November 1986

# The Pesticide Situation in Thailand

## Final Report

Prepared for the United States Agency for International Development

by

Janice King Jensen*
Short-Term Consultant

*American Embassy
95 Wireless Road
Bangkok 10500
Thailand

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## INTRODUCTION

The United States Agency for International Development has sponsored several studies on many important natural resource and environmental issues in Thailand, especially in the area of hazardous chemical management. As a continuation of this strategy, USAID sponsored this study on "The Pesticide Situation in Thailand."

## PEST MANAGEMENT PRACTICES

Thailand grows a wide variety of crops. Rice is by far the biggest and most important crop, being the staple food.

The main insect pests for rice are the stem borers, leaf hoppers and plant hoppers. Fungal diseases such as mildew, blight, rust and rot are common. Weeds, too, are a major problem in most crops.

Current pest control practices are still focused on chemical control methods which have traditionally been accepted as the most convenient and effective means of controlling pests.

Insecticides are most widely used, followed by herbicides and fungicides. Rice, cotton and vegetables are the main users of insecticides. The herbicide market is focused on sugarcane, pineapple, rubber and rice. For fungicides, the major crops are fruit trees, vines, vegetables, rice and orchids.

Estimates on the extent of usage of pesticides on major crops vary widely. On rice, for instance, estimates range from 30-60%. On cotton, estimates range from 75-90%.

## PESTICIDE INDUSTRY PROFILE

In 1984, Thailand imported US$ 65 million worth of pesticides, with about 58.5% for insecticides, 29.2% for herbicides and 12.3% for fungicides.

Only paraquat is manufactued in Thailand. Most pesticides are imported as technical grade ingredients and formulated locally. In 1985, 102 insecticide products were imported.

For agro-pesticides, there are 161 registered active ingredients. There are 85 importing companies, 22 formulators and 61 registered repackagers. For household use, there are 23 active ingredients and 40 importing companies.

Pesticides are primarily distributed by the private sector, although the Department of Agricultural Extension distributes about 10% of the market in its free-of-charge plant protection campaigns. Pesticides for agriculture are taxed at 5%, for public health use, 20%.

## ENVIRONMENTAL AND HEALTH CONCERNS

Several surveys on pesticide poisonings in Thailand have been conducted. Estimates on acute poisoning range from 4 : 100,000 to 8,268 : 100,000.

Most of the poisonings at the Siriraj Hospital in Bangkok are suicide cases, mainly females in the 15-29 age group. There were about 500 cases of poisoning in the 0-12 age group between 1980-1984, suggesting accidental poisoning.

Pesticide residue levels that exceed Thai or FAO standards do not appear to be a major problem.

Mungbeans were the main Thai products detained by the US because of pesticide residues which exceed US tolerance limits.

The Agricultural Toxic Substances Division analyzes about 600 samples of export crops a year. Less than 1% exceed tolerances set by WHO/FAO.

The lower Chao Phraya River and klongs were surveyed for common pollution indicators, including organochlorine and organophosphate pesticides. Low levels of dieldrin, BHC and aldrin were found. Thailand does not yet have drinking water standards for pesticides.

Occupational exposure in pesticide plants appears to be a problem. Some obvious examples of unsafe practices are described.

## PESTICIDE REGULATORY POLICIES AND PROCEDURES

The Poisonous Articles Act, 1967 (amended in 1973) was enacted to control the import, export, manufacture, sale, storage, transport and use of poisonous substances, including pesticides. Three ministries enforce the PAA : Ministry of Agriculture and Cooperatives; Ministry of Public Health and the Ministry of Industry.

One of the main weaknesses of the PAA is that before any poisonous substances can be regulated, it must first be registered. Substances that have not been officially registered are therefore not subject to control under the Act.

Registration of pesticides is too simple, requiring minimal data and scientific review.

The following pesticides are banned for use on agricultural products in Thailand: chlordimeform, aldrin, leptophos, toxaphene, endrin, BHC, sodium arsenite, DDT, EDB and TEPP.

To date the MOPH has registered 23 pesticides and the MOAC, 161.

## PESTICIDES USED FOR PUBLIC HEALTH AND HOUSEHOLD PEST CONTROL

Thailand uses about 500 metric tons of DDT and 150 tons of fenitrothion per year for malaria control.

There are five Anopheles species that carry malaria in Thailand. They are not yet resistant to DDT. Malaria deaths have been reduced from 200 deaths per 100,000 population thirty years ago to 4.4 in 1984.

The household pesticide market is about 20% of the agro-chemicals market.

There is no training requirement or exam for household commercial applicators.

## PROBLEMS WITH PESTICIDES IN THAILAND

Several major problem areas exist with pesticide management in Thailand. These areas are legislation, poor quality of formulations, farmer attitudes and practices, the toxicity of pesticides available at the farmer level, pesticide give-aways and industrial safety. Each of these areas is discussed in detail.

## CONCLUSIONS AND PRIORITY AREAS FOR DONOR ACTIVITIES

General conclusions are discussed and priority areas for donor activities identified. It is recommended that a policy dialogue be initiated in the areas of legislation, enforcement and allowing highly toxic chemicals to be sold without restriction in Thailand. Areas that should be studied further are appropriate disposal technology, groundwater contamination and the effect of the Department of Agricultural Extension's pesticide give-away policy. Recommendations were made for additional training and education programs.

## PESTICIDES : WHAT'S GOING ON IN THAILAND

Key people in twenty-four organizations were interviewed. Their activities involving all aspects of pesticides are described in Chapter 9.

## BIBLIOGRAPHY

Chapter 10 contains a bibliography of the studies and miscellaneous pesticide information collected for this study.

# LIST OF ABBREVIATIONS

| | | |
|---|---|---|
| ADI | - | Acceptable Daily Intake |
| ARSAP | - | Agricultural Requisites Scheme for Asia and the Pacific, ESCAP, Bangkok. |
| CICP | - | Consortium for International Crop Protection |
| DIW | - | Department of Industrial Works |
| DOA | - | Department of Agriculture (Research) |
| DOAE | - | Department of Agricultural Extension |
| EPA | - | United States Environmental Protection Agency |
| ESCAP | - | Economic and Social Commission for Asia and the Pacific (United Nations), Bangkok. |
| FAO | - | Food and Agriculture Organization, Rome. |
| GIFAP | - | International Group of National Associations of Pesticide Manufacturers |
| GLC | - | Gas Liquid Chromatograph |
| GTZ | - | Deutsche Gesellschaft fur Technische Zusammenarbeit (German Technical Aid) |
| HPLC | - | High Pressure Liquid Chromatograph |
| IPC | - | Integrated Pest Control |
| IPM | - | Integrated Pest Management |
| JICA | - | Japan International Cooperation Agency |
| LC | - | Lethal Concentration |
| MOAC | - | Ministry of Agriculture and Cooperatives |
| MOI | - | Ministry of Industry |
| MOPH | - | Ministry of Public Health |
| NEB | - | Office of the National Environment Board |
| NICE | - | National Institute for the Improvement of Working Conditions and Environment |

| | | |
|---|---|---|
| PAA | - | Poisonous Articles Act, 1967, as amended in 1973 |
| RENPAF | - | Regional Network for the Production, Marketing and Control of Pesticides in Asia and the Pacific, Manila |
| TDRI | - | Thailand Development Research Institute |
| TDRI | - | Tropical Development Research Institute, London |
| TPA | - | Thailand Pesticides Association |
| USAID | - | United States Agency for International Development |
| WHO | - | World Health Organization |

# CHAPTER 1

# INTRODUCTION

## 1.1 WHY THIS STUDY ?

As a part of the Action Dialogue on Resources and Environment between the Royal Thai Government and the United States Agency for International Development, USAID has been sponsoring studies on many important natural resource and environmental issues in Thailand, especially in the area of hazardous chemical management (Roos, 1985; Manring, 1985; and Cohen, 1985). As a continuation of this strategy, USAID sponsored this study on "The Pesticide Situation in Thailand."

USAID's objective in sponsoring these studies is to respond to the growing government and public interest and concern over the increasing use of hazardous chemicals, especially pesticides. In addition to summarizing available information on specific topics, each study has included an analysis of specific problems and made recommendations for improving hazardous chemical management in Thailand.

## 1.2 SCOPE OF THIS STUDY

This study summarizes the information collected by pesticide specialist Janice Jensen during an eleven-week consultancy covering the period of February - October, 1986. The first draft of this report was completed in May 1986. Based on comments received on that draft, the final report summarizes more information on pesticide use in the public health sector, research work done at major universities and information about household use of pesticides.

The Scope of Work of the study was as follows :

1) Survey recent and current literature, research and researchers regarding pest management practices and use of pesticides.
2) Prepare a preliminary analysis of key issues involved.
3) Identify and meet with appropriate representatives of government, donor, university and private sector agencies involved in pest/pesticides research and management. Key individual will be interviewed regarding their own work and their perception of issues and solutions to problems of pesticide misuse and plant protection. Also, major collections of research literature are to be examined, and significant works are to be identified and compiled into a bibliography.
4) Prepare an inventory and a written summary of the relevant work being done at major universities in Thailand.
5) Include health related and household use of pesticides into the survey.

## 1.3 ORGANIZATION OF THIS STUDY

This study is organized into three main parts. The issues are briefly discussed in Chapters 2-8. The organizations and individuals active in pesticides in Thailand are included in Chapter 9 and a bibliography listing all the information collected during this eleven-week consultancy is in Chapter 10.

The major crops, economically important pests and practices to control these pests are briefly discussed in Chapter 2. Chapter 3 gives a profile of the chemical industry in Thailand. Significant environmental and health concerns are summarized in Chapter 4. Pesticide regulatory policies and procedures are discussed in Chapter 5. Chapter 6 addresses pesticides used for malaria control and commercial pest control. Chapter 7 identifies problems. Chapter 8 gives conclusions and areas for additional donor activity.

Chapter 9 contains the heart of this study. Key people, organizations and activities involving all aspects of pesticides are described in this chapter.

Chapter 10 contains a bibliography of the studies and miscellaneous pesticide information collected for this study.

# CHAPTER 2

# PEST MANAGEMENT PRACTICES

## 2.1 MAJOR CROPS AND IMPORTANT PESTS

Thailand grows a wide variety of crops. Rice is by far the biggest and most important crop, being the staple food. Cassava, cotton, fruit trees, sugarcane, vegetables, coconuts, rubber, fruits, castor beans, soybeans, and peanuts are also economically important crops (Bhatraruji, 1983).

Much of the land is under rotational cropping. From these diverse agro-ecosystems, Thailand has numerous pests which can inflict a considerable damage to agricultural production. They range from insects, plant diseases, weeds, to rodents.

The main insect pests for rice are the stem borers, leaf hoppers, and planthoppers. For the rest of the crops, the main insect pests include aphids, spider mites, whiteflies, stalkborers, leaf rollers, bollworms and cutworms. Fungal diseases such as mildew, blight, rust and rot are common. Weeds, too, are a major problem in most crops.

## 2.2 PEST CONTROL PRACTICES

Pests (insects, weeds, diseases, rodents, etc.) are a serious problem in crop production and the estimated yield losses due to pests amounts to about 20-30% annually (Gaston and Pavey, 1986).

Thailand is participating in the FAO Inter-Country Programme for Integrated Pest Control in Rice in South and Southeast Asia, but the application of these techniques on a commercial scale might take several more years, as the concepts are still at the research and manpower development stage.

The Thai-German Surveillance and Warning Service (SEWS) is another project which has developed an Integrated Pest Management (IPM) technology package and is now training the 6,000 extension personnel to use this package. However, this project is also still in the manpower development stage.

Current pest control practices are still focused on chemical control methods which have traditionally been accepted as the most convenient and effective means of controlling pests.

Insecticides are most widely used, followed by herbicides and fungicides. Rice, cotton and vegetables are the main users of insecticides. The herbicide market is focused on sugarcane, pineapple, rubber and rice. For fungicides, the major crops are fruit trees, vines, vegetables, rice and orchids.

## 2.3 EXTENT OF USE ON SELECTED CROPS

Estimates on the extent of usage of pesticides on major crops vary tremendously. Dr. Banpot Napompeth (1981) estimated that on rice, 30% of the area under cultivation is under pesticide usage, with 90% on cotton. Gaston and Pavey (1986) estimated 60% for rice and 75-80% on cotton. They estimated the pesticide market for rice to be about US$ 88 m (insecticides 55%, herbicides 40%).

## 2.4 EXTENT OF USE BY REGION

Pesticide usage varies considerably from region to region (Staring, 1984). Considerably more pesticides are used in the prosperous Central Region than in the rest of the country, for an estimated 62 per cent of the country's total. Bangkok is the distribution center for this region. The main crops are fruit, vegetables, rice and orchids for the Bangkok and export markets.

The North ranks second, for an estimated 25.8 per cent of the total used in the country. Lampang and Chiang Mai are the distribution centers. The principal cash crops are rice, tobacco, groundnuts and fruit.

The South accounts for about 7.8 per cent of the country's total. Had Yai is the distribution center, with rubber being the main cash crop.

The Northeast accounts for the smallest portion of pesticides used, estimated at only 4.3 per cent. The distribution centers are Nakorn Ratchasima and Khon Kaen. Only a few farmers spend money to buy pesticides for rice. The rest prefer to spend their limited money on fertilizers and irrigation.

# CHAPTER 3

# PESTICIDE INDUSTRY PROFILE

## 3.1 PESTICIDE SUPPLY AND USE PATTERN

Pesticides in Thailand are big business. According to a recent compilation by J. W. Southern (1985) of pesticide markets in the Association of Southeast Asian Nations (ASEAN), Thailand imported US$ 65 m worth of pesticides in 1984. About 58.5% of that was for insecticides, 29.2% for herbicides and 12.3% for fungicides. Table 1 below provides a regional perspective on Thailand's pesticide market.

**Table 1 Volume and Value of Pesticides in ASEAN Countries in 1984**

(Modified from Southern 1985)

| Country | Insecticides | | Herbicides | | Fungicides | |
|---|---|---|---|---|---|---|
| | metric tons thousand | US $ million | metric tons thousand | US $ million | metric tons thousand | US $ million |
| INDONESIA c | 17 | 18 | 2 | 3 | 1 | 5 |
| MALAYSIA b | 3 | 10 | 14 | 68 | 8 | 4 |
| PHILIPPINES b | 13 | 18 | 7 | 7 | 2 | 13 |
| THAILAND a | 8 | 38 | 6 | 19 | 4 | 8 |

a Import volume and value excluding paraquat
b Market volume and value
c Market volume and value for subsidized and nonsubsidized crops

The Thai farmer is willing to try new crops or new crop protection chemicals if they have been shown to be profitable. According to Southern, the major high pesticide use crops in 1984 were rice (25%), vegetables (25%), and cotton (10%).

The bulk of the insecticides are used on rice, cotton and vegetables, while herbicides are mainly used in rubber and palm oil plantations. Fungicides are mainly used to control diseases in vegetables, fruit trees, bananas and pineapples.

Although there was a 40% increase in pesticide import values (as a reasonable proxy for use data) from 1980-1985 (MOAC/DOA, 1985), the trend of increasing pesticide use has leveled off. A significant reason for this is because of continued depressed export prices for rice, maize, cassava, sugarcane and rubber. Increases in pesticide use are not expected until export prices improve.

## 3.2 THAI PESTICIDES ASSOCIATION

The Thai Pesticides Association represents 29 members that import and repack over 80% of the pesticides in Thailand. The TPA, which was formally registered in 1983, has assumed a high profile for improving pesticide management in Thailand, especially in the area of farmer training (See Section 4.1) and public relations. As an example of the latter, TPA along with GIFAP, the International Trade Association of agrochemical manufacturers, sponsored in early '86 a workshop encouraging members to conform to the FAO "Code of Conduct for Pesticides." This effort is being taken one step further. In early December, the TPA will have a closed meeting to discuss strategies for implementing the FAO code within its membership. An open meeting will be held in early January.

### 3.3 LOCAL PRODUCTION AND REFORMULATION

The early importation of pesticides into Thailand were in the form of finished products. In order to reduce costs of the pesticides, some companies subsequently started to import the technical grade ingredients and formulate them locally. In Thailand, the herbicide paraquat is the only pesticide that is actually manufactured from raw materials.

Thailand had a total formulation capacity of 51,920 metric tons in 1982, although only 33% of that capacity was actually used (RENPAF, 1985).

In 1985, 102 insecticide products were imported (MOAC/DOA, 1985). Some of the major ones in decreasing order of tons imported are carbofuran, methyl parathion, dimethoate, monocrotophos, methyl bromide, dicofol and mevinphos. For the 54 fungicides products imported, copper oxychloride, sulphur, zineb and captan were imported in the largest quantities. For the 40 herbicide products, paraquat intermediates, 2,4-D, dalapon and atrazine were the major imports.

There are 85 companies importing agro-pesticides, 61 repackagers and 22 reformulators in Thailand. In 1985, the top seven represented about 50% of the market. These companies, in order of decreasing market share, are Bayer, Dupont, Ciba Geigy, Shell, Metro, Monsanto and Pitsulin (MOAC/DOA, 1985).

The major products locally formulated include carbofuran (3% granules), methyl parathion, endrin, carbaryl and captan.

Pesticides for agriculture are subject to an import tariff of 5%. Pesticides for use in other sectors including public health are taxed at 20%.

## 3.4 PESTICIDE DISTRIBUTION

Agro-pesticides are primarily distributed by the private sector, although the Department of Agricultural Extension does have about a 10% market share that it uses in free-of-charge plant protection campaigns for preventing large scale pest outbreaks.

Liquid finished products usually are imported in 200 liters drums and then repackaged into smaller containers of 1 gallon, 1 litre, 1/2 litre and 100 ml. There are many small repackaging plants in Thailand. Some importers sell directly to farmers, but generally, there is a repackaging agent involved.

There are three main types of distributors in the private sector (Staring, 1984):

1. Regional wholesalers.
2. Dealers at the district level.
3. Small retail shops selling a variety of pesticide products from various souces.

Based on an ARSAP study (Staring, 1984) on marketing margins on ten selected products, the difference between dealer price and farmer price ranged from 10% - 38%. Selling pesticides can be a profitable business. In addition to the profit made from selling chemicals, many of the bigger chemical companies have incentive campaigns for selling quotas of certain products. Common incentives for dealers are trips, cash rebates, cash awards, TVs, videos, radio, cars and trucks. Incentives to farmers include T-shirts, long-sleeve shirts and TVs.

CHAPTER 4

# ENVIRONMENTAL AND HEALTH CONCERNS

## 4.1 HEALTH HAZARDS

In Thailand as well as other tropical countries, pesticide-related health problems are of great concern. This is directly related to the types of pesticide formulations used, the impracticality of using heavy protective clothing in a warm climate, the difficulty in handling highly toxic pesticides by insufficiently trained people, the low level of official control and the lack of adequate technical information to the farmers. As a consequence, pesticides are often improperly selected and handled and they are frequently misused, leading to undesirable acute and chronic health effects to the user, and undesirable pesticide residue levels on food.

In Thailand, World Health Organization classification IB (highly hazardous) pesticides are sold without restriction at the farmer level. Five out of the seven main insecticides imported into Thailand in 1985 were classified 1B, totalling 8,334 metric tons (MOAC/DOA, 1985).

Pesticide poisoning data collected in Thailand usually are based on hospital records, which would primarily address acute poisoning cases, usually suicide attempts. Estimates of acute poisonings range from 4:100,000, which excludes suicides

(MOPH/FDA, 1983) to 8,268:100,000 (Wongphanich, 1985). The latter data were collected during an extensive survey in the agricultural province of Rayong in 1984. The National Environment Board is also collecting hospital data on pesticide poisonings. NEB's 1984 nationally collected data indicate an 9:100,000 value. Interestingly, Dr. Malinee Wongphanich, who conducted the survey in Rayong, found that only 2.4% of the individuals who had experienced pesticide poisoning had spent any time as an in-patient. If that statistic can be validated for other parts of Thailand, the NEB and MOPH would have to consider that their data only represented a portion of the actual cases.

Because of widespread availability, pesticides are becoming favored as a way to commit suicide, although jumping from buildings (men) and hanging (women) are still popular methods (Wongphanich, 1986). 1980-1984 data from Siriraj Hospital, which covers mostly the urban Bangkok population, show that there were a total of about 1,700 cases of pesticide poisoning cases, and mainly females in the 15-29 age groups (Siriraj, 1985). About 500 cases were in the 0-12 age group, which is suggestive of accidental poisoning of young children.

No data was found to evaluate the prevalence of health hazards associated with chronic pesticide exposure. Examples of these health hazards would be liver toxicity ("I just don't have any energy," "I just don't feel good") or toxicity to the nervous system ("My legs feel weak," "My hands shake"). Pesticide users at the farmer level are not yet aware that these toxic problems could be related to chronic pesticide exposure, and that in most cases they are avoidable.

According to Dr. Lucas Brader, Director of the Plant Production and Protection Division of FAO, "the most important public health problems in the tropical regions, however, are intoxications occurring during pesticide application" (Brader, 1986).

To address this problem in Thailand, a national program is being developed for training farmers to use pesticides safely and effectively. This train-the-trainer program is being developed by a working group of the Environmental Protection Committee for Toxic Substances. This working group has representatives from the Department of Agriculture, Department of Agricultural Extension, the National Environment Board and the Thai Pesticide Association. The current plan is to have a five-day intensive train-the-trainer course for thirty participants in early January 1987. Lectures will be videotaped and then used as part of the training package. It is planned that each of these thirty participants will train at least thirty more people. At that point, there will be an intensive evaluation of the training materials and techniques used. Changes will be made if necessary. The long-range goal of this program is to reach 5 million farmers. This time-frame depends on external funding that has not yet been identified.

## 4.2 RESIDUES ON FOOD AND EXPORT CROPS

Good agricultural practices dictate that when directions for use are followed, pesticide residues on crops during harvest would fall below the maximum residue limits (MRLs) set by the Thailand Ministry of Public Health (MOPH). These maximum residue limits are listed in Table 2, and WHO/FAO residue limits are included for comparison. In general, MOPH and FAO MRLs are similar.

In practice, however, this is rarely the case, especially on vegetables, where farmers rarely follow the recommended dose rates and recommended timing. Surveys in fruit and vegetable growing areas indicate that farmers often spray double the recommended dose, 1-3 times a week and mix 2-4 pesticides to together for quick insect knockdown. (Roos, 1985; Sinhaseni, 1985; Wongphanich, 1985).

Even though there are no regulations on time intervals between last application and harvest, residues that exceed the Thai maximum residue limits do not appear to be a major problem. In 1985, of the 200 samples of primary food that were collected from the market place and analyzed for pesticide residues by the Thai MOPH, 70% were contaminated with detectable levels, but all were lower than maximum limit (Vongbuddhapitak, 1986 b). In a total diet study conducted in 1980, actual intake of residues was calculated and it was found that dieldrin intake was near the WHO acceptable daily intake (ADI), DDT and endrin were 3 and 6 times

## TABLE 2

### A COMPARISON OF THAILAND AND WHO/FAO PESTICIDE RESIDUE STANDARDS IN FOOD*

| | Vegetable | | Fruit | | Cereal | | Dry Bean | | Fat & Oil | | Meat | | Egg | | Aquatic Animal | | Milk | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Thai | FAO | Thai | FAO | Thai | FAO | Thai | FAO | Thai | FAO | Thai | FAO | Thai | FAO | Thai | FAO | Thai | FAO |
| Aldrin | 0.05 | 0.01 | 0.15 | 0.05 | 0.01 | 0.02 | 0.10 | NL | 0.20 | NL | 0.20 | 0.20 | 0.10 | 0.10 | 0.10 | NL | 0.30 | 0.15 |
| BHC | 1.00 | NL | 1.00 | NL | 0.20 | NL | 0.20 | NL | 0.30 | NL | 0.30 | NL | 0.50 | NL | 0.50 | NL | 0.30 | NL |
| DDT | 2.00 | 7.00 | 7.00 | 7.00 | 0.50 | NL | 1.50 | NL | 6.00 | NL | 5.00 | 7.00 | 1.50 | 0.50 | 5.00 | NL | 1.00 | 1.25 |
| Dieldrin | 0.10 | 0.01 | 0.10 | 0.05 | 0.02 | 0.02 | 0.10 | NL | 0.10 | NL | 0.20 | 0.20 | 0.10 | 0.10 | 0.30 | NL | 0.30 | 0.15 |
| Endrin | 0.05 | 0.02 | 0.05 | 0.02 | 0.02 | 0.02 | 0.05 | NL | 0.30 | 0.10 | 0.30 | 0.10 | 0.20 | 0.20 | 0.30 | NL | 0.30 | 0.02 |
| Heptachlor & H. Epoxide | [illegible] | 0.05 | 0.05 | 0.01 | 0.03 | 0.02 | 0.05 | NL | 0.02 | 0.02 | 0.03 | 0.20 | 0.05 | 0.05 | 0.30 | NL | 0.30 | 0.15 |
| Lindane | 3.00 | 2.00 | 1.00 | 0.50 | 0.50 | 0.50 | 0.50 | 1.00 | 0.30 | NL | 7.00 | 2.00 | 0.50 | 0.10 | 0.50 | NL | 0.30 | 0.20 |
| Malathion | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 0.60 | NL | 4.00 | NL | 0.20 | NL | 0.60 | NL | 0.50 | NL |
| Parathion | 1.00 | 0.70 | 1.00 | 1.00 | 0.20 | NL | 1.00 | NL | 0.20 | NL | 0.20 | NL | 0.20 | NL | 0.20 | NL | NA | NL |
| Captan | 15.00 | 15.00 | 20.00 | 25.00 | 2.00 | NL | 25.00 | NL | NA | NL | NA | NL | NA | NL | NA | NL | NA | NL |

Source: Thai Standards. Notification of the Ministry of Public Health no. 71, issued under Food Act (1979), printed in Royal Government Gazette (Special issue) Vol. 169, Part 168, dated November, 1982, (NEB, 1985 a).

FAO Standards. Guide to CODEX MAXIMUM LIMITS FOR PESTICIDE RESIDUES, Joint FAO/WHO Food Standards Programme, CODEX Alimentarius Commisssion, CAL/PR 1-1978, updated March 5, 1982.

NL = Not Listed
NA = Not Allowed

* Residue levels listed as mg pesticide per kg food.

lower than the ADI, while chlordane and heptachlor residue levels were very low (Vongbuddhapitak, 1983). No other total diet studies have been done since 1980.

The Agricultural Toxic Substance Division, Department of Agriculture, although mainly research oriented, also has analyzed market produce for pesticide residues in vegetables, fruit, cereals and meat. Based on 1043 samples analyzed in 1978-1982, only "very few" exceeded tolerance limits (Deema, 1983). As only the average residue levels are given, it is not possible to further define "very few." Mungbeans and soybeans were considered to be the main problems.

This problem with mungbean was verified by the US Food and Drug Administration. Of the 346 shipments of Thai agricultural products detained by the US because of pesticide residues exceeding US tolerance limits, 331 were mungbeans (USFDA, 1986). Most of these contained residues of endrin, which is banned for use in the US and also in Thailand. It is possible that these endrin residues have resulted from translocation from contaminated soil (Deema, 1986).

As an exporting country, Thailand is concerned with residues on their export crops and uses the residue limits set by the importing country as standards. To check samples for export, the Agricultural Toxic Substances Division analyzes about 600 samples a year. These are mainly rice, corn, sorghum, coffee, tapioca and mungbeans. Less than 1% exceed tolerances set by WHO/FAO (Impithuksa, 1986).

## 4.3 ENVIRONMENTAL HAZARDS

DDT is banned in Thailand for agricultural use. There can be little doubt that the widespread use of DDT, as exemplified by some earlier agricultural and forestry practices in the US and Europe, resulted in the contamination of fishery products and progressive and alarming decreases in the population of certain predatory birds. These unhappy side-effects are due to the remarkable facility of living organisms to concentrate organochlorine insecticides in the environment. The problem is aggravated by the conversion of DDT to DDE which is even a more stable pollutant.

Reports on the deterioration of fish and marine life traced to indiscriminate pest control practices, especially in rice production areas, cause concern to the government. It is common that farmers rear fish in the rice paddies as an added source of food and income.

Carbofuran, isazophos and chlorpyrifos insecticides are commonly used in rice paddies in Thailand for controlling many major rice pests. However, because fish mortality has resulted primarily from the use of carbofuran and endosulfan, a better understanding of pesticide degradation in a rice paddy is needed for safe fish production. Residue studies have been conducted by the Agricultural Toxic Substances Section, Department of Agriculture, which evaluated the impact of these insecticides in water in the rice paddy (Impithuksa, 1986; Yingchol, et. al., 198?; Isensee and Tayaputch 1986). It was found that in water there was in some cases only a two-fold safety factor before fish mortality may occur. This indicates that the application rate is critical if fish are to be cultured in rice paddies.

In a report prepared for the Office of the National Environment Board, Onodera (1985) surveyed the common pollution indicators in the Lower Chao Phraya River and klongs, including organochlorine and organophosphate pesticides. BHC, lindane, heptachlor, aldrin, dieldrin, p, p'-DDE, p, p'-DDD, and p, p'-DDT had the highest frequency of occurrence in the samples of sediment and water collected from the rivers and klongs. The concentration of BHC (0.022 ug/l), aldrin (0.126 ug/l) and dieldrin (0.022 ug/l) in the water collected in the hot and dry season of 1984 were 3-10 times higher than those measured in a typical rainy season. This is as expected, indicating a dilution of the pollutants. On the distance distribution from the mouth of the lower Chao Phraya River, there were three peaks for pesticide residues, one at 60 km, the second at 170 km and the third at 340 km, indicating a source of pollution at each peak. Klong water contained higher pesticide residues than river water. This indicates that klong water may be a source of pollution for the river. Sediment from the river contained residues 10-100 times higher than in the water, indicating an accumulation in the sediment which could impact on aquatic organisms.

Another environmental concern is pesticide pollution of Thailand's watersheds in the Northeast highlands. Programs are being developed to substitute cash crops for opium production. The rather exotic nature of these cash crops require plant protection practices (often using pesticides) that are quite sophisticated by hilltribe standards (Black and Jonglaekha, 1985).

Thailand does not yet have drinking water standards that include pesticides.

The effect of numerous pollutants, especially the organochlorines, are detrimental to fish gametogenesis and reproduction. Sometimes, the depressed reproduction observed in polluted water cannot be related to any particular factor, which suggests a possible synergism of the various sources of pollution (Pickering, 1981).

## 4.4 PEST RESISTANCE

Pest resistance is a growing problem in Thailand as well as the rest of Southeast Asia. Additional ecological effects to resistance are resurgence of pest species and increases in populations of other species. According to Gaston and Pavey (1986), pest resistance is such a problem in countries like Pakistan and Indonesia that regulatory safeguards have been instituted against resistance. In these countries, as a general rule, no insecticide mixtures may be registered in order to avoid cross resistance. In Thailand, where mixtures are sold and where farmers routinely mix from 2-4 chemicals at a time, it is little wonder that the resistance problem is worsening.

Because of the growing interest, pesticide resistance will be the subject of a half-day session at the USAID/CICP Southeast Asian Pesticide Management/IPM Workshop, which will be held in Pattaya, Thailand, February 1987.

## 4.5 OCCUPATIONAL EXPOSURE IN THE PESTICIDE INDUSTRY

Thailand is in the midst of rapid industrial development. Although in most cases health and safety regulations do exist, the infrastructure for monitoring the compliance to these regulations has not kept pace. In two recent studies (TDRI, 1986; Jensen and Zweig, 1986), pesticide reformulating and repackaging plants around Bangkok were visited. Some obvious examples of potentially unsafe conditions and practices were observed, including : inadequate protective clothing worn by workers reformulating and repackaging highly toxic chemicals; poor ventilation; no alarm system in case of emergency; improperly stored chemicals, many of them outdoors; very little safety training; unsafe methods of loading and unloading chemicals; insufficient fire fighting equipment; no color codes on pipes; no containment structure around large liquid containers to stop accidential spills; no evaporation pond for chemical waste; and improper chemical waste and container disposal.

Although rarely enforced, Thailand does have workplace air standards for pesticides. These can be found in Table 3. Regarding industrial effluent standards, pesticides are listed only as "insecticides" and the amount allowed is "none" (NEB, 1986 b).

TABLE 3

ATMOSPHERIC CHEMICAL STANDARDS IN THE WORK PLACE FOR THAILAND (NEB, 1985 a)

The average atmospheric chemical concentration in the work place throughout a normal working period shall not exceed the specific level as follows:

| NO. | Substances | Chemical concentration mg/m |
|---|---|---|
| 1. | Aldrin | 0.25 |
| 2. | Azinphos-methyl | 0.2 |
| 3. | Chlodane | 0.5 |
| 4. | D D T | 1 |
| 5. | D D V P | 1 |
| 6. | Dichlorvos | 1 |
| 7. | Dieldrin | 0.25 |
| 8. | Dimethyl 1,2-dibromo 2, 2 dichloroethyl phosphate (Dibrom) | 3 |
| 9. | Endrin | 0.1 |
| 10. | Guthion | 0.2 |
| 11. | Lead arsenate | 0.15 |
| 12. | Lindane | 0.5 |
| 13. | Malathion | 15 |
| 14. | Methoxychlor | 15 |
| 15. | Nicotine | 0.5 |
| 16. | Systox | 0.1 |
| 17. | Thallium (soluble compounds) as Tl | 0.1 |
| 18. | Thiram | 5 |
| 19. | Toxaphene | 0.5 |
| 20. | Parathion | 0.11 |
| 21. | Phosdrin | 0.1 |
| 22. | Pyrethrum | 5 |
| 23. | Warfarin | 0.1 |
| 24. | Carbaryl (Sevin (R) ) | 5 |
| 25. | 2, 4-D | 10 |
| 26. | Paraguat | 0.5 |
| 27. | 2, 4, 5-T | 10 |

Penalty: Any employer and employee who shall violate or neglect to act in compliance with the prescription of the Ministry of Interior issued under Article 2 shall be liable to a term of imprisonment not exceeding six months or to a fine of not over twenty thousand baht, or both.

Source: Notification of the Ministry of Interior issued under the Announcement of the Revolutionary Party, no 103, dated May 30, B.E. 2520 (1977), printed in the Royal Government Gazette, Vol 95, Part 64, dated July 12, B.E. 2520 (1977).

# CHAPTER 5

# PESTICIDE REGULATORY POLICIES AND PROCEDURES

## 5.1 LEGISLATION AND REGULATION

This section will briefly address only the major pieces of legislation relevant to pesticide management. For a more in-depth discussion of legislation in Thailand, it is recommended that the reader refer to the study of Manring (1985).

### Poisonous Articles Act (PAA), 1967 amended 1973

The PAA was enacted to control the import, export, manufacture, sales, storage, transport and use of poisonous substances including pesticides. The PAA is jointly enforced by three ministries: Ministry of Agriculture and Cooperatives (MOAC), Ministry of Public Health (MOPH), 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, labelling 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.

Under the Act, a poisonous chemical is classified as a highly poisonous article (with an acute oral LD 50* lower than 50 mg/kg body weight) or an ordinarily poisonous article (with a LD 50 higher than 50 mg/kg body weight).

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.

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* LD 50 stands for the amount of lethal dose per weight of a tested animal, mainly rats, above which will be fatal to at least one half the number of animals tested. The lower the LD 50 is, the more toxic the chemical.

Manring (1985) discusses these laws in detail and gives concrete recommendations for improving pesticide legislation in Thailand. One of his main points is that toxic substances (including pesticides) should be controlled by a separate, unbiased body or agency with an adequate, legislated budget. As it is now, three ministries have the mandate, but have inadequate manpower to enforce their existing law. A revision of the PAA was studied by a subcommittee of the Advisory Board of the Toxic Substances Control Committee. The subcommittee recommended that the PAA be revised. However, the Advisory Board decided in March 1986 not to amend the PAA at this time.

It is worth noting that the three phases of pesticide registration as recommended in the FAO Guidlines on Registration of Pesticides are being drafted to improve the registration process in Thailand (Rumakom, 1986).

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 Articles Act.

The Factories Act 1969

This Act gives 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.

## 5.2 BASIC PROVISIONS OF THE LAW

The Poisonous Articles Act has many limitations as analyzed in Manring (1985) and Roos (1985). However limited, it does provide certain basic concepts that conform to existing FAO Guidelines, primarily registration data and label requirements, a technical advisory committee to assist in evaluation of scientific data for registration, officers to monitor and enforce the law, and control of imports and restrictions on availability of pesticides.

## 5.3 LABELS

Thailand has adopted the WHO classification, which classifies pesticide formulation into different levels of potential hazard based on toxicity. Labels have a skull and crossbones and words "POISONOUS ARTICLE." For color coding, red is used for extremely and highly hazardous and yellow for moderately hazardous. The date of manufacture (not expiry) is required.

## 5.4 REGISTERED PESTICIDES

To date, Thailand has 161 active ingredients registered for agricultural uses and 23 for public and household uses. There are many different trade names listed for each chemical. For example, dimethoate is available under 110 different trade names, 15 of which are from one company. So many registrations make monitoring the chemicals in the market place in Thailand an unmanageable task.

## 5.5 LIST OF BANNED PESTICIDES

As an important part of the registration process, a registration should limit the availability and use of the more toxic pesticides by banning the product or restricting its use to a trained group of applicators or to a specific target crop.

Pesticides that have been banned for agricultural use in Thailand are chlordimeform, endrin, leptophos, aldrin, dieldrin, BHC, chlordane, heptachlor, toxaphene, sodium arsenite, DDT, TEPP and EDB. Only Compound 1081 has been banned for public health use.

Thailand does not restrict the use of pesticides and most of the popular brands with the farmer are classified by WHO as 1B (highly hazardous). They are popular because they give quick insect knockdown. Although people who sell pesticides are required to have a license (it has been estimated that only about half the dealers actually are licensed), there is no training or examination requirement. This is a major problem, as about 70% of the farmers get their chemical recommendations from the chemical dealers, not from extension personnel.

## 5.6 IMPLEMENTATION

Thailand falls short on the implementation of its existing legislation. Registration is too simple. A registration form requiring physical and chemical properties is summitted along with efficacy and minimal toxicology data. That is all that is required for registering a pesticide in Thailand. No residue nor environmental data are required. The registration system can be improved, as evidenced by the progress the Department of Agriculture is making in getting a three phase registration process set up, as recommended in the FAO guidelines.

Only minimal toxicological data are required. The requirements for toxicology data should be strengthened. To avoid duplicating work done in other countries, it has been suggested by the Thai Ministry of Public Health that toxicology studies should also have, if possible, a letter of approval from a recognized international authority like the United States Environmental Protection Agency.

## 5.7 MONITORING AND ENFORCEMENT

Substandard agro-pesticides in the market place are a major problem in Thailand (MOPH/FDA, 1983; Wieland, 1985; Mahidol University, 1985). It is estimated that 50% of the formulations are sub-standard by FAO specifications. This subject is covered in more detail in Chapter 7.

# CHAPTER 6

# PESTICIDES FOR PUBLIC HEALTH AND HOUSEHOLD PEST CONTROL

## 6.1 VECTOR CONTROL

Like most of the countries in the region, Thailand prefers to use DDT for malaria control. The rationale for using residual insecticides such as DDT for malaria control or eradication depends on the assumption that malaria vectors rest indoors either prior to, of more often after, feeding either inside or outside on man. DDT is sprayed at 2 grams per square meter on the walls and ceilings of living quarters.

The rational for preferring DDT over other chemicals is that it is relatively inexpensive, it is effective, it stays active a long time and it can be sprayed safely. The acute toxicity to DDT to mammals is about the same as aspirin.

While it is acknowledged that outdoor applications of DDT, including larviciding for mosquito control, are cause for environmental concern, residual house spraying as practiced for malaria eradication will pose negligible danger to the environment (Perring and Mellanby, 1977).

Thailand needs to import 700-800 metric tons of 75% DDT. However, the Ministry of Public Health (MOPH) only has a budget of 25 million baht which will buy 500 metric tons. In recent years, the 200 ton shortfall has been met by a Japanese grant for fenitrothion (Vongprayoon, 1986).

Ten years ago, about 1100 metric tons were imported every year for malaria control. That represents a reduction of about 40%.

There are five species of Anopheles mosquito that carry malaria in Thailand. These are rural vectors, preferring clean, slow-moving streams. As yet, there is no resistance by these five species to DDT.

Mobile teams spray for malaria control for two cycles a year, for a total of about eight months a year. Every sprayman is trained every cycle for three days by a section chief who uses a MOPH malaria training manual. A sprayman is trained in many relevant areas such as spraying techniques, sprayer maintenance, safety practices and communication skills.

A dwelling is sprayed from once to twice a year, depending on the incidence of malaria in the area.

Because of the relative safety using DDT, no special protective clothing is provided to the applicator. However, for spraying fenitrothion, the MOPH provides all protective clothing including masks and gloves and limits a spraymen only thirty days per cycle. Cholinesterase (CHE) levels are monitored as an estimate of exposure. Only 1-2% of the spraymen have had to stop spraying because of lowered CHE levels.

As an alternative to chemical control, the MOPH has encouraged the breeding and use of fish that eat mosquito larvae.

It is likely that chemical residual spraying will be continued in the future. About 20% of Thailand's population lives in areas with a high incidence of malaria, which are mostly in forested and border areas. Thirty years ago, there were 200 malaria deaths per 100,000 population. This has been reduced to 4.4 deaths in 1984.

Dengue fever is another mosquito transmitted disease. When outbreaks occur, malathion and fenitrothion are used for fogging. A very low amount of insecticides are used for this vector, and only on an as-needed basis.

## 6.2 HOUSEHOLD PEST CONTROL

The market for household pesticides is about a fifth the size of the market for agro-chemicals. This is mainly because chemicals used in household products have a very low per cent active ingredient (i.e. a little goes a long way). There are 40 registered importing companies and 31 formulators. Household pesticides are registered by the Ministry of Public Health. There are 23 active ingredients registered for household use, mainly insecticides. The most popular chemicals are dichlorvos, propoxur, Neo-pyr amin, S-bioallethrin and diazinon (Leelaprute, 1986). Dichlorvos is commonly mixed with propoxur or a synthetic pyrethroid. Dieldrin and aldrin are used for termite control. Household use pesticides are widely available and are formulated as coils, aerosols, powders, liquids, mats and baits. There is a 20% import tax on household pesticides.

There are 44 registered commercial applicators. Other companies are active, but not registered. In 1982, there were just 19 companies registered, so the competition has more than doubled since then. Although there is no special training requirement for registration (which costs 300 baht), the MOPH does monitor a company's storage and formulation procedures, ingredients used and contractual agreements with customers. The MOPH does train about poison prevention. Although there is a legal requirement that commercial applicators must pass an exam, this requirement is not enforced because of lack of budget and trained manpower. Of the ten randomly selected pest control companies contacted during this study, only one company (ACM Company) openly answered questions about the commercial applicator business in Thailand. Of the other nine companies, two had moved and seven became evasive when asked questions concerning training, chemicals used, etc., presumably out of fear of tax liability. The manager of ACM gained his experience working for the US Army many years ago. For general indoor pest control, he uses a synthetic pyrethroid. For fogging, he uses fenitrothion. For outdoor ant control, sevin is used. And for soil treatment for termite control, chlordane and aldrin are used.

# CHAPTER 7

# PROBLEMS WITH PESTICIDES IN THAILAND

## 7.1 LEGISLATION

As discuss in Chapter 5 and in detail in Manring (1985), the Poisonous Articles Act of 1967 (as amended in 1973) covers only the pesticides that have gone through the official gazetting process, not all pesticides or other toxic chemicals, including pesticides. The PAA should be amended to include all toxic chemicals. It has been estimated that it takes the governmental regulatory system about two years to find out about an unregistered pesticide being sold on the market. In a limited survey conducted by the Department of Agriculture, 8 out of 47 herbicides products were not registered.

The registration process for pesticides is too simple. Only an application form must be submitted along with efficacy and limited toxicity data, and a registration is granted with minimal scientific evaluation. Residue and environmental data are not required.

The registration process for pesticides should require residue and environmental data. It should also require more complete toxicology data, and, if available, include an endorsement of these data by a recognized authority like the United States Environmental Protection Agency.

Additional enforcement of the existing PAA is needed. For example, the lack of tight control is a major reason for the poor quality of formulations in the market. (See Section 7.2.) Several studies have indicated that about 50% of the agro-pesticides in the marketplace are substandard by FAO criteria. The authorities mandated to enforce the PAA should be given additional equipment, travel funds and manpower resources to effectively carry out this mandate.

## 7.2 POOR QUALITY OF FORMULATIONS

As mentioned above, about 50% of the agro-pesticides found in the marketplace in Thailand are substandard by FAO criteria (Wieland, 1985; Mahidol University, 1985; Sriplakich, 1986). Many of the formulations have no active ingredient of any sort in them. This has very serious implications for the farmer's use of pesticides, such as:

-- loss of money. The farmer can loose money on his crop and also on the money he spent on the pesticides.

-- loss of confidence in government personnel. If the extension service recommended that a farmer should use a particular pesticide at a specified rate, but the pesticide does not control the pest, then the farmer will lose faith in government recommendations.

-- pest resistance. If underdosing, a farmer could be encouraging the problem of pest resistance.

-- encourages farmers to use bad practices. Farmers overdose, usually by a factor of 2, in order to get the desired knockdown effect.

## 7.3 FARMER PRACTICES AND ATTITUDES

Studies indicate that pesticide management in Thailand, as practiced at the farmer level, is a problem (Sinhaseni, 1985; Wongphanich, 1985; Ross, 1985). Typical farmer attitudes are:

- -- pesticide use is necessary, unavoidable
- -- these pesticides should be used often, 1-3 times per week
- -- more chemical than indicated on the label should be used
- -- good to mix 2-4 chemicals together
- -- quick knockdown of insects means good control
- -- do not need more training
- -- see no relationship between high pesticide use and low benefitial insect populations

Typical farmer practices are:

- -- get pesticide recommendations mainly from their local pesticide dealer
- -- know that should use protective clothing, but don't
- -- sell empty pesticide containers to a middleman

The subsistence and near subsistence farmers purchase pesticides at the nearest retailer as soon as low populations of a pest appear. In a 1985 survey done by the Department of

Agricultural Extension in the Eastern Region, about 70% of the farmers relied on the retailer to advise them which pesticide to use. Most of the retailers have had no training except that given by the larger pesticide companies. They, of course, have a bias in favor of the retailer selling their chemicals, not necessarily the best and/or least toxic pesticide available. For the other 30%, they relied on chemicals used effectively by neighbors and recommendations from extension personnel.

It has been estimated that half of the farmers use larger concentrations of pesticides than recommended. Often, different pesticides are mixed. This is the classic syndrome of "if a little is good, then a lot must be better." And with the formulations being as inferior as the results mentioned above indicate, then it is little wonder that the farmers have to use increased doses to get the desired results. This encourages pest resistance and resurgence problems.

Because of the hot weather, farmers do not want to wear heavy plastic protective clothing. Often, the only protective clothing that would be worn in addition to regular work clothes (shorts and a shirt, no shoes) would be a scarf worn as a cover over the nose and mouth. Over 50% of rural farmers complain of some toxic reaction. (Wongphanich, 1985).

Banpot Napompeth, Director of the National Biological Control Research Center in Thailand, described one of the practices which result from the availability of toxic pesticides:

"When mixing the formulation for spraying, the farmer may dip his finger into the mix and taste it by dabbing his finger to his tongue. If it gets numb it indicates the right concentration." (Bull, 1982)

The storage of pesticides at the farmer level is almost always unsatisfactory. For the small farmer, pesticides were stored in the living area, often within reach of small children. In some of the larger farms, however, pesticides were stored away in separate shacks. Some of the additional problems are:

-- The shacks are poorly ventilated. This leads to a high rise in temperature during mid-day, hence a speedy decomposition of the pesticides.

-- The containers are not sufficiently well closed after some of the pesticide has been taken out. Thus, the entering humidity increases the destruction of the active ingredients.

-- The pesticides are not stored systematically. This leads to mix ups which can have severe consequences, especially when herbicides are confused with insecticides.

-- In-coming and out-going dates are not usually recorded.

-- Unusable pesticides are not properly destroyed but are stored in a corner. After a certain length of time the containers corrode and the contents flow onto the floor and make walking in the storage area dangerous.

## 7.4 TOXICITY OF PESTICIDES

A survey of pesticides conducted between 1966-1970 on farms in Rajburi Province revealed the following among the most commonly used: methamidophos (207 farms), methomyl (1965), ethyl parathion (94) and endrin (52). All of these are either banned or restricted for use in the USA. The survey report concludes:

> "Pesticides used in agricultural holdings are not necessarily those which are the best ones for the purpose sought by the farmer, but rather those which the retailers wish to push forward under the influence of the central distributors. Substantial divergences are found in accuracy of labelling and warning against potential risk." (Wongphanich, M., Kritalugsana, S., and P. Deema, 197?)

The situation has not changed much since then. Although different chemicals are now popular, the chemicals available are still classified as highly toxic and the farmer is still getting recommendations from the local retailer, who have their own economic position in mind.

Most of the popular brands of insecticides (monocrotophos, methyl parathion and carbofuran, for example) are classified as highly hazardous by the World Health Organization. Countries like Indonesia and Bangladesh impose limits on the toxicity of products allowed for use in the country. This automatically bans a product for use.

There are no restrictions on pesticide sales in Thailand. In the US and the Philippines, for example, highly toxic pesticides are restricted to use by a certified trained group of applicators or to a specific target application.

A reasonable approach for Thailand would be to follow the Indonesia/Bangladesh scheme and limit the toxicity of pesticides allowed for use by the farmer.

## 7.5 PESTICIDE GIVE-AWAYS

The Department of Agricultural Extension distributes free pesticides to farmers when there is a generalized pest outbreak. The plant protection units in each region have a warehouse that they keep stocked with pesticides all year. This is a very politically attractive policy. Local government representatives often give away pesticides as they go door-to-door to meet the electorate. This policy clearly encourages the use of pesticides, although a case could be made that it allows plant prctection and extension officers a chance to give away the appropriate pesticides. A study should be initiated to evaluate this give-away policy.

## 7.6 INDUSTRIAL SAFETY

The pesticide industry has focused insufficient resources on accident prevention for its workers, the surrounding environment, or the population living nearby. Pesticide manufacture in Thailand is limited to paraquat and a Bhopal-type disaster unlikely. However, an environmental disaster caused by fire like at the Sandoz plant in Switzerland is in the clear realm of possibility. This kind of disaster would be especially bad for Thailand, considering its intensive use of waterways for such varied activities as transportation, drinking, bathing and fishing.

But on a less spectacular scale, general plant hygiene and safety should be improved. As examples: fire fighting equipment should be available and maintained; appropriate protective clothing should be worn at all times; containment structures should be around all large liquid containers; and health and safety records kept for all employees.

# CHAPTER 8

# CONCLUSIONS AND PRIORITY AREAS FOR FURTHER DONOR ACTIVITIES

Thailand considers pesticides as vital inputs to agricultural production. However, there is considerable concern on their potential hazards to man and the environment.

Thailand accepts the concept of Integrated Pest Management (IPM), although its wide scale implementation is several years away.

The use of pesticides will likely increase, as will the concerns on safety of applicators, environmental effects, residues on food and pest resistance.

There is a need to strengthen the Poisonous Articles Act. However, this appears unlikely in the near future.

Farmers rely on pesticides and tend to over use them. Highly toxic pesticides are readily available.

## 8.1 PRIORITY AREAS REQUIRING A POLICY DIALOGUE

1. Strengthen existing legislation.
2. Restrict or ban highly hazardous pesticides.
3. Strengthen enforcement activities.

## 8.2 PRIORITY AREAS REQUIRING FURTHER STUDY

1. Disposal technology appropriate for Thailand.
2. Groundwater monitoring for pesticide residues.
3. The policy of giving free pesticides to curb wide-spread pest outbreaks.

## 8.3 EDUCATION AND TRAINING : RECOMMENDED FUNDING

1. The national train-the-trainer pesticide safe use program being organized by a working group of the Environmental Protection Committee. (See Section 4.1.)
2. In-country toxicology courses for regulatory personnel.
3. The development of a national pesticide public awareness program.
4. Study tours for toxicology training for regulatory personnel.

# CHAPTER 9

## PESTICIDES
## WHAT'S GOING ON IN THAILAND*

**Chiang Mai University**, Faculty of Agriculture, Chiang Mai 50002, Thailand.

Dr. Nuchnart Jonglaekha, Plant Pathologist

USDA funded Chiang Mai University to do a project called Development of a Plant Protection Programme to Facilitate Agriculture Development in the Highlands to Replace Opium Based Agriculture, September 1984 - March 1985. As part of this project, CMU investigated the problems of pesticide use in Northern Thailand. In summary, these problems often arose because of the low level of education and agricultural development of the hilltribes. Also, the rather exotic nature of the cash crops (carnations, asparagus, arabica coffee, Chinese apricots, roses, as examples) being used in opium substitution programs required practices and techniques of plant protection that were quite sophisticated by hilltribe standards. Take these two factors and add in an array of readily available very toxic pesticides and the stage is set for some serious health and environmental problems. The latter is a concern because the highlands are major watersheds for the urban populations of the north and central regions. Water supplies and fisheries are at risk.

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*includes organizations, contacts and a brief summary of past, current, and future programs.

**Chulalongkorn University**, Bangkok 10500.

Dr. Palarp Sinhaseni, Aquatic Toxicologist
Dr. Vilailag Im-Udom, Pharmacologist
Dr. Surin Setamanit, Director, Environmental Research Institute
Dr. Siriwat Wongsiri, Biologist

Dr. Palarp (Faculty of Pharmaceutical Sciences, telephone 251-1900-2) is an aquatic toxicologist. She became involved with pesticides during a fish kill epidemic in 1982, because it was initially believed that pesticides were the cause of the problem. She did sub-lethal and acute exposure tests. Working with a team from Stirling University in Scotland, it was found that the problem was not caused by paraquat as originally believed, but caused by a virus that originated in Australia. Several countries in Southeast Asia had the same disease problem.

In 1985, Dr. Palarp, in conjunction with other researchers from Chulalongkorn, conducted a survey on "Knowledge and Attitude of Farmers to Pesticide Usage and Their Sources of Information Concerning the Effects of Pesticides on the Environment." Results from the 171 people surveyed in the "green belt" around Bangkok showed various attitudes about pesticides, such as:

-- pesticide use is necessary, unavoidable
-- these pesticides should be used often, 1 - 3 times per week
-- more chemical than indicated on the label should be used
-- good to mix 2 - 4 chemicals together
-- quick knockdown of insects means good control
-- know that should use protective clothing, but don't

-- 50 % complained of some toxic reaction

-- used pesticide containers are sold to a middleman

-- do not need more training

-- see no relationship between high pesticide use and low benefitial insect population

Dr. Palarp is currently trying to set up a continuous flow-through laboratory for testing the sub-lethal effects of pesticides on fish hormones.

Dr. Vilailag (Faculty of Pharmaceutical Sciences, telephone 251-1900-2) has a small pesticide residue laboratory with one GLC. She is currently setting up the methodology that she will use for testing fruits and vegetables collected from the market place for pesticide residues. She would like to be able to do routine analyses on fruits and vegetables.

Dr. Surin (252-5929) said that the Environmental Research Institute is not yet involved with pesticide projects. However, there will likely be a pesticide sub-component in two future projects. The first will be for ERI to assess the environmental impact of "green belt" farming on the development of Bangkok metropolis. As part of this project, it is planned that the distribution of pesticides to the various sectors will be studied. The second is an irrigation project in the Northeast of Thailand where water is regulated by an electric pump. The water quality of the water pumped out will be monitored. Pesticides and other toxic substances will be included in the parameters monitored.

ERI does not yet have any analytical equipment for pesticide residue work, although the equipment is ordered and is expected to arrive this year.

Dr. Siriwat (Faculty of Science, Biology Department, telephone 252-7077) is a specialist in honey bee toxicology. He has tested most of the commonly used pesticides for toxicity to honey bees. For example, monocrotophos toxicity is 0.08 u/bee, methyl parathion is 0.11 u/bee up to 2,4-D with a 82.13 u/bee. Dr. Siriwat has observed a significant decrease in the populations of wild bees in the last few years. This decrease could be due to increased pesticide use in Thailand.

**ESCAP**, Agricultural Requisites Scheme for Asia and the Pacific (ARSAP), ESCAP Agricultural Division, United Nations Building, Rajadamnern Nok Avenue, Bangkok 10200, telephone 282-9161.

Mr. Luc M. Maene, FADINAP/ARSAP Team Leader
Mr. Peter Hegenbarth
Mr. Emmanuel Lepeu

From 1975-1982, the Government of the Netherlands funded ESCAP to manage a regional pesticides project called ARSAP, which is short for Agricultural Requisites Scheme for Asia and the Pacific. The broad objective was to better utilize agricultural inputs by small-scale farmers. This was a very successful regional project that focused on information collection (mainly on regional economic surveys), train-the-trainer courses for agricultural extension agents and pesticide vendors, and developing good training materials for these courses in the local language, including Thai. (See bibliography.)

The ARSAP agro-pesticides index, which was published in 1984, is currently being updated. This index is a directory of common and trade names of agro-pesticides compiled for the Asia-Pacific region, which will also be a source of information on main uses, properties, recommended doses and toxicity.

ARSAP is also initiating a computerized plant protection information service as a pilot project in Thailand, called IPHYTROP. Specific information gathered from many tropical countries on diseases, pests and pesticides will be made accessible through this project.

**Food and Agriculture Organization (FAO),** FAO Regional Office, Maliwan Mansion, Phra Atit Road, Bangkok 10200, telephone 281-4230/3/5 ext. 268.

Dr. W. L. Zhu, Regional Plant Protection Officer

FAO Rome has been very active in the last few years working on guidelines for a variety of pesticide issues: packaging and storage of pesticides, environmental criteria for the registration of pesticides, disposal of waste pesticide and pesticide ntainers on the farm, good labelling practices for pesticides, .fficacy data for the registration of pesticides for plant protection, and registration and control of pesticides.

Regionally, FAO is sponsoring the Inter-Country Programme for Integrated Pest Control in Rice in South and Southeast Asia. Dr. Peter Kenmore, who is based in Manila, is the acting regional program coordinator. Mr. Montri Rumakom from DOA (telephone 579-8540, 579-2350) can be contacted about the Thailand participation in that program.

FAO Rome (Dr. Kopisch-Obuch) also wrote up the project proposal called "Regional Pesticide Training Centre and Service Laboratory" which would be located at Chaing Mai, Thailand. This proposal was submitted to the Thai government for consideration in April 1986. The Thai government contribution is US $ 1,375,000 and donor contributions of US $ 4,244,213. No donor funding has yet been secured. Dr. Sakpryoon Deema (telephone 281-0857) [illegible] is a good local contact for this project.

**GTZ**, Thai-German Plant Protection Programme (TG-PPP), P. O. Box 9-100, Bangkok 10900, telephone 579-3839.

Dr. J. Schaefer, Project Manager
Dr. B. Heuel-Rolf, IPM Researcher
Dr. H. Waibel, Agricultural Economist
Dr. J. Hamelink, Plant Protection Extension Specialist

The German government has been very active in plant protection in Thailand. Currently, GTZ is implementing a project called Surveillance and Warning Service (SEWS) in rice-based cropping systems. This project was started in 1982 after the six year GTZ rodent control project ended. This current project will end in May 88.

The objective of the SEWS project is to increase farmer income by reducing pesticide inputs and at the same time increasing yields. Hence, this project should have an overall positive impact on the environment.

Initial results show that using the SEWS package, a rice farmer can average netting 80 baht per rai more per season than a farmer not using this technology package.

To accomplish the objective of the project, Department of Agriculture (DOA) and GTZ researchers first developed simplified sampling methods for insect monitoring. Next, they developed sampling methods for crop loss assessment using economic threshold levels (ETLs). The ETLs developed at the International Rice Research Institute were used as models, then modified to fit the local conditions. New ETLs were developed when necessary.

The main research component for SEWS has now been completed. The current effort is to transfer this technology package to the farmers using the training and visit system regularly used by Department of Agricultural Extension (DOAE) personnel. There are three pilot areas, with collaboration in these areas between DOA, DOAE and GTZ personnel.

GTZ has provided extensive equipment and vehicles for the DOAE offices at the national, regional and provincial levels. This represents quite a substantial financial input as there are 31 plant protection units (each with 2-3 mobile units to cover all 73 provinces) around the country, with 6 regional offices, for a total plant protection staff of 450 people. As a result of much effort, each plant protection officer is now acting as a subject matter specialist and involved with training the 6,000 DOAE extension officers. Each plant protection officer is also responsible for the collection of pest data. These data are then computer-processed at the regional level before being sent to DOAE in Bangkok.

An interesting pesticide sub-project of SEWS began in June 86 and will last for about two years. Hildegard Tuttinghoff from Stuttgart University will start collecting information for her Ph.D thesis on three subjects: 1) farmer practices in plant protection in rice cultivation, especially irrigated rice, 2) risk attitudes of farmers, and 3) information flow to the farmer. She will work in three provinces: Cha Choeng Sao, Chainat, and

Suphan Buri. For the first phase, she will survey from 180-240 farmers in six villages. Then, from November 86-May 87, the she will live in Cha Choeng Sao and closely observe 10-15 farmers, watching land preparation, pesticide purchase and use. This may be repeated another season. This will be an in-depth study that should be useful to clarify pesticide decision-making at the farmer level.

GTZ also sponsored another useful study in 1985, this one was to evaluate the quality of randomly selected pesticide formulations on the market in Thailand. The results were interesting. Of the 59 samples analyzed, about half of the samples were below 10% of the claimed concentration, with the rest being +/- 10% from the claimed concentration. These data have serious implications about the poor quality of pesticides being sold in the market place in Thailand. The lack of tight government control has to be a significant contributing factor.

**Japan International Cooperation Agency (JICA)**, Thai-Japan Weed Science Project, c/o Botany and Weed Science Division, Department of Agriculture, Bangkhen, Bangkok 10900, telephone 579-4230.

Dr. Kenji Noda, Project Leader

This project focuses on cooperative weed research activities in Thailand. The project was started in 1980. In addition to research, the Japanese have supplied equipment and machinery, and trained Thai researchers in weed science in appropriate institutions in Japan.

JICA has also funded several activities at NEB that are pesticide-related. According to Mrs Monthip, JICA has purchased several main pieces of pesticide analytical equipment for the NEB laboratory. JICA has also supported three analytical experts for one year each to come and work with the Thai staff to upgrade their analytical capabilities. Several important reports were produced with JICA collaboration. (See bibliography under NEB and Onodera). NEB has requested JICA to fund a research and training center for the analysis of toxic substances. This center would be located outside Bangkok near the airport. This is a 200 million baht proposal. Two Japanese are currently in Thailand for one year in order to draw up the master plan for this center. With that type of time and manpower investment, JICA must be serious about setting up this center.

Kasetsart University, Bangkhen, Bangkok 10900.

Dr. Sutham Areekul, Rector
Dr. Prasan Yingchol, Dean, Faculty of Agriculture
Dr. Neugpanich Sinchaisri, Entomologist
Dr. Kwanchai Sombatsiri, Entomologist
Dr. Banpot Napompeth, National Biological Control Research Center
Mrs. Patana Anurakpongsatorn, Chemist
Dr. Vichai Korpraditskul, Head, Central Laboratory

Dr. Sutham has a long and distinguished record of working on various aspects of insect pest management, especially in biocontrol. His list of publications is at least three pages long. His most recent work was on the King's project for suppression of opium and poppies in the hilltribe region. The report of his five year research effort is "Research on Indigenous Plants Containing Insecticidal Properties for the Effective Control of the Oriental Fruit Fly." Over 300 plants were studies for their insecticidal properties.

Dr. Neugpanich (telephone 579-3720) is researching the resistance of diamond back moths to synthetic pyrethroid insecticides on vegetable crops, mainly cabbage, radish and chinese kale. He has found that non-chemical Bacillus Thuringiensis controls the moths very well. This is a cooperative effort with the Department of Agriculture.

Dr. Kwanchai (telephone 579-1027) is researching neem extracts to control larvae of tobacco cutworm, aphids, diamond back moths, leafhoppers and American bollworm. Interestingly, neem is effective only when there is no insecticide resistance.

The Thai and India-type neem trees are plentiful in Thailand. The neem in Burma are believed to have even better insecticidal properties than the neems in Thailand.

Dr. Banpot is the Director of the National Biological Control Research Center which is headquartered at the Kasetsart campus. The center is a joint venture of various academic institutions and governmental agencies dealing with in biological control in Thailand. At HQ, there are laboratory, quarantine and training facilities. Regional substations for screening biological control agents are located at various geographical areas around the country.

The pesticide laboratory at the Bangkhen campus is run by Mrs. Patana. The laboratory equipment at Bangkhen consists of two GLCs (Perkin Elmer Model 910 with 2 FID, and Pye Unicam with 2 FID), one HPLC (Du Pont Model 860 with UV detector), one AA (Perkin Elmer Model 360), one IR (Beckman Model 4250, one UV (Beckman ACTA), and one double beam spectrophotometer (Hitachi Model 200-20). There are only two chemists working in the pesticide laboratory. All the residue work is for research only, and mainly on carbamates. Currently, decay curves for methomyl and carbaryl residues on jasmine flowers and mushrooms are being studied.

There is another pesticide research laboratory headed by Mr. Vichai (telephone 579- 0113 ext. 323) at the Kamphaengsaen Campus, 80 kms. from Bangkok. In this laboratory, decay curves for malathion and mevinphos in lettuce are being studied. No routine work is done there. This lab is equipped with one Shimadzu GLC, with FID/TCD detectors. The three laboratory chemists have access to two HPLCs (Jasco Model 100) and a UV spectrophotometer (Hitachi Model 100-20) located the biochemistry laboratory.

**Mahidol University**, Bangkok 10400.

Dr. Mathuros Ruchirawat, Pharmacologist
Dr. Jutamaad Satayavivad, Pharmacologist
Dr. Malinee Wongphanich, Head, Occupational Health Department
Dr. Somchit Viriyanondha, Clinical Toxicologist
Ms. Kanjana Pumala, Chemist

Dr. Mathuros (Department of Pharmacology, Faculty of Science, telephone 282-0197) has started to investigate the effect of chronic exposure to pesticides on acute toxicity of a known carcinogen. Nitrosamine has been selected as the model carcinogen because relatively high levels (ppm) of nitrosamines have been found in food in Thailand. Lindane or chlordane, both organochlorines, will be the first pesticide studied. Then one representative chemical will be selected from the organophosphates, carbamates, and synthetic pyrethroids. She is currently completing the first part of her research in which she studied the effect of selected pesticides on nitrosamine metabolism. The next step will be to study the effect of pesticides on two N-demethylation enzymes.

Dr. Jutamaad, a specialist in neuropharmacology (Department of Pharmacology, Faculty of Science, telephone 246-1378), is just starting to study the effect of pesticides (mainly organophosphates) on the susceptibility to malaria infections. Her main focus will to study the receptors of acetylcholine.

Dr. Malinee (Head, Department of Occupational Health, Faculty of Public Health, telephone 245-7793, 246-0053) was the senior author of a study in 1984 -1985 on "Pesticide Poisoning

Among Agricultural Workers." This was a survey on incidence of poisoning of 10,557 individuals in 2,298 households in agricultural communities in Rayong province. Her survey indicated a statistical value of pesticide poisoning incidents of 8,268 per 100,000. Of that group, only 2.4 % spent any time as an in-patient in the hospital. That shows what small number of poisoning cases actually are included in most hospital statistics.

The local hospital, which handles the whole province, had 44 in-patients listed under the category of poisoning for the calender year 1983. The majority of the cases were female (68%) and suicidial (61%). There was only one death, and the average stay was 2.5 days. The categories of specified chemical substance in order of frequency were: non-pesticide, bipyridyl (paraquat) and organophosphates.

A random sample (8 %) of the agricultural population was monitored for cholinesterase levels by the tintometric method. 37% of this group had been exposed to pesticides within the last month. Of the total group, 3 people were in the first stage of danger, 2 were marginal, and 12 were slightly below normal.

Recently, Dr. Malinee has completed the pilot for a more in-depth study in Rayong province which will focus on getting the farmer level health personnel, with participation of farmers (and approval by merchants and local government officials) and agricultural extension personnel, to get a daily health report (check list of symptoms) from farmers. The purpose is to educate health personnel and farmers into using pesticides more safely.

There is a system in place for getting this type of information to flow back up to the clinics, hospital and traditional practioners. However, this system is not working too well yet. An objective of this study is to get this system working efficiently and to fill in the data gaps for determining the actual incidence of pesticide poisoning in agricultural areas.

In 1985, Dr. Somchit (Department of Medicine, Ramathibodi Hospital, telephone 281-3566 ext. 1405) and Ms. Kanjana (Research Center, telephone 246-0024 ext. 1620) conducted a study on commercial pesticide formulations and found that most contain less active ingredient and volume than the claimed amount on the label.

Cypermethrin, monocrotophos and mevinphos were analyzed by gas chromatography. Ten from twelve brands of Cypermethrin contained the active ingredient within FAO limit but the exact volume of all brands was less than the labeled amount. Only one out of eleven brands of monocrotophos had the active ingredient within the FAO limit (98.70%). The other average contents were only 58.40% of the label (0-86.23%). Two of these products had the same volume as the label. For mevinphos, twelve brands were analyzed. Only one contained the active ingredient within the limit (98.96%). The average concentrations of the others were 76.12% of the label (0-93.38%). None of those satisfied the volume labeled.

**Ministry of Agriculture and Cooperatives (MOAC)**, Department of Agriculture (DOA), Agricultural Regulatory Division, Bangkhen, Bangkok 10900, telephone 579-4652.

Mr. Patanan Sangkatawat, Chief, Pesticide Regulatory Section

Mr. Patanan's section registers pesticides for agricultural uses in Thailand. His section also issues permits which allow import, manufacture and selling of pesticides. This section has access to pesticide supply and consumption figures and is responsible for publishing this information every year. Much of the information on pesticide supply in Thailand came from this very important section of DOA. Unfortunately, it is understaffed for enforcement purposes. Only recently has Mr. Patanan's section been given a gas chromatograph for monitoring pesticide formulations.

**Ministry of Agriculture and Cooperatives** (MOAC), Department of Agriculture (DOA), Entomology and Zoology Division, Bangkhen, Bangkok 10900, telephone 579-8540/579-2350.

Mr. Montri Rumakom, Division Director

Mr Montri is one of the key people involved with pesticides research in Thailand. His division is huge, with 13 research groups. His division is responsible for making the official DOA recommendations for pesticides used for agricultural purposes in Thailand. The FAO regional integrated pest control project and GTZ SEWS project are coordinated out of this division.

**Ministry of Agriculture and Cooperatives (MOAC),** Department of Agriculture (**DOA**), Agricultural Toxic Substances Division, Bangkhen, Bangkok 10900, telephone 579-3577.

Mr. Adul Worawisitthumron, Division Chief
Mrs. Yubon Yingchol, Chief, Research Sub-Division
Mrs. Nuansri Tayaputch, Chemist
Mrs. Supranee Impithuksa, Chemist
Mrs. Chiraporn Sriplakich, Chief, Pesticide Formulations

This division is mandated to carry out various phases of research on toxic substances, provide service for product quality control, and certification of pesticide residues in agricultural commodities.

There are two laboratories in this division. First, there is the central formulation control laboratory. There are seven chemists (4 BS, 3 MS) and three lab technicians. The lab is equipped with two Tracor GLCs with FID detectors and one Tracor HPLC.

The laboratory analyzes about 1,300 samples a year. They originate from various sources: 500 from DOAE (the pesticide purchased for "give-aways" to farmers); 300 from the Regulatory Division; 300 from the private sector; 100 from DOA researchers and 100 from the market place. Only the 100 or so marketplace samples are actually collected by personnel in Mrs. Sriplakich's section. The results are interesting. From DOAE, about 95% of the samples meet FAO specifications for active ingredient (a.i.), but about half have bad suspensibility. From the Regulatory Division, again about 95% of the samples are acceptable for a.i.

(suspensibility tests are done by the RD itself). From the private sector, about 70% are good for a.i. These samples are often brought in by the formulators themselves to try to check their products before distribution, as they may lack analytical capacity to do testing at the plant. From the DOA researchers and market place samples, about half of the samples do not meet FAO specifications for a.i., with many formulations having no active ingredient of any sort in them, which is about the same as GTZ and Mahidol University found. The data suggest several possible problem areas including sampling errors and old formulations in the market place. Or else companies may be switching to cheaper suppliers without knowledge of the regulatory officials.

Mrs. Sriplakich also had information about registered vs non-registered herbicides on the market in Thailand. In a limited survey, 22% (8 out of 47) of the herbicide products on the market in Thailand are not registered.

This Division also has the main DOA pesticide residue laboratory, which is the biggest and most extensively equipped in Thailand. There are at least ten gas chromatographs, but most of them are of the older Tracor type, with only two modern Shimadzus available. There are approximately 72 laboratory personnel. There are about 1,200 analyses done annually by this laboratory. About half are done on export crops to certify that they have pesticide residues below tolerance levels. They also do service work for DOAE and NEB.

In addition to the routine work mentioned above, this division has its own research projects on toxic substances. In 1986, there were 102 projects on their work agenda. Many of these were pesticide residue trials in various crops and soils. A complete list of these projects can be found in the MOAC/DOA file at USAID.

**Ministry of Agriculture and Cooperatives (MOAC),** Internal Security Operation Command (ISOC), 68 Paholyothin 45, Bangkok 10900. telephone 281-0857.

Dr. Sakprayoon Deema, Inspector-General

Dr. Deema is another key person in pesticides in Thailand. He was trained in the US as a pesticide residue chemist and worked for many years for MOAC/DOA as the Division Director for Toxic Substances before being promoted to his current position. As Inspector-General, he is very much involved all aspects of pesticides for MOAC, especially in the policy area.

**Ministry of Agriculture and Cooperatives (MOAC),** Department of Agricultural Extension (DOAE), Plant Protection Service Division, Bangkhen, Bangkok 10900, telephone 579-3008.

Mr. Udom Dechmani, Division Director
Miss Orapin Thirawat

In the area of pesticides, DOAE has a policy of providing pesticides free of charge when a widespread pest outbreak occurs. A whole range of pesticides are warehoused outside Bangkhen. Specific orders for pesticides are placed by the plant protection units in the regions for distribution in these areas.

As a component of the GTZ Surveillance and Warning Service (SEWS), 6,000 DOAE tambon extension agents will receive training in IPM field techniques and instruction on safe and efficient use of pesticides.

In 1985, DOAE funded certain plant protection units to give training to licensed pesticide retailers at the village level. This was a successful project, but it appears that funding for this type of training was limited in 1986. This is an important training course as most subsistence farmers purchase pesticides on the recommendation of the nearest pesticide dealer. These dealers do not necessarily have to be trained at all to sell pesticides. It is estimated that about half of the village level dealers are not even licensed, much less trained.

DOAE is trying to set up a pesticide residue laboratory so that they can monitor crops, etc. on which their pesticides have been used. They do have one Shimadzu gas chromatograph, however they are requesting that USAID assist them with the purchase of more equipment and training. This laboratory would also be a service laboratory for samples collected by extension agents.

**Ministry of Public Health,** Food and Drug Administration, Bangkok 10200, telephone 282-4180-5, ext 24 or 37, 282-2569.

Mrs. Yupa Leelaprute, Chief of Toxic Substances Section

Mrs. Yupa's section is responsible for registering pesticides for public health and domestic uses. She is a member of the Toxic Substances Control Board Sub-Committee. Her office serves as the coordinating unit for the UN sponsored International Programme on Chemical Safety (IPCS). Last July-August (1986), she organized a WHO-sponsored a five-day training course for regulatory personnel in Thailand on basic toxicology and chemical safety. She believes many more training courses on toxicology are needed.

Mrs. Yupa is also the contact person for the recently funded UNDP/WHO project on "Safty and Control of Pollutants and Toxic Chemicals." The total funding for Thailand is US$ 60,000 and this includes short-term consultants, contracts with national institutions, study tours, supplies and equipment.

**Ministry of Public Health,** Malaria Division, Vector Control Operation, Bangkok 10200, telephone 281-6642.

Dr. Surin Pinichpongse, Division Director
Mr. Samart Vongproyoon, Chief, Spray Operations

DDT is still the insecticide of choice for malaria control in Thailand. From 700 - 800 metric tons of DDT 75 % wp are used per year. DDT use has decreased from 1100 metric tons used ten years ago.

Thailand now buys its DDT from Indonesia, although it used to be purchased from the USA and Europe. The annual budget for pesticides for malaria control is about 25 million baht. This will buy only 500 metric tons, leaving a shortfall of about 200 metric tons. This shortfall has been covered in recent years by a Japanese government grant which provides fenitrothion.

The Anopheles mosquitoes transmitting malaria in Thailand are An. minimus, An. divus, An. maculatus, An. sunduicus and An. aconitus. These species of Anopheles are rural vectors only as they like clean, slow-moving streams as breeding sites. The klongs of Bangkok are too dirty. Hence, no malaria in Bangkok.

These five species have not developed resistance to DDT, although one or two other Anopheles species have. So, DDT is still the chemical of choice in Thailand for malaria control (with World Health Organization approval) because of several reasons including its relatively inexpensive price, low toxicity to applicators, and its long residual life, which is a desirable property for malaria control.

Spraying is done in residential dwellings during two cycles per year, for a total of about 8 months. In these dwellings, the walls and roofs are sprayed with two grams of DDT per square meter (or one gram for fenitrothion), once or twice a year, depending on the incidence of malaria in the area.

All spraymen are trained for three days before each cycle begins. It is a combination of lecture and practical training, preferably done in a village to get residential involvement.

The training is conducted by a sector chief who has a training manual which covers topics like practical spraying techniques, sprayer maintenance, protective measures and communication skills (to deal with villagers).

A DDT sprayman can only spray 60 days per cycle. A trained sprayman can spray from 5 - 7 houses per day. It is estimated that of an 8 hour day, four hours are spent actually spraying. The remainder of the time is spent waiting, walking and mixing.

A fenitrothion sprayman, because of the high toxicity of this insecticide, is only allowed to spray thirty days per cycle. Cholinesterase levels of the spraymen are monitored every week by the team leader using a Tintometer field test kit. There have only a few cases (1 -2 %) of lowered enzyme level, indicating some level of toxicity.

To reduce problems with villagers who may be reluctant to have their houses sprayed, a new USAID sponsored system has recently been started. Now, vehicle mounted loud speakers announce what the spraymen will do and why. This new system is working well.

**Ministry of Public Health**, Department of Medical Sciences, Division of Food Analysis, Yod-se Bumrungmueng Road, Bangkok 10100, telephone 233-1444, ext. 265, 233-9873.

Mrs. Chaweewon Halilamian, Division Chief
Miss Amara Vongbuddhapitak, Chief, Pesticide Residue Analysis Laboratory

This division is mandated to do routine analysis and research on food, beverages, water, food containers, food additives and contaminants to ensure consumer safety. This includes pesticide residues on food.

For routine survey work, chemists from this laboratory analyze primary and processed food, both for domestic consumption and export. The samples are collected at the wholesale and retail level by MOPH inspectors. All types of primary food (for example, fruit, vegetables, milk, eggs, etc.) are collected. In 1986, a total of 120 samples will be collected. Each year, a class of primary food is chosen for more intensive analysis of pesticide residues. In 1985, pulse crops were focused. This year it is vegetables.

In 1985, of the 200 samples of primary food that were analyzed, 70% were contaminated with detectable levels of pesticide residues, but all were lower than the maximum residue limit set by the Thai MOPH. Of the 40 samples of paddy and polished rice analyzed for organophosphates and carbamates (not for organochlorines), none had detectable residues.

In 1984, 200 samples of primary food were analyzed. Again, about 65-70% of the samples were contaminated with pesticide residues, with only about 3% of the samples exceeding Thai maximum residue limits. The results from the last five years are currently being compiled and will be completed by January 1987.

As part of their research program, this division has done several interesting studies. In the area of fish contamination, marine fauna from the Gulf of Thailand were monitored for organochlorine residues. In salt water, 62% of the samples had low level DDT residues, in addition to dieldrin (8%) and BHC (2%). In fresh water, shrimp, water and sediment from farm pond and canal water were monitored. Low levels of organochlorine residues were detected in shrimp (68%), water (11%) and sediment (76%).

In 1980 Miss Amara from this division did the only pesticide residue total diet study yet done in Thailand. (See bibliography under Vongbuddhapitak.) Daily meals were collected (including water and beverages) served to 20 year old males in Bangkok for 30 consecutive days were collected and analyzed. Actual intake of residues was calculated, and it was found that dieldrin intake was near the WHO-ADI (acceptable daily intake), DDT and endrin were 3 and 6 times lower than the ADI, while chlorane and heptachlor were very low. Whole blood residue levels were also determined for these 20 year old males. Total DDT was calculated to be 11.7-45.7 mean 25.5 +/- SD 8.1 ppb. (See bibliography under Thoophom.)

The Medical Science Laboratory is well equipped. The laboratory has four GLCs (Varian Model 2700 AFID/ECD, Hewlett Packard Model 5880A ECD/FPD, Hewlett Packard Model 5790 capillary ECD, and Shimadzu GC-7AG with TEA Model 543 Analyzer), two HPLCs (Varian Model 8500 and Hewlett Packard/Spectra Physics combination), a new GC-Mass Spectrometer (Hewlett Packard Model 5988A), one AA (Perkin Elmer Model 403), and several spectrophotometers. There are eight chemists in this lab, all with a B.S. degree or above.

The pesticide research will soon be moved to a new facility being built near Bangkhen by JICA, as part of a 400 million baht Japanese grant aid project to the MOPH. As part of that project, the Japanese are providing the following additional all Hitachi brand equipment for pesticide research: two GLCs (one ECD/FPD and one ECD/FID), two HPLCs Model 655, one AA Model 180, one IR Model 270, one MNR Model R600, one large spectrophotometer Model 557 and several smaller spectrophotometers.

**National Environment Board,** Environmental Quality Standards Division, Soi Prach-Sampan 4, Rama 6 Road, Bangkok 10400, telephone 279-7180.

Mr. Sirithan Pairoj-Boriboon, Division Director
Ms. Usanee Uyasatian, Chief Solid Waste Section
Dr. Jarupong Boon-Long, Chief, Toxic and Hazardous Substances Section
Mrs. Monthip Tabucanon, Chief, Laboratory and Research Section
Ms. Sukanya Buchalermkit, Toxic and Hazardous Substances Section
Ms. Rachanee Kaojarern, Toxic and Hazardous Substances Section

NEB is involved with several survey activities for pesticides. Regarding poisonings, letters have gone to all hospitals in the country requesting information on pesticide poisonings. In 1984, NEB got about a 48% response rate from the hospitals contacted. There were 129 deaths out of 2013 reported cases of pesticide poisonings in 1984. NEB agrees that these data are not necessarily reliable indicators for the actual cases of poisonings in the agricultural areas, but believe it is at least a start in the right direction. The response rate for 1985 will be higher, with the rate being 68% to date, with more data arriving daily.

Also, with an approved budget of 1.3 million baht from January '87 - October'87, NEB is conducting farmer pesticide surveys and collecting samples of produce, soil and water from the "survey" farms for pesticide residue analysis. They are sending teams to interview farmers in six provinces in both the wet and dry seasons on what agro-chemicals they are using and how they decide what to use. Samples of sprayed produce (mainly fruit and vegetables) are being analyzed for pesticide residues by the Medical Science Division of the Ministry of Public Health. Residue levels of organochlorines (mainly DDT and dieldrin) are being detected on produce, although organochlorines are banned in Thailand for agricultural (not public health) uses. Water and soil samples are being analyzed by the Department of Agriculture (DOA) at Bangkhen. According to Dr Jarupong, NEB has already approved the funding for five more staff members to carry out the survey work, starting in January 1987. He is planning to do extensive survey work all over Thailand, not just in the areas around Bangkok.

Mrs. Monthip and experts from JICA have been analyzing organochlorine pesticides in the Chao Phraya River and Bangkok klongs. In April (dry season) and October (wet season) 1984, water and sediment samples were collected from 33 sites located from 10-333 kms from Bangkok and analyzed for pollution levels of detergents, phenols, pesticides (organochlorines and organophosphorus compounds) and PCB's. Background levels of heavy metals were also established. Dry season organochlorine residue levels in water were 3-10 times higher than levels in the rainy season. Aldrin (supposedly banned in Thailand) showed up in 100% of the water samples, ranging from 0.002-0.284 ppb. And sediment samples contained residue levels that were 10-100 times higher than water residue levels. Accumulation in the order of 10 times is not unusual, but in the order of 100 times could cause a long term negative impact on aquatic organisms.

NEB, through the help of JICA, is rapidly developing as a major laboratory for doing pesticide residue analyses in Thailand. The laboratory has three GLCs (Varian 3700, Shimadzu 8A-F10, Shimadzu 7A) with all the standard detectors, three spectrophotometers (Hitachi 200-10, Jasco UNIDEC-340, and Cecil CE 343 for field use), one new HPLC (Shimadzu RF 530), two atomic absorptions (Perkin Elmer 372 and 2380), one infrared (Shimadzu 435), one total organic carbon computational system (Beckman 915B), three mobile labs (a trailer, a bus and a boat) for water, analysis, and two mobile labs (trailers) for air analysis.

National Institute for the Improvement of Working Conditions and Environment (NICE), Thaling Chan, Bangkok 10170. telephone 424-8001/4.

Dr. Peter Hasle, Associate Expert on Labour Inspection

In 1985, NICE and Thailand Development Research Institute (TDRI) collaborated in a study on a "National Strategy for Major Accident Prevention in the Chemical Industry." This study produced profiles of selected chemical industries emphasizing the manufacturing processes, the wastes generated, working environment, and the occupational safety, health and welfare of the employees. Ten pesticide factories were visited.

In early 1987, NICE is planning to survey several pesticide formulating and packaging plants in Thailand. This will be a second generation study, the need for which was identified in the NICE/TDRI study mentioned above. Air dust samples will be taken, then analyzed for pesticide residues, probably by the MOPH. NICE does not have the equipment or trained personnel to do the analyses in-house. Factories will be chosen where known problems exist.

**Regional Network for the Production, Marketing and Control of Pesticides in Asia and the Far East (RENPAF),** c/o Fertilizer and Pesticide Authority, 4th Floor, Benavides Street, Legaspi Vill., Metro Manila, Philippines, telephone Manila 818-5115.

Mrs Cecilia P. Gaston, Regional Coordinator
Mr Riksh Syamananda, MOAC, Thailand Representative, telephone 579-0151-8

The RENPAF project with nine member countries including Thailand was conceived in November 1983 at a meeting of data collection experts in Chiang Mai. It was decided at that meeting that there was an insufficient amount of information on pesticide supplies in the region. As an off-shoot from that meeting, a sub-project on data collection was started. Data from 1980-1982 have been compiled already.

Another sub-project is on the harmonization of pesticide registration requirements in member countries. This is a beginning of a very long-term effort, based on experiences in other parts of the world. The World Bank in conjunctions with UNDP, FAO, UNIDO and RENPAF will sponsor in 1987 a short-term regional laboratory training program for testing pesticide formulations and residues. The residue training may be done here in Thailand at the DOA laboratory at Bangkhen, with the formulation training likely to be done in India.

**Shell Chemical Company**, Chong Nonsei Installation, Klong Toey, Bangkok 10110, telephone 249-0531.

Mr. Suchon Boonchanawiwat, Agrochemicals Development Manager
Mr. Chugiad Saneetonikul, Pesticide Formulation Chemist
Miss Patchanee Chittawisuttikul, Pesticide Formulation Chemist

Shell has about a 7.1% share of the agro-pesticides market in Thailand. About 10% of the whole agro-chemicals market in Thailand (or about 400 million baht) is to DOAE. Shell is also a major reformulator, importing the technical active ingredient and reformulating in Bangkok at their Klong Toey facility. They have a capacity to reformulate about 1,500 tons per year (based on MOAC data).

Shell has 27 salesmen for agro-chemicals and 400 dealers. For dealers selling certain products, incentive programs are fairly typical: tours, rebates, fancy merchandise (TVs, videos, etc) and sometimes pick-up trucks. Farmer incentives include T-shirts, long-sleeve shirts, briefcases and sometimes TVs, etc.

The Shell laboratory is equipped to analyze for active ingredient of formulations only. They have one Hewlett Packard FID Model 5880A GLC. The GLC is computerized, so 99 samples a day can be run, although only about 50 are actually run. A HPLC has been ordered and will arrive in late 1986.

In 1982, Shell conducted a study on market place formulations of its major suppliers of monochrotophos (a very competitive market in Thailand). This is confidential data, so I was only allowed to get a summary of the results. From analyses of formulations from fourteen companies, the active ingredient was from + 1.88 to - 44 % off labelled content. Regarding volumes (many companies dispense less than the labelled amount in the containers), the volume was from -0.4 to - 11% off the labelled quantity. This indicates either out and out fraud, or else very poor quality control on the part the chemical companies. This causes good citizen companies like Shell to be at a serious market disadvantage, as their monocrotophos costs 240 baht per liter, and non-brand name chemicals cost 180 baht, or 33% less. And then there are all kinds of copy cat names and labels that their competitors use to imitate Shell products.

**Siriraj Poison Center,** Siriraj Hospital, Mahidol University, Bangkok 10700, telephone 411-2003.

Sompool Kritalugsana, M D, Director of Center, President of the Toxicology Society of Thailand.

Dr. Sompool runs an impressive clinical toxicology laboratory and can confirm suspected pesticides poisoning cases. He has compiled statistics on poisonings from 1980-1984. Interestingly, most of the poisonings were attempted suicides by women in the 15-29 year age group.

**Thai Pesticides Association.**

Khun Chalat Sripicharn, former president of TPA, Du Pont (Thailand) Ltd., 9th Floor, Yada Building, 56 Silom Road, Bangkok 10500, G.P.O. Box 2395, telephone 236-8585-93.

Khun Chuer Pavasant, current president of TPA, ICI Asiatic (Agriculture) Co., Ltd., 53-55 Oriental Avenue, Bangkok 10500, G.P.O. Box 1510, telephone 233-2020.

TPA was formally registered in February 1983. It presently consists of 29 members that import and repack over 80% of the pesticides in Thailand.

In 1985, the TPA in conjunction with DOAE conducted one day training courses for dealers on several subjects: safe handling, storage and use of pesticides; crop economics; the pesticide law; and pest economics. A film in Thai produced by Bayer on pesticide safety was also shown. Nine courses were held in the Western Region; and five courses in the Southeastern region. In 1985, 452 dealers actually attended these courses. In 1986, six courses were held in the southern region, with 271 dealers invited (an 80% attendance was expected). Courses in the Northern Region are being planned for the second half of 1986.

This type of activity should be encouraged. Also, along with GIFAP, the international trade association of the manufactures of agrochemicals, TPA sponsored the TPA-GIFAP/Asia Working Group workshop on pesticides in February 1986. Important issues were discussed such as encouraging members to conform to the FAO Code of Conduct for Pesticides.

TPA is very much involved with national train-the-trainer program for pesticide safe and effective use described in Section 4.1.

**Thailand Development Research Institute (TDRI)**, Natural Resources & Environment Program, Rajapark Building 163 Asoke Road, Bangkok 10110, telephone 258-9012 - 17, 258-9027 - 29.

Dr. Dhira Phantumvanit, Associate Director
Dr. Yothin Unkulvasapaul, Research Fellow

In January 1986, TDRI completed a study for the International Labor Organization on "National Strategy for Major Accident Prevention in the Chemical Industry." A field survey was conducted in 27 chemical plants producing pesticides, basic chemicals, explosives, LPG and paints. The objective was to make a first-hand assessment of the toxicity and potential hazards in the chemical industry. Types and quantities of dangerous substances were identified, and disposal techniques observed. The safety procedures being followed were assessed, in particular chemical handling and storage practices.

Using World Bank criteria, 20 of the 27 plants visited possessed hazardous substances in sufficient quantity to be classified as a major hazard installation. Practices such as unsafe methods of loading and unloading chemicals, improper storage of chemicals and improper disposal of toxic waste were observed.

**Tropical Development Research Institute** (TDRI), Pesticide Management Section, College House, Wrights Lane, LONDON W8 5S.J.

Dr. I. H. Haines, Head

The TDRI is currently implementing a research project called "Pesticide Management in Relation to User Safety." Thailand will be one of the countries included in this project. Phase I of this project is to identify, in the context of developing countries, the nature and extent of hazards that pesticides present to users in pest control operations. Phase II of this project will be to determine (through a program of research and development on key factors in pesticide management), systems, the extent to which hazards might be reduced in given pest control situations.

**United States Agency for International Development (USAID),** 37
Soi Somprasong 3, Bangkok 10400, telephone 252-8191.

Mr. Doug Clark, Director, Office of Technical Resources
Mr. Will Knowland, Natural Resource Advisor
Mr. Ian Craig, Cropping Systems Specialist, NERAD project,
Tha Phra, Khon Kaen 40260, Thailand

USAID/Thailand is currently involved with several efforts in the area of toxic chemical management. Through its Emerging Problems in Development II project, USAID sponsored three studies on the management of hazardous chemicals in Thailand in 1985. These are listed in the bibliography under Cohen, et. al., Manring, and Roos. These studies were broad in scope, dealing with all hazardous chemicals in Thailand, not just pesticides. This study on the "Pesticide Situation in Thailand" represents a continuation of this USAID strategy.

In mid-86, USAID sponsored a pesticide disposal study. The objective of this study was to determine if there are any imminently hazardous pesticide dump/storage sites in Thailand. Although no large dump sites were found, the study did include disposal technology applicable to Thailand. (Jensen, 1986).

In the Northeast Agricultural Development project (NERAD), USAID is running IPM experiments in order to reduce the need for pesticides. As part of that project, a survey was conducted in 1985 among farmers in all NERAD tambons to determine their general knowledge about pesticides, application procedures, and usage patterns on various crops. This survey is written in Thai, but will soon be translated into English.

The NERAD project has also had several specialized experimental IPM projects including one on papaya cross-resistance and the introduction of Bacillus Thuringiensis for non-chemical pest control.

In February 1987, USAID will sponsor the Southeast Asian Pesticides and IPM Workshop in Pattaya, Thailand.

# CHAPTER 10

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