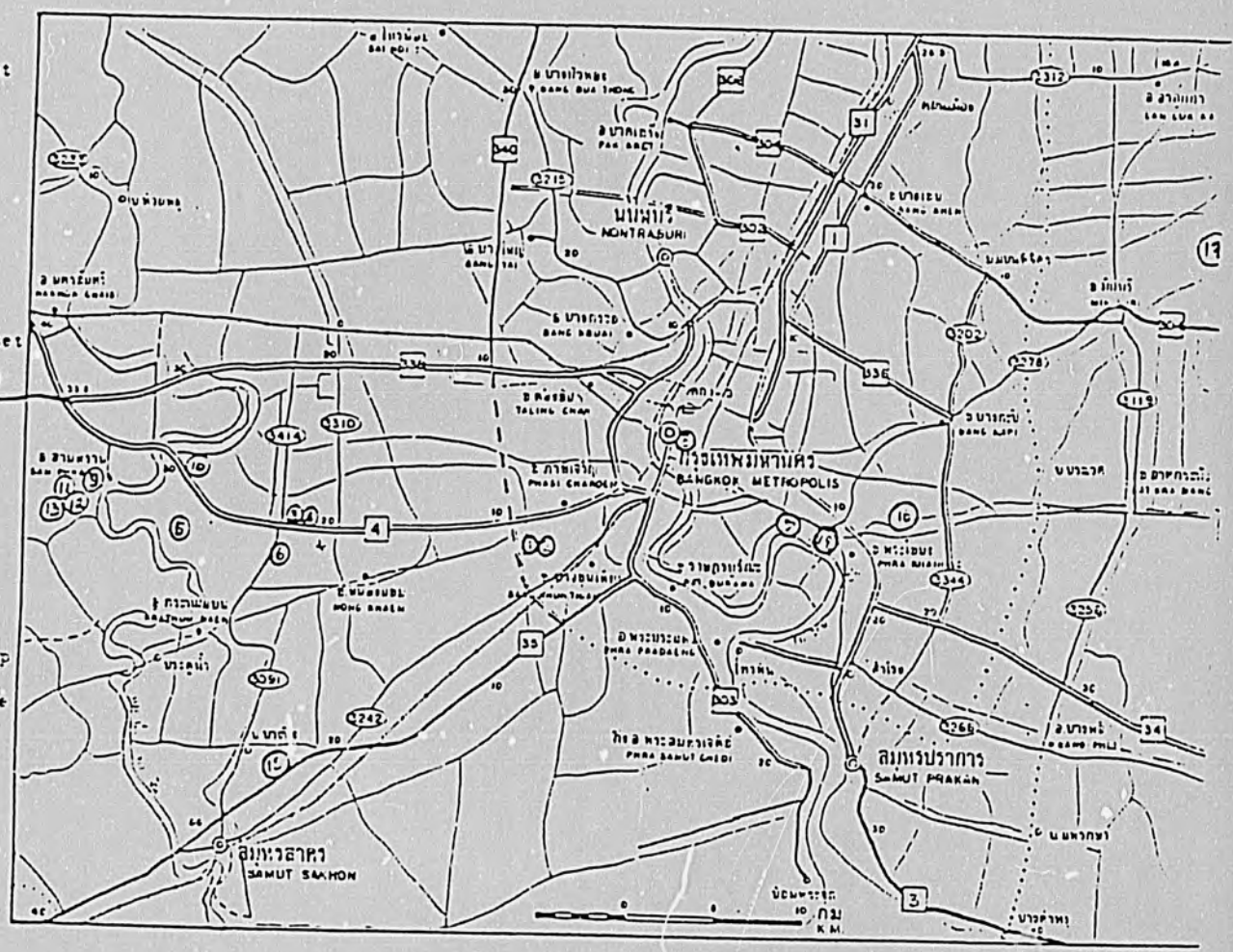
V. Site of Pesticide Fire in Nong Jok District

VI. Port of Bangkok

VII. Department of Agricultural Extension (DOAE)

Map of Site Visits

1. Small Pack
2. The Unico Co.
3. Drum Recycling Plant
4. Chia Tai Company
5. Viva Chemicals
6. Sharp Formulators
7. The Shell Co.
8. Manarerk Limited
9. Dealer No.1, Chai Kaset
10. Dealer No.2
11. Farm No.1
12. Farm No.2
13. Farm No.3
14. Farm No.4
15. Waste Site No.1
16. Bangkok Municipal Dump
17. Site of Pesticide Fire
18. Port of Bangkok



I. FORMULATORS AND REPACKAGING PLANTS

1. SMALL PACK , Ltd.

Plant : Sukapiban 1, Bangkae, Pasicharoen, Bangkok; tel: (02)413-1524.
Main office: 431 Banmoh Road, Pakklongtalad, Bangkok; tel: 223-3535-9.

Mr. Vitoon Sultornsanee, General Manager

Liquid formulations repacked at this plant include the following main products:

methyl parathion
mevinphos (Phosdrin)
monocrotophos (Azodrin)
dimethoate
malathion
paraquat
Supracide (methidathion)
Dicofol
Tetradifon (Tedion)
Brodifacoum (ICI rodenticide)

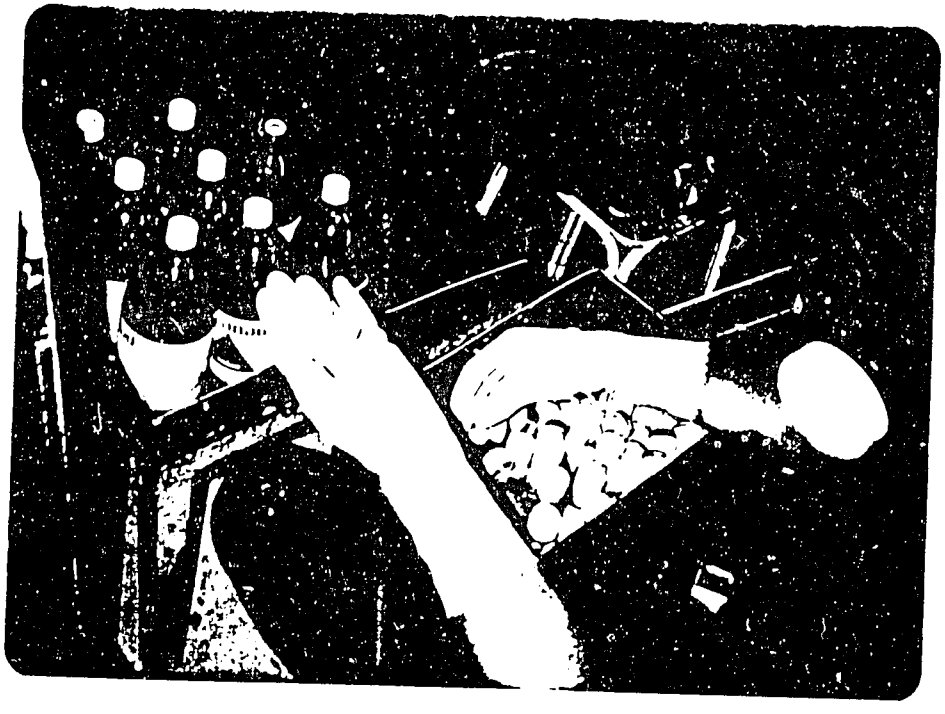
The company's annual pesticide production is 200 tons of liquid formulations, 150 tons of paraquat, and 60 tons of rodenticides.

Formulated materials are shipped to them in 200-L drums. Formulations are repackaged into small containers (glass and aluminum) of the following sizes: 100 ml; 500 ml; and 1,000 ml. There are no measuring devices included in any of the packages. The company has no independent quality control program and depends entirely on obtaining good quality products from reputable multinational companies. Storage of filled containers and raw material drums appeared satisfactory. The bottling operation (organophosphate product) appeared staged because the gloves worn by the filling crew seemed to be brand new (see photo). They have a gaseous effluent scrubber with NaOH which is supposed to reduce odors, but it was not working.

They have an underground concrete tank without a bottom liner for wastewater. Sodium hydroxide is added. A water sample was taken for future pesticide residue analysis to measure the efficiency of this waste water treatment (see Appendix 4).

According to the manager, there are no waste pesticide products even though some products may have been banned in the past for agricultural use (e.g. dieldrin). Under existing laws, the Thai Government allows stocks to be used up.

SMALL PACK



Note cleanliness of gloves.

Cancellation is controlled by not issuing import licenses for cancelled products. As was discovered during a later visit to Shell, dieldrin is still permitted to be used as a structural pesticide control agent (termite control).

Small Pack sells its products directly to about 300 dealers who cater to the fruit and vegetable market. They employ 5 salesmen who are graduates from Kasetsart (agricultural) University. The company has plans to wash workers' clothes on site. Currently this task is done by each worker at home.

Employees of Small Pack live right above the packing area of the plant.

2. THE UNICO COMPANY, Ltd., 49/2 Soi Boonmee, Bangkae, Bangkok; tel: 413-0712; 413-0411; 412-1712.

Miss Siwilai Tankun, Warehouse Manager

This is a repackaging plant for liquid and powders including the following main products:

methyl parathion
mevinphos
paraquat
malathion
cypermethrin
methamidophos
monocrotophos

Used drums are sold to drum refurbishers for 60-100 baht (US$ 2.28-3.80). The manager informed us that excess or nonsalvageable products were sent by a local trucker to a mangrove waste site near Samutsakorn. No further details could be obtained.

At an apparent trash site within the plant confines and in the warehouse proper, several questionable practices were observed. Although these practices might be considered deficiencies in the U.S., on the other hand, in Thailand they might be acceptable by reducing excess pesticide stock which would have to be disposed of otherwise. These operations were:

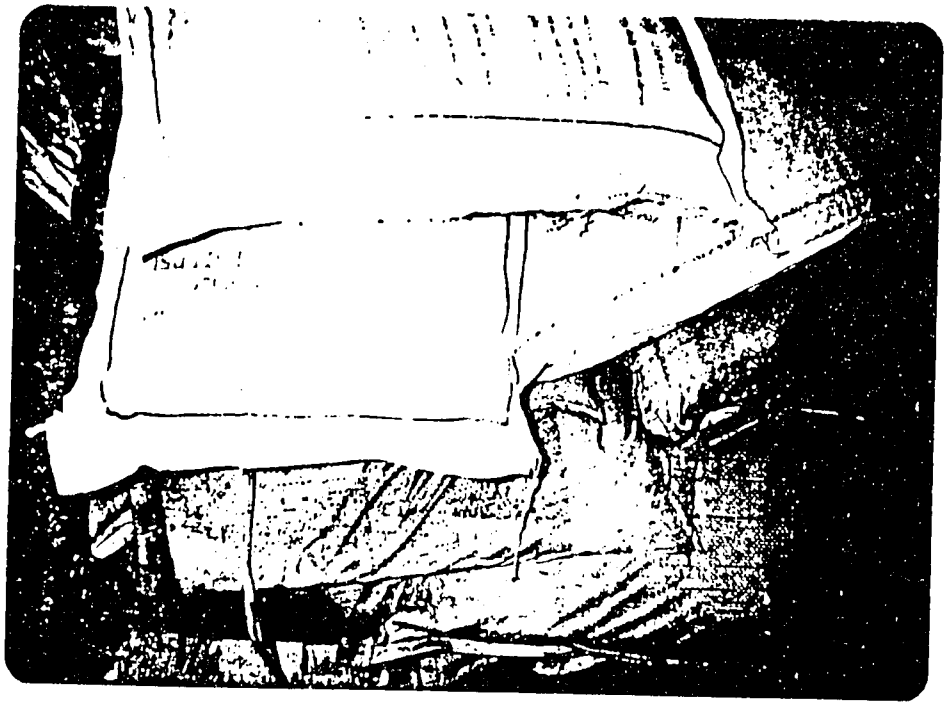
- An old DDT metal container with a malathion label pasted over (see photo).

- Flood-damaged fabric bags containing 2,4-D stored in the warehouse to be repackaged (see photo).

UNICO

Malathion label pasted over an old DDT container.

UNICO



2,4-D bags to be repackaged and sold.

In addition to the above, we observed several dozens of glass containers (1 L) filled with Monitor stored near a trash bin. It was not clear why they were stored there.

The living quarters of some plant workers (including their children) were within the plant. Undoubtedly, this could lead to unnecessary pesticide exposure by workers and their families. There are 20 employees at this facility.

The plant is located next to canals adjoining agricultural areas. A water sample was collected for future pesticide analysis from the water ditch from outside the warehouse (see Appendix 4).

3. DRUM RECYCLING PLANT

This facility processes about 1000 used 200-L or smaller drums a month containing all sorts of chemicals, including pesticides. The drums are cleaned by washing with water, cleaning by rotary machine using metal chains to scour the inside surface, and then repainting the interior and exterior. The manager tells his customers not to use the drums for drinking water, which is not a usual practice anyway in Thailand, as large clay cisterns are commonly used to collect rainwater for drinking. The price for a refurbished drum was about 220 baht (US$ 8.36), representing a gross profit of at least 100%. In Thailand, old drums are very valuable, making the required destruction of old drums improbable (see Shell visit). The photograph shows drums before (background) and after refurbishing (foreground).

This plant only had a gravity oil water treatment system. The manager said that the Bangkok Metropolitan Administration (BMA) removes the waste oil from the plant.

4. CHIA TAI COMPANY, Ltd., km 24-25, Petkasem Road, Omnoi, Samutsakorn; tel: 420-2112.

Dr. Visutr Sucksoong, Manager, Quality Control and Research Division

Mr. Prapoj Wuttigornvipark, Plant Manager, Agricultural Chemicals

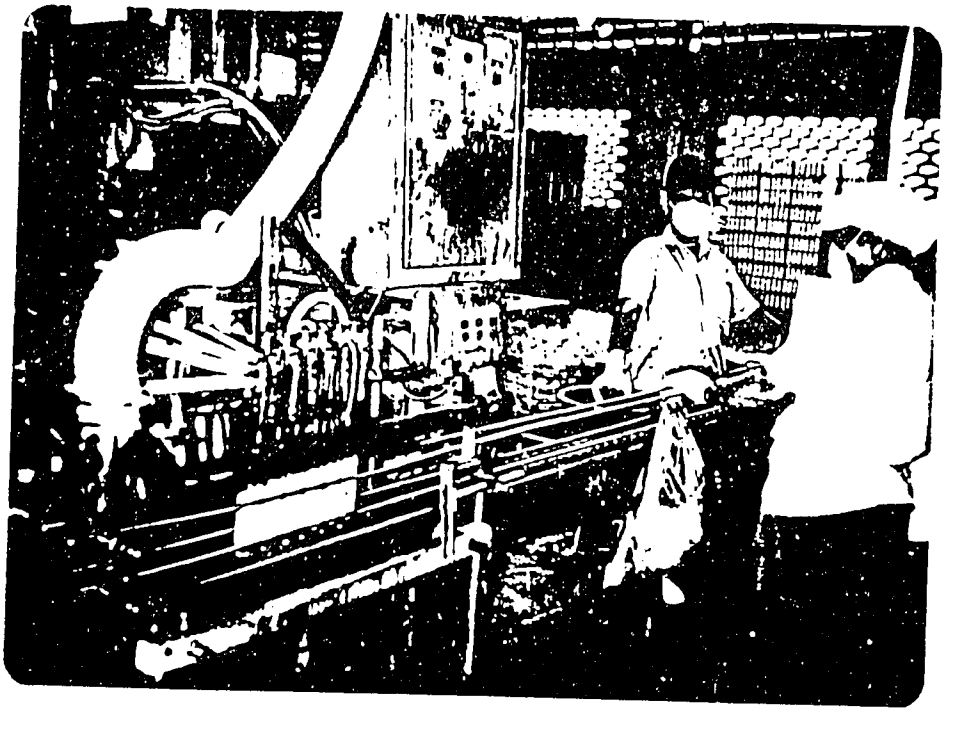
This is a formulation and repackaging plant, one of the larger pesticide facilities in Thailand. The seed company was started 60 years ago and the pesticide business 40 years ago.

Among the chemicals which are processed in this plant are the following:

DRUM RECYCLING PLANT

Drums before (background) and after (foreground) refurbishing

CHIA THAI



Dust masks not suitable for liquid formulations.

monocrotophos
methyl parathion
ethyl parathion (minor product)
dicofol
malathion
BPMC (N-methylcarbamate)
captafol

There is another facility of this company in Kanganaburi (140 km from Bangkok) where paraquat is being manufactured. As we later discovered, BHC was also produced there at one time. The local management at the Samutsakorn facility arranges the transport of any products to be disposed to the Kanganaburi site where they are burnt and buried. We were informed that last year only small quantities of material were disposed. Excess stock from dealers can sometimes be returned to Chai Thai for disposal by the method just described.

The quality control laboratory of the company was very well equipped with the latest chromatographic equipment. The storage of finished products in the warehouse appeared to be good. The storage for technical grade chemicals was in an old warehouse with a corrogated metal roof and poor ventilation, creating excessive heat. The operators in the filling operation for liquid formulations wore protective masks suitable for dust and not vapors (see photo). This appeared to be the main deficiency of the repackaging operation. For the packaging of dusts, on the other hand, this type of mask is perfectly satisfactory (see photo). During our visit, no formulation processes were in operation, but the equipment for liquid and dust formulations seemed to be of a satisfactory design.

There is a scrubber with filter bags in the part of the plant formulating BPMC dust. Waste water from all processes is collected in an earthen pond without lining. A water sample was collected for future pesticide analysis from the first evaporation pond (see Appendix 4).

An incinerator capable of achieving 500 C temperatures was on site but would not be suitable for pesticide incineration due to its limited maximum range of temperatures.

There are 107 employees including workers in the seed operation of this facility. This represents a planned decline in personnel from 300 persons who were working there in 1983, due to a forecast in declining sales of pesticides.

We observed a loaded truck from Chia Tai with boxes of finished products which were improperly stacked and were leaning to one side. This could lead to possible breakage and spillage during transport over bumpy road (see photo).

CHIA TAI

Dust mask is suitable for dust formulations.

CHIA TAI

Improperly stacked pesticides.

5 VIVA CHEMICALS AND PESTICIDES COMPANY, Ltd. 69/123 Charansanitwongse Road 23, Bangkok-Noi, Bangkok 10700; tel: 412-2109.

This facility is a very small repackaging operation and a good example of this type of pesticide business in Thailand. In this facility only four pesticide formulations are repackaged and they are as follows:

parathion (50% EC)
dicofol
azinphos methyl
dimethoate

The total production is four metric tons per year which is handled by 4 employees.

The owner/manager of VIVA told us that her main interest was a fermented fishmeal product suitable as a fertilizer, and that the pesticide repackaging operation was becoming less important for the business.

Finished products were stored in a roofed warehouse and seemed to comply to standard storage and safety requirements (see photo). Since the company produces pesticides only on demand, they have no need for disposing of excess products.

6. SHARP FORMULATORS COMPANY, LTD. No. 119 Moo 9, Tumbon Suan Luang, Krathum Baen, Samutsakorn; tel: 233-5660-1.

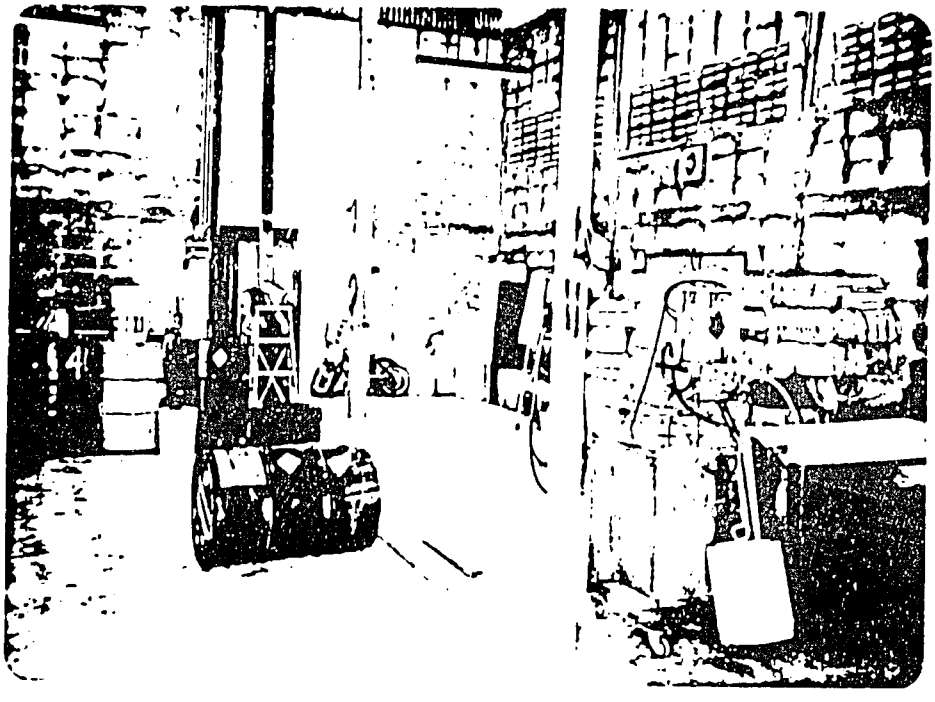
Mrs. Rena Khawtephawan, Director

Mr. Pitoon Khawtephawan, Managing Director, Pitsulin Co., Ltd.

This is one of the larger pesticide formulators in Thailand. They are the exclusive dealers/formulators for Chevron (USA) and FMC (USA) with the exception of Furadan insecticide. They formulate liquid and wettable powders and repackage some products in 1-L bottles. They also package rodenticides in small disposable paper sachets for the Thai Government.

In the formulation process, the plant has an activated carbon filter system to remove odors. Waste water from the processes is collected in the concrete evaporation pond. Excess is pumped to an unlined nearby ditch. A water sample was collected from both the evaporation pond and another from the nearby ditch for pesticide residue analysis (see Appendix 4).

VIVA



Typical small repackaging operation in Thailand.

SHARP

No photos could be taken inside this plant.

The operation of Sharp appears to be modern and up-to-date. The plant was built only five years ago. No pictures were allowed to be taken inside the plant (see photo of the gate outside the facility). The company has a well equipped formulation laboratory with the latest chromatographic equipment. Upon repeated questioning, the directors had little to offer about disposal of excess pesticides in Thailand. For example, if a pesticide company went out of business, the stock would probably be sold at a discount and no need for disposal would arise.

Solid waste products (bags, etc.) are burned at the back of the factory.

7. THE SHELL COMPANY OF THAILAND, Ltd., 10 Soonthornkosa Road, Klong Toey, Bangkok 10110; tel: 249-0531-7.

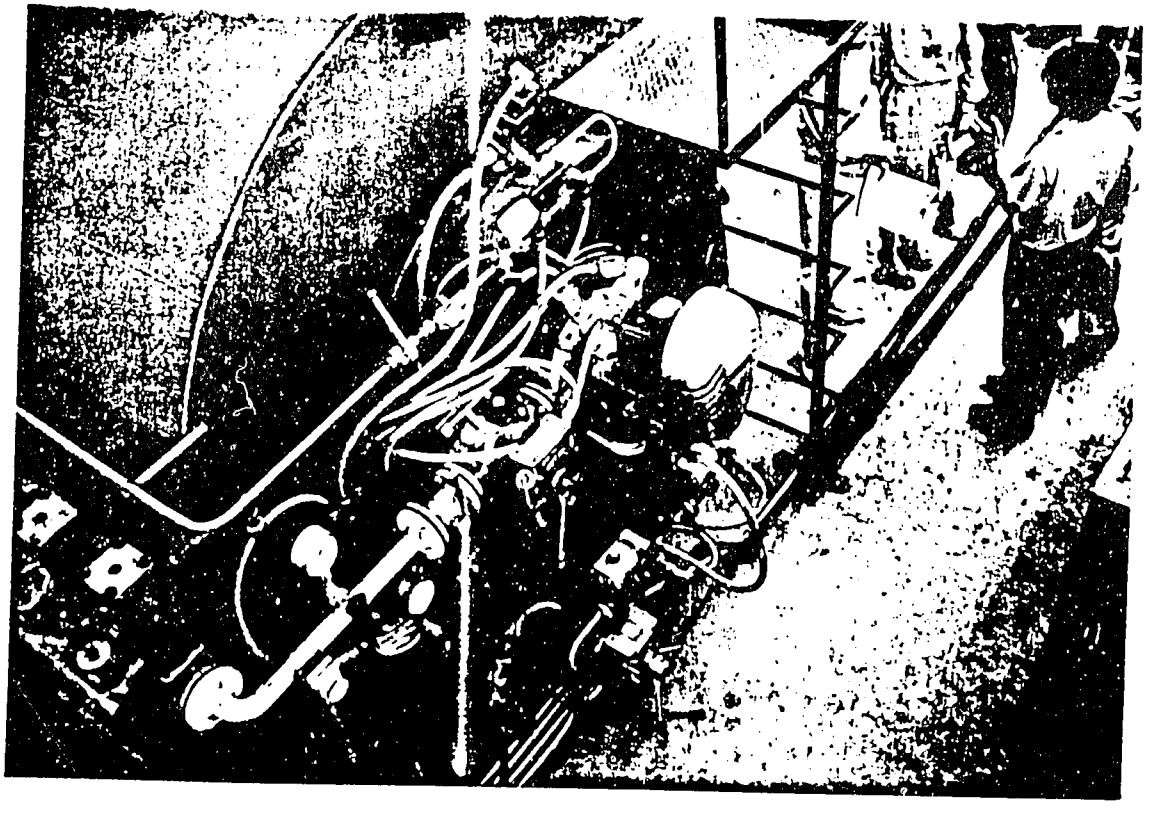
Mr. Thrapsin Punyodyana, Agrochemical Safety and Regulatory Affairs

Mr. Chaovalit Mahatumaratana, Chemicals Plant Manager

The purpose of the visit to the Shell facility was to view the incinerator used for disposing of pesticides. The incinerator is made by Pribico Company of Holland, and the spray nozzle injection system by H. Saacke, Bremen, Germany. The incinerator was installed five years ago at a cost of 6 million baht (approximate US$300,000). It has a batch capacity of 500 kg/batch but can be used on a continuous basis for liquid wastes. The temperatures at the second stage are about 1000 C although the incinerator is designed to reach 1300 C; fuel is liquified LPG. The incinerator is operated after 17:00 so that the occupants of the adjoining office building are not exposed to the excessive heat generated from the incinerator during working hours. The managers told us that upon request by the Government, they would incinerate pesticide wastes, but that an exact description of the materials must be provided. Used plastic Monsanto containers labeled Roundup (glyphosate) were stored near the building housing the incinerator.

Used steel drums which contained technical grade pesticides are disposed by incineration. They are first washed with solvent which is reused in formulation, then washed with aqueous solution of a detergent which is disposed by dumping it into a waste evaporation pond. The drums are then burnt in the incinerator and afterwards crushed and sold to a steel smelter. Only the ashes from the incinerator are buried. Soil samples were taken from the burial site and ash samples were taken from the incinerator, all for analysis of pesticide residues (see Appendix 4).

Shell is still marketing dieldrin and aldrin for structural pesticide use; all agricultural uses for dieldrin and aldrin have been canceled.



Shell-Thailand Incinerator Facilities, Bangkok

8. MAHARERK LIMITED PARTNERSHIP (Arsenic Repackager), 447/1 Mahachai Street, Bangkok; tel: 221-3776.

Mr. Maharerk, Owner/Manager

This is a tiny repackaging operation located in a seemingly residential area of Bangkok. The company is engaged in packaging a 79.4% powder formulation of arsenic trioxide (As203) in 2-kg cans to be used for termite control in households. The raw material is obtained from Red China and Belgium. They package about 200 kg/month. The raw material is imported in 50-kg drums and stored in another facility near Samutsakorn from which they had to move due to zoning restrictions.

Another commercial product of this company is natural pyrethrin imported from Japan. This is sold as a 0.1075% formulation in 1-L containers. It appeared the room had not been used in a long time.

Equipment for weighing and repackaging arsenic was simple, but there was no activity during our visit. There appears to be no concern about disposal of excess pesticides or solvents.

II. DEALERS

1. DEALER NO.1, CHAI KASET CO., Ltd.; tel: 034-311261.

Mr. Chairin Oon-Anant, Owner

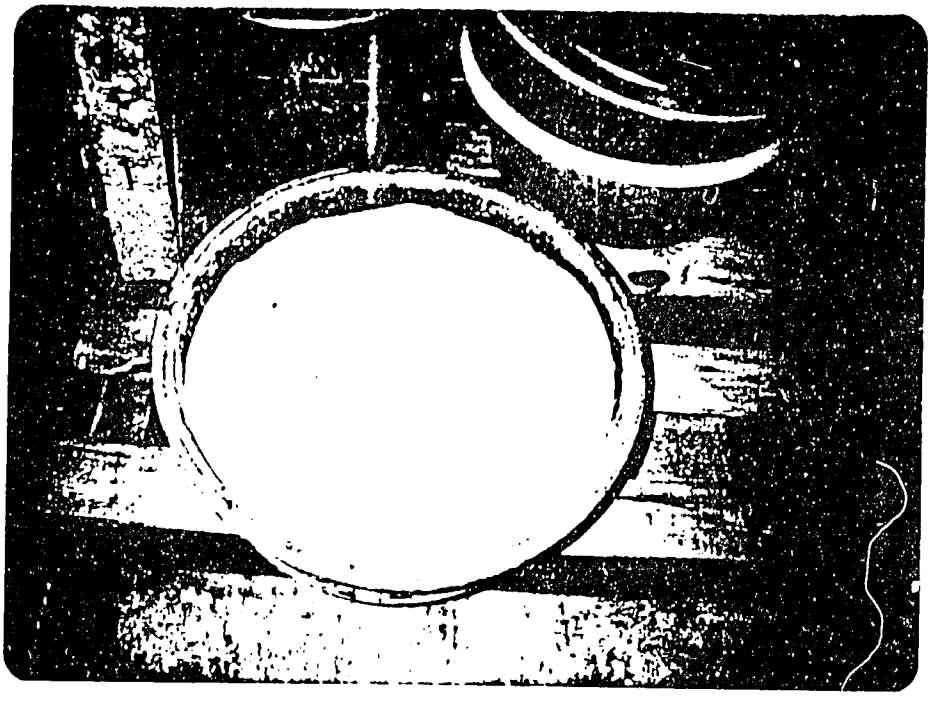
This dealership is located in a small town in a region where fruit and vegetables are grown. Some of the important crops are pomelos, guava, and orchids.

There are no restrictions on the pesticides that farmers can purchase, including Class I (LD 50 less than 50 mg/kg) or restricted (U.S. regulations) pesticides. For example, a farmer was observed to purchase one liter of paraquat use on his citrus crops. (See photo as an example of the ready availability of paraquat). This farmer, however, was familiar with the hazards associated with the improper use of paraquat. Another farmer was seen purchasing a container of methyl parathion. A third farmer purchased a face mask to be used during the application of liquid formulations of pesticides. He did not want to purchase a facial respirator because it would be too hot for the Thai climate. This farmer was asked if he used gloves as a protection during pesticide spraying; he responded that he did not because "Thais are brave."

The dealer told us that if he had pesticides on the shelf which he could no longer sell, he would bury them on a piece of land which he owns. The dealer was quite knowledgeable about pesticides because he used to work for Bayer. The dealer also showed us several glass containers which had leaked some or all of the contents.

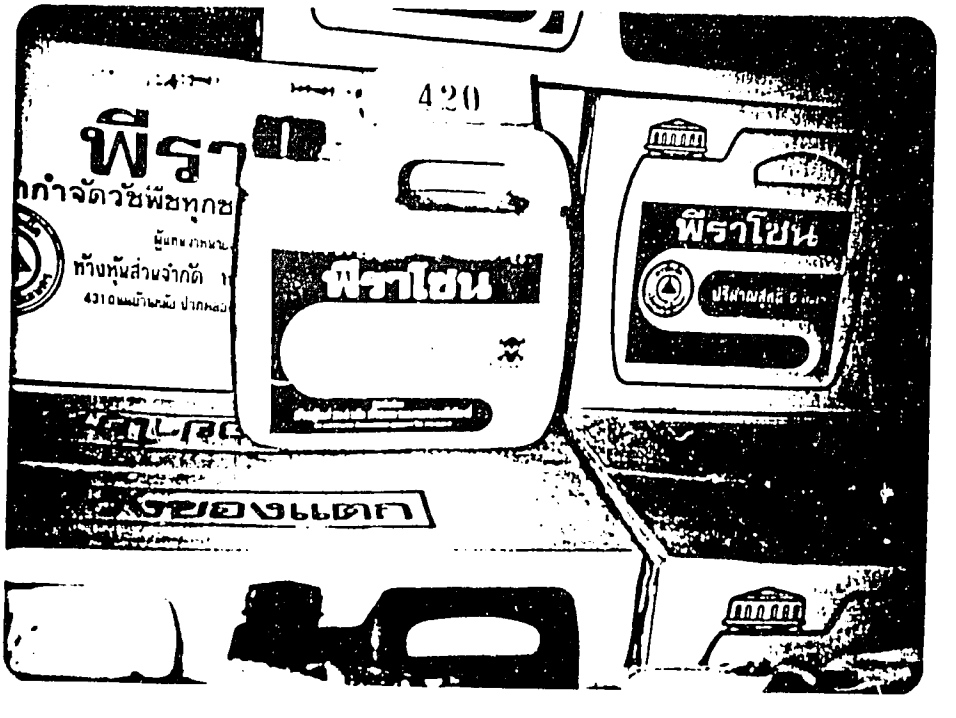
The dealer prefers to purchase his pesticides from smaller companies. Based on experience, he knows which ones have adequate quality control. The reasons for his preference are larger profit margin and better credit conditions.

A technical advance for proper container disposal is the water-soluble package. However, according to this dealer, the Thai farmer does not like these packets because their size is not appropriate (usually too big).



Arsenic trioxide mixing site.

DEALER 1

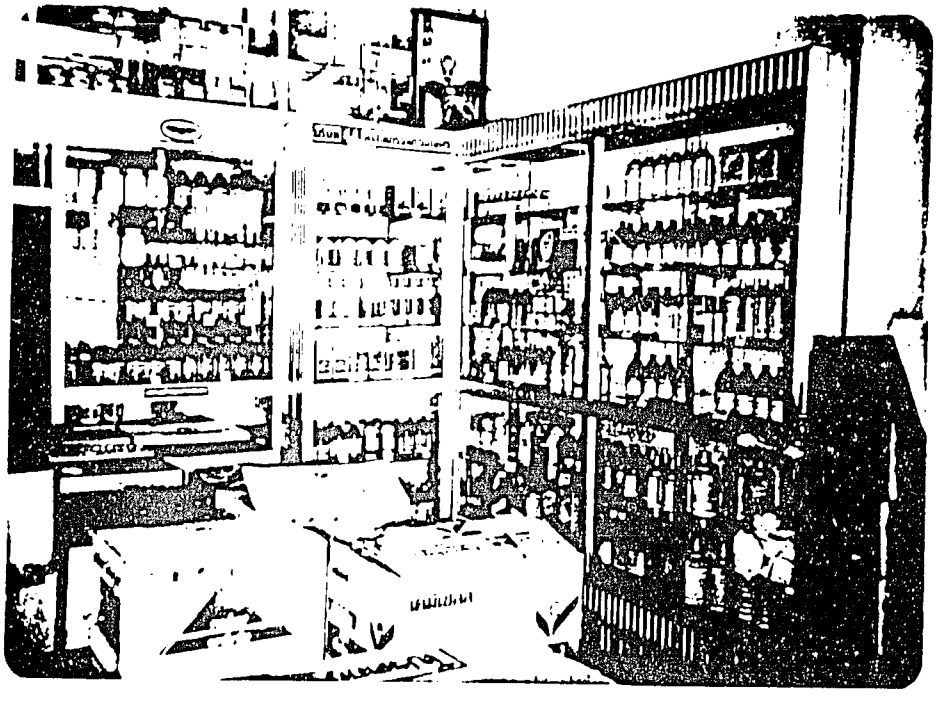


Paraquat can be sold to anyone (420 baht = $ 16).

2. DEALER NO.2

The store of this dealer is located on the main highway and is next to his brother's pharmacy. The pesticide store almost resembled a pharmacy (see photo) with glass display cases for his merchandise. This dealer did not have any excess or obsolete stock which could not be sold. Thus, he had no disposal problems. All pesticides including parathion were readily available to any customer. This dealer has an educational background in the biological sciences and has worked previously for a multinational pesticide company in Thailand. Based on this experience, it is reasonable to assume that this dealer could advise his farm customers on the efficacy and safety requirements for using pesticides.

DEALER NO. 2



Pesticide store resembles a pharmacy.

FARM NO. 1

Disorder in farmer's pesticide storage shed.

III. FARMS

1. FARM NO.1

This farm was mainly engaged in raising orchids for the local and export markets. Between 30-50 thousand bahts per month of pesticides (US$1200-2000) were used on this farm alone. The pesticides were applied by fogging. The storage shed which was under lock and key was in complete disorder and contained sacks and glass containers of pesticide products (see photo). There appeared to be no inventory of the contents of the storage shed. Outside the shed we observed an open case of 1-L bottles of monocrotophos.

2. FARM NO.2

This family-run farm was growing guavas. Even this small farmer uses a relatively large amount of pesticides (US$ 114-380 per month). This is a year-around cost in this part of the world because crops are grown twelve months of the year.

From the photo it may be seen that the pesticide storage on this farm is within the living area of his house, which consists of one big room for all activities of man and pets (many dogs).

3. FARM NO.3

The agriculture prevalent in the central region is one in which the crop (fruit trees) is planted on dikes interspersed by water canals built for irrigation and/or flood control. We observed the spraying operation of two farmers with the spray rig in a boat and the nozzle being directed by two applicators on the dike underneath the guava trees. The photos clearly demonstrate this application technique and the potential source of water pollution from the spray drift. The spray cocktail consisted of a mixture of methyl parathion, dimethoate, and an unidentified fungicide. Another observation was that all of the guava fruits were individually wrapped with a clear plastic bag protecting the ripening fruit from insect attack (IPM). In spite of this protection, the trees are still sprayed on a weekly schedule, bugs or no bugs.

4. FARM NO.4

This is a large and what is considered a model farm owned and managed by an exceptional farmer who is experimenting with new pest control techniques, both chemical and biological. The main crops are citrus, with some pomelos. An interesting approach which this farmer has successfully used to reduce his pesticide requirement by 30% is the use of light traps (see photo) with a "black light" to attract white moths, a significant pest for this crop, and drawing them into a detergent solution where they drown.

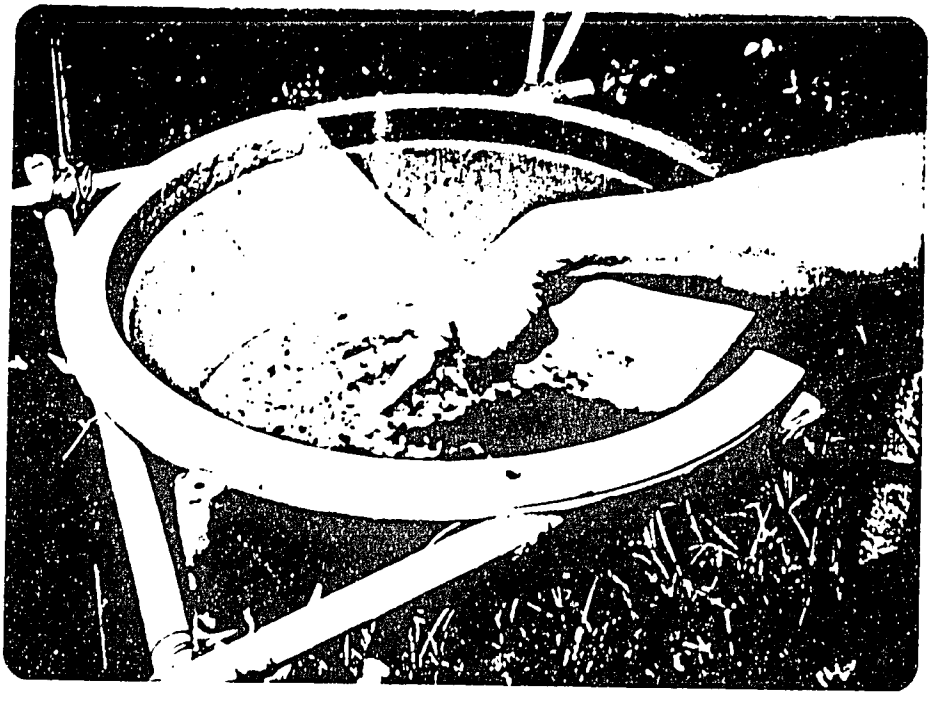
FARM NO. 2

Pesticide storage within living area

FARM NO. 3

Spraying coctail of methyl parathion, dimethoate and fungicide on guava trees. Note: fruit covered with plastic bag to prevent fruit fly damage.

FARM NO. 4



Use of light trap to catch moths to reduce use of pesticides.

WASTE SITE NO. 1 - SAMUTSAKORN

Pots from fireworks (foreground), mangrove (background).

IV. PRIVATE AND MUNICIPAL GARBAGE DUMPS

1. WASTE SITE NO.1 - SAMUTSAKORN

As alluded to by the manager of the Unico Company, the pesticide waste products from the company's repackaging plant at Bangkae were hauled off to a mangrove dump site near Samutsakorn. After visiting the Sanitation Department at Samutsakorn, we were able to locate a private dump at the edge of a mangrove roughly fitting the description which we had been given. We saw no evidence of disposal of organic chemicals as judged from the lack of chemical odor, discarded packaging materials, and other traces which might have suggested that dumping of pesticides and other chemical waste had taken place at this site. It is possible, of course, that chemical waste products have been buried at this site so that any obvious trace of such chemicals would be hidden.

We interviewed several local persons about the dumping of chemicals, but they were not able to give any clues if chemicals and solvents had ever been dumped at this site or at other locations in the vicinity.

The waste which was found at this site consisted of miscellaneous vegetable and household trash, and clay pots remaining from fire works (see photo).

We concluded, therefore, that the mangrove dump which we had located did not seem to have been used for chemical dumping or that the wastes were hidden so well that they could not be located during such a brief inspection.

2. WASTE SITE NO.2 - BANGKOK MUNICIPAL DUMP

Dr. Woravit Lebnark, Director, Environmental Health Division, Bangkok Municipal Authority

We made a field trip to Onnut, the major one of the three municipal waste dumps of the city of Bangkok located off Sukhumvit Road. We walked around the site and observed the municipal dump trucks unloading garbage. Quite a number of independent scavengers and their staff were searching through the trash for valuables and other recoverable items (see photo). Although there does not appear to be a specific site set aside for hazardous wastes, we did not see any empty pesticide containers nor did we discern a chemical smell. Dr. Lebnark and the staff at the dump told us that they did not think that any chemical dumping is taking place or has taken place at this site. Our own observations seem to confirm this claim.

WASTE SITE NO. 2 BANGKOK MUNICIPAL DUMP

Scavengers at work removing bottles, cans, etc.

PESTICIDE FIRE, NONG JOK DISTRICT

Ashes, broken bottles scattered over fire site.

V. PESTICIDE FIRE IN THE NONGJOK DISTRICT

VACHARAPANICH, 64-66-67, 3rd Sub District, Tambon Kratumsai, Nong Jok District, Bangkok.

Mr. Vitaya Vachararpapanukorn, Owner

On the 12th of April, 1986, several commercial and residential buildings burnt to the ground, among them a retail pesticide store. The owner of the shop was interviewed by us on July 11, 1986, and we inspected the site where the pesticide store had stood. According to a written report by the Department of Agriculture, Chief of Poisoneous Substance Section, dated 11 June 1986, the pesticides had been stored in the middle building of three, measuring 4 x 9 meters. According to this report, the owner reported that 2.8 tons of formulated pesticides had been stored in this building at the time of the fire and were made up of the following products:

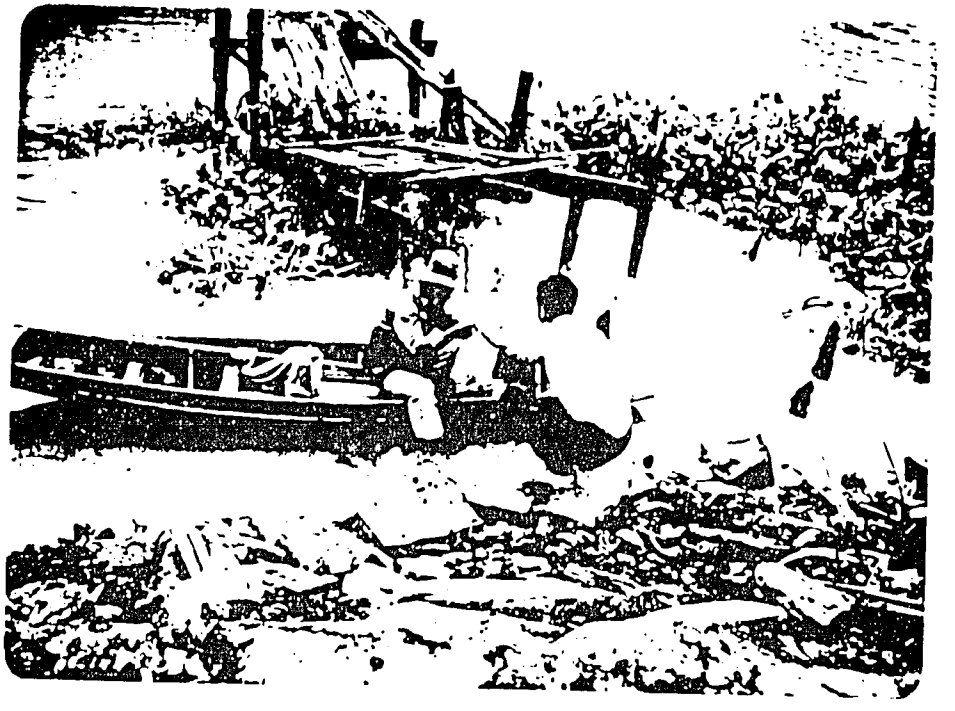
Chemical	Quantity	Concentration
Methyl parathion	60 liters	50% EC
Monocrotophos	30 liters	55% WSC
	60 kilograms	55% WSC
Methomyl	60 liters	90% WD
	6 kilograms	90% WD
Endosulfan + BPMC	1050 kg	2.5% + 2% G
Isazophos	450 kg	5% G
2,4,-D	900 kg	80% WD
Paraquat	60 kg	27% AS
Pretilachlor	192 kg	30% EC
Propanil	60 kg	25% EC

The burnt down buildings had stood near the confluence of the Saensab and Lumpatu Canals about 5 meters from the Saensab Canal.

When we arrived at the site, the stench from pesticides was still very strong. Ashes, broken bottles and burnt out metal containers were scattered over the site (see photo).

We observed a man fishing in the canal directly adjacent to the site. We purchased (see photo) four specimen of the genus Puntius gonionotus, fam. Cyprinidae, commonly known as silver carp. Samples of soil, ash and water (see photo) were taken and together with the fish samples will be analyzed for pesticide residues at the laboratory of the Division of Toxic Substances in the Department of Agriculture.

PESTICIDE FIRE NONGJOK DISTRICT



We collected fish samples from man fishing in canal adjacent to fire site.

NEB team collecting a water sample.

VI. PORT OF BANGKOK

PORT OF BANGKOK - DANGEROUS CARGOES STORAGE WAREHOUSE

Mr. Prasong Limpawattana, Chief of Stevedoring Control Section
Mr. Pruthigrai Kraipipadh, Technical Specialist
Mr. Preecha Puthipreechpong, Division of Poisonous Material, Department of Agriculture (stationed at port).

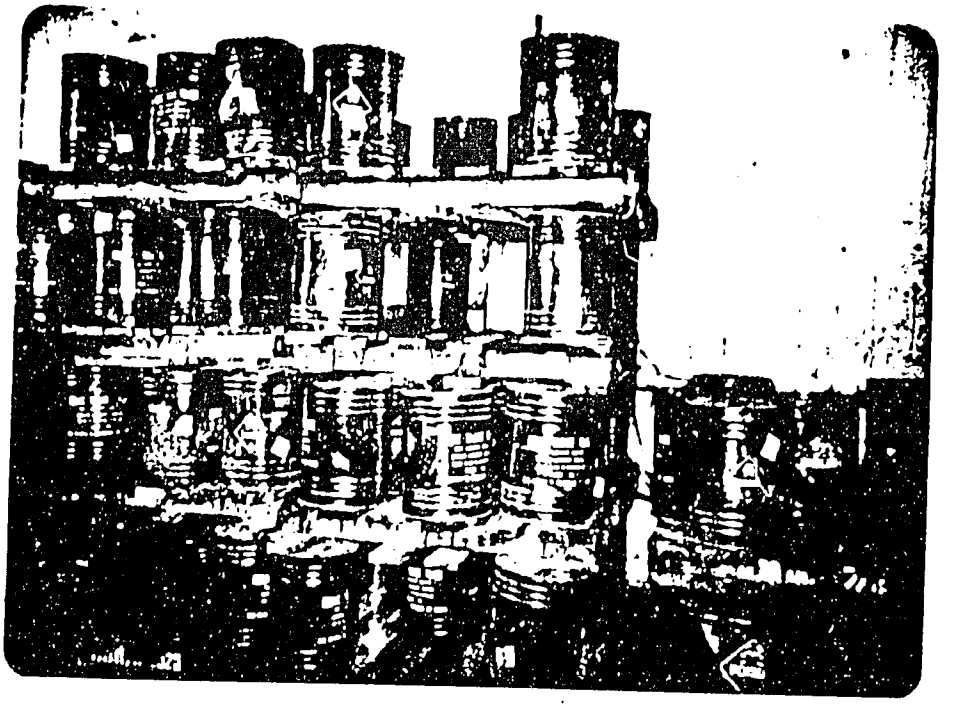
Pesticides are considered IMO (International Maritime Organization) categories 3 and 6 of "Dangerous Cargoes" and stored in special warehouses (Warehouses 4 and 5). During our site visit, we noticed a large number of used metal drums from China containing methyl parathion and dimethoate. The drums were stored outside in the sun and showed a considerable degree of corrosion. The pesticides stored inside the warehouses in metal and plastic containers were neatly stacked, and the fact that no chemical odors could be discerned, indicated that no leakage was occurring. A large number of sacks containing 50% captan, originating in Israel (Makhtishim Co.) were stored at least twenty-high. Although one sack had split open, the inside contained another plastic container so that no chemicals had spilled.

We were informed that most cargoes leave the port within 24 hours; after that time the consignee is charged a relatively small demurrage fee (US$1.00/day/ton), which might encourage the consignee to leave the cargo at the port rather than storing it in his own warehouse.

The only pesticide stocks that we observed that appeared to have been stored in a warehouse for a long time were over 25 drums of arsenic trioxide (see photo). According to port officials, this consignment has been there for five months. Other than this consignment of arsenic trioxide, there appear to be no serious problems of cargoes which are not picked up and would be creating a potential disposal problem. Provisions have been made for cleaning up pesticide spills with water. The wastewater, however, drains into a nearby ditch.

There is an automated alert system for smoke and fire releasing CO_2. There is no set procedure for disposing of shipments without a consignee. This is the responsibility of Customs.

PORT OF BANGKOK



These drums of arsenic trioxide from China have been stored in the warehouse at the port at least five months.

VII. AGRICULTURAL EXTENTION, CENTRAL WAREHOUSE FOR PESTICIDES

MINISTRY OF AGRICULTURE AND COOPERATIVES, Department of Agriculture (DOA) and Department of Agricultural Extension (DOAE), Bangkhen, Bangkok 10900.

Mr. Patanan Sangkatawat, Chief, Pesticide Regulatory Section, DOA

Mr. Pol Supater, Acting Director, DOAE

Dr. Jarupong Boon-Long, Chief, Toxic and Hazardous Substances Section, NEB (served as interpreter); tel: 270-7180, ext. 131.

Mr. Udon Dechmani, Director of Plant Protection Service Division, DOAE; (He was not present at the meeting but we met him socially several days later); tel: 514-0741.

Agricultural Extension is divided into 8 sections (Biological Control, Pesticides, Entomology, Vertebrates, Weed Control, Locust, Inspection, etc.).

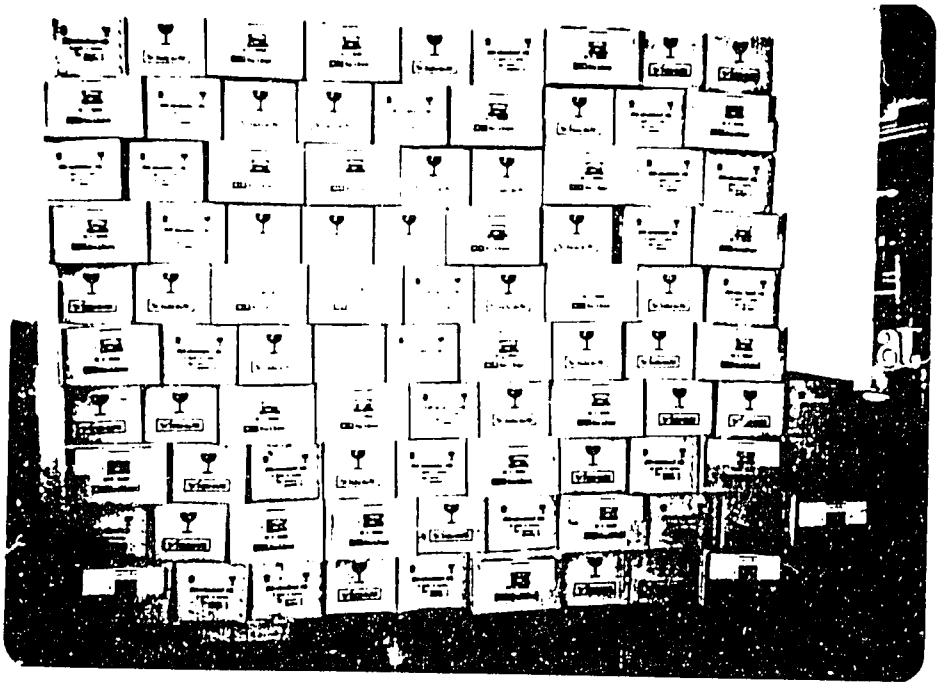
The activities of the Pesticide Section among other duties, are to distribute about 150 million baht (approximately US $ 6 million) of pesticides to farmers for the control of locust and other pests recognized to be a problem in the growing season.

There is one central warehouse for receiving and storing pesticides before shipping them to 31 local warehouses in the various districts of the country. Mr. Supater requested that we advise him on storage design. He thinks that there may be a problem of obsolete stock in the local warehouses, but he is not sure where these stocks are stored and what products are involved.

The central warehouse for pesticides of the DOAE is located in a rural area near Bangkok. Another warehouse which was originally located near the Department of Agricultural Extension (DOAE) on the Kasetsart University campus was damaged in a fire four years ago. The fire, as it turned out after extensive efforts to get the information, lasted only twenty minutes before the fire department was able to put it out. About 25% (or 1.8 million baht = US$ 70,000) of the total warehouse stock was destroyed. The undestroyed stock was distributed to the 31 local warehouses. The residues remaining from the fire were buried in a one meter deep pit that was 5 meters by 5 meters. The warehouse manager estimated that the residue filled the pit about half way (or one half meter). The rest of the pit was then filled with soil. DOAE has requested USAID assistance in obtaining information on how this waste site should be properly monitored.

The new warehouse is built of cement with a concrete floor. The finished goods of formulated pesticides are neatly stored on wooden pallets and arranged according to class of pesticides, e.g. insecticides, rodenticides, etc. It was noted that a water supply for fire does not exist. However, it appeared that the turnover of goods into and out of the warehouse was rapid. We noticed a crew loading a truck with ferilizers and one of the workers was not wearing shoes. We did not notice any obvious stock of obsolete pesticides (see photo).

DOAE WAREHOUSE



This is an example of the neatly stacked rows of pesticides in the DOAE warehouse.

APPENDIX 3

SUMMARY OF STUDY OBJECTIVES

APPENDIX 3

STUDY: Pesticide Storage and Disposal: Is It a Problem in Thailand?

DURATION: Preparatory Phase, June 23 - July 4
Site Visit Phase, July 7 - July 18

OBJECTIVES: The objectives of this pilot study are:

-- to identify potential pesticide storage and disposal hazard sites

-- to prioritize these sites by internationally recognized standards

-- to identify local resource personnel and agencies who could deal with cleaning up these sites

-- to provide appropriate technology recommendations for cleaning up or containing hazardous sites identified

BACKGROUND: In many developing countries, especially in Africa, large quantities of old, abandoned pesticide stocks can be found. These were often purchased by governments or through donor agencies and never used. This problem has also been found in Asia. Please refer to the attached case studies from Pakistan and Indonesia. In most cases, these abandoned stocks and their containers have been poorly stored and have degraded to such an extent that pesticides are leaking on the ground. For the residents living near such a site, the fumes can potentially be harmful when inhaled. And, with leaking drums, there is the very real threat of pesticides getting into the soil and eventually reaching the watertable, thereby contaminating the groundwater.

SPONSOR: The USAID Office of Foreign Disaster Assistance (OFDA) in Washington deals with disasters, both before and after they happen. OFDA has become sensitized to the hazards associated with pesticides which have been improperly disposed. Therefore, as part of its disaster prevention activities, OFDA offered a small amount of money to certain USAID Missions in Africa and Asia so that a pilot study could be done to determine if the storage and disposal of old pesticide stocks was a problem. USAID Thailand responded positively to the offer by OFDA.

DETAILS: OFDA has agreed to fund a multi-person team for a pilot study to determine if there is a problem with the storage and disposal of pesticides in Thailand. The team will consist of three people from the National Environment Board (NEB), one person from the Thailand Development Research Institute (TDRI), one from the Ministry of Agriculture, Janice Jensen (a pesticide consultant based in Bangkok) and Dr. Gunter Zweig, a pesticide disposal expert from the USA.

The Thailand team members will spend the first two weeks (working only part-time on this project) identifying sites around the country that may have potential storage and disposal problems. They will then make arrangements for the team to officially visit these sites. The last two weeks (July 7 - 18) will be spent making these site visits. Dr. Zweig will arrive on July 5. A specific scope of work is being prepared for each Thailand team member.

CONTACT: Mrs. Janice Jensen, Pesticide Consultant, USAID, 37 Soi Somprasong 3, Bangkok 10400; tel: 251-8191 (work), 392-0783 (home).

INDONESIA

In 1984, in Banjarmasin, South Kalimantan, Indonesia, a thief broke into a warehouse and died from the effects of fumes from wood preservative pesticides that had been stored there for more than five years. Following the publicity surrounding the "discovery" of the pesticides, the local government transported approximately seven tons of the material to an isolated site for burial. They acted before the national environmental ministry could complete its consultations with domestic and foreign technical experts regarding proper disposal. There are lingering fears that the disposal site may become the source of leakage of the materials into local groundwater supplies.

PAKISTAN

According to the official estimate, there is an approximate 5,000 tons of abandoned pesticides in the province of Punjab in Pakistan. This estimate is based upon the official records of the Department of Agriculture when the importation and distribution of pesticides was turned over to the private sector in 1977.

According to a study on the pesticide situation existing in the 1970-1978 period in Punjab, supply exceeded consumption by 3 to 6 times (Staring, 1984). Disposal of the now abandoned pesticide stocks is urgently needed to prevent a major contamination of the environment.

APPENDIX 4

INFORMATION ON ENVIRONMENTAL SAMPLES COLLECTED AND RESULTS OF PESTICIDE RESIDUE ANALYSIS

APPENDIX 4

INFORMATION ON ENVIRONMENTAL SAMPLES COLLECTED
*
AND RESULTS OF PESTICIDE RESIDUE ANALYSIS

(7-16 July, 1986)

Sample No.	Type of Sample	Name of Formulators and Repacking Plant	Sample site	Date of Collection	Results
1	Water	Fire pesticide dealer shop	canal near shop	11 July 86	Dimethoate 0.36 PPM Carbofuran < 0.01 PPM
2	Fish	"	"	"	Heptachlor & epoxide 0.007 PPM Dieldrin 0.033 PPM Endrin 0.003 PPM Endosulfan 0.001 PPM Total-DDT 0.062 PPM
3	Fish	"	"	"	Aldrin 0.03 PPM Dieldrin 0.05 PPM Endrin 0.006 PPM Total-DDT 0.034 PPM
4	Fish	"	"	"	Aldrin 0.018 PPM Heptachlor & epoxide 0.007 PPM BHC 0.002 PPM Dieldrin 0.049 PPM Endrin 0.005 PPM Total-DDT 0.029 PPM
5	Fish	"	"	"	Heptachlor & epoxide <0.001 PPM BHC 0.002 PPM Dieldrin 0.001 PPM Endrin 0.006 PPM Total-DDT 0.017 PPM
6-1	Soil	"	1m. edge of property	"	Dimethoate 0.176 PPM Methyl parathion 0.278 PPM Malathion 0.041 PPM Profenophos 0.121 PPM
6-2	Soil	"	"	"	Mevinphos 1.208 PPM Dimethoate 0.183 PPM Methyl parathion 0.609 PPM Malathion 0.144 PPM Parathion 0.024 PPM Profenophos 0.365 PPM

* Samples collected by NEE team members

** Samples analyzed by the Agricultural Toxic Substances Division, Department of Agriculture, Bangkhen, Bangkok 10900, Thailand.

Sample No.	Type of Sample	Name of Formulators and Repacking Plant	Sample site	Date of Collection	Results
7	Soil&Coal		2m. edge of property		Dimethoate 0.264 PPm Methyl parathion 1.75 PPm Malathion 0.102 PPm Parathion 0.021 PPm Fenitrothion 0.027 PPm Profenophos 0.246 PPm
8	Water	Small Pack	chemical pond	7 July 86	Dieldrin 0.83 PPb Endrin 0.66 PPb Total-DDT 2.41 PPb Dimethoate 0.1 PPb Diazinon 0.01 PPb Methyl parathion 0.34 PPb Carbofuran 0.01 PPb
9	Water	The Unico Co.,Ltd	ditch around plant	7 July 86	Total-DDT 69.37 PPb Dichlorvos 138.26 PPb Mevinphos 12.31 PPb Dimethoate 3.42 PPm Methyl parathion 197.14 PPb Parathion 4.82 PPb Methomyl 160 PPb Carbofuran 0.11 PPb
10	Water	Chai Tai Company	evaporation pond	8 July 86	Total-DDT 28.47 PPb Dichlorvos 33.63 PPb Mevinphos 5.68 PPb Methyl parathion 2.82 PPb Carbofuran 0.06 PPb Paraquat <1.00 PPb
11	Water	Sharp Formulator	1st chemical NaOH pond	9 July 86	Aldrin 50.99 PPb Total-DDT 1.71 PPm Dichlorvos 3.05 PPm Mevinphos 5.17 PPm Dimethoate 70.46 PPm Methyl parathion 587.72 PPm Malathion 1.67 PPm Methomyl 100.00 PPm Carbofuran 1.40 PPm Paraquat <1.0 PPb

Sample No.	Type of Sample	Name of Formulators and Repacking Plant	Sample site	Date of Collection	Results
12	Water	Shell Formulator	2nd evaporation pond		Dieldrin 6.48 PPb Parathion 3.81 PPb Dichlorvos 23.45 PPb Mevinphos 112.31 PPb Dimethoate 1.94 PPb Methyl parathion 64.75 PPb Methomyl 1.20 PPb Carbofuran 120 PPb Paraquat <1.0 PPb
13	Water	Sandtond Repacking Plant	ditch around farm	10 July 86	Heptachlor 1.53 PPb Dieldrin 2.15 PPb Endrin 0.12 PPb Total-DDT 0.71 PPb Dimethoate 11.9 PPb Methyl parathion 0.05 PPb
14	Ash	The Shell Co.Ltd.	incinerator	18 July 86	-
15	Soil	"	Dumping site (new) 1m. from new site		Dimethoate 0.016 PPm
16	Soil	"	Dumping site (old) 1m. from old site		-

APPENDIX 5

APPENDIX 5

GOVERNMENT, INDUSTRY, AND UNIVERSITY REPRESENTATIVES CONTACTED

BANGKOK METROPOLITAN ADMINISTRATION (BMA), Environmental Health Division, Department of Health, 173 Thanon Ban Dinso, Bangkok 10200; tel: 222-6846.

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Dr. Visutr Sucksoong, Manager, Quality Control and Research

Mr. Prapoj Wuttigornvipark, Manager, Agricultural Chemicals

GIFAP, Avenue Hamoir 12, 1180 Bruxelles, Belgium, tel; (02) 374-59-82.

Mr. G. A. Willis, Chairman, GIFAP Residue Committee

ICI ASIATIC (AGRICULTURE) CO, LTD., 53-55 Oriental Avenue, G.P.O. Box 1510, Bangkok 10500; tel: 236-0220.

Dr. Apichai Daorai, Manager for Product Safety and Registration

Japan International Cooperation Agency (JICA), 1674/1 New Petchburi Road, Bangkok 10310; tel: 251-1655.

Mr. S. Suzuki, Deputy Director

KASETSART UNIVERSITY, Bangkhen, Bangkok 10900; tel: 579-0588.

Dr. Prasan Yingchol, Dean of Faculty of Agriculture

Dr. Banpot Napompeth, Director, National Biological Control Research Center

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Mr. Maharerk, Owner/Manager

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Mr. Paitoon Pisuthsin, Agricultural Technical Officier

Mr. Sukhum Wong-Ek, Agricultural Technical Officier

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Mr. Udom Dechmani, Director of Plant Protection Service Division

Mr. Pol Supater

Mr. Thongchai, Supervisor of Pesticide Warehouse

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Dr. Sakprayoon Deema, Inspector-General

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Mrs. Yuwaree Thithuan

Mr. Teerasakedi Pongpanakrai

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Ms. Usanee Uyasatian, Chief, Solid Waste Section

Ms. Sukanya Buchalermkit, Toxic Substances Section

Ms. Rachanee Kaojarern, Toxic Substances Section

NATIONAL INSTITUTE FOR THE IMPROVEMENT OF WORKING CONDITIONS AND ENVIRONMENT (NICE), Thaling Chan, Bangkok 10170; tel: 424-8001/4.

Dr. Peter Hasle, Associate Expert on Labor Inspection

PORT AUTHORITY OF THAILAND, Soonthornkosa Road, Klong Toey, Phrakhanong, Bangkok 10110; tel: 249-0399, 249-0362 ext. 2445.

Mr. Opas Karasanandana, Director, Warehouse Division

Mr. Pruthigrai Kraipipadh, Technical Specialist

Mr. Preecha Puthipreechpong, Division of Poisonous Material (DOA), (stationed at port)

Mr. Prasong Lumpawattana, Chief of Stevedoring Control Section

SHARP FORMULATORS CO., LTD., NO. 199 Moo 9, Tumbon Suan Luang, Krathum Baen, Samutsakorn; tel: 233-5660-1.

Mrs. Rena Khawtephawan, Director

Mr. Pitoon Khawtephawan, Managing Director, Pitsulin Company

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Mr. Thrapsin Punyodyana, Agrochemical Safety and Regulatory Affairs

Mr. Chaovalit Mahatumaratana, Chemicals Plant Manager

SMALL PACK COMPANY, Sukapibani, Bangkae, Pasicharoen, Bangkok; tel: (02) 413-1524.

Mr. Vitoon Sultornsanee, General Manager

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Dr. Yothin Unkulvasapaul, Research Fellow

Dr. Dhira Phantumvanit, Associate Director, Natural Resources and Environment Programme

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Mr. Chalat Sripicharn, Former President of TPA

THE UNICO COMPANY, 49/2 Soi Boonmee, Bangkae, Bangkok; tel: 413-0712, 413-0411, 412-0712.

Miss Siwilai Tankun, Warehouse Manager

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT (USAID), 37 Soi Somprasong 3, Bangkok 10400; tel: 252-8191.

Mr. John Eriksson, Mission Director

Mr. Will Knowland, Environmental Advisor

Mrs. Janice Jensen, Pesticide Consultant

VIVA CHEMICALS AND PESTICIDES COMPANY, 69/123 Charansanitwongse Road 23, Bangkok-Noi, Bangkok 10700; tel: 412-2109.

USEPA Hazardous Waste Engineering Research Laboratory, Cincinnati, OH 45268. Telephone: (513) 569-7876.

Mr. Douglas Ammon, In Charge of Research in Waste Disposal

Mr. Donald Sanning, Research on Waste Disposal

Mr. Tom Sell, In Charge of training courses on Chemical Fires

APPENDIX 6

THAILAND

APPENDIX 6 - Thailand

Reference : KS0954/004/1532 (translated from Thai)

Date : 11th June 2529 (1986)

Subject : **Disposal of Poisonous Substances Destroyed by a Fire**

To : Director of Agriculture regulatory through Chief of Poisonous Substance Section

From : Sub-section of Poisonous Substances Regulatory Division

On the 6th of June 1986, the Nong Jok district has telephoned this section informing us about a fire that has destroyed 60 commercial and residential buildings on the 12th April 1986, and there was a pesticide dealer among these buildings. The District Officers feared that if the debris from the fire were left unattended or disposed of improperly, there could be a danger to the public, animals or the environment. Therefore, they have requested this section to inspect the site and to recommend disposal methods to them.

On the 9th of June 1986, I went to the site together with Mr. Visanusilp Petcharak (C5 officer) and Mr. Vachara Chumpalee (C4 officer). The District Officers together with two local public health officers also joined in the inspection.

The dealer shop name was Vacharapanich. It was located at No. 64-66-67, 3rd Sub-District, Tambon Kratumsai, Nong Jok District, Bangkok. The name of the owner is Mr. Vitaya Vacharaarpapanukorn. The shop occupied three continuous wooden buildings. The middle building, being 4 meters wide by 9 meters long, was used to stored poisonous substances for sale. The owner informed us that there were about 2.8 tons of poisonous substances at the time of the fire as follows:

No.	Name	Site of Containers	No. of Containers	Total Quantity
1	Methyl Parathion 50% W/EC	1000 cc	5 cases	60 l
2	Monocrotophos(Nuvacron) 55% W.S.C.	500 cc	5 cases	30 l
		1000 cc	5 cases	60 kg
3	Methomyl(Lannate) 90% W.D.	1000 cc	5 cases	60 l
		500 g(powder)	1 case	6 kg
4	Endosulfan + BPMC (Thiocarb) 2.5+2% G	15 kg	60 sacks	1050 kg
5	Isazophos (Miral) 5% G	15 kg	30 sacks	450 kg
6	2, 4-D 80% W.P.	1 kg	40 sacks	900 kg
7	Paraquat(Gramoxone)27.4%	1 gal.	3 cases	60 kg
8	Pretilachlor (Sofit)30% E.C.	1000 cc	16 cases	192 kg
9	Propanil 25% E.C.	1000 cc	5 cases	60 kg
			Total	2880 kg

The buildings were near the confluence of Saensab and Lumpatu Canals about 8 meters away from the Saensab Canal. People in the neighbourhood had complained of bad odour and feared that during the rainy season, the poisonous substances could be washed down the canals which could cause water pollution.

At the site there are powder substances in bags and broken bottles scattered over an area of about 8 by 10 meters, and people have scavengered the site for more than two months.

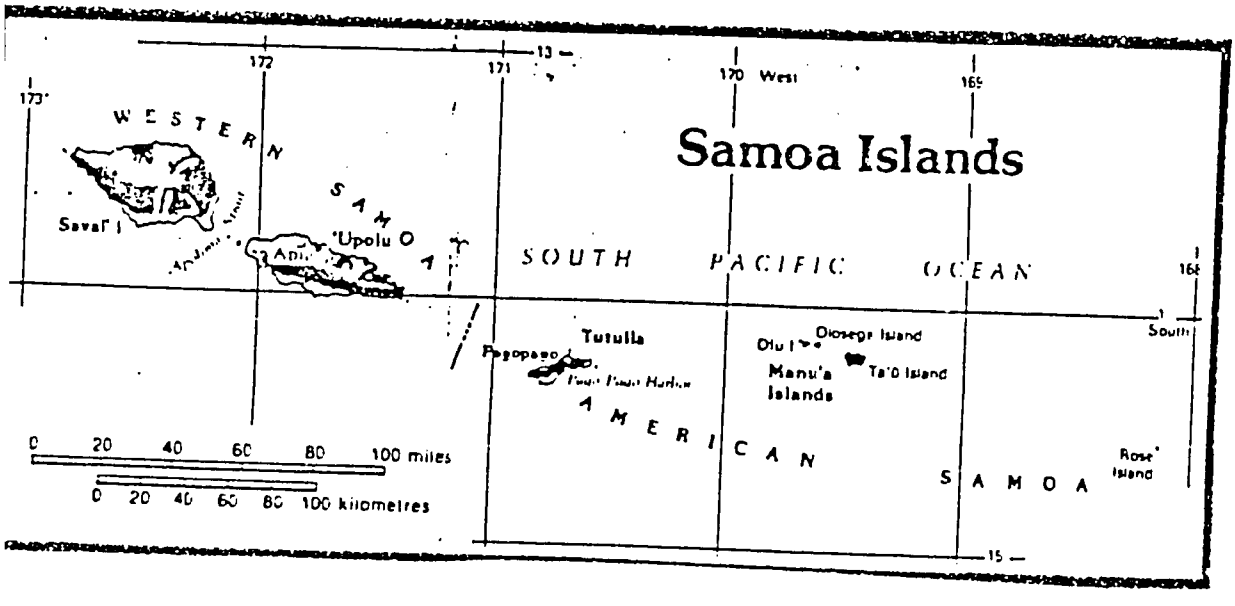
I recommended to the District Officers that they should haul the debris to a burial site that is above water table, has no flooding, and at a reasonably distance away from water sources. The substances should be buried together with NaOH at about 1 meter deep.

The Deputy District Officers informed me that a formal request has already been sent to our section requesting us to send them a written statement, so that the District can secure funds for the disposal.

(Paitoon Pisuthsin)
C5 Agricultural Technical Officer

PART II

WESTERN SAMOA



PART TWO : WESTERN SAMOA

Result of Study

Western Samoa consists mainly of two large islands Upola and Savai'i with a total area of 2,934 sq. km. (1,133 sq. mi.). The capital of Apia is located on Upola which is the more densely populated island; the total population is 160,000 (1983). The country is a parliamentary democracy based on the British pattern. Western Samoa became independent on January 1, 1962 after German and New Zealand rules.

The country is mostly agricultural with the major crops being bananas, coconuts, cocoa, taro and tropical fruits. To raise commercial crops the use of pesticides is mandatory for the control of insect and rodent pests and plant diseases. The use of herbicides, especially paraquat, has become an important economic factor for the larger plantations. The Samoan Government recognizes the importance of the judicious use of pesticides even by small farmers and, therefore, subsidizes the purchase of pesticides for these farms. All pesticides used in W. Samoa are imported as formulated products, and the import and sales of pesticides remain the virtual monopoly of the Government. That this situation is changing is manifested by the fact that several private companies have obtained import licenses for pesticides. According to the books of the Agricultural Store, the total value of pesticide imports for 1985 amounted to WS$ 561,000 (appx. US$ 285,000).

The pesticide business is being conducted by the Agricultural Store located in the center of Apia next to the central market and bus station. The Store is governed by a Board whose chairman is the Minister of Agriculture. In Appendix 5, the organization of the Agricultural Store and the personalities involved are described. Purchases of particular pesticides, mostly from New Zealand, are based on recommendations by the German-Samoan Crop Protection Project and the Agricultural Extension Service. The personnel of the Agricultural Store have been selected on the basis of business acumen and not necessarily their knowledge of pesticide usage.

The Agricultural Store conducts its sales operation from a central location (see photograph) and has a small branch on Savai'i Island. In addition, two mobile stores consisting of 2.5 ton trucks circle both islands on a regular schedule to serve farmers in outlying districts.

There are two main warehouses owned by the Agricultural Store, one located at the Port of Apia which serves as temporary storage of pesticides while the merchandise is in Customs. The other warehouse is located in an industrial park in the village of Vaitele, about 15 km west of Apia on the main road leading to the airport. A small storeroom is kept in the back of the central store.

During the past two years, the two large warehouses have been refurbished by USAID funds to provide improved ventilation and drainage for washings after spillage.

My visit to the Agricultural Store during a one-week stay mostly in Apia have led to the following observations:

The Central Store located on the main street is like most older buildings in Apia, of wooden construction. Some of the liquid pesticide formulations in tin cans with screw cap closures are not provided with an inner vapor-proof seal. The electrical wiring directly above the shelves on which these inflammable pesticides are kept, pose, in my opinion, an explosion - and fire hazard. I observed that at least three new fire extinguishers were standing on the floor in their original wrappings. The managerial staff said that they had not been trained in the use of these fire extinguishers and, therefore, they had not been properly installed and positioned throughout the store.

The small storeroom showed evidence of previous spillage, and the housekeeping was not exemplary. Outside the storeroom a 2% diazinon dust was being weighed out on a scale from an open 25-kg fiber box, and there was evidence for contamination around the scale. Generally, the sales area where pesticide products were displayed on open shelves was neat and odor-free. The only corrective action to be taken in this area is the disposal of the rusty and leaking tin cans of malathion and diazinon (ICI-New Zealand) (see Recommendations). Some of the paper labels had fallen off these cans or were loose.

The agricultural Store was out of paraquat for which there seems to be a large demand. Apparently, a shipment of paraquat was on its way.

I found the pesticide warehouse at the Port of Apia empty during my visit. I understand that this warehouse near the wharves is rarely used for storing pesticide cargoes and only then when the cargo is held up in Customs due to shortage of funds. This warehouse, as was mentioned before, has been upgraded and certainly represents a resource which should be utilized other than for the temporary storage of pesticides.

The central warehouse at Vaitele is a large concrete-block building which is only partially occupied to store fertilizers, pesticides and light agricultural items. On the outside of the

building I saw three unmarked buckets filled with a liquid, which I was told contained Gammexane (BHC or lindane) taken from a leaking container.

A closed room fitted with a ventilating fan of questionable efficiency was used to store liquid pesticide formulations. As is detailed in the Appendix, a number of safety deficiencies were observed, as for example leaking containers, unmarked containers, broken bags, damaged containers, and evidence of past spillage. The entire housekeeping of this storage facility requires vast improvement. There was a strong odor emanating from this area, typical of OP compounds.

I do not believe that Samoa is prepared to handle a pesticide disaster like fire, explosion, or accidental spills. The entire country possesses one antique fire truck and employs 12 fire fighters for all three shifts. A few months ago, the central post office burnt to the ground, and if the Agricultural Store ever caught fire, a serious disaster would ensue (see Recommendations).

The German Samoan Crop Protection Project and one private agricultural consulting firm represent valuable resources on which the Agricultural Store should draw (see Recommendations). I suggested that the overseas supplier of pesticides may be persuaded to dispose of obsolete and outdated pesticides and containers (see Recommendations).

A previous study team from the U.S. (Freed and Krueger 1983) recommended the establishment of a toxic waste disposal site. Based on documents made available to me during my visit, it appears that this project had moved forward but was stopped for unknown reasons at the last moment. Based on my own observations and the recommendations which I will be making, I do not believe that the pesticide disposal problem as it exists in W. Samoa today warrants the establishment of special disposal site. The situation might change if the use of pesticides in Samoa were to expand greatly during the next 5-10 years. This might be the result of private enterprise challenging the Government pesticides monopoly.

During my debriefing by the agricultural specialist and training consultant at AID-Suva, headquarters for W. Samoa AID activities, favorable reaction was elicited for a regional training course on the safe handling of pesticides during transport and storage and emergency measures for spillage, fire and other disasters.

CONCLUSIONS AND RECOMMENDATIONS

1. Did we find any pesticide waste dumps in Western Samoa?

During the tour of pesticide facilities (Appendix 1-Samoa) and discussions held with persons well informed on the pesticide use in W. Samoa, it is very unlikely that we would have found a pesticide waste dump. The only major importer of pesticides is the Government-run Agricultural Store, and the pesticide stocks which are not on display at the Central Store in Apia are stored at the warehouse in Vaitele.

The establishment of a pesticide waste site on WESTEC land east of Nu'u had been proposed previously but did not gain approval by the W. Samoa Government. The total quantities of obsolete and waste pesticide stocks are not large enough at this time to warrant the establishment of a central pesticide waste disposal site. Therefore, our recommendations are for alternate means to dispose of excess and obsolete pesticide stocks (see below).

2. What to do about obsolete and outdated pesticide stocks?

The Vaitele Warehouse presents a potential hazard to human health. As detailed in Appendix 1, there are a number of pesticides which must be disposed of for the following reasons: some containers are leaking; labels have fallen off some of the containers; several open vessels contain unknown pesticides; several large stocks of pesticides are no longer efficaceous. The following recommendations are made to improve the safety conditions at Vaitele and to dispose of pesticide stocks which can no longer be sold:

Appointment of Technical Advisory Committee

The Board of Directors of the Agricultural Store appoint a four to five-member advisory committee composed of a representative of the Store, a board member, a representative from the German-Samoan Crop Protection Project, a representative of the Extension Service, a technical expert from the community or the agrochemical industry, and, if possible, a foreign pesticide expert.

The role of this committee is to advise the Store which specific pesticide stocks they consider as surplus and should, therefore, be disposed of. Secondly, this committee will advise the purchasing agent of Store on the type(s) and quantities of pesticides which should purchased for the coming growing season. For example, the Store was out of stock of paraquat and consequently lost sales.

3. How to dispose of surplus pesticides?

As mentioned above, we recommend against the establishment of a central pesticide waste disposal dump in W. Samoa. The commercial suppliers of pesticides, mostly located in New Zealand and Australia will be requested to receive these surplus pesticides which will be shipped in prescribed safe containers. The suppliers will give detailed instructions how to pack and ship these pesticides to their destination. The ICI representative in W. Samoa has declared his willingness to negotiate with the home office to arrange for receipt and disposal of surplus and outdated pesticides.

4. Requirements for leak-proof containers

We found that some of the ICI-metal cans with malathion and dimethoate had rusted on top and did not contain an inner leak-proof seal. Furthermore, the labels were falling off the containers. In the future, the Store must require that the suppliers of pesticides provide and guarantee leak-proof containers.

5. Improvement of storage conditions at Vaitele and Central Store

It is recommended that the inner storage room at Vaitele be emptied and all pesticides stored temporarily in the warehouse at the Port of Apia. The Vaitele facility must be completely decontaminated by treating the area with lime, caustic, sawdust, activated carbon, and finally a thorough water rinse. Specific instructions will be telexed upon request by the Store. All shelves must be painted with solvent-resistant and rust-proof coating. The ventilation system must be improved so that the air in the room is exchanged at least four times per hour. Since no analytical services appear to be available on the island, as a minimum no chemical odor must be discernable after the storeroom has been stocked again. In the future it may be possible to install an air monitor and alarm system in the facility.

Similar housekeeping chores must be performed at the Apia storeroom It is further recommended that no surplus pesticides be kept at the Central Store except products on the open shelves. The practice of manually weighing out dimethoate powder must cease.

6. Safety Inspection of Pesticide Facilities

It is recommended that the Fire Marshall of W. Samoa or his representative inspect all facilities where sizable quantities of pesticides are kept. Many pesticide formulations contain inflammable solvents. Leaky containers also present a fire hazard. Recommendations by the fire marshall must include corrections of deficiencies in electrical wiring and ventilation.

Secondly, the Store and warehouse personnel must be trained in elementary fire fighting (fire extinguishers) and how to clean up accidental spills (see below for description of training course).

7. Training Course in Chemical Fire Prevention and Fighting and Handling of Chemical Spills

The training officer of AID-SUVA and the Peace Corps administrator in Apia have agreed to underwrite the cost of a training course designed to train personnel in the prevention of chemical fires and spills and the elementary procedures to put out a chemical fire during the early stages. AID-Suva has indicated an interest to broaden the course on a regional basis.

It is recommended that FEMA or USEPA (Cincinnati) be contacted for possible instructor (s). An outline of the proposed topics to be covered in this course are found in Appendix 2.

8. Amendment of Pesticide Legislation

During my visit, I did not have an opportunity to study the present pesticide legislation which is in effect today. One basic tool of any legislation is import control. A provision which can be incorporated into the present law might be a restriction against importing highly toxic pesticides (LD-50 < 50mg/kg), unless no substitutes exist. This has been discussed with a pesticide expert in W. Samoa and was suggested to the Prime Minister. It is recommended that the Advisory Committee (see #2a. above) be involved in drafting legislation along these lines.

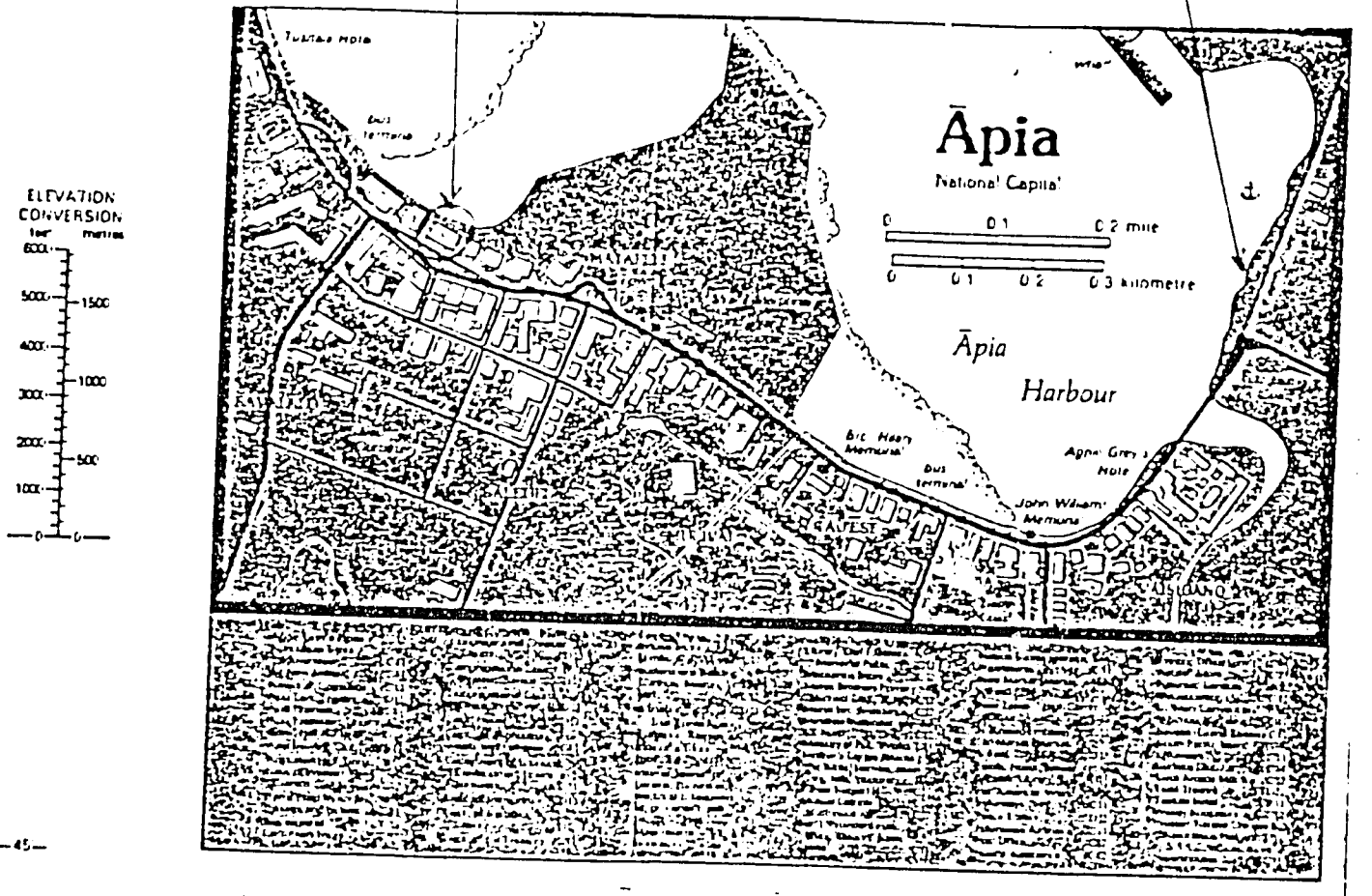
APPENDIX 1

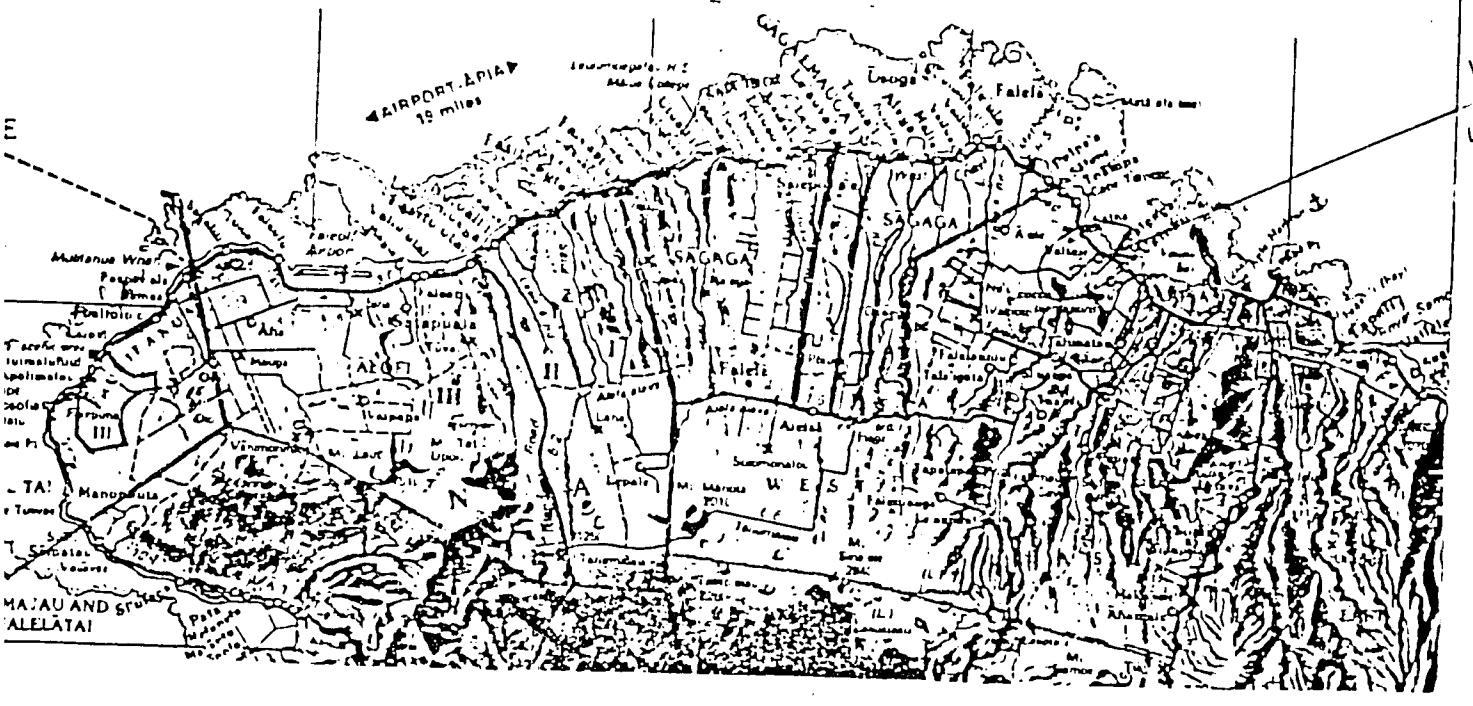
WESTERN SAMOA

MAP

Agricultural Store

Approximate Location of Warehouse of Hort.





APPENDIX 1 - W. SAMOA

WESTERN SAMOA, July 20 July 27, 1986

PEACE CORPS, APIA, WESTERN SAMOA
APCD, PEACE CORPS, PVT. MAILBAG, APIA, WESTERN SAMOA, Tel: 22345

Kevin O'Keefe, Staff Officer (Parks); will be leaving W. Samoa in September).

Garry Patzke, Peace Crops Volunteer (Parks); will be leaving W. Samoa in September).

The presumption by Peace Crops staff and the AID Agric. Officer in Suva (contacted by telephone) was that my mission was to make final arrangement for a training course, originally recommended by V. Freed of Oregon State U. I informed the staff that my mission was to investigate possible pesticide waste sites and the disposal of obsolete pesticide stock in W. Samoa. However, it was agreed that I would try to accomplish two goals during my one-week stay in Apia, to study the pesticide disposal problem in W. Samoa and to make recommendations for the contents of a training course. It was also agreed that at the end of my mission, I was to brief the Agric. Officer of AID, Richard Nishihara ("Noosh") in Suva, Fiji, on my findings in W. Samoa

The PC staff had arranged meetings for me with the Ministry of Transportation, the Fire Marshall, and the Agricultural Store, the last being a government-owned and run entity (see below).

DEPARTMENT OF TRANSPORTATION

MR. POLLARD J. MOORE, Maritime Consultant (Assignment from Commonwealth Secretariat), tel: 23-700

Mr. Moore had prior knowledge of my visit through the Foreign Ministry and had prepared a memo on the type of training course which would be suitable. The emphasis would be on training in the prevention and fighting of chemical fires, especially toxic materials like pesticides and should include lectures and demonstrations on the prevention of fires and clean-up of accidental spills.

Mr. Moore told me about a storage shed in the harbor which had been refurbished with U.S. funds (1983 visit to W.S. by Freed and Krueger) and implemented by Gail Nystrom, former PC volunteer.

The Minister of Transportation owns the land on which the storage shack is built but deeded the building to the Department of Agriculture. The Department of Agriculture has the only key to the building. This seems to be a point of contention between the two ministries. Moore had no information on the goods which are kept in the storage shed.

Moore then referred me to the agents for Warner Pacific Line for information on the arrival of pesticide shipments. Moore had no information what merchandise was kept in the storage shed, and it was used to store anything at all.

WARNER PACIFIC LINE AGENTS, Pvt. Bag, Apia, W. Samoa, tel: 22352

Mr. Toimoana Takataka, Manager

Mr. Takataka stated that ICI-New Zealand was the main supplier of pesticides to W. Samoa. Takataka notified that Ag. Store in advance when a shipment is expected If the Ag. Store truck is not at the port when then cargo is unloaded, the pesticides are stored temporarily in the Western Pacific warehouse.

FIRE DEPARTMENT, W. SAMOA

Aksuao T. Williams, Fire Chief

Mr. Williams, who is an American citizen and once served in the U.S. Navy, is the fire marshall for W. Samoa. His department is directly under the Prime Minister's Office. There are 12 professional fire fighters in the department and one truck for the whole country. Williams' men have not received training in fighting chemical fires, and he wants to have information on the methods used to put out fires for specific classes of chemicals. Mr. Williams suggested the following topics for a proposed training course:

1. Emergency Procedures

2. Type of agents

   water
   CO2
   sand
   foam
   others

3. Protective Clothing

   respirators
   boots
   garments
   gloves, etc.

4. First Aid

5. Fire prevention

6. Accidental Spillage While in Storage and during Transportation

   clean-up of spillage

7. Ammonia Leakage - how to handle it.

8. Demonstration of a simulated chemical fire and how to put it out.

Mr. Williams would like to receive training overseas in the prevention and handling of chemical fires. He also needs a new truck, the present one being at least 13 years old and in need of overhaul. The truck is equipped with 2.5-in. British fittings.

I recommended that the Fire Department inspect the Ag. Store and warehouses (see below). The fire department should also receive an inventory of chemicals, especially the inflammable components, stored in all places of the island.

AGRICULTURAL STORE, Main Street, Apia, next to Central Market.

Tom Meredith, Retail Store Manager

Dr. Asi Faletoese, Chairman of Sub-Committee for Ag. Store; member of the Ag. Store Board of Directors and member of Parliament.

Mr. Fritz Lee, Accountant and 2nd in command.

The organizational chart for the Ag. Store is as follows:

Board of Directors

Chairman: Minister of Agriculture

General Manager
Tavita Moala (presently in Australia)

Ag.Store,Apia	Vaitele Warehouse	Agro.Store,Savaii	Mobile Stores
Tom Meredith	Beni Lefale	Leilua Opapo	Tuli Filipo

The Samoan pesticide law is based on import control since all pesticides are imported. A Sub-Committee of which Dr. Asi is chairman, monitors the law and the Ag. Store. It is not clear what the respective authority of the Board of Directors and the sub-committee is. Probably the subcommittee has only advisory functions.

Inside the Central Agricultural Store

Mobile Pesticide Store in W. Samoa

Central Agricultural Store in Apia

When a pesticide cargo arrives at the Port of Apia, the Ag. Store is notified by the shipping agent. The warehouse at the port is only used for the cargo from Customs has been delayed. The pesticides are then shipped by truck to the Vaitele warehouse (see below) and stored there until needed at the retail store. Meredith claims that he keeps a one-day supply of pesticides at the retail store and a one-month supply at the Savaii store. This statement appeared unlikely by observing the amount of business transacted during the week of my visit.

The shelves of the retail store are kept clean, and the containers do not appear to leak with the exception of one-liter in cans of malathion and diazinon (ICl products) which are rusting on the outside and are not provided with an inner leak-proof seal. The paper labels are also coming off the same metal cans, making it impossible to identify their contents and representing a potential fire and health hazard.

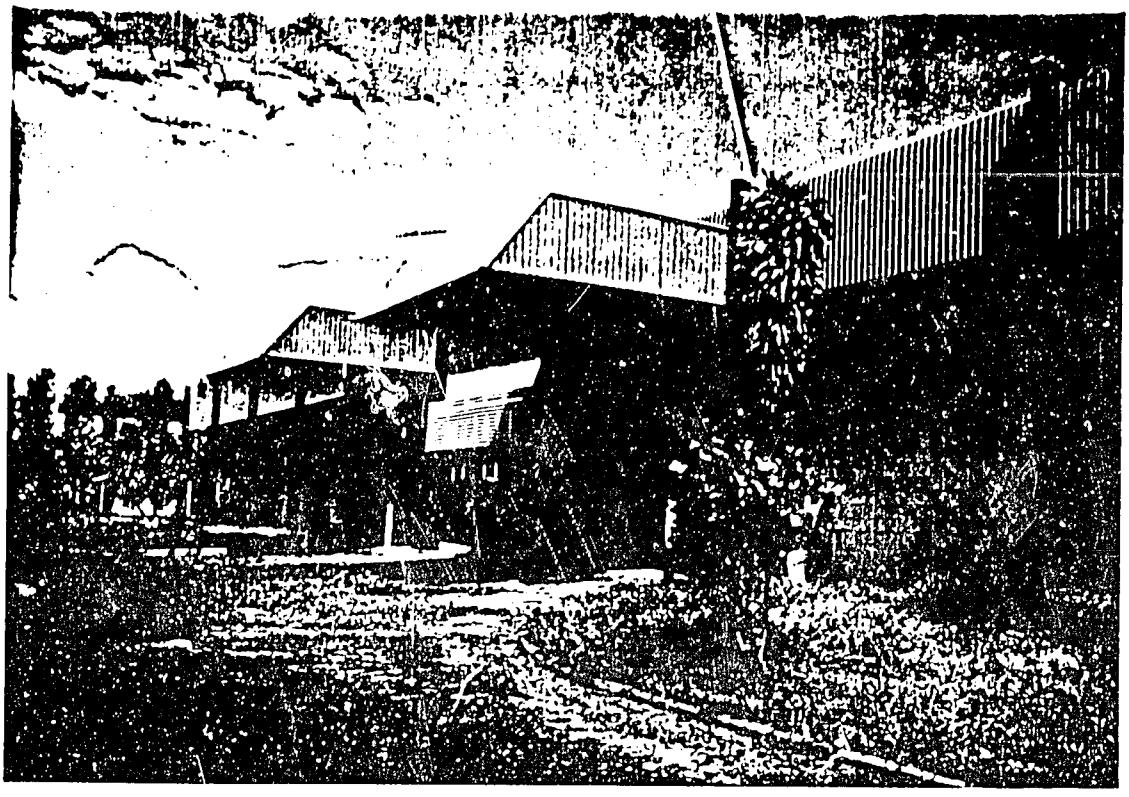
In the back of the retail store is a small store room in which several containers of pesticides are stored. The store room is not well organized and appears to have been contaminated in the past from leaky containers. On the outside of the store room, an open cardboard box containing about 25 kg of 2% diazinon dust (Diazotac Sheep Dust) is kept to manually weigh out and dispense individual sales into plastic or paper bags. Yellow dust, presumably pesticides, contaminated the area.

The store had run out of Gramoxone (paraquat) which is the largest single pesticide sold in W. Samoa. The purchase for pesticides in 1985 totaled WS$ 561,000 (appx. US$ 285,000). Sales of fertilizers for bananas, misting oil, Gramaxone + benlate, and Calixin are subsidized by the government. The Ag. Store has a virtual monopoly on the import and sales of pesticides in W. Samoa. However, this situation might change shortly, because several private enterprises have been granted import licenses for pesticides, including a license for paraquat.

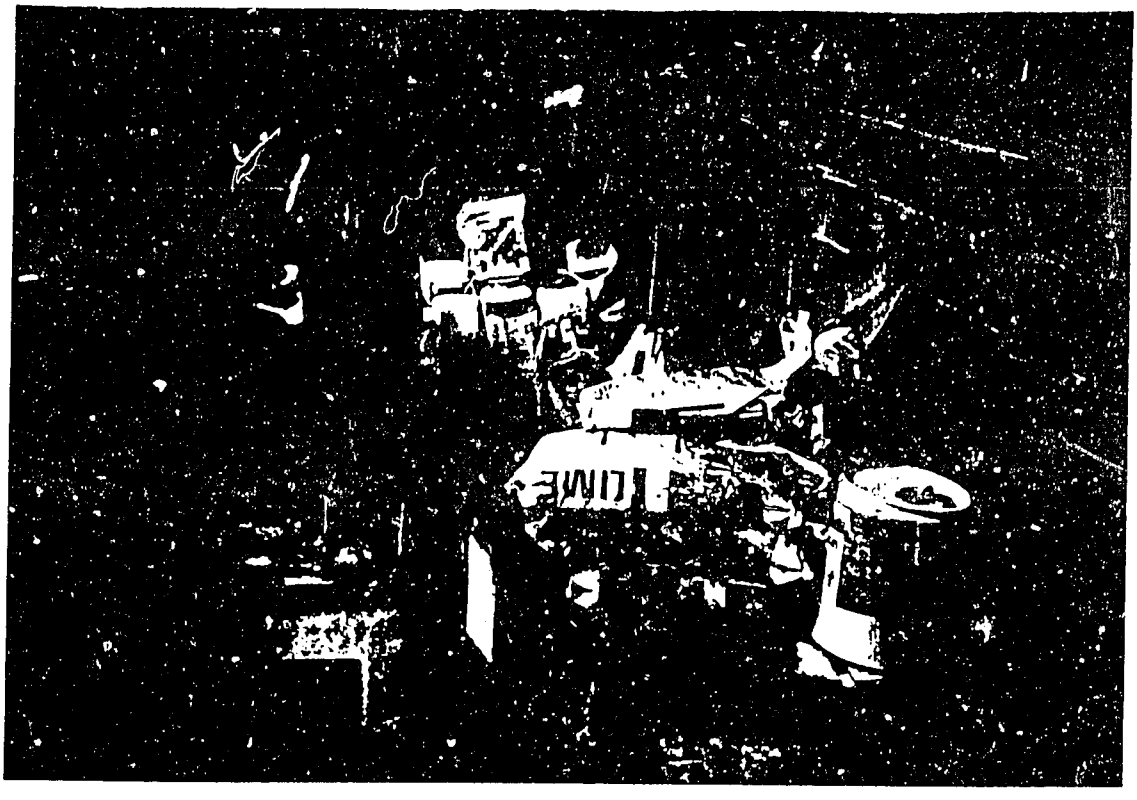
AGRICULTURAL STORE, SAVAI'I

Leilua Opapo, Manager

This is a small branch store on Savai'i Island to serve local farmers. The store has recently been moved to new quarters formerly occupied by the Ministry of Fisheries. Just like in Apia, the store sells light agricultural equipment and supplies in addition to pesticides. The shelves holding pesticide packages are neat, but again, 3-year old Malathion 50 EC (ICI Product) in one-liter metal cans caused the containers to corrode. Just like in Apia, the cans are not fitted with a vapor-proof inner seal. The pesticide supply is limited to 14 products.



Pesticide Warehouse in Vaitele, W. Samoa



Storage of Toxic Pesticides at Vaitele, W. Samoa

I then inspected an old warehouse recently vacated by the Ag. Store. The building was almost empty with the exception of about 25 lbs. of Captan-83 in plastic bags and no longer salable. This should be disposed of. I will transmit a recommended and feasible procedure on my return to the U.S.

TWO MOBILE AGRICULTURAL STORES

Tuli Filipo, Manager and Driver

A novel feature of the Ag. Store are two trucks, one of which is kept on Upolu Island (main island); the other on Savai's. Mr. Filipo is both driver and manager of both trucks and serves the rural population by selling light agricultural equipment and supplies and small quantities of packaged pesticide products directly from the side of the truck. He makes weekly rounds, but there are plans to place the Savai's store. I inspected both trucks and found the inside of both to be essentially empty. There were no indications of pesticide spillage or pollution in either truck as gauged by the lack of odor or traces of powder or liquid.

CENTRAL WAREHOUSE, VAITELE

Beni Lefale, Manager

This large concrete-block, corrugated roofed building is located off the main highway leading to the international airport about 5 km from the center of Apia. The area is an industrial park housing a local cigarette factory and a beer brewery. The inside of the building is divided into three large areas: 1. for pesticides; 2. for fertilizers; 3. for volatile and toxic pesticides. The last area is an enclosed space outfitted with a ventilation fan which was not very effective in removing the pungent "pesticide odor" emanating from this enclosure. The outside pesticide area contained a large amount of well packaged Ambush insecticides; 25-kg containers of ICIPON (dalapon), one of which had begun to corrode and leak; a large number of bags of Polyram (metiram fungicide). The outer pesticide area requires some housekeeping, but essentially the area is provided with shelving, and there is little evidence for contamination due to leakage.

Three buckets of a dark liquid characterized as Gammexane (BHC or lindane) and supposedly having been used for wood treatment were discovered in the back of the building. This liquid apparently originated from a leaky container, but the buckets contained no other signs of identification.

The inner chamber presented a drastically different picture. The stench characteristic of sulfur-and organophosphorus compounds was very noticeable. I have obtained the official inventory list from the Ag. Store, dated July 19, 1986, but I found a number of discrepancies comparing it with a cursory inventory which I took myself during the visit.

The following safety deficiencies were noted:

Ortho Dibrom 8 (Product of ISpray, New Zealand) - labels were falling off containers.

Benlate WP - open container.

Three open and unidentified containers.

One bag of unknown green dust.

Milcurb (dimethirimol) - damaged container.

Dibrom EC - 7 containers without tops.

Cobox (copper oxychloride) - broken bags.

Lepidex (trichlorfon) - leaky container.

Mesurol WP - damage container.

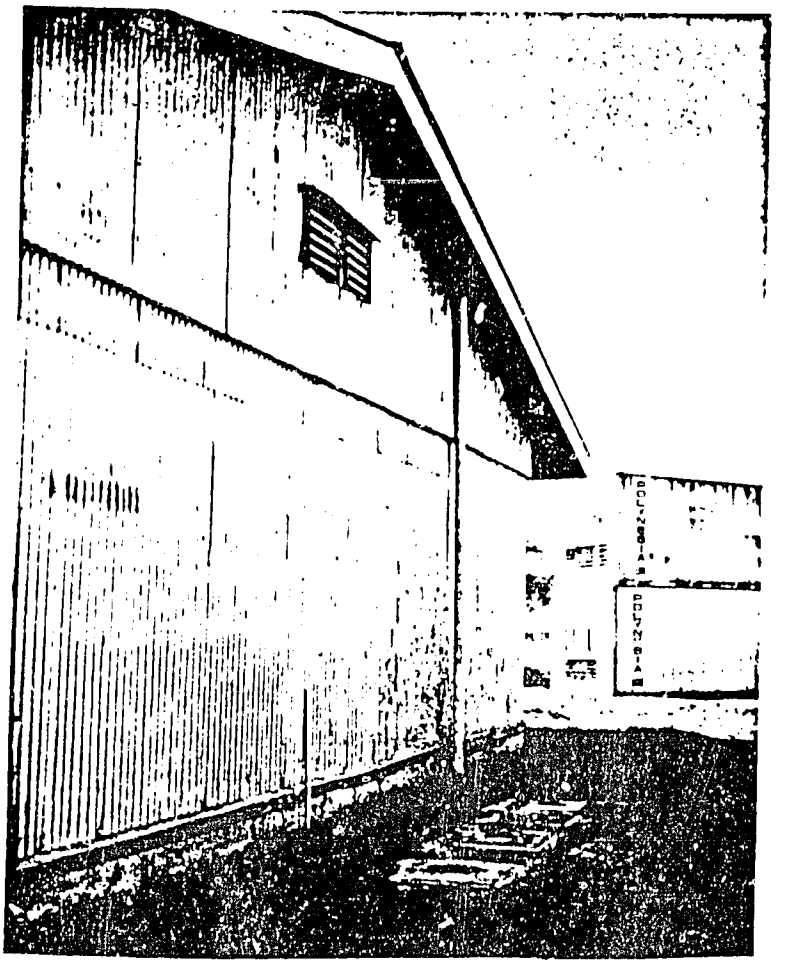
Diazinon 2P - rusty cans (same product in similar condition was found in the two stores).

Ethone (2,4-D) - leaky container.

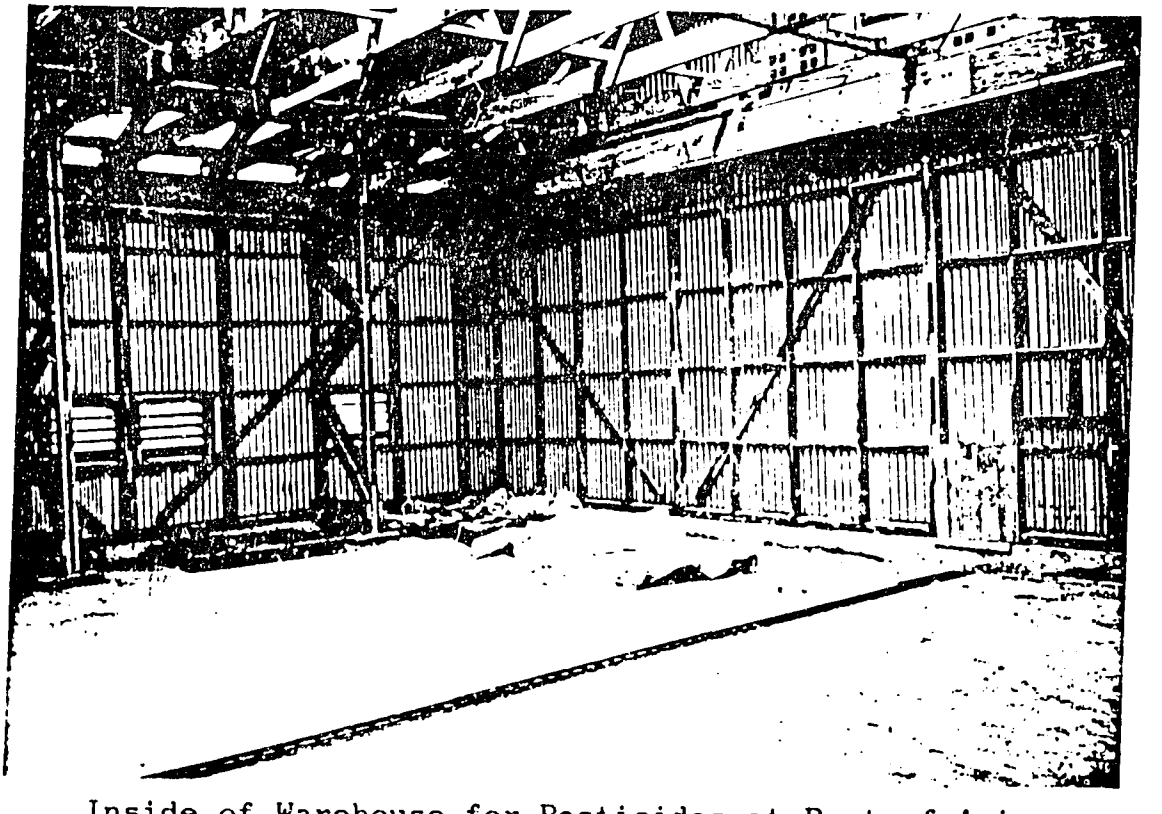
The general condition of this "toxic" enclosed storeroom can best be illustrated by the photograph taken of one of the corners (see photograph). A principal recommendation for the disposal of pesticides in Western Samoa will center on the complete clean-up of the inner pesticide supply room at the Vaitele facility. Previous attempts by other U.S. pesticide experts to improve the safety conditions of this storage facility resulted in the installation of ventilation equipment (fan) and a drain containing lime and activated carbon filters. There is no evidence that this drain has been utilized. There were no written instruction on recharging the filters.

PESTICIDE STORAGE SHED AT THE PORT OF APIA

This corrugated building situated in the Port of Apia was recently refurbished with a grant from U.S. AID. The improvements on the building included the contruction of a drainage system and a decontamination sump so that spilled pesticides could be flushed into the drainage bed.



Pesticide Warehouse at Port of Apia (note drainage system)



Inside of Warehouse for Pesticides at Port of Apia

At the time of my visit, the storage shed was completely empty (see photograph). This storage facility serves the Agricultural Store as temporary pesticide storage at the port if the paper work might be held up at Customs. I have no way of evaluating the utility of this seemingly excellent storage shed but have been told by different people and observers that this shed is rarely used. An occasional use might be envisioned if there is a shortage of funds to release a shipment from Customs.

MISCELLANEOUS MFETINGS AND INTERVIEWS

T.V. Bourke, Principal, Pacific Agricultural Consultancy, Apia; tel: 23518

Mr. Bourke has lived in this part of the world over 20 years and was associated with the FAO before starting his own consulting firm. He is very knowledgeable about the technical and political aspects of pesticide purchase, sales and usage in W. Samoa. He stated that he is now the official ICI representative in W. Samoa. Another one of his companies sells pesticides. He would be a good resource for the Ag. Store, but his commercial interest might preclude his active or advisory participation. He is willing to help to arrange a shipment of outdated, damaged, or obsolete pesticides to ICI-New Zealand for disposal by incineration or other recommended means. He is unalterably opposed to the establishment of a pesticide waste site as had been proposed but was rejected for reasons not known to me.

Dr. Wolfgang W. P. Gerlach, Director Samoan German Crop Protection Project, P.O. Box 597, Apia; tel: 20505

Dr. Gerlach recently was appointed Director of the German project succeeding Dr. Hammans who has returned to Germany. Dr. Gerlach, a plant pathologist, thinks that the large stock of Polyram at the warehouse is useless and should be disposed. Dr. Gerlach would be willing to serve as an advisor to the Ag. Store. Purchase plans for pesticides by the Ag. Store are based on the recommendations by the German Crop Protection Project.

The Hon. Mr. Vaai, Prime Minister of W. Samoa

I met briefly with the Prime Minister during Parliament recess. I was introduced to the PM by Dr. Asi. Based on my study of the pesticide situation in W. Samoa, I made the following points:

1. Training course for fire fighters and employees of the Ag. Store.

2. Suggested that the W. Samoan pesticide law be amended to limit imports to pesticides, whenever possible, with an LD-50 of about 100 mg/kg (oral) or higher to reduce the number of accidental poisonings among pesticide users.

3. Recommended that the issue of a pesticide disposal site be re-examined.

4. Suggested that the W. Samoan Government request the services of a pesticide expert (sales and efficacy), preferably someone older with commercial experience.

U.S. AID, SOUTH PACIFIC REGIONAL DEVELOPMENT OFFICE, American Embassy, P.O. Box 218, Suva, Fiji; tel: 311-399, Telex: 2647 USAID FJ

July 29, 1986

Richard "Noosh" Nishihara, Agric. Development Officer

Kathryn E. Hawley, Assistant Training Advisor

I reported on my two-fold mission in W. Samoa and the need for a training course on fire fighting and prevention involving pesticides and toxic chemicals. Both AID staff members believe that this could be expanded to a regional course. I promised that I would furnish them with U.S. experts in this field. I do not believe that the normal pesticide expert who teaches farmworker and pesticide applicator safety is the type of instructor who is needed for the course which I am recommending.

I reported on the progress of the pesticide projects in W. Samoa, the refurbishing and improvements on safety features at the pesticide stores and warehouses. Since the departure of Gayle Nystrom, no other Peace Corps volunteer has been assigned to the pesticide project on a full-time basis. I suggested that an "old timer" in the pesticide business be recruited as volunteer or paid consultant. This report and the recommendations should be made available to the Mission as soon as it has been approved by HQ.

APPENDIX 2

SAMOA

APPENDIX 2 - Samoa

Contacts made during trips to W. Samoa and Fiji

July, 1986

APIA, WESTERN SAMOA

T.V.	Bourke	Director, Pac. Agric. Consultancy Serv.	Pvt. Bag, Apia
Dr. Asi	Faletoese	Board of Directors, Agric. Store	P.O. Box 1030, Apia
Tuli	Filipo	Manager, Mobile Stores	Apia
Wolfgang	Gerlach	Plant Pathologist and Director	Samoan German Crop Protection P.
Fritz	Lee	Chief Account, Agric. Store	Apia
Peni	Lefale	Manager, Warehouse in Vaitele	Apia
Tom	Meredith	Manager, Agric. Store	Apia
Pollard J.	Moore	Maritime Consultant	Ministry of Transport, Apia
Kevin	O'Keefe	APCD, Peace Corps	Pvt. Mailbag, Apia
Toimoana	Takataka	Manager, Warner Pacific Line Agents	Private Bag, Apia, W. Samoa
The Hon.	Vaii	Prime Minister of W. Samoa	Apia
Aksuao T.	Williams	Fire Chief of W. Samoa	Fire House, Apia

SUVA, FIJI

Kathryn E.	Hawley	Asst. Training Advisor, U.S. AID	P.O. Box 218, Suva
Richard	Nishihara	Agric. Development Officer	P.O. Box 218, Suva

APPENDIX 3

TOPICS FOR PROPOSED TRAINING COURSE ON FIGHTING AND PREVENTION OF CHEMICAL FIRES AND CLEAN-UP OF SPILLS

APPENDIX 3

Topics for Proposed Training Course on

Fighting and Prevention of Chemical Fires and Clean-Up of Spills

This course will last five days, three days of classroom work and two days field demonstrations. The course is designed for officers and enlisted men of the fire department, selected harbor personnel, and personnel handling the transportation, storage and sales of pesticides. Although originally planned for Western Samoa, there is now interest by USAID to broaden the participation on a regional basis.

Western Samoa has an international airport and adequate and economic hotel accommodations for housing and conferences.

The qualifications of the teaching staff must include experience in handling chemical fires and spills. Knowledge of the chemistry of pesticide formulations and the toxicity of liquids and vapors is mandatory.

Topics to be covered include the following:

- Basic information on the chemistry of all ingredients (active and inert) of pesticide formulations. Discussion of vapor pressure, boiling point, flash point, solubility, combustion products.

- Discussion of broad principles of dermal and inhalation toxicology of components in a fire and spill (see Item# 1).

- Safe handling of pesticide products during unloading, storage, and transportation.

- Fire prevention.

- First course of action in a disaster before the fire department reaches the scene.

- Appropriate means for controlling specific chemical fires.

- Personal protection and first-aid.

- How to prevent spills. How to clean up specific spills.

- Demonstrations of simulated fire and spill.

Budget (Based on USAID Contract):

Salaries	
2 consultants @ 250/day for 10 days	$5,000
Administrative support; 4 days @ 200	800
Secretarial support	1,000
Travel	
International travel and per diem for 2 instructors	7,000
Other costs	
Training materials	2,000
Postage/shipping	400
Communication	300
TOTAL (does not include local costs and tuition)	$16,500

APPENDIX 4

PRESS RELEASE FOR VISIT BY PESTICIDE EXPERT

PEACE CORPS

P.O. Box 880
Apia
Western Samoa

Telephone: 22-345

Telex 274 PEACECO SX

22 July 1986

PRESS RELEASE

FROM: United States Peace Corps
&
American Consular Agent

TO: Announce the Visit of Dr. Gunther Zweig

Dr. Zweig is an expert consultant in the field of hazardous material management.

The United States Agency for International Development (USAID) has sponsored his week-long visit to Western Samoa. His mission is to analyse the handling and disposal of pesticides and other hazardous chemicals and to design a training program to assure the safe and effective handling of pesticides in Western Samoa.

It is anticipated that USAID will sponsor the implementation of the training design at a later date.

Dr. Zweig arrived in-country over the weekend and began work on Monday, 21 July. He will meet with officials of the Ministry of Transport, the Department of Agriculture and the Agricultural Store, and the Fire Department during the week.