PUBLICATION SERIES NO. 5

Crop Protection Policy in Thailand

Economic and Political Factors Influencing Pesticide Use

Frauke Jungbluth

Crop Protection Policy in Thailand

Economic and Political Factors Influencing Pesticide Use

Frauke Jungbluth

A Publication of the Pesticide Policy Project

Hannover, December 1996

Publication Series No. 5

Pesticide Policy Project Publication Series
No.5, December 1996

Institut für Gartenbauökonomie,
Universität Hannover

Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH

Crop Protection Policy in Thailand

Economic and Political Factors Influencing Pesticide Use

Editors of the Pesticide Policy Project Publication Series:

Prof. Dr. H. Waibel
Institut für Gartenbauökonomie
Universität Hannover
Herrenhäuser Str. 2
30419 Hannover
Germany

Dr. T. Engelhardt
Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH, Abt. 423-4
Postfach 5180
65726 Eschborn
Germany

Publication of the Institute of Horticultural Economics, Herrenhäuser Str. 2, 30419 Hannover

Printing: Uni Druck Hannover, 30419 Hannover

Table of Contents

List of Figures

List of Tables

List of Annexes

List of Abbreviations

BAAC	Bank of Agriculture and Agriculture Cooperatives
Baht	Thai Currency
BPH	Brown Plant Hopper
c.i.f.	cost, insurance, freight
DOA	Department of Agriculture
DOAE	Department of Agricultural Extension
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GIFAP	International Group of National Associations of Manufacturers of Agrochemical Products
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH
ha	hectare
IPM	Integrated Pest Management
NEB	National Environmental Board
NGO	Non Governmental Organization
mill.	million
MRL	Maximum Residue Level
MOAC	Ministry of Agriculture and Cooperatives
MOPH	Ministry of Public Health
PIC	Prior Informed Consent
PPSD	Plant Protection Service Division
rai	Thai Measurement = 0.16 hectare
TDRI	Thailand Development Research Institute Foundation
t	tons
TGPPP	Thai German Plant Protection Programme
TPA	Thai Crop Protection Association
US$	United States Dollar
WHO	World Health Organization

Currency Exchange Rate:

1 US$ = 25.6 Baht (at Dec. 11th, THE ECONOMIST, 14th Dec. 1996)

Acknowledegments

Information and data compilation of this report has taken place in Thailand. Numerous individuals and institutions contributed to this process through their profound knowledge and expertise. I like to thank all of them for their willingness and kindness to contribute their knowledge to this report.

The support of the following institutions is gratefully acknowledged: The Department of Agriculture, the Thailand Development Research Institute and the Thai-German Plant Protection Programme. I am grateful to all of them for making my stay in Thailand possible and for their strong support during the research. Among these, I like to thank especially Mr. Ocha Prachuabmoh and Mr. Wit Namrungsi from the Entomology Division of DOA, where I found a homebase, Dr. Nipon Poapongsakorn of the Sectoral Economics Program of TDRI who supported the second part of my research and Dr. Günther Baumann of the TGPPP who has always been a very strong source of information and support.

Mark and Ursula Childs' and Julia Motta's English revision as well as Suwanna Pranetvatakul's Thai translation have been highly appreciated.

To Jaree Kiatsupimol, Jaruvan Jansai, Nat Rathanadilok, Lakchai and Patcharee Menakanit, Sarut Sudi-Aromna and Saranchit Krairiksh my deepest thanks. Their assistance and support contributed extensively to my research in various ways and made my stay in Thailand a very pleasant one.

I am grateful to Prof. H. Waibel and Gerd Fleischer for comments and discussions on earlier drafts of this paper.

Preface

The paper on crop protection policy in Thailand by Frauke Jungbluth is the second case study that follows the "Guidelines for Pesticide Policy Studies", published as the first issue of this publication series.

Thailand provides an excellent example for such a study for two reasons: firstly, because of its successful economic development during the past decade which brought about significant structural change in the agricultural sector and secondly because of the pivotal role it is playing in the transfer of technological and institutional innovations to its neighboring countries on the Indochinese peninsular.

The growing diversity of forces and opinions in the Thai society provides the ground for initiating plant protection policy reform taking into account criteria of welfare economics. A German-sponsored project on pesticide policy is taking up the task of assisting the Thai government in developing and implementing a more effective regulatory framework in pesticide registration and use. A workshop, as a collaborative effort of Hannover University, the Thailand Development Research Institute (TDRI), FAO and GTZ, on building consensus towards pesticide policy reform will be conducted during 1997.

The paper written by Ms. Frauke Jungbluth provides an excellent basis for stimulating the discussion on the extent and the direction of forces that affect the social optimum level of pesticide use in Thailand. As shown in the expert survey of chapter seven, a considerable variation in the understanding, the interpretation and the assessment of the technical, economic and social forces that affect pesticide use exists. The discussion among experts of crop protection issues will certainly be stimulated further by the nevertheless crude assessment of the costs to society caused by current pesticide use. The author must be commended for showing the courage to provide useful estimates based on a really sparse data situation. The report therefore also identifies information gaps that need to be filled if decision-making at various levels of the production, consumption and conservation process will be improved.

It is anticipated that the report will initiate similar studies in other Asian countries and contribute to a higher regard given to economic instruments in crop protection policy.

Hermann Waibel December 1996

Executive Summary

This report is based on the hypothesis that in many countries pesticides are used at levels exceeding the social optimum. For several decades pesticides have been the primary method to control pests in agriculture. Therefore, two assumptions can be derived: Real costs of pesticide use are not yet fully internalized and ongoing support of chemical pesticides influences the pesticide use level. Continuous subsidization of pesticides in national agricultural policy may be one indicator for these assumptions as well as the neglect of external costs in cost-benefit assessments of pesticide use.

Thailand has been chosen as one country for an analysis of crop protection and crop protection policy. Leading questions of this report are: How did the agricultural sector and the pesticide market in Thailand develop? How is the crop protection policy in Thailand designed and where are constraints? To what extent do externalities from pesticide use exist in agricultural production? What factors are contributing to a pesticide use level above the social optimum?

Chapter 2 gives an overview about the role of agriculture in the overall economy as well as agricultural development trends. Mainly due to the fast growth of the manufacturing sector, the share of agriculture within the gross domestic product is declining steadily to almost 11% in 1994. However, agriculture continues to be important in terms of employment. In 1994, 63% of the total labor force worked in the agricultural sector. Being mainly a rice producing country in the past, Thailand's agricultural sector became more diversified in the last decade. Especially, horticultural crops like vegetables, fruit and flowers gain a growing importance. Chapter 3 analyzes the situation of the pesticide market and pesticide use patterns. Thailand's annual agrochemical market growth is forecasted at a 2.5% rate for the next years. In 1994 the total sales volume of the Thai pesticide market amounted to 247 million US$. The horticultural sector as a pesticide intensive sector is hereby of growing importance. The pesticide market can be considered very liberal and many companies are importing and selling pesticides in the country.

Chapter 4 and 5 summarize important aspects of agricultural policy and of the institutional framework related to crop protection policy. Price factors, institutional factors as well as biased information and human resource capacities can be identified as factors in favor of pesticide use. Thus, pesticides experience continuous strong support neglecting economic considerations. The tolerance of negative externalities of pesticide use is another factor of support. Externalities like health hazards, residues in food

and water or resistance build-up are discussed in chapter 6. Costs of externalities are calculated and a preliminary assessment of the social costs of pesticide use is undertaken. For pesticide related health hazards, costs ranging from 1 to 13 million Baht have been assessed depending on the data set chosen. Costs for residues in food amount to roughly 5,000 million Baht for fruit and vegetables, if products with residue levels above the MRL would not be marketed. For resurgence the annual costs for a BPH outbreak are considered amounting to 57 million Baht, crop losses not considered. Costs for other negative externalities have not been assessed due to lack of data. Summarizing the costs for negative externalities to health and the environment as well as governmental budgets for research, monitoring and regulations related to pesticides, the social costs of pesticide use amount to 5,492 million Baht.

In chapter 7 an expert assessment has been the tool for a quantification of factors supporting pesticide use. Results prove that current crop protection policy has a high priority for chemical crop protection methods. Price factors and factors related to information were assessed to have the strongest stimulating effect on pesticide use, followed by institutional constraints.

In Thailand tax reductions for pesticides and complementary inputs along with the provision of the “outbreak budget“ of the crop protection service clearly subsidize pesticide use. Institutional and information constraints contribute to the support of chemical crop protection. Market transparency is lacking and little measures are taken to control and supervise the pesticide market. Research and extension targets focus on chemical crop protection to a large extent. Biased information is existing, firstly, at the farmers’ level concerning benefits of pesticide use, quantities applied as well as safety measures taken, secondly, at the policy level due to lack of information on crop protection alternatives as well as on costs and benefits related to pesticide use.

Ongoing support of pesticide based crop protection methods hampers the dissemination of alternative methods like IPM. However, adoption of alternative technologies can only be expected if systems are sufficiently developed. Therefore more research is needed regarding crop protection alternatives, calculation of benefits of pesticide use and external costs. Policy actions would be desirable minimizing ongoing pesticide support and reducing use levels towards the social optimum.

1 Introduction

For several decades crop protection in agriculture focused on the use of chemical pesticides. On the one hand this was a consequence of changes in agricultural systems. The introduction of intensive monoculture with high yielding varieties and high use levels of fertilizer made adoption of pesticides a cost-effective choice[1]. On the other hand pesticides themselves induced changes in agricultural systems and ecosystems with negative consequences such as pest resistance, destruction of beneficial organisms and pesticide residues in food and water. Even though pesticide use on a world wide scale increased steadily in the last four decades, crop losses could not be reduced correspondingly (PIMENTEL et al., 1993). Due to negative side effects pesticide use in agricultural production became more and more a controversially discussed issue.

Pesticides still have a high reputation in their relevance for securing sufficient agricultural production and increasing yields. The ongoing support of pesticides in national agricultural policy is one indicator of this belief. This leads to the assumption that the common opinion about benefits of pesticide use has been taken for granted and external effects caused by pesticide use have not yet been sufficiently taken into account.

Therefore a hypothesis can be formulated which states that in many cases the amount of pesticides currently used in various cropping systems is at levels exceeding the social optimum. Two assumptions can be drawn from this hypothesis: Costs of pesticide use are not yet fully internalized into the market process and ongoing support of chemical pesticides influence the pesticide use level. Economic assessment of pesticide use, therefore, has to be treated within a framework that covers both, the point of view of farmers as well as of the society. The criterion for the farmer is to maximize expected net returns, the one for the society is to maximize net social benefit. The last differs from the private optimum in the externalities which are not taken into account by the farmer (WAIBEL, 1994).

This study is based on the methodological framework of the ‘Guidelines for Pesticide Policy Studies’ (AGNE, FLEISCHER, JUNGBLUTH, WAIBEL, 1996). Factors influencing the use of pesticides have been classified into four groups: a) Price factors, b) Institutional factors, c) Factors related to

---

[1] The term ‘pesticide’ in this report refers to all chemical pesticides used in plant protection, including insecticides, herbicides, fungicides, fumigants, rodenticides as well as plant growth regulators.

information and human resources as well as d) Lack of consideration of external costs of pesticide use. The aim of the GTZ/University of Hannover project on pesticide policies is to apply this framework to country studies.

Thailand has been chosen as one case study. A detailed analysis of the driving forces in crop protection has been regarded as an useful approach to explain the current existing design and constraints in crop protection policy. The research has been carried out in cooperation with a broad spectrum of organizations and individuals working in the field of crop protection. Information given in this study derives from numerous discussions and interviews with experts from the agricultural departments and other governmental agencies, technical service organizations, the chemical industry and its organizations and farmer and consumer organizations. Additionally, available background information has been included. The data compilation for this report has been conducted between March 1995 and August 1996.

Chapter 2 gives a short overview of the role of agriculture in the overall economy and the characteristics of Thailand's agricultural sector. Chapter 3 introduces the development of the pesticide market, the pesticide import situation as well as recent developments in pesticide use. Chapter 4 and 5 concentrate on agricultural and crop protection policies. Existing pesticide legislation, registration and regulations are discussed and organizational structures relevant in the crop protection as well as their impact and other aspects of crop protection policies are introduced. Chapter 6 discusses the existence and evidence of external effects related to pesticide use. A preliminary assessment of external costs is conducted. Chapter 7 summarizes the results of an expert survey about crop protection policy and its influencing factors. Experts in the field of crop protection have been asked to conduct an impact assessment of factors influencing pesticide use. Chapter 8, finally, presents conclusions and recommendations as well as further research needs in the area of crop protection policy. The appendix provides additional information on every chapter of the report.

2 The Agricultural Sector in Thailand

2.1 The Role of the Agricultural Sector in the Economy

With the rapid expansion of the overall economy came a structural adjustment in the agricultural sector and a diversification of agricultural production[2]. Although Thailand's manufacturing industry is leading in the country's overall development, the agricultural sector remains important in terms of capital accumulation, employment and contribution to government's revenues through export earnings. To date, Thailand is still one of the world's leading rice exporters. The agricultural sector has been outward oriented, traditional agricultural exports seem to have reached their limits. But nevertheless, the sector continues to be important for the economy in terms of employment and strategies to alleviate poverty (WORLD BANK, 1994).

The agricultural sector's share of the total gross domestic product (GDP) declined steadily in the last decade to almost 11% in 1994, although it continued to increase slightly in total value (BANK OF THAILAND, 1995). The agricultural sector could not compete with the fast growth of other sectors, especially the industrial sector. The agricultural sector employs with around 64% a substantial share of the total labor force[3]. Figure 1 shows the development of the sectoral shares of the GDP. The manufacturing and the service sector are contributing mostly to the GDP while agriculture and trade have a declining trend.

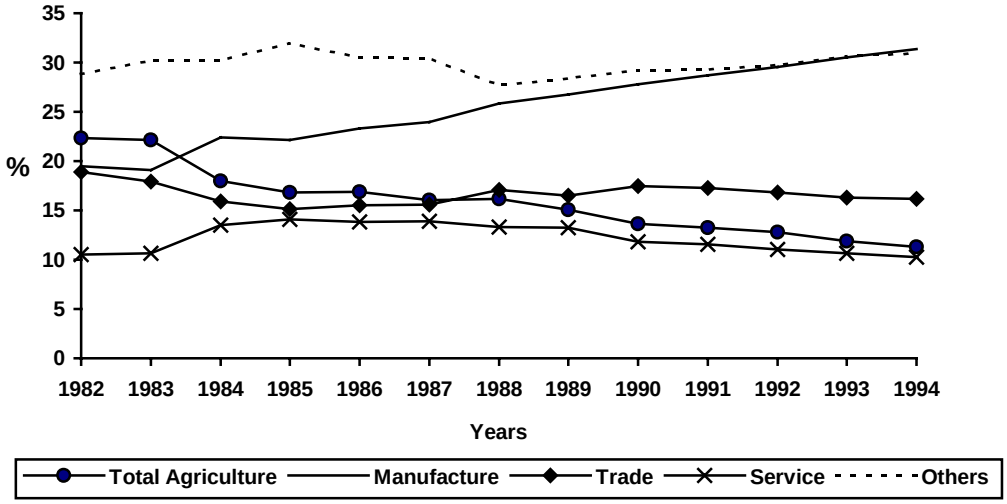
In recent years declining prices for most agricultural products and especially rice led to diversification in agriculture (SIAMWALLA et al., 1992). POAPONG-SAKORN (1994) raises three main points for changes in the agricultural sector: a) The diversification of agricultural production, b) The migration of agricultural laborers into other sectors and c) A lack of manpower in the central region. Most economic development has taken place in the central region, increasing the discrepancies between production sectors, employment and income possibilities among the regions.

---

2 A map of Thailand is shown in Annex I. Table 1 and Figure 1 in Annex II give some background information on Thailand's economy.

3 According to Labor Statistics 18,834,000 persons worked in the agricultural sector in 1994. Thirty-nine percent are own account workers and 46% are unpaid family workers while the rest splits into employers, government and private employees (Thailand in Figures, 1996).

Figure 1: Development of Sectoral Shares of the GDP (%)



Source: Quarterly Journal Bank of Thailand, various issues

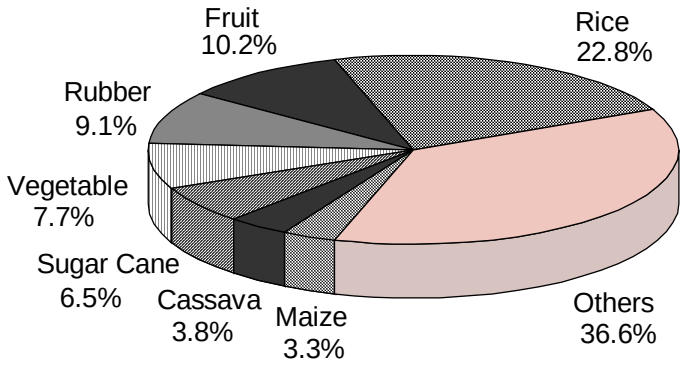
2.2 The Agricultural Sector: Characteristics and Trends

Agricultural production is taking place on 22.9 million hectare. This corresponds to 44.6% of the total land area of Thailand (513,115 km^2). The value of agricultural exports dropped from a sector share of 46% in 1982 to around 15% in 1992 (WORLD BANK, 1994) amounting to roughly 100 billion Baht (BANGKOK POST, 1995)[4]. Rice still remains the most important agricultural crop and is planted on around 44% of arable land. Its share of agricultural exports is still around 22%. Figure 2 summarizes the farm value of important agricultural products.

4 Refer to Table 2 and Figure 2 in Annex II for details about land utilization.

Figure 2: Important Agricultural Crops by Farm Value, 1993

(Total farm value 283,516.8 million Baht)

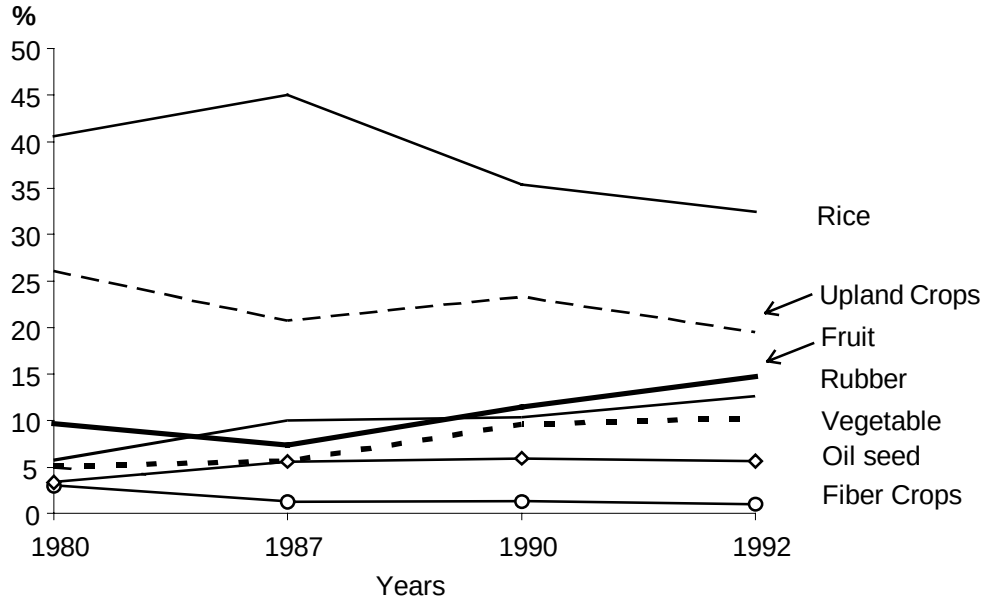


Source: Office of Agricultural Economics, Agricultural Statistics, 1994/95

Figure 3 summarizes the development trends in crop production in the last decade. The decline in rice production as well as upland crops, being of major importance in the early eighties, can be seen. The area for paddy cultivation is projected to continue declining in the 1994/95 season (BANGKOK POST, 1995). In particular, the most important changes are taking place in the rapidly growing horticultural sector. The Ministry of Agriculture now strongly promotes fruit production. A production restructuring program (MINISTRY OF AGRICULTURE, 1994) has been enforced to transform land cultivated with rice, cassava, coffee and pepper into fruit orchards[5]. The increasing importance of fruit and vegetables in terms of crop values is visible.

[5] The major objective of the program is to transform 1.4 million rai of the acreage currently occupied by the above mentioned crops due to their marketing problems. Farmers receive low interest loans and additional assistance in factor inputs (BANGKOK POST, 1993).

Figure 3: Development of Crop Value for Different Crops in Thailand in Percent of Total Crop Value (1980 - 1992)



Fiber crops: cotton, kapok, kenaf
Upland crops: maize, cassava, soybean

Source: Office of Agricultural Economics, Agricultural Statistics, various issues, author's calculations

The trend towards diversification within the agricultural sector goes along with a tendency to cultivate more pesticide intensive crops. The intensity of pesticide use in vegetables and fruit is comparably high and does therefore contribute to the overall trend of increasing agrochemical use in the country[6]. Overall, land for agricultural use is still slightly expanding but is reaching the limits, as natural resources are gradually being used up. In the future marginal areas will contribute little to agricultural production because of price declines of crops planted and labor shortages due to migration. Production increases are thus only possible through agricultural intensification. This is especially the case in the Central Plains where market access is good. Depletion of natural resources is regarded as a factor for retarded agricultural growth in the future (SETBOONSARNG, 1993).

6 Refer to Table 2 in Annex III for more details.

3 Pesticide Market and Pesticide Use in Thailand

During 1982-1992 the annual growth rate of the agrochemical market in Thailand amounted to 8.8%. The market increase slowed down in the last years. The forecast for agrochemical market growth predicts an annual growth rate of 2.5% for the following five years (WOOD MACKENZIE, 1993). In 1994, the pesticide market reached a sales volume of 247 million US$ (LANDELL MILLS, 1994).

This chapter firstly concentrates on the structure and development of the pesticide market, followed by a closer look at pesticide imports and their trends. Finally, patterns of pesticide use and their importance in selected crops are discussed[7].

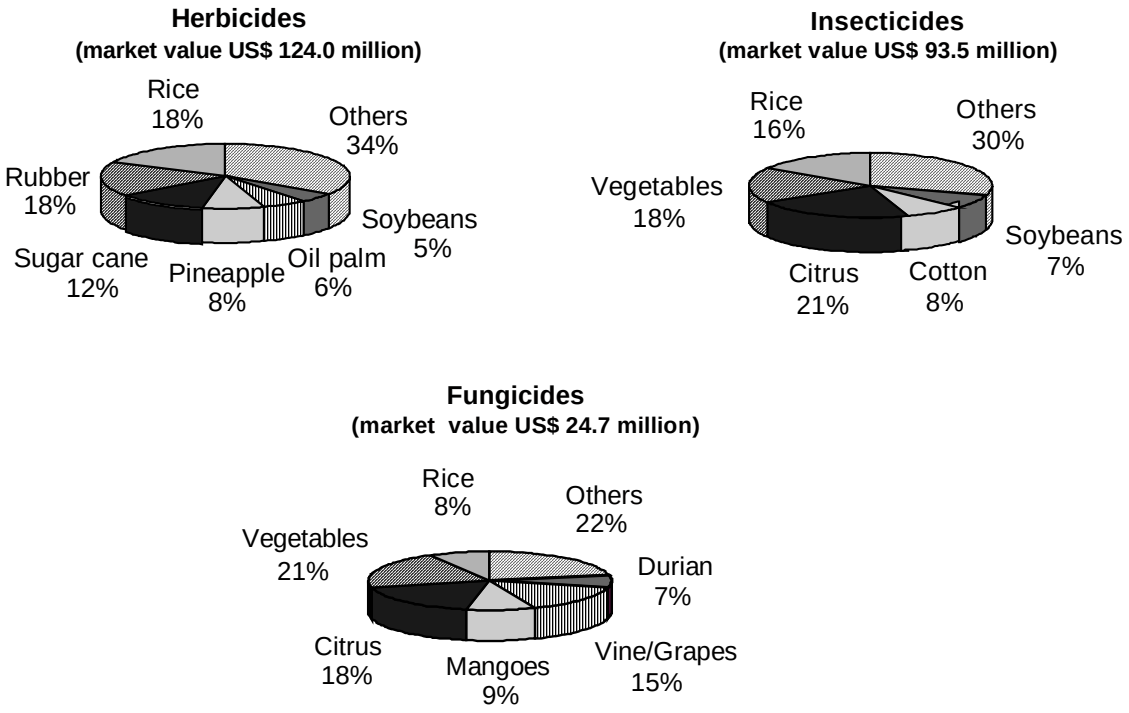
3.1 The Pesticide Market

Thailand's pesticide market can be regarded as liberal. Import and sale of pesticides are handled by the private sector. Imports can be either formulated products or active ingredients, which are formulated in the country. The latter has an increasing import share, though many international pesticide companies established formulating plants in the country or cooperate with local plants. The only pesticide manufactured in the country is paraquat. Two manufacturing plants produce 5,500 metric ton per year (TAYAPUTCH, 1992).

Figure 4 gives an impression of the market share by crop and pesticide product class. For the herbicide market the plantation crop and the rice sector are of great importance. Most important for the insecticide market are the rice and the horticultural sector. The horticultural sector is most important for the fungicide market.

7 Annex III provides more background data on the Thai pesticide sector.

Figure 4: Market Share by Crop and Product Class, 1994



Source: Landell Mills, 1994

Imports of pesticides increased heavily in the last decade[8]. The biggest increase can be observed for herbicide imports, while insecticide imports increased moderately. As fruit belong to the group of pesticide intensive crops it is expected that pesticide use will increase again, if the new policy of the Ministry of Agriculture successfully changes field crop land into fruit growing areas. This development is unlikely to be halted by concerns over heavy pesticide use due to the increasing importance of the fruit sector in agricultural exports and increased consumer demands for a good physical appearance of the products.

The ten leading imported pesticides for 1994 split by product class can be seen in Table 1. These pesticides have a total import share of 70% for insecticides, up to nearly 90% for herbicides as well as for fungicides, respectively. The three most important pesticides per class cover more than 50% of the total quantity of imported pesticides. This indicates a market concentration on few pesticides. However, the variety of pesticide products available results in the large amount of product names.

8 More details in Table 1 and 2 in Annex III.

Table 1: Main Pesticides Imported in 1994 (tons)

Insecticides		**Herbicides**		**Fungicides**	
name	*quantity*	*name*	*quantity*	*name*	*quantity*
monocrotophos	1,363	glyphosate	6,187	copper oxychloride	1,574
methamidophos	1,149	2,4-D	2,665	sulfur	1,097
methyl parathion	1,117	atrazine	1,640	zineb	972
dimethoate	354	ametryn	990	mancozeb	630
methomyl	329	paraquat	766	captan	539
malathion	247	alachlor	582	carbendazim	476
carbosulfan	240	diuron	564	propineb	325
mevinophos	196	butachlor	561	metalaxyl	225
fipronil	181	bromacil	196	phosphorous acid	177
carbaryl	147	thiobencarb	179	maneb	146
Total	**5,323**	**Total**	**14,330**	**Total**	**6,161**
% of all imports	**69.06**	**% of all imports**	**88.96**	**% of all imports**	**87.20**

Source: Regulatory Division, Pesticide Statistics, 1994

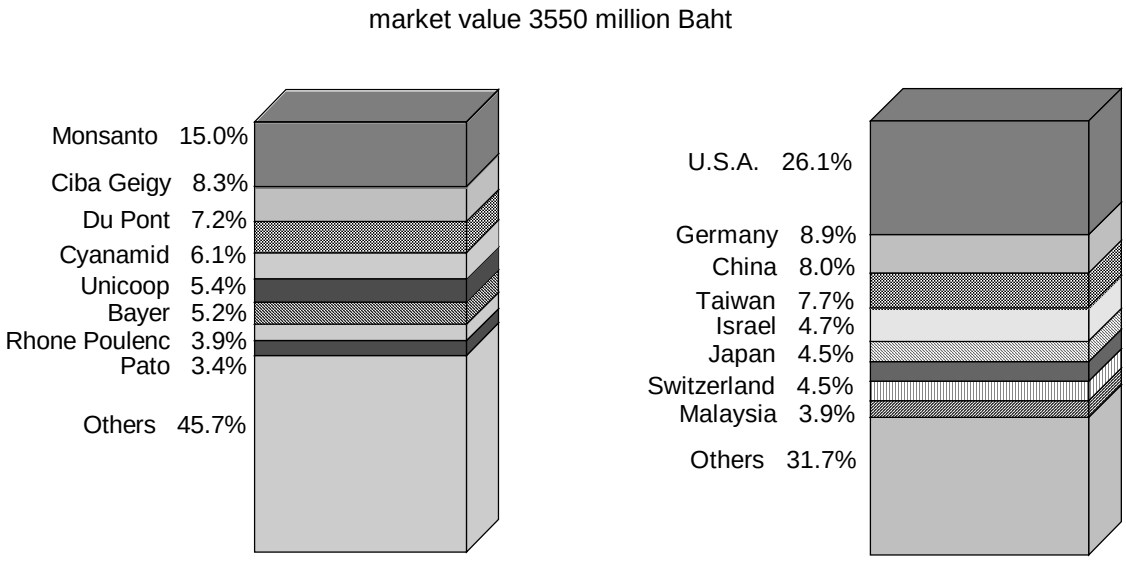
Many companies import and sell pesticides in Thailand[9]. Apart from numerous traders the most significant specialty of the Thai pesticide market is the large amount of trade names. Trade names do not necessarily relate to either the active ingredient, the effectiveness of the product or the recommended field of usage. For example, monocrotophos is being sold under 274 different trade names, methyl parathion under 296 and paraquat under 55 (CIRAD, 1990). Additionally, retailers have the possibility to apply for a product registration which allows producers to sell the same product under different trade names. This confusing number of trade names in the pesticide sector makes market transparency for users and the monitoring and control of the market for governmental agencies nearly impossible.

Thirty seven companies are large scale producers and belong to the Thai Pesticide Association, just recently renamed to Thai Crop Protection Association. The Thai Crop Protection Association claims 82% of the market share (SINHASENI, 1992). The remaining companies are small to medium scale producers and partly belong to the Local Thai Association of Pesticides, which has currently 46 members. Currently, 69 formulating and repackaging plants, 438 distributors and around 5000 retailers conducting business in Thailand (DOA, personal communication, 1996).

9 Refer to Table 4, Annex III for the main manufacturers and their main products.

The biggest market shares are possessed by international pesticide companies. Figure 5 shows market shares of major producers as well as major exporting countries. In 1994, the pesticide statistics list 71 pesticide importers originating from 33 countries. The major exporting countries are the United States of America followed by Germany, China and Taiwan. In terms of quantity of market shares the U.S.A. are the major supplier followed by China, Malaysia, Taiwan and Israel. This may indicate that a major share of pesticides imported in terms of quantity belongs to the category of pesticides of the first generation, which are more voluminous, generally off-pattern and therefore cheaper.

Figure 5: Market Share of Major Pesticide Producers and Major Countries Exporting to Thailand in 1994
(in percent of market value)



Source: Regulatory Division, Pesticide Statistics, 1994, author's calculations

Distribution of agrochemical products in Thailand is usually a two stage process. Products are sold from the producer or formulator to dealers and afterwards to sub-dealers or retailers. The pesticide companies employ sales personnel for the wholesale business as well as for retail at the farmer's level.

One problem associated with the pesticide production is the insufficient quality of the products. In a survey of 373 randomly selected pesticide formulations conducted in 1983, 44% of the samples differed significantly from the indication on the label (TAYAPUTCH, 1992). Taking this into account, farmers have limited opportunities to control the amount of active ingredients

sprayed on their land. Several studies indicate that farmers experienced that the amount recommended on the label is not effective and consequently start to apply higher quantities (GRANDSTAFF, 1992).

As stated in a report of FAO-JICA (1995) in Thailand a strong preference for cheap pesticide products still exists. This explains partly the enormous share of pesticides classified as most hazardous in the Thai pesticide market which tend to be cheap on international markets. SONGSAKUL (1991), for example, found that for vegetable production in the Pathum Thani province the pesticide costs have an average share of 14.6% of the total variable costs. This already may be a level where input prices play an important role in the management decision making process.

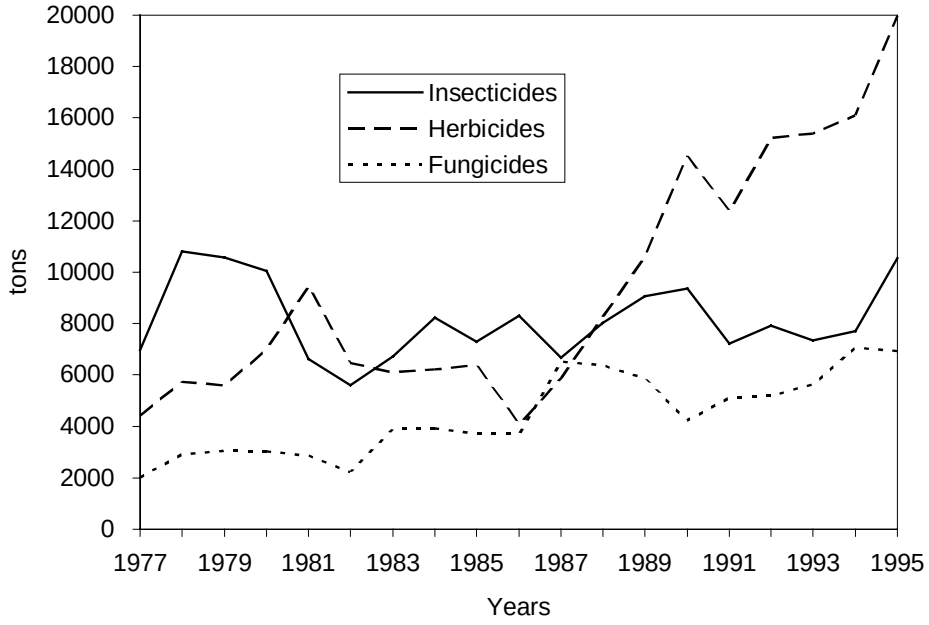
3.2 Pesticide Imports

As most of the pesticides used in Thailand are imported the development of pesticide imports is closely related to development trends of pesticide use. Figure 6 shows that the import of pesticides strongly increased over the last twenty years[10]. From 1976-1995, the quantity of insecticides imported increased from 5,960 tons to 10,560 tons, resulting in an average annual growth rate of 2.9%. However, imports varied from year to year partly depending on the actual pest occurrence. Herbicide imports increased more remarkably from 2,293 tons in 1976 to 19,954 tons in 1994, equivalent to an annual growth rate of 11.4%. Fungicide imports increased from 1,299 tons to 6,937 tons, with an annual growth rate of 8.7%.

Figure 7, informing about the trend of pesticide imports, indicates only a small difference of the market value of insecticide and herbicide imports. For many years, the majority of imports were insecticides. Since 1988, they have been exceeded by herbicide imports. High demand for insecticides in the year 1989/90 seems to be largely a result of a Brown Plant Hopper (BPH) outbreak (WOOD MACKENZIE, 1993). Herbicide use is strongly driven by the expansion of the plantation sector. Therefore, focus lies on non-selective products. Increases in herbicide use can also be related to higher labor costs for mechanical weeding and labor scarcity (GRANDSTAFF, 1992).

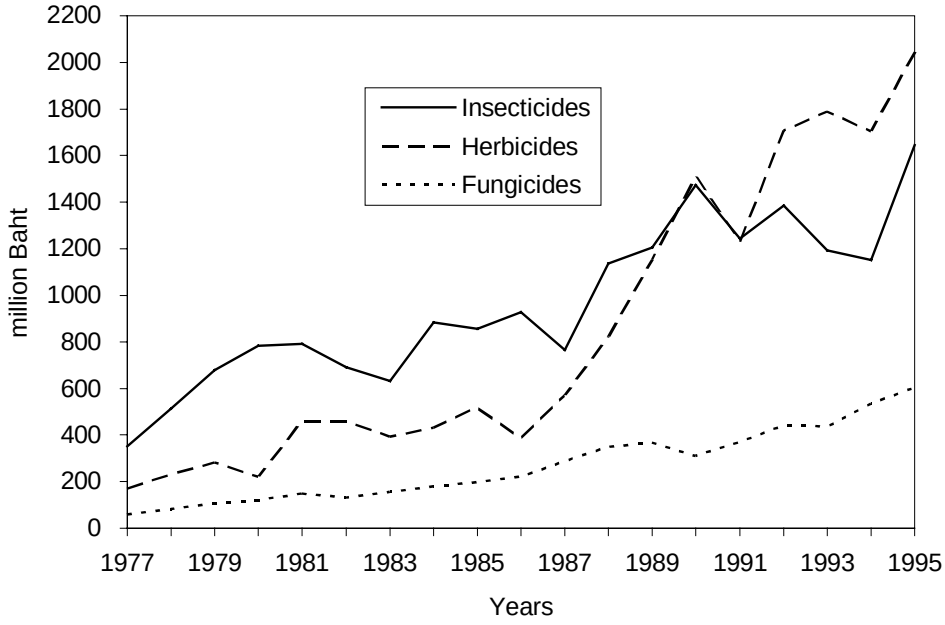
10 Refer to Annex III, Table 1 and Figure 1 for the development of pesticide ex- and imports.

Figure 6: Quantity of Pesticide Imports 1977-1995



Source: Regulatory Division, Pesticide Statistics, various issues

Figure 7: Value of Pesticide Imports 1977-1995



Source: Regulatory Division, Pesticide Statistics, various issues

The list of the main pesticides imported in 1994 underlines the increasing importance of herbicides (refer to Table 5, Annex III). In 1994, in terms of quantity three herbicides are the most imported pesticides, followed by a fungicide and insecticides. 115 tons of bio-pesticides have been imported in 1994[11]. The trend for the use of bio-pesticides is rising. On the other hand still a large amount of pesticides imported to Thailand belong to the group of more hazardous pesticides. In 1992, according to WHO classification more than 60% of the imported pesticides belong to the classes “extremely“ and “highly hazardous“ (SINHASENI, 1994).

Table 2: **Quantity of Imported Pesticides by WHO Classification**

	Hazardous Class	Quantity (tons)	Percentage
I_A	Extremely Hazardous	1,765.2	23.50
I_B	Highly Hazardous	2,979.6	39.67
II	Moderately Hazardous	2,494.7	33.21
III	Slightly Hazardous	267.0	3.56
III+	Unlikely to present hazard in normal use	4.7	0.06

Source: Sinhaseni, 1994

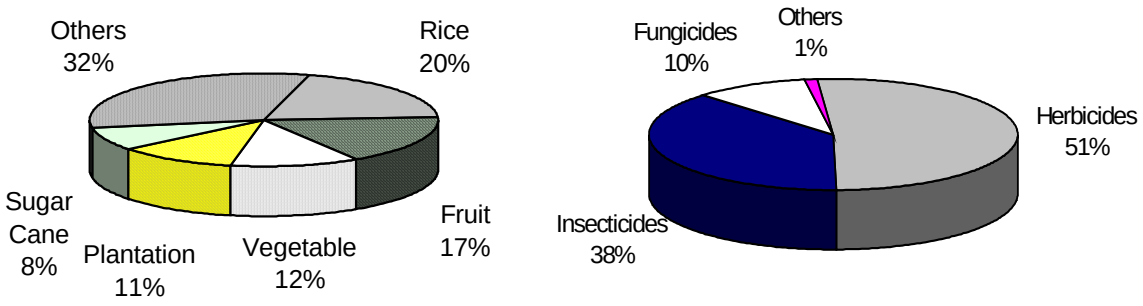
3.3 Patterns of Pesticide Use in Thailand

In 1993, the pesticide market has reached a sales volume of 247 million US$ (LANDELL MILLS, 1994). Herbicides hold a share of 51%, insecticides 38% and fungicides 10% (Figure 8).

Looking at pesticide use by crop, rice continues to be the major user of pesticides. However, rice grown on around 44% of total agricultural land has a share of the pesticide market of 20%. In contrast the fruit’ and vegetables’ share, grown on less than half of the rice cultivated land, amounts to 29%. While pesticide use intensity in rice is comparatively low on a per unit basis, pesticide use in fruit and vegetables is much more intensive. However, rice is still an important crop for the pesticide market because of its large growing area.

11 mainly bacillus thuringiensis and vertimec

Figure 8: Pesticide Use in Selected Crops and Product Classes, 1992
(in percent of market share, total market volume 175 million US$)



Source: Wood Mackenzie, 1993

Table 3 shows the average intensity of insecticide use for various crops[12]. It is obvious that fruit and vegetable production are much more intensive regarding insecticide use.

Table 3: Average Insecticide Use by Crops of Economic Importance
(in US$ pesticide market value/ha)

Crop	Planted area (ha)	Percentage share of insecticide market[1]	Insecticide market volume (million US$)[1]	Average intensity of insecticide use (US$/ha)
Rice	10,112,833	16%	14.96	1.5
Citrus	83,696[2]	21%	19.64	234.7
Vegetable	80,106[3]	18%	16.83	210.1
Cotton	59,117	8%	7.48	126.4
Soybeans	454,000	7%	6.55	14.4
Others	11,266,795	30%	28.05	2.5
Total	22,179,364	100%	93.5	4.2

Source: [1] = Landell Mills, 1994, [2] = Fruit Statistics, DOAE, 1994, [3] = Vegetable Statistics, DOA, 1993, others: Agricultural Statistics, 1994; author's calculations

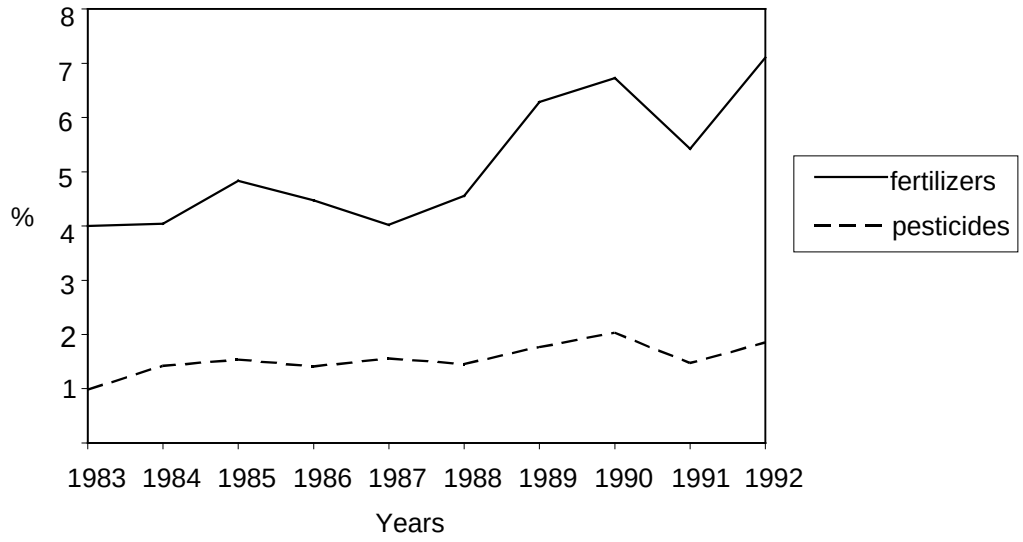
Use of chemical pesticides in Thailand began in the early 1950's. Increasing pesticide use has been accompanied by other changes in pest control. This is reflected in the increasing amount of application equipment owned by

12 For more detailed information on the amount of pesticides used per crop refer to Table 2 and 3 in Annex III.

farmers[13] and the increasing average of pesticides used per hectare of land, which grew from 1.6 kg per hectare in 1978 to 3.3 kg in 1988 (GRANDSTAFF, 1992).

Figure 9 emphasizes the fact that inputs increased in relation to crop value which implies that the input intensity of agricultural production is rising. In other words, more pesticide and fertilizer inputs are used to obtain the same crop value. Fertilizer imports are increasing even faster than pesticide imports.

Figure 9: Fertilizer and Pesticide Imports in Percent of Crop Value



Source: Office of Agricultural Economics, Agricultural Statistics, various issues, author's calculations

The determining factors for the trend of increasing pesticide use are largely found in the agricultural policy focusing mainly on certain crops for specific areas, resulting in uniform cropping patterns and a loss of diversity. This, invariably, has implications for pest control, making production systems more dependent on pesticides. At the same time problems with the chemical approach of pest control become more obvious. SINCHAISRI (1988) pointed out some possible reasons for the failure of chemical control: Improper pesticide application, use of expired chemicals and incorrect labeling of active ingredients. Resistance problems and pesticide overuse can be added to this list.

[13] The OFFICE OF AGRICULTURAL ECONOMICS used an annual growth rate of 24% for hand operated sprayers and 10% for machine operated sprayers for their calculations during the last five years in the Agricultural Statistics.

Farmers use pesticides intensively and there is little control of the amounts used and the application frequency. THONGSAKUL (1990) states that application of pesticide mixtures is a common practice. Pesticide mixtures often consist of several pesticides and are mixed without relation or knowledge about effectiveness or combination possibilities. Spraying frequency is crop dependent, but can reach high levels. Often the farmer's lack of awareness is seen as one major reason for pesticide problems. Several studies about farmers' awareness conducted in Thailand (studies from 1985 summarized in GRANDSTAFF, 1992) concluded that more than one half of the farmers applied dosages higher than recommended on the label. Almost all of the farmers regularly mixed two or more pesticides for one application. Reasons can be to save time or the common belief that pesticide mixtures are more effective. Decisions about pesticide mixtures are made either by retailer recommendations or according to the common habit in the area (SONGSAKUL, 1991). The studies mentioned above concluded that either farmers did not care or have not been aware of potential hazards. It is assumed that meanwhile the awareness of potential hazards of pesticide usage has increased. At the same time farmers fear the consequences of assumed crop loss and perceive that risk can be reduced with higher pesticide inputs. With the increasing trend of pesticide use and the continuing insufficient efforts to control pesticide hazards the negative consequences will become more apparent in the future. Concerns about the use of pesticides will hardly disappear.

4 Overall Agricultural Policy and Pesticide Legislation

4.1 Agricultural Policy

Agricultural policy is part of the National Economic and Social Development Plan of Thailand. In general the objectives of the agricultural policy cover almost all aspects of agriculture: infrastructure, inputs, production, productivity, marketing and price, natural resources, farm incomes etc. Special attention and emphasis on specific areas were identified in each development plan. The current seventh development plan (1992-1996) emphasizes the following (TDRI, 1995):

- efficient use of natural resources
- support of research, development and technology transfer in agriculture
- restructuring of agricultural production according to local conditions and market demand
- support of agro-industry
- improvement of agricultural and cooperative development systems

Rationale for diversification and restructuring are on the one hand declining world market prices and a declining Thai comparative advantage of the commodities (rice, cassava, coffee and pepper) on world markets. On the other hand the increasing problem of water shortages. Recommended and promoted crops are vegetables and cut flowers as well as fruit trees, fast growing trees, cattle dairy and mixed farming.

For most of the period from 1950 - 1980 government intervention and support of agricultural development were moderate and assistance to agricultural exporters not significant. The main forms of governmental assistance have been the construction of the Chao Praya irrigation system in the Central Plains, concessional credits and the establishment of agricultural research and extension services (SIAMWALLA et al., 1992).

The government intervened to some extent to restrain the export of agricultural products through various forms of premiums, duties, quotas and licenses, aimed at ensuring adequate domestic supply and preventing inflation in domestic food prices. However, export taxes for rice (in 1986), maize (in 1981) and rubber (in 1989) have been abolished, cassava and sugar still receive some governmental protection. Support and protection of

the importable commodities (palm oil, soybeans, pigs and pig meat, dairy products, cotton, vegetables and fruit) is existing (EAST ASIA ANALYTICAL UNIT, 1994).

4.2 The Pesticide Legislation

The creation of the Hazardous Chemicals Act can be regarded as a major change in crop protection policy in Thailand. As of April 6th 1992 the Hazardous Chemicals Act replaced the Poisonous Articles Act of 1967. The Hazardous Chemicals Act is the main act which regulates pesticide use in agriculture. At the moment around twenty laws exist related to the control of chemicals in all areas of pesticide use (BOON-LONG, 1995). BOON-LONG (1995) states that the reason for the new legislation lies in the big number of hazardous substances used in various businesses of which some caused serious injuries to persons, animals, plants, properties and the environment.

Poisonous Articles Act

The *Poisonous Articles Act* of 1967, amended 1973, focused mainly on chemicals for agricultural use. The term poisonous articles refers to ingredients or an article containing active ingredients including ordinary and highly poisonous articles. Only the differentiation between highly poisonous and ordinary poisonous existed. The act's main focus was on agriculture as the chairman of the Poisonous Articles Board came from the Ministry of Agriculture and members of the Ministry of Agriculture were dominant on the board.

The Hazardous Substances Act (1992)

This act includes ten categories of hazardous chemicals. In contrast to the old act, chemicals for agricultural use are only one category[14].

---

[14] Hazardous substances refer to articles which are explodable, flammable, oxidizing agent or peroxide, poisonous, cause of illness, radioactive, cause of mutations, erosive and others, whether they are chemicals or of other nature that may cause danger to a person, animal, crop, properties or the environment. Hazardous substances are classified according to four groups:

- I hazardous chemicals for which the production, import, export must be in compliance with the principles and procedures promulgated
- II hazardous chemicals for which the production, import, export or being in possession must be informed to the authorities
- III hazardous chemicals for which the production, import, export or being in possession must be permitted
- IV hazardous chemicals for which the production, import, export or their possession are legally forbidden

No registration is necessary for chemicals of category I while category II and III need to be registered before manufacture and/or import.

In the new act, the Hazardous Substances Committee has been enlarged[15]. The Hazardous Substances Board represents the legislative arm of the act. There are several Sub-Committees working on more specific issues of hazardous chemicals[16]. One of the new aspects enclosed in the Hazardous Substances Act is the responsibility given to all persons being in possession of a hazardous chemical for damages to persons, animals, crops and the environment (BOONLONG, 1995).

Although progress has been initiated with the new act, implementation is slow and difficult. Some reasons for inconsistencies in common practice and law enforcement are:

- Insufficient monitoring and control of the pesticide market
- Lack of market transparency due to large number of companies trading with pesticides and the unreasonable high amount of trade names
- Time lag between constitution of legislation and its implementation

4.3 The Pesticide Registration

Within the amendment of the Hazardous Substances Act, the regulatory process changed slightly. Thailand agreed to the FAO Code of Conduct and the Prior Informed Consent (PIC) in 1991. Efforts have been made to follow the Code of Conduct in the regulatory set-up.

Since April 4th 1991 the Department of Agriculture notified the phased registration system according to the Code of Conduct as the new system for pesticide registration. However, the ministerial decree for enforcing the phased registration came into action on May 27th 1995 only. This indicates the slow process of implementation. All types of pesticides are controlled by the Act. The regulatory process involves three steps: First, the registration license, second import, manufacturer and/ or retailer license and finally market inspection.

---

15 For the constitution of the Hazardous Substances Board see Table 1 in Annex IV.

16 For the Department of Agriculture the existing three Sub-Committees are:
Sub-Commitee for
- Hazardous Substances Control (in collaboration with Dep. of Fisheries)
- Registration of Agricultural Toxic Substances
- Evaluation and Assessment of Toxicological Data, Residue Data (under Sub-Committee for Registration)

According to the phased registration, there are three groups of pesticides for the registration process:

- Pesticides which have never been registered in any country must be registered in phase 1
- Pesticides already registered in other countries but not in Thailand may be registered in phase 1 or 2
- Pesticides which are registered in other countries and in Thailand may be accepted to phase 2 or 3

Each pesticide has to be tested in Thailand for risk-benefit assessment and effects on humans and the environment. If a product already has been tested elsewhere, only missing toxicological or bio-efficacy data are requested. After testing the Sub-Committee for Registration decides on the registration license[17]. The registration license has to be issued for every formulation. Once issued, licenses may be revoked if evidence for hazards can be proved, but that rarely occurs. It is unclear how products already registered shall be integrated into the new act. According to the act, an import license can be issued for three years. Currently the licenses are only issued on a yearly basis thus giving the regulatory division some chance to deny the import if evidence occurs according to the registration requirements. The fees for permits have been increased in the Hazardous Substances Act. In fact, the actual fees (notified in the hazardous substances decree of November 1994) are much lower. Currently, the costs for pesticide registration are 1000 Baht (the upper limit is fixed at 5000 Baht according to the act); additional fees for import and trade licenses exist.

In order to ban a certain pesticide, the Sub-Committee is responsible in the first stage and has to prove the reasons for a ban. Then, the Hazardous Substances Board makes the final decision for banning the active ingredients[18]. The Sub-Committee discussed the case of monocrotophos which is still available in a 60% solution. The Sub-Committee agreed on observing the effects of monocrotophos but a ban does not seem likely in the near future. Nine other pesticides are currently under consideration for a possible ban, which are: Chlordane, aramite, chlordecone, chlorphenol, 2-4-5-TP, MCPB, phenothiol, mercoprop, DBCP.

---

17 Refer to Table 2 in Annex IV for the constitution of the Sub-Committee.

18 Pesticides banned in Thailand are listed in Table 3 in Annex IV.

5 Crop Protection Policy and its Institutional Framework in Thailand

Crop protection policy is an important aspect of the overall agricultural policy. Various policy targets influence management decisions at the farm level and therefore especially the pesticide use. The focus of this chapter, therefore, is both the crop protection policy as well as the applied institutional framework[19]. Furthermore, factors are discussed which are believed to be of major influence on pesticide use. Consequences of these influencing factors or the overall framework may be subject to change in the future. However, as mentioned earlier, the overall trend of pesticide use in the country is rising, thus creating the necessity to focus on unwanted or unexpected developments in the field of pesticides.

5.1 Tax Policy

In general, the total import taxes consist of import duty, business tax and municipal tax and are based on c.i.f.-price value. The tax structure related to pesticides has been favorable compared to other inputs and has therefore helped to keep pesticide prices low. The import duty of pesticides is not considering the hazardousness of a pesticide. Before 1991 effective total tax rates for pesticides have been 6.9% compared to 32.4% for fertilizer and 27.6% for agricultural machinery (WAIBEL, 1990).

In case of pesticides being identified for agricultural use only, they have been exempted from import duty, business and municipal taxes since 1991 (Customs Department, 1995). Taxes may occur for some ingredients in pesticide formulation which can be used for other than agricultural purposes. Starting from 1995 import duty for fertilizer is also favored with a reduction of import duty to 10% (formerly at 30%).

This tax exemption can be clearly defined as an indirect subsidy for pesticide imports and pesticide prices. It can also be seen as a subsidy for hazardous products which are cheap on the world market and do not face taxation according to their hazardousness when imported to Thailand.

19 Annex IV has more details about the institutional set-up in crop protection policy.

5.2 Import, Trade and Use Regulations

The Regulatory Division of the Department of Agriculture is in charge of the process of pesticide registration and the supervision of law-conform use of pesticides. At the same time, the division is responsible for controlling of the pesticide market concerning the quality and the date of expiry of pesticides. Pesticide quality control and residue analysis, necessary for the registration process, is the duty of the Toxic Substances Division of the DOA. There are two Designated National Authorities for the PIC scheme. The Department of Agriculture is in charge of all chemicals used in agricultural production. The Pollution Control Department is responsible for all other chemicals.

At present, all pesticides require registration prior to import, manufacturing, and distribution. Currently there are 298 active ingredients registered in Thailand, which sum up to a several times higher number of product names (2,258 names in 1991) and the trend is still rising. GRANDSTAFF (1992) stated that there also exist illegal repackers who never applied for a permit and who are therefore not under regulatory control.

From the viewpoint of the implementing agency the registration process raises some concerns. On the one hand the inadequate size of personnel and budget is reported and on the other hand there exists a strong dependency on other divisions of the department for registration related research and requirements which are not classified as priority issues in their work descriptions. Pesticide market inspection is currently conducted by 25 inspectors who are in charge for the whole country[20]. Inspection is therefore limited to a very small sample size and only a few quality control tests can be conducted. Here, a shortcoming of the current legislation is visible as the quality of pesticides is one major concern related to the inappropriate use of pesticides.

Starting July 1995, a retailer training has been made compulsory, otherwise no further retailer license would be issued. Retailers are required to attend a training course within eighteen month. Prior to July 1995 retailer training existed, but it was not compulsory and it was partly initiated from pesticide companies. Training lectures are arranged by the DOA as well as the Thai Crop Protection Association in cooperation with GIFAP. The training focuses mainly on the introduction to the new act and includes also aspects of entomology, plant pathology issues, storage regulations and safe use.

---

[20] Currently around 5000 retail shops exist in Thailand (DOA, personal communication, 1996).

However, the success and the sufficiency of these two day training modules may be questioned. The impact of the retailer on farmers' pest management decisions is of high relevance as retailers are often the only or main source of pesticide recommendations and information for the farmer (KHUANKAEW, 1995). The lack of market transparency can be regarded as a pesticide supporting factor.

5.3 Research and Extension

Public agricultural research and extension in Thailand are mainly conducted by the Ministry of Agriculture and Cooperatives (MOAC) and universities. Approximately, 95% of the total government budget for agricultural research and extension goes to the MOAC, while around 5% are dedicated to the universities (TDRI, 1995).

The Agricultural Departments

Two departments within the MOAC cover almost all aspects of agricultural crop production policy. They share more than 50% of the MOAC's budget for research and extension.

The Department of Agriculture (DOA) is in charge of all agricultural research projects and responsible for developing technologies, which are supposed to be tested and transferred to the farmers by the Department of Agricultural Extension (DOAE). The DOAE is in charge of extension work and conduction of strategies on technology dissemination according to national policy targets. Several divisions in each department focus on various aspects of agriculture[21]. Governmental research allocation focused more on importable commodities in the past. Funding of research followed rather than led market signals. The relation of government expenses of its extension work to its research is approximately 1.7:1 (SIAMWALLA et al., 1992).

Plant protection issues are dealt within the Plant Protection Service Division (PPSD) of DOAE and the recently formed Bio-control Center as well as several divisions of DOA (Regulatory, Toxic Substances, Entomology, etc.). Integrated Pest Management (IPM) related research or extension work falls under no special division instead it is part of the overall agricultural policies. In the Department of Agriculture IPM research projects for different crops are conducted for several years (the rice project started in 1983, cotton in

[21] Figure 1, Annex IV shows the organizational structures of DOAE and DOA.

1981, sugar cane in 1985 and fruit in 1989). Apart from these projects most research conducted by DOA in the field of pesticides concerns pesticide efficacy and application techniques. From 1981 - 1988, a project on surveillance and early warning systems has been carried out nationwide. In 1980 a bio-control subdivision in DOA as well as in DOAE was established. The DOAE has offices on the regional, provincial, district and sub-district level.

Outbreak Budget

The DOAE overlooks a regular budget for the purchase of pesticides. This budget is meant for sudden pest outbreaks and is given to farmers at no costs. In theory it is based on the request of a group of farmers with at least 80 hectare of infested area. The regional offices of DOAE submit their pesticide request to the Plant Protection Service Division. The budget is allocated within the country according to last years' evidences of pest outbreaks. The calculation of the yearly outbreak budget request of PPSD is based on estimated infested areas for rice, field crops and the horticultural sector multiplied by the calculated pesticide expenses per rai. Purchases have to be in line with the pesticide recommendations of the DOA. The volume of the outbreak budget is based on 10% of the cropping area roughly, i.e. to assure pest control as a special measure of food security and stabilizing agricultural production. The share of the outbreak budget of the total budget of the Plant Protection Service Division has been constant for several years while the IPM budget increased.

The outbreak budget in 1995 amounted to 78 million Baht divided in around 24 million Baht for rice, 40 million Baht for field crops, 6 million Baht for horticultural crops and 8 million Baht for fruit. The 1996 outbreak budget request amounts to approximately 80 million Baht. The outbreak budget today contains a component for bio-control products also, i.e. neem, bacillus thuringensis and other bio-agents produced by the bio-control division itself. The outbreak budget finances regular pesticide purchases and distributes them to farmers and extension offices throughout the country. Their use is not further investigated.

The outbreak budget represents an important support for pesticides. FARAH (1993) mentioned the outbreak budget as the major pesticide subsidy in the country. If a pest outbreak occurs the necessary budget may be several times higher than the regular annual amount as happened in 1989/90 when an outbreak of the Brown Plant Hopper emerged. The "emergency funds" amounted up to 250 million Baht (FARAH, 1993). The usefulness of such a

budget should be further investigated since the past experience showed that, when a pest outbreak occurs, the budget was not sufficient and, additionally, for a serious limitation of damages the allocation of pesticides to the infested area has been observed as too slow.

The governmental crop protection policy might be described as dualistic. On the one hand does the outbreak budget present a continuous support of pesticides on the other hand promotion of IPM tries to limit pesticide overuse.

More cooperation between research and extension would help to meet the demands in agricultural development more efficiently. The current design of the research and extension departments hinders their effective cooperation. This can be regarded as pesticide supportive.

5.4 Agricultural Budget Allocation

To date, all extension aspects of pesticides or alternative crop protection methods are under the Plant Protection Service Division of DOAE, while in DOA research is conducted in several divisions. In the past, research in plant protection concentrated mainly on chemical pesticides. FARAH (1993) stated that 98% of the research budget was allocated for chemical pesticides. This has changed in the meantime. During the years 1991-1995 the total budget of the DOAE nearly doubled (OFFICE OF AGRICULTURAL ECONOMICS, 1994), while the IPM related budget increased four times to currently nearly 20 million Baht (IPM in vegetables, fruit, leguminous plants, rice and maize). Additionally, a budget for bio-control research and extension is allocated which increased more than eight times during the last five years. However, these IPM related budgets are still relatively small when compared to the outbreak budget.

In the recent past, DOA pays more attention to research in the area of IPM methods and bio-control. In 1993 the annual budget of the Entomology Division amounted to roughly 63 million Baht, around 7% of the budget has been allocated for integrated pest control, 11% to biological control, compared to 19% for chemical control and 20% to related research (crop loss, pesticide application, plant resistance) (DIVISION OF ENTOMOLOGY, 1994).

Another indicator for the growing importance of research on alternative methods is the promotion of the bio-control section of the PPSD to the division level. This change has implications for the budget allocation in plant

protection. Thirty percent of the 95/96 budget which amount to roughly 40 million Baht, were allocated for bio-control. With the new formation of the DOAE a special budget is given to district DOAE offices on request and according to targeted areas which may vary between the regions and are not fixed. This budget can be used to buy pesticides. Additionally, the mentioned new agricultural policy of structural and production system adjustment provides incentives for pesticide purchases[22]. These budgets can also be regarded as factors supporting pesticide use.

5.5 Credit Policy

The Bank of Agriculture and Agricultural Cooperatives (BAAC) is regarded as the key institute for the implementation of agricultural credit policy (TDRI, 1995). It was established in 1969 to provide low interest, short-term working capital loans to farmers. From 1975, all commercial banks were required to lend 14 % of their deposits to the agricultural sector (SIAMWALLA et al., 1992). Formal lenders supply about 44% of all credit given to rural households, while informal credit suppliers are the remaining lenders, including farmers, merchants, salaried individuals and rentiers (SIAMWALLA, 1994).

No direct subsidies for agricultural inputs in the form of loans existed prior to 1992 (WAIBEL, 1990). Credits provided to farmers by the BAAC did not include loans for pesticide purchases. In 1992, short term credit opportunities for agricultural inputs including pesticides managed by the BAAC were created (GRANDSTAFF, 1992). Short term loans have to be repaid within twelve months and can be used to meet production costs during one cropping season. In 1993, short term loans amounted to 41.8% of total lending. The demand for loans was highest in rice production (31.6% of the loans were given to rice farmers) followed by cassava and maize, but lending for fruit and vegetable production shows an increasing trend (BAAC, 1994). TDRI (1995) states that this trend can be interpreted as an encouragement for agricultural diversification. Within the governmental restructuring program farmers receive free agricultural inputs (e.g. root stocks) as well as short and long term credits through BAAC.

---

22 There is a total budget of 10 billion Baht allocated for the restructuring plan. The program aims to promote 45,500 ha of fruit area, 26,000 ha of bamboo, 15,000 ha of fast growing trees, 3,800 ha of vegetables and flowers and 32,000 ha of pasture. Planting material and inputs will be subsidized (FAO, 1994).

A credit policy which explicitly includes pesticides in its credit program has a supporting effect on pesticide use. Pesticides are included regardless of sufficient information about using guidelines and other crop protection alternatives.

5.6 Information and Training

Information is essential to make decisions about crop protection issues. There are several kinds of information needed - at the policy level, at the research and at the farmer level. Two kinds of information related to pesticide use are essential. One concerns the benefit and cost for the use of a certain pesticide while the other can be seen as the need for general information about possible alternatives to its use.

The main basis for the DOA recommendations of pesticide use are efficacy tests. Assessment of crop losses is not conducted on a regular basis for every crop. For some crops economic threshold levels exist, it is lacking for others. However, pesticide recommendations of the DOA seem to be far too complex for daily use and are not a major source for farmers' decision making in crop protection. Although in general, these measures encourage pesticide use as the available information promotes the use of pesticides.

Additionally, information about pesticide quality can seriously affect pesticide use levels. It has been reported that farmers apply increased dosages due to the experience that the recommended amount was found not to be effective, other farmers reduced the dosages. It can be stated that a lack of information regarding the actual amount of active ingredient applied does not support good management decisions and pest control. Quality tests conducted by the DOA indicate that a high amount of pesticides do not fulfill minimum standards. Expired or deteriorated products can be found in numerous retail shops (GRANDSTAFF, 1992). In 1995, the industry started a product quality monitoring program. Samples were taken from paraquat. Three of four samples were below standard, while in another trial two of six glyphosate and paraquat samples were below standard (GIFAP, 1996). However, the sample size is far too small to cover and to improve the situation on the pesticide market. Unfortunately, these kinds of studies are rare, they are not conducted on a regular basis and the results are not made available to the public. Quality control does not belong to the routinely conducted analysis of the DOA. Contaminated packing material is another problem related to these aspects. It is estimated that approximately 4000 tons of contaminated packaging materials exist in Thailand. A study cited by

SINHASENI (1994) comes to the result that a proper system for the disposal of pesticide containers does not exist.

WAIBEL (1990) states that a lack of information on the danger of application and handling of pesticides exists as well as about the quality and formulation of pesticides, the production date and the ingredients of pesticides.

Extension and training conducted by the extension service focuses mainly on pest management based on pesticide use. Increasing attention is given to IPM methods in recent years, but the concept of IPM in terms of using several management and pest control possibilities at the same time has not yet been sufficiently transferred to agricultural extension services. Special training courses for IPM are conducted and extension workers at the village level are responsible for advice on pesticide issues as well as alternative management methods. However, IPM is mostly not the primary concern.

In addition to the governmental extension service, training is also held by the pesticide companies in cooperation with GIFAP's safe use training. As the name indicates, focus lies on the safe use of pesticides and on the training of application methods. During the last four years 600,000 farmers have been trained. The training takes place during one half day, the per capita costs are around 150 Baht. A total of 60 trainers who are at the same time company technicians conduct this training. Training of trainers, retailers training, medical training as well as the distribution of protective clothing is additionally taking place.

On the regional or provincial level several NGO's conduct training and educational work in the field of alternative management systems. Most of the programs are focusing on farmers or farmer groups, another program is focusing on IPM education in schools.

6 External Effects Related to Pesticide Use

An externality can be defined as a positive or negative effect of the actions of one individual, firm or nation on another without compensation (SEITZ et al., 1994). In relation to pesticides, negative externalities are unintentional side effects of pesticide use like resistance build-up, destruction of beneficial insects, pesticide residues and health effects. Negative external effects can be subdivided into two categories. The first harming the user directly and the second concerning both the user and the society in total. Clearly, there are costs associated with negative externalities. These costs decrease if the externality is reduced, although reducing the externality also costs money. Often does a market value for these externalities not exist and the external effects cannot be directly measured with the help of market instruments.

This chapter describes existing evidence of external effects related to pesticide use in Thailand. Furthermore, an assessment of the costs involved is conducted and a calculation of the additional costs occurring for the society in relation to the use of pesticides is made. Externalities related to pesticide use discussed in this paper are: Health effects, residues in food and the environment, resistance and resurgence, the governmental budget for research and extension related to pesticides and the monitoring and control of the pesticide market.

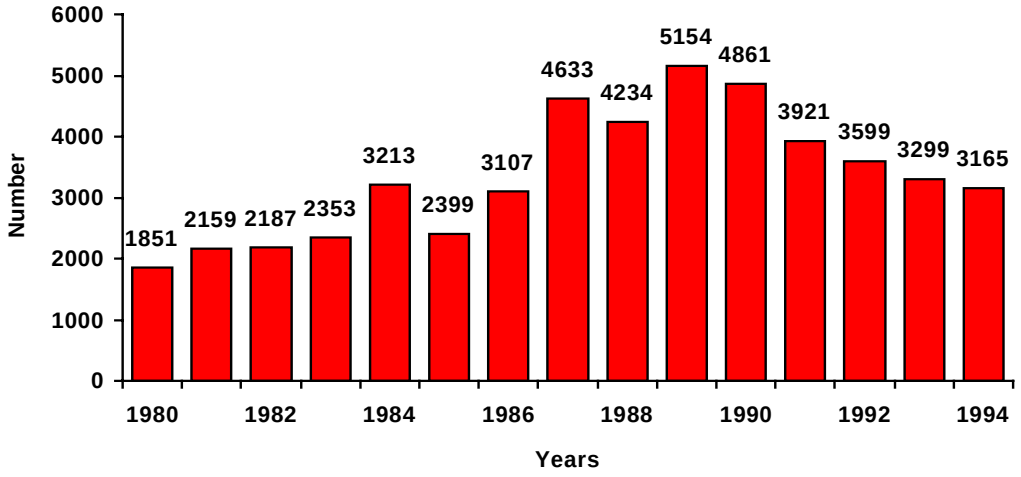
6.1 Health Hazards

An assessment of health hazards related to pesticide use in agricultural production raises some difficulties. On the one hand, if poisoning cases do occur, it is difficult to identify without doubt a specific pesticide as the source of poisoning. On the other hand, many poisoning cases are never reported to a doctor and will therefore never appear in the official occupational poisoning statistics.

In Thailand the Division of Epidemiology of the Ministry of Public Health has the primary responsibility of collecting poisoning data. Since these data rely on case reports of governmental hospitals and some private clinics, the actual poisoning cases are assumed to be understated (SINHASENI, 1990). A survey about poisoning cases among agricultural workers by WONGPANICH (1985) came to the result that only 2.4% of workers with poisoning incidents consult a hospital.

The number of occupational poisoning cases officially listed has decreased in the recent past (Figure 10). There are no apparent reasons for this reduction since the amount of pesticides imported and used has increased and no radical change in the type and the hazardousness of pesticides used and the application technology chosen has taken place.

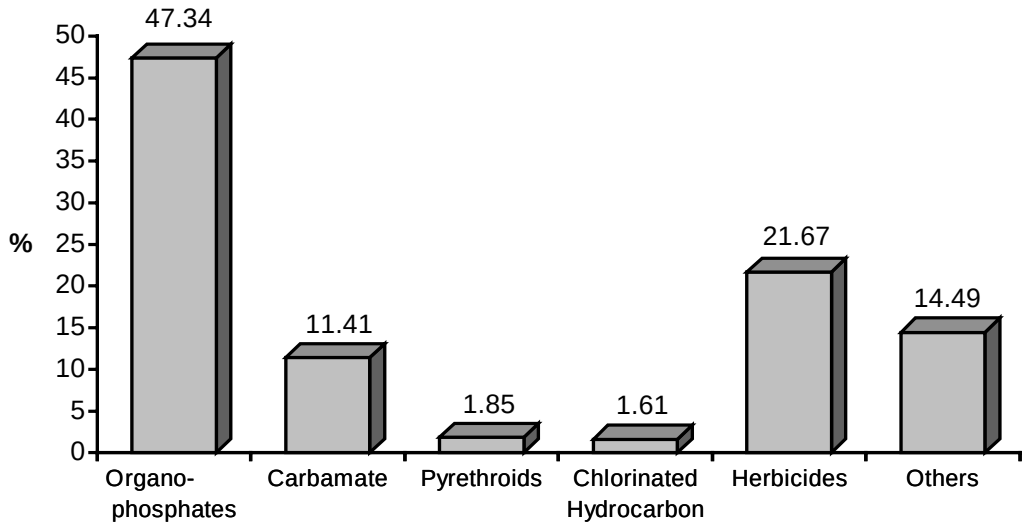
Figure 10: Occupational Pesticide Poisoning Cases (1980-1994)



Source: Epidemiological Division, Ministry of Public Health, 1995

According to the Ministry of Public Health, 1,760 persons have been hospitalized and 16 persons died due to poisoning within the first seven months of 1996 (BAGOGLU, 1996). Figure 11 splits the poisoning incidents with regard to the type of chemicals for 1994. Pesticides identified being mostly related to intoxication are organophosphate compounds, carbamate compounds and herbicides. Nearly 47% of all poisoning cases are based on organophosphate use, followed by herbicides (22% of the cases) and by the carbamate group (11% of the cases). While acute poisoning data, as mentioned above, is already assumed to be understated, no information on long term effects of pesticide use is available.

Figure 11: Pesticide Poisoning by Type of Chemical (1994)



Source: Epidemiological Division, Ministry of Public Health, 1996

Studies reviewed by GRANDSTAFF (1992) concluded that farmers generally do either not care about or are not aware of potential hazards pesticides may cause for themselves and the consumer. The majority of farmers interviewed used to spray pesticides frequently, especially in the horticultural sector, and harvested their crops for marketing before the end of the recommended waiting period. Good market prices have been mentioned to be more important than following the required waiting period. The studies concluded, that even though the farmers state their concern about possible health hazards, their behavior in spraying, mixing and handling of pesticides and pesticide disposals indicates a lack of real knowledge or an unawareness of actual danger. About half of the Thai farmers apply higher than recommended concentrations and do not pay any or very little attention to labels and protective clothing (SINHASENI, 1994).

The increasing number of farmers who hire laborer for spraying can be regarded as another evidence of health hazards. Wages for spraying pesticides can be twice as high as wages of other farm works. Eighty percent of the women questioned in a survey by KHUANKAEW (1995) state that they have been poisoned. They reported acute effects like dizziness, muscular pain, headache, nausea, weakness and difficulty in breathing. According to a survey of 445 tangerine growers in Pathum Thani (POLRAT, cited in SINHASENI, 1994) there is a significant relationship between pesticide poisoning incidences and the amount of powder pesticide formulation used.

Almost 50% of the growers had a history of poisoning symptoms and only half of the poisoned patients went to governmental clinics.

Assessment of Health Costs Related to Pesticide Use

As a result of the limited knowledge of the total number of poisoning incidents the available official data may serve as a 'lower boundary' for an assessment of implied health costs. It would be desirable to conduct in-depth studies on health effects which includes non-reported poisoning cases. This would increase the current knowledge of the extent of occupational poisoning. For an assessment of health costs the expenses for medical treatments and the income loss due to work inability have to be calculated. In case of the occurrence of poisoning deaths the value of fatalities would have to be considered. Additionally, long term effects of pesticide poisoning are also contributing to the implied health costs. But no information about the extent and related costs of long term effects is available.

If we consider the official data from the Epidemiology Division, 3,165 occupational poisoning cases occurred in 1994. In a study conducted by WHANGTHONGTHAM (1990a) health costs have been assessed for poisoning cases in Pathum Thani. According to this survey 25% of poisoning cases are treated in hospitals, 52% in private clinics and 23% in health offices. The costs related to these treatments are 550 Baht for hospitals (3 days treatment), 120 Baht for clinics and 70 Baht for health offices. Additionally, labor costs in form of lost labor days have to be calculated. The costs per labor day are calculated with 100 Baht, the loss of labor days amounts to 3 days for hospital treatment and 0.5 days for both clinic and health office treatment. Relating the poisoning cases to the average costs for medical treatment and lost labor days assessed in that survey of 328.5 Baht, the implied total health costs therefore amount up to about one million Baht[23]. If we consider that the available statistics underestimate the actual poisoning incidents and that the death cases are not included, these calculated costs may serve as the lower boundary of the actually implied health costs[24].

---

[23] (550*0.25) + (120*0.52) + (70*0.23) + (300*0.25) + (50*0.52) + (50*0.23) = 328.5 Baht
328.5 Baht * 3,165 occupational poisoning cases = 1,039,702.5 Baht

[24] The study of WHANGTHONGTHAM (1990a) states 2,121 poisoning cases in the Pathum Thani province. Regarded in relation to the total 3,165 cases for the whole country of the Poisoning Statistics of the MOPH, this may serve as another indicator that the official statistics underestimate the actual cases to a large extent. Arguing with one statement of the MOPH that only around 60% of the actual cases are reported, the official data would increase to around 5,275 cases. However, this does still not seem to meet reality.

To conclude to a more realistic amount of the health cost assessment results of the study of WHANGTHONGTHAM (1990a) are used to calculate poisoning cases in relation to insecticide market volume. The poisoning cases per hectare and the intensity of insecticide use are needed for this calculation. Additionally, some assumptions have to be made for the calculation. Firstly, the reported poisoning cases are mainly due to insecticide use and are therefore related to the quantity of insecticides used. Secondly, poisoning cases are not location specific and finally, the hazardousness of the pesticides used is comparable for all crops.

If we consider, as indicated in the study, that 86% of the total poisoning cases of tangerine growers (total of 2121 cases) in Pathum Thani are caused by insecticides, the number of cases would amount to 1,824[25]. These cases are related to the tangerine growing area of Pathum Thani (149,734 rai) and the intensity of insecticide use in citrus (235 US$/ha = 39.12 US$/rai, refer to Table 3, section 3.3). The derived poisoning cases per US$ insecticide use are then related to the total insecticide market in Thailand (93.5 million US$). The result would be 29,118 poisoning cases due to insecticides in Thailand per year.

Furthermore, considering the data of Figure 11 which shows that only 64% of all poisoning cases are related to insecticides and 36% are related to herbicides and other pesticides, the calculated number of insecticide poisoning cases (29,118) could be used to calculate the total number of pesticide poisonings. Consequently, 36% (10,482 cases) of poisonings due to other pesticides have to be added to the insecticide cases. Therefore the total number of poisoning cases would amount to 39,600 cases. If these cases are weighted with the average health costs per poisoning case (see above), total health costs sum up to about 13 million Baht.

6.2 Residues in Food and in the Environment

Survey and monitoring of pesticide residues in the environment have been conducted since 1976 (TAYAPUTCH, 1988)[26]. In addition to several kinds of

---

25 (I) 1,824 poisoning cases/ 149,734 rai = 0.0121816 poisoning cases/rai
(II) (I) / 39.116 US$ insecticide use/rai = 0.0003114 poisoning cases/ US$ insecticide use
(III) (II) * 93.5 million US$ insecticide market volume = 29,118 poisoning cases due to insecticides
(IV) (III) * 1,36 = 39,600 total poisoning cases
(V) (IV) * 328.5 Baht health costs = 13,008,600 Baht.

26 Annex V has more information on external effects. Table 1 provides a summary of the compounds analyzed in residue analysis.

organochlorines, traces of organophosphates such as dimethoate, diazinon, malathion, methyl parathion, fenitrothion and profenophos were found in the environment.

From 1982 - 1985 the Food and Drug Administration and the Department of Medical Science monitored pesticide residues in food (SINHASENI, 1990). Agricultural products have been categorized into nine groups, namely vegetables, fruit, dry beans, plant and animal fats, meat products, eggs, aquatics and fresh milk (663 samples in total). Fifty-two percent (348) were found to contain pesticides, DDT existed in all nine groups (39%) and dieldrin was found in around 15% of all food samples.

According to a survey by the National Environment Board trace levels of residues were found in soils, water, fruit, vegetables and field crops. The results are shown in Table 4. Most residues have been found in soil and water.

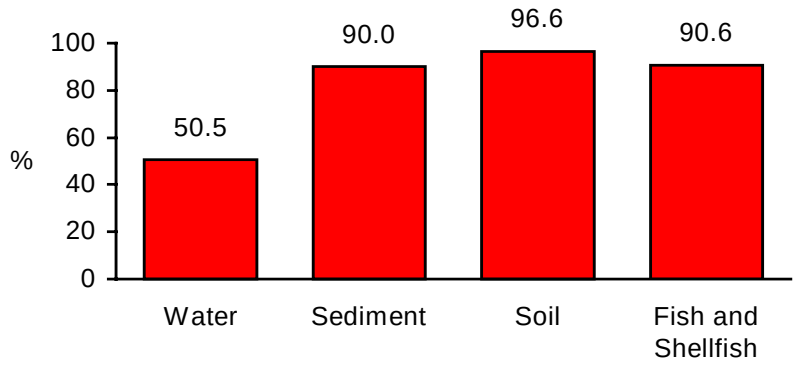
Table 4: Pesticide Residues in Plant Products and the Environment, 1988

Sample	Number of Samples Analyzed	Percentage of Samples with Residues
Soil	76	100 %
Water	139	86 %
Fruit	34	32 %
Vegetables	246	25 %
Field Crops	71	17 %

Source: National Environment Board, cited in Thai-German Plant Protection Programme, 1993

Another analysis demonstrated that more than 90% of the soil, sediment and fish samples were positive, while residues in water have been found in 50% of all cases (Figure 12). These two analyses show that there is a strong evidence of pesticide residues in the environment. Residues of Methyl-Parathion, a heavily used insecticide in various crops, have increasingly been found in agricultural products. Effects in soil and groundwater as well as health effects to humans have been observed (GRANDSTAFF, 1992).

Figure 12: Pesticide Residues in the Environment (1976-1985)



Type of Sample	Number of Samples	Collection Site
Water	1644	rivers, canals and reservoirs
Sediment	602	rivers, canals and reservoirs
Soil	1005	agricultural areas, crop fields and orchards
Fish and shellfish	1283	markets, rivers and canals

Source: Tayaputch, 1988

A recent study focusing on pesticide residues in rice which was conducted in the central region of Thailand in 1991/1992 states that residues could be found in paddy soil as well as in paddy and run off water. None of them has been found to be over the maximum residue level (MRL) (TAYAPUTCH, 1994). Major pesticides analyzed are monocrotophos, methyl parathion, 2,4-D and carbendazim. The study concluded that there is no implication for short-term effects of these residues.

Another study of the Division of Toxic Substances on residues in fruit and vegetables found that around 37% of the vegetables were contaminated with organophosphorous insecticide residues. About 20% of kale and 10% of cowpea showed residues exceeding the MRL. 73% of tangerine samples were contaminated with pesticide residues (around 10% exceeding the MRL) which consisted mainly of malathion, monocrotophos and methyl parathion (PALAKOOL, 1995).

Assessment of Costs Related to Pesticide Residues

Mitigation costs of the polluted environment are as well a factor of the total costs related to pesticide residues as the unknown long term effects and the loss of produce due to residues in food. Additionally, the costs of monitoring and control mechanisms which are to assure the MRL set by the government have to be considered.

Insufficient information about the dimension and severity of environmental pollution and the lack of knowledge about long term effects hampers the

conclusions about the related costs. Some calculations can be conducted for food residues. A preliminary assessment of costs related to food residues shall be undertaken by using residue data in fruit and vegetable stated above. The Division of Toxic Substances found 10% of the samples of tangerine and 20% of kale as well as 10% for cow pea over the MRL. Additionally, it is assumed that the sample is representative and that products exceeding the MRL cannot be marketed.

The 1992 farm value for tangerine is estimated at 6,026 million Baht, for all fruit at 29,504 million Baht and for vegetables at 20,667 million Baht (THAILAND IN FIGURES, 1996). Taking the assumptions made above, the loss in net income for tangerine amounts to 602.6 million Baht as 10% of the produced tangerine are not supposed to be marketed because of food residues over the MRL. For vegetables the loss amounts to 2,067 million Baht and to 2,950 million Baht for all fruit, if 10% non-marketable products are assumed. These calculation together with the costs of monitoring may serve as an upper boundary for the actual costs of pesticide residues. If effective market control existed, the risk for the producer of not being able to market his products would increase and as a likely result it could be assumed that cases of residues decreased. These calculations present a very rough assessment as they are based on the assumption that the products were withdrawn from the market. However, if this is not the case other costs occur like health effects related to food residues. For complete cost assessment more detailed data about the real amount of residue cases and the costs related to prevent or cure the effects is needed.

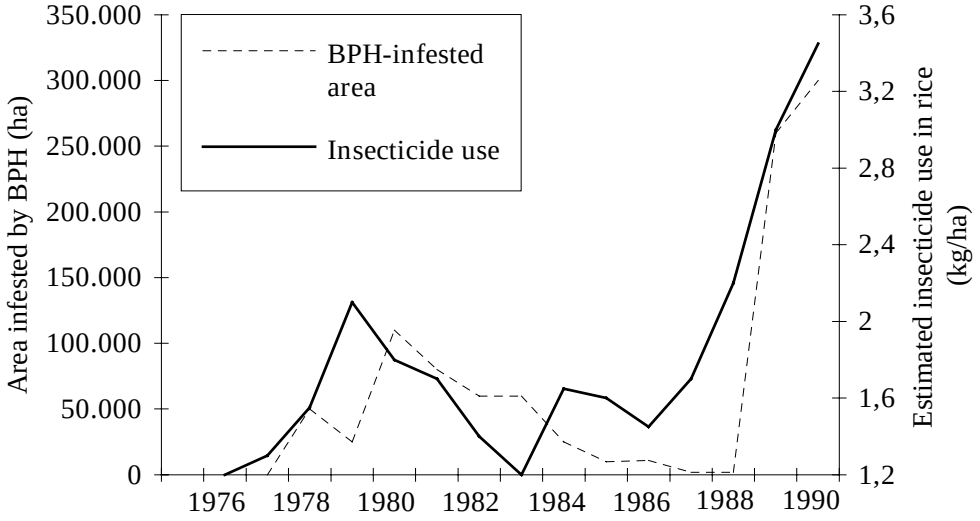
Another way of assessing residue related costs would be to calculate the costs of residue control. In this case the assumption is made that without the use of pesticides residue control would be unnecessary. Therefore, the budget of residue control in the Toxic Substances Division of DOA has to be taken into account. If only budget costs are considered it is implied that no costs occur due to residues. Therefore this calculation may serve as the lower boundary for residue related costs. The ‘real’ costs involved will be located somewhere in-between these boundaries.

6.3 Evidence of Resistance and Resurgence

Methyl-Parathion has been used widely to control the Brown Plant Hopper (BPH) in rice production. However, the heavy use of pesticides seemed to increase the problem with the BPH due to the reduction of the population of

natural enemies[27]. Data from Thailand show a strong correlation between increased use of pesticides and the BPH infested area (Figure 13). Strikingly, BPH infestation level does not precede insecticide use, but follows its trend.

Figure 13: Insecticide Use in Rice and the BPH Infested Area



Source: Grandstaff, cited in IRRI, 1994

SETBOONSARNG (1993) stated that the BPH outbreak is the most recent example for the build-up of a pest population problem and resistance development. The example of the BPH does not only prove increasing resistance build-up but indicates the problem of pest resurgence. BPH has never been a serious problem before farmers started to intensify pesticide use and thus killing also beneficial insects which helped to control BPH. The use of only one major high yielding rice variety induced farmers to plant rice more intensively. Increasing amounts of pesticides were used to control the BPH, but resurgence of BPH became worse and led to the most severe outbreak in 1990.

Another study tested the efficacy of pyrethroids in cotton (Figure 1 in Annex V). Within one decade efficacy decreased from around 80% to nearly zero percent. Increasing use of herbicides can be expected to also induce weed resistance build up (SINCHAISRI, 1988).

Another sign of growing resistance problems in some crops, especially vegetables, may be the increasing demand for new insecticides. Farmers

[27] Other reasons for the increase of BPH are seen in susceptible varieties, narrow planting distances and intensive use of fertilizer (Rumakom, 1992, in Ooi et al.).

found some old products less effective, which made them shift to newer products. Even though these products tend to have a much higher price, farmers are willing to pay it. The new products are used heavily which already resulted in new resistance build up. The dependency on pesticides can be most clearly shown in the area of vegetables where problems of pest resistance lead to an overdosing of pesticides by a factor of up to eight times the recommended rate (WAIBEL and SETBOONSARNG, 1993). A recent study in vegetable growing concluded that vegetable growers seem to accept the fact that pests build resistance after a short period of time. The period between introduction of a new pesticide product and first occurrence of resistance build up is shrinking, as the same product is intensively used by almost all farmers in one region (JOURDAIN and RATTANASATIEN, 1995). This resulted in the promotion and use of ready made tank mixtures consisting of an average of two different pesticides to prevent resistance build-up. Pesticide companies claim the resistance build-up as one of the major concerns when introducing a new product. All these evidences indicate that heavy use of pesticides cannot prevent pest outbreaks, but help to create new problems and leave the farmer in the so-called pesticide spiral.

Assessment of Costs Related to Resistance and Resurgence

At present it is impossible to assess the costs related to resistance of pesticides as no data is available which would indicate the relation between evidences of resistance and the costs involved. Costs of resistance built-up could be expressed as increase in pesticide use over time for a specific crop with stable pest effectiveness or the increasing share of pesticides in total production costs. WAIBEL and SETBOONSARNG (1993) state that 66 % of the vegetable farmers surveyed reported increasing pesticide use, while 23 % reported no change in use levels. However, changes in pesticide use levels may not be related to resistance only, which makes an assessment difficult, but nevertheless indicate existing relations.

For costs related to resurgence we calculate the costs which occurred during the last BPH outbreak in 1989/90. Assuming that such an severe BPH outbreak would occur every ten years in average and also assuming that the damage would be similar to the one observed in 1989/90, annual costs for resurgence can be derived. The additional governmental budget

needed during the outbreak can be calculated[28]. Given these assumptions the costs amount to 57 million Baht yearly[29]. However, the 'real' costs are assumed to be much higher as crop losses should be considered as well as the fact that studies indicate that resurgence costs increase over time (OERKE et al., 1994).

6.4 Other External Effects

In addition to the external effects discussed above other external effects do exist. However, these can solely be listed here as sufficient information on their evidence and related costs in Thailand is not available. More knowledge in these fields would be desirable in the future. Other external effects which have to be considered for calculating the social net benefit are:

- destruction of beneficial insects
- reduction of biodiversity
- pollution of drinking water
- non-agricultural consequences

6.5 Summary of the External Costs of Pesticide Use

The discussion of externalities in this chapter indicates the difficulties in assessing costs not included in the market price of a pesticide. As already mentioned before, this does not only include the costs of external effects to human health and the environment but also costs related to research, regulation and control of the pesticide market. To calculate the additional costs of the society for every monetary unit spent on pesticide purchases, these costs are therefore summarized in Table 5[30]. As the information background for such an analysis is weak, the presented assessment is an approximation of the real costs involved.

---

28 The observed crop damage in monetary terms should be included in the assessment also. But, as crop losses are generally overestimated, the monetary crop loss will not be considered in this calculation, but nevertheless represents a pesticide related externality.
Crop damages value 3,000 million Baht (until Aug.1990, 1.8 million rai affected) and 2,578 million Baht (Sep. 1990, 1.6 million rai affected) have been reported from official side.

29 Derived from the 1989/90 outbreak (WHANGTHONGTHAM, 1990b):

Additional support of rice farmers	500 million Baht
Supply of rice seeds	74 million Baht
Total	574 million Baht every ten years = 57.4 million Baht per year.

30 Refer to Table 2 in Annex V for a detailed listing on the estimation of the external costs.

Table 5: Estimated External Costs of Chemical Pesticide Use

Type of costs	Derived from	Estimated annual costs (million Baht)
Health	- official health data from Epidemiology Division	1.00
	- Estimated acute poisoning cases related to quantity of pesticide used from case study results (section 6.1)	13.00
Residues in food	- Residue analysis in fruit (f) and vegetable (v) (section 6.2)	2,067 (v) 2,950 (f)
Resistance and Resurgence	- Costs related to BPH outbreak in 1989/90 (section 6.3)	57.40
Research budget related to chemical pesticides	- Budget of Entomology Division, DOA, for research in pesticide related issues(section 5.4)[1]	25.29
Pesticide quality and residue monitoring budget	- Budget of Toxic Substances Division, DOA[2]	48.47
Budget for pesticide regulation and market monitoring	- Budget of Regulatory Division, DOA[2]	46.00
Budget for governmental extension related to chemical pesticides	- Budget of PPSD, DOAE[3]	284.64
Total		
Lower boundary[4]		**462.80**
Upper boundary[5]		**5,491.80**

Source: [1] Annual report, Entomology Division, DOA, around 40% of the total budget (63,235,520 Baht) are spent for pesticide related research,
[2] DOA, personal communication,
[3] DOAE, personal communication - budget for fertilizer purchase and for Thai-German IPM Project not included; author's calculations
[4] lower boundary includes official health data and excludes residue costs estimations,
[5] upper boundary includes all costs listed above and considers the estimated acute poisoning cases

It can be assumed that the real costs are likely to be several times higher because only a small range of all types of external costs involved could be considered in the assessment. Further research is desirable to fill the information gap in the presented framework. One may argue that the costs included in the calculation cannot be solely related to the quantity of pesticide used. However, that pesticides cause negative externalities despite of regulations about their use is a fact although the methodology for their assessment raises questions.

In terms of budget allocation one should note that the calculated costs which have to be paid by the society and which are costs for research and extension work dealing with pesticides and costs of monitoring and regulating the pesticide market and of safe use efforts. Governmental budget costs are “real“ costs which have to be paid from the society. This is different for costs like those assessed for residues being more hypothetical costs as it can be assumed that contaminated products are not always removed from the market.

Relating the result of Table 5 (5,491.8 million Baht) to the total pesticide market sales volume (247 million US$ = 5,928 million Baht, 1994) amounts to additional 0.93 Baht for every Baht spent on pesticide purchases. This comes close to a relation of 1:1. In a very rough assessment of pesticide use related to social and environmental costs in the United States PIMENTEL (1993) calculated a relation of 1:2. In Germany a study (WAIBEL, FLEISCHER, 1996) concluded that for every German Mark spent on pesticides additional 0.23 Mark have to be paid by the society. Once again, it shall be emphasized that the assessment of external costs conducted in this chapter may as well overestimate some costs as it underestimates costs due to lack of data.

Additionally, the costs occurring for the safe use training conducted by the pesticide companies should be mentioned. In average 150,000 farmers are trained per year with costs of 150 Baht per farmer (refer to section 5.6). This amounts to yearly costs of 22.5 million Baht for the training of farmers only. There are additional costs for the training of retailers and medical doctors as well as for the distribution of protective clothing material. However, it can be assumed that these costs are included in the market price and in the profits of the pesticide companies and therefore are already internalized.

7 Forces Affecting Pesticide Use and Pesticide Policy in Thailand: An Expert Assessment

In the political and institutional framework of the decision making process several factors indicate an ongoing support of pesticide use. Among crop protection experts there is a consensus that pesticides are in many cases either mis- or overused and therefore have measures to be conducted to limit the use of pesticides to an economically viable and environmentally sound use level.

To assess the current situation in Thailand's crop protection policy, the related problems, determinants and opinions an expert survey has been conducted. In contrast to the study of AGNE (1996) in Costa Rica where the experts expressed their opinions in questionnaires during a workshop, a direct dissemination of questionnaires to the expert has been undertaken in this study. Questionnaires have been distributed among various key persons in the governmental and non-governmental sector. Twenty-seven questionnaires have been distributed, nineteen were returned and are the basis of the analysis[31]. The several backgrounds of the experts can be divided into the following five groups:

- Ministry of Agriculture, Department of Agriculture, Department of Agricultural Extension (5 experts)
- Other ministries and governmental organizations (4 experts)
- Research institutions (3 experts)
- Local and international pesticide companies (4 experts)
- Other non-governmental institutions (3 experts)

The expert survey consists of questions related to actual governmental policy, personal assessment and opinions about the current policy and its future development. One major aim of the survey was to present a ranking of factors which influence the use of pesticides. The results of the ranking, done by experts in the field of pesticide use and pesticide policy, is meant to frame earlier identified influencing factors with the help of the various opinions of persons actually involved in pesticide policy, research and sale. As an impact valuation in monetary terms of most factors identified is not

31 Questionnaires not returned were distributed equally among all groups.

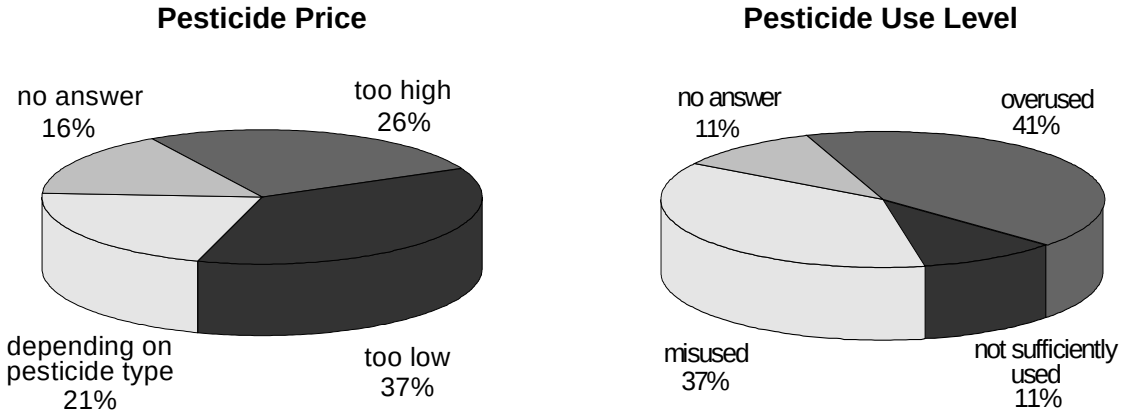
directly possible, an expert assessment is one approach to cope with these methodological problems. As experts from several organizations, with several viewpoints, targets and backgrounds contributed to the survey it is expected to gain an overall picture of current pesticide policy.

7.1 Crop Protection Issues: An Assessment of Major Trends and Opinions

Crop protection consists of various elements. Therefore the focus of the survey has been on chemical crop protection and its constraints as well as possibilities and limits of IPM systems.

There are different opinions regarding the optimal price of a pesticide and the level of pesticide use. Among these the price is more controversial. Almost 37% of the experts state that the price is too low compared to 26 % who feel that the price is too high. Nearly 80% of the experts agree that pesticides are over- or misused. Some stated that the price for more sophisticated pesticides like more selective, less toxic and botanical pesticides is too high while the price for non-selective pesticides is too low. The opinions about prices and use levels differ which makes it even more obvious that biased information and assessment hinders more conform conclusions (Figure 14).

Figure 14: Opinions about Pesticide Price and Use Level



Cross-table:
(number of answers)

		Pesticide Price			
		too high	too low	dep. on pest. type	no answer
Pesticide Use Level	overused	3	3	2	-
	not sufficiently used	1	1	-	-
	misused	1	2	2	2

no answer	-	-	-	1

Source: Own Survey

The cross-table, the lower part of Figure 14, underlines the diversity of opinions. The number of experts believing that overuse of pesticides occurs in combination with too high pesticide prices equals the number believing that overuse occurs in combination with too low prices. Experts agree that the future trend in crop protection are: IPM, less use of hazardous pesticides and increased use of biological pesticides. However, some experts believe that widespread and heavy use of pesticides will continue, herbicide use will increase due to labor shortage and the current situation will not change drastically. The latter statement is based on the fact that nearly all experts see constraints involved for the future development like pesticide subsidies, pesticide regulation, research and extension practices.

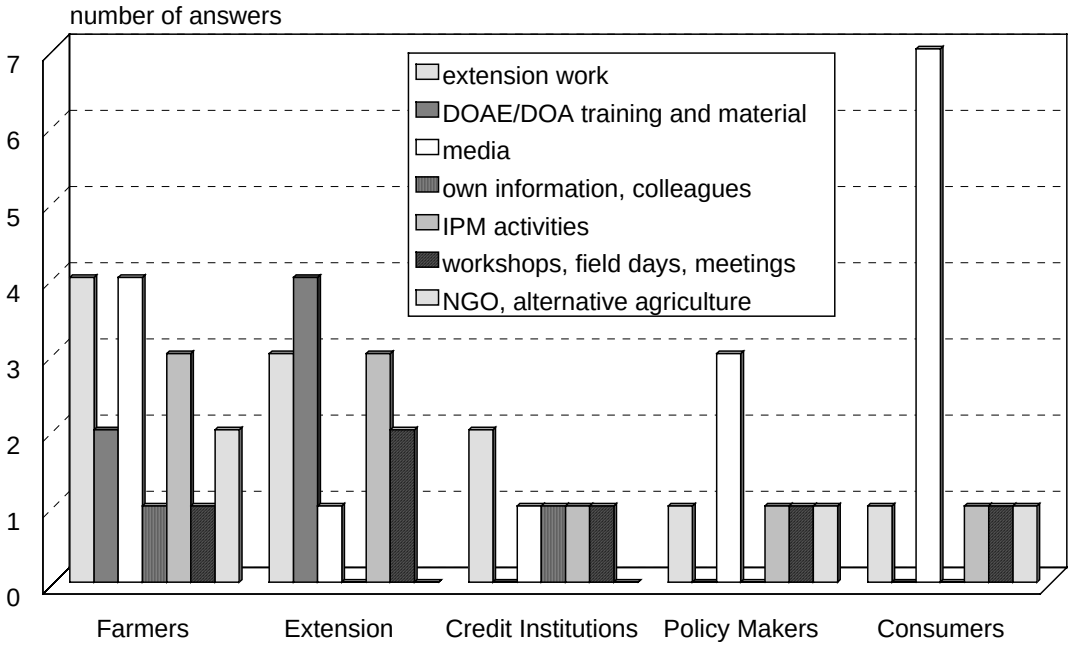
The experts more or less agree that IPM could be a solution to more sustainable agriculture. Major constraints are raised for the implementation of IPM or other than chemical crop management practices. According to some statements, no common understanding of the concept of pest management exists and the opinions of all groups involved are diverse. There is a lack of implementation of IPM at the farmers level on the one hand, on the other hand for most of the crops no sufficient sophisticated and adaptable technology is available for a more expanded adoption of IPM. This leads to the conclusion that there is a lack of research on IPM based production systems as well as poor development of extension and training tools for the transmission of knowledge on IPM methods at farmers' and extension levels. As long as IPM practices are not fully developed for a wide range of crops, existing extension and training methods, e.g. farmer field schools, are not efficiently used or other adaptable training methods are not designed, farmers will hardly adopt practices. Furthermore, a wide range of cheap and long used pesticide products is still available and the lock-in of current pesticide based technology makes management changes even harder.

However, asked about the estimated crop losses for some major crops if no pesticides are used, most of the experts agree that crop losses would be comparably low in rice production while losses for fruit and vegetables would exceed on average 30% and could reach up to 100% of the current yields. The very wide range of crop loss estimates expresses the need for more research with the focus on current management systems compared to alternative systems and resulting crop losses.

Furthermore, the expert assessment focused on activities or institutions which provide information on non-chemical control methods to the various actors in crop protection, namely farmers, extension services, credit institutions, policy makers and consumers. The ranking by the weighted number of answers is shown in Figure 15. The impact of the way of transferring the information depends on the specific interest group.

According to the experts, farmers are mainly reached through extension work, media and IPM activities. Extension work refers to the work conducted by DOAE, while IPM activities refer to several organizations conducting work in that area. The column “workshops, field days and meetings“ refers to activities from various institutions also including DOA, DOAE and pesticide companies. Both the extension service as well as credit institutions are mainly informed by extension work while, additionally, existing training material is of high relevance for the extension service. Media have a big impact on policy makers as well as on consumers.

Figure 15: Ways of Information Transfer to Various Interest Groups



Source: Own Survey

7.2 Pesticide Policy Issues: An Assessment of the Current Situation in Thailand

Another focus of the expert survey was to assess the current situation in crop protection policy, to value the impact of different factors influencing the use of pesticides and the development of other crop protection methods.

The ten subjects asked for in the survey are listed according to the priority given to them in respect to current policy assessment by the experts and are ranked from 1 to 10. Hereby rank one is the subject with the highest priority while rank 10 indicates the lowest priority[32]. In a second step the experts have been asked to rank the same subjects according to their own opinion of a preferable ranking. Table 6 summarizes the results of these rankings.

Table 6: Priorities Given in Plant Protection in Thailand, Actual and Preferred Ranking

ACTUAL SITUATION			PREFERRED SITUATION	
Subject	**Rank**		**Subject**	**Rank**
Chemical crop protection	2.12	HIGH	IPM training for extension service	3.31
Safe use training[1]	3.21	PRIORITY	Safe use training[1]	3.53
Outbreak budget	3.35		Regulatory policy	3.63
Regulatory policy	4.47		IPM training for farmers	3.75
IPM training for extension service	4.73		Non-chemical pest control methods	3.88
Economic threshold	5.33		Residue analysis	4.80
Residue analysis	5.77		Economic threshold	4.87
IPM training for farmers	6.06		Consumer awareness	6.00
Non-chemical pest control methods	6.93		Chemical crop protection	6.43
Consumer awareness	9.00	LOW	Outbreak budget	7.00

1 'safe use' does not expressively refer to the Safe Use Projects conducted by pesticide companies in cooperation with GIFAP

Source: Own Survey

32 It was not necessary to rank all subjects. Same ranks could be given to different subjects.

The ranking of the actual crop protection policy shows a clear priority on pesticide related issues like safe use, outbreak budget and regulatory policies. Chemical crop protection has been ranked as the subject with the highest priority in current pesticide policy by the experts. The first non-chemical issue is the IPM training for the extension service. IPM training for farmers and non-chemical control methods are at the bottom of the scale.

Non-chemical issues are gaining more importance in the ranking of crop protection policies preferred by the experts, also shown in Table 6. This includes IPM training for the extension service and farmers as well as non-chemical control methods. Safe use of pesticides and regulatory policy yield rank two and three. Chemical crop protection is here not regarded as a policy priority. The assessment conducted by the experts shows the massive divergence between the actually given priorities and the preferred priorities in crop protection policy. More focus on training issues as well as on non-chemical methods of crop protection is desired.

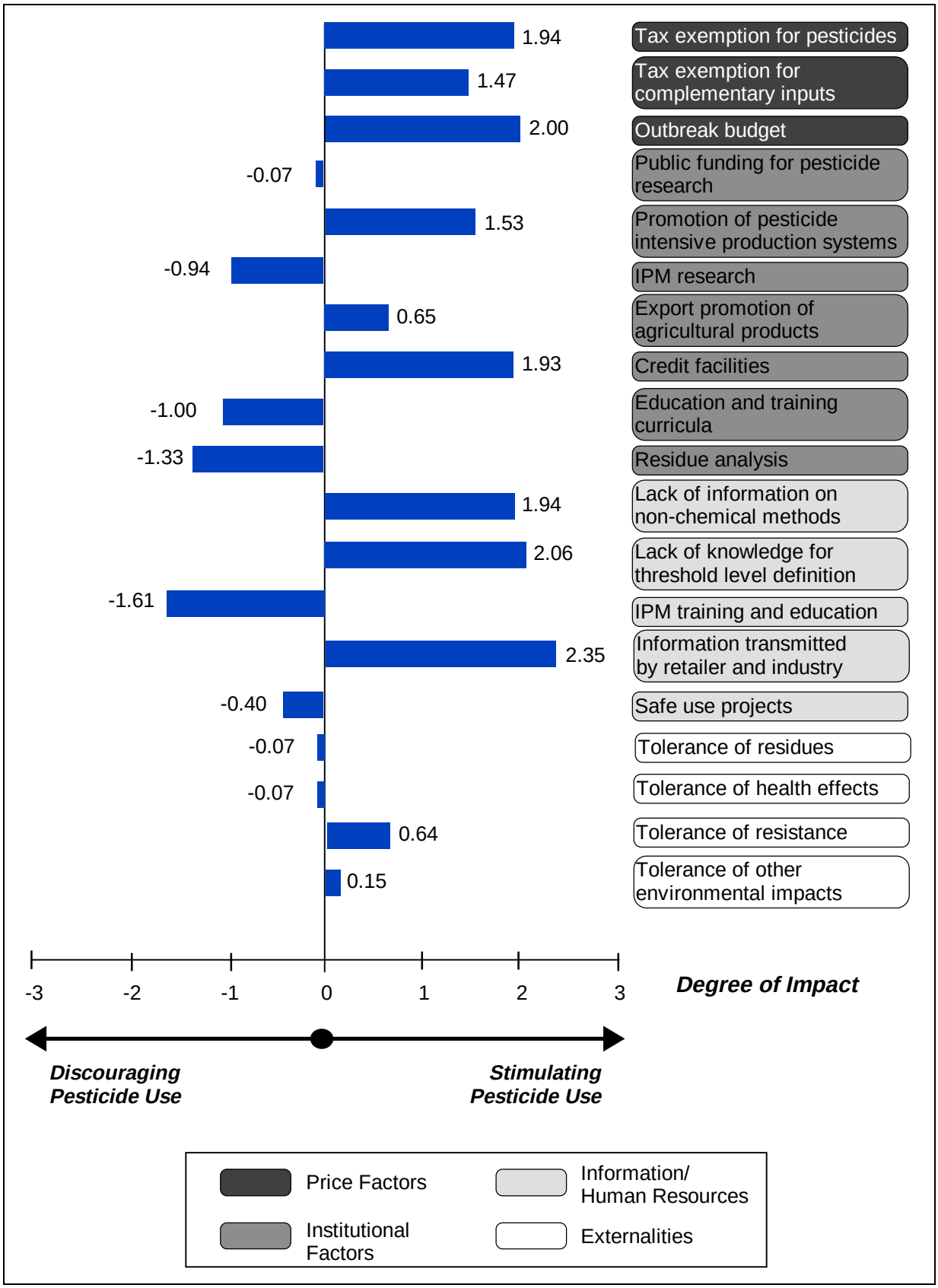
The second part of the expert policy assessment consisted of a ranking of factors influencing pesticide use in Thailand. These factors have been broadly discussed in earlier sections of this paper and will now be assessed for their impacts. A list of factors which are believed to influence the pesticide use has been presented to the experts. Additionally, the impact of each factor should be expressed on a scale in seven categories. These categories range from -3 to +3. The positive numbers express the influence in favor of higher pesticide use while the negative numbers show an impact to a reduced use of pesticides. Zero implies that a factor has no impact on the pesticide use level. The higher the number the higher is the impact of the factor - in the positive and in the negative direction. It was explicitly asked for an assessment of the current situation in Thailand.

The factors have been divided into four groups. The first group consists of price factors which are believed to have a direct influence on the pesticide price. The second group includes institutional factors dealing with the institutional aspects of crop protection policy. The third group summarizes factors regarding aspects of information and human resources. The last group deals with tolerance levels of negative externalities. If the tolerance of negative externalities in a society is high little incentives are existing to reduce pesticide overuse.

Figure 16 summarizes the average value of the grade of impact for each factor assessed by the experts. Major factors enhancing pesticide use are the group of price factors and information factors. Both the outbreak budget and the tax exemption for pesticides have been identified as high distortional factors within the group of price factors. For the institutional factors may be assumed that the discouraging impact given to education and training curricula is based on the general opinion that effective education and training discourage pesticide use. According to the previous chapters, this opinion is not fully applicable to the situation in Thailand. In the group of factors related to information and human resources, the lack of information on non-chemical measures and of definitions for damage and threshold levels have been highlighted as major imperfection. Consequently, these missing information contribute to a suboptimal use of pesticides.

Education and training curricula along with IPM training and school education are highlighted as having a major influence on discouraging pesticide use. However, the degree of impact for factors reducing pesticide use is not as strong as the one for factors enhancing pesticide use. Finally, it is interesting to note that tolerance of residues and health effects are assessed as having a discouraging impact (negative prefix) while the level of tolerance for resistance and other environmental impacts still supports pesticide use. In other words, recognition or knowledge of resistance build-up and other environmental effects is either much smaller than the one for residues and health effects or concern is not as big. This may be due to the fact that only a limited group of the society is openly confronted with these effects. In the recent past, increased awareness building through the media made residue findings and reported health effects widely known and agreed upon the fact that they do have negative effects for the farmer as well as for the society.

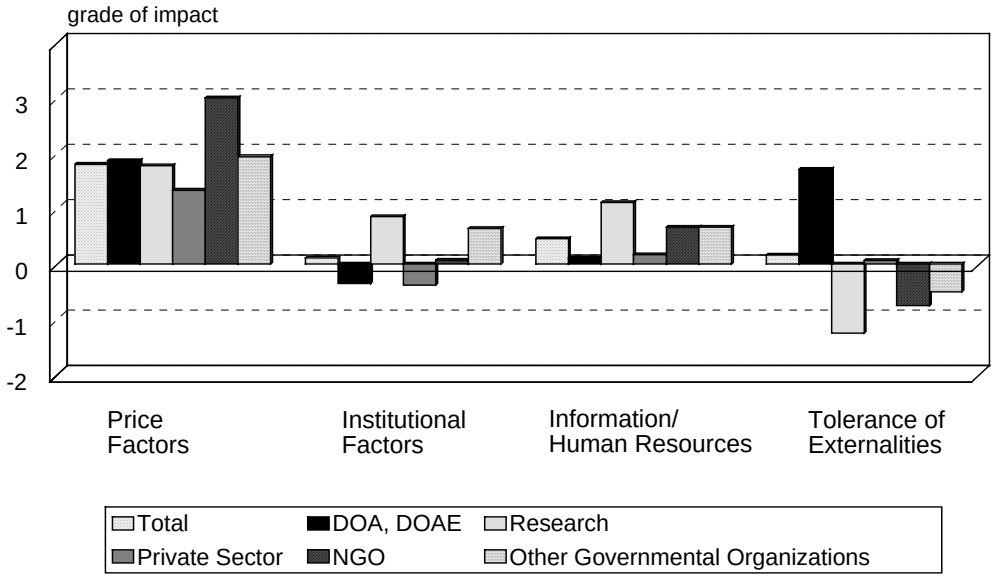
Figure 16: Factors Related to Crop Protection Policy and their Impact on Pesticide Use According to an Expert Survey



Source: Own Survey

Figure 17 provides a more detailed insight in the assessment of the five expert groups. The overall analysis as well as the single group statements are aggregated by factor and expert group. However, deviations of the grade of impact of one factor among the experts exist, but are generally leading into the same direction. This may be due to the insufficiency of the current information available as well as to the different interests involved. Again, it can be underlined that a common belief of all experts is that price factors have a strong distortional effect on pesticide use. While in the other factor groups opinions about the direction of the distortion and the grade of impact may differ.

Figure 17: Grade of Impact by Factor Groups Assessed by All Experts and by Expert Group



Source: Own Survey

8 Conclusions and Recommendations

The above analysis of the crop protection sector in Thailand raised various concerns and problems related to the use and ongoing support of pesticides as the main crop protection strategy. Important aspects and probable developments shall be summarized.

Pesticide use for high-value crops will continue to increase. Especially pesticide use for fruit and vegetables is remarkably higher because physical appearance of this crops is substantial for good market prices. Herbicide use becomes more intensive due to labor shortages. Most of the pesticides used still belong to the group of “extremely“ and “mostly“ hazardous according to WHO classification. As application technology will hardly change in the near future, health effects are likely to increase. Examples show that the misuse of pesticides can result in more pest related crop losses, e.g. the BPH, than not applying pesticides at all.

At all levels information plays a very important role in the agricultural decision making process. Biased or lacking information hinders the spreading of alternatives to pesticides as well as it limits the political decision making process. Farmers’ perception of crop losses is heavily distorted by misuse of the insurance argument promoted by the pesticide industry. Decision making is often based on information given by retailers, other farmers, extension workers and pesticide companies.

In Thailand negative side effects of the current pesticide use result in considerable costs to the society. If these pesticide-related health and other external effects are put into consideration, the economics of pesticide use becomes questionable in many cases.

The promotion of agricultural exports stimulates overall pesticide use due to the emphasis on the quality and the appearance of the crop and export standards (KHUANKAEW, 1995). Especially in the fruit sector, where exports are increasing, this will gain more importance in the future and lead to increased pesticide use as this helps to prevent fruit skin damage. Price differentiation for pesticide free products or less intensive production is not existing and neither are clear regulations for their production introduced. As exports of agricultural crops are strongly promoted, higher consideration to the safety standards of export crops in terms of production and production process will be necessary.

The liberal pesticide market resulted in many companies importing, trading and selling pesticides. Control of this market is a difficult target and the implementation of existing rules is lacking. Tax reduction increases the profitability of this market. Many factors support the use of pesticides directly or indirectly. It can be assumed that the current price for pesticides does not include all costs which occur in the ecosystem. Studies indicate that the price of pesticides has an important influence on the quantity used (FAO-JICA, 1995). Little policy action is implemented to reduce the distortion of pesticide use levels. Governmental actions have a dualistic effect. Efforts are strong to improve pesticide based management systems on the one hand, on the other hand more and more IPM methods are introduced. Law enforcement of policies for pesticide imports, licensing, registration, control and pricing are essential components for successful national IPM programs. Sustainable IPM programs should be location specific and thus considering local conditions, constraints, management systems and prices. IPM programs should not focus on one crop only but on the farming system.

The consumer awareness of possible effects related to pesticides creates a growing market for controlled or pesticide free produced crops. However, this market is very small. NGO's working in the field of pesticide free or organic food production are designing rules and regulations for the production of these products thus creating the necessary foundation for consumer's acceptance.

Thailand's role as a nucleus for conceptual and technological development in its neighboring Indochinese countries must be taken into consideration when looking into crop protection policies. The illegal export of outdated pesticides to these countries creates a link between regulatory policy in Thailand and pesticide use in these countries.

However, further research is needed to analyze the current situation and, more important, to draw conclusions with respect to future crop protection targets. To be able to recommend a desirable crop protection policy more information about benefits of pesticide use, external effects related to pesticide use, alternative management systems - especially successful IPM systems - are necessary. More sophisticated crop loss assessment methodology including farming systems' perspective should be adopted. Much more information is needed related to relevance and severity of external effects of pesticide use. More data are essential based on natural science and more realistic terms to assess the implied costs. For an implementation of IPM activities more research is needed on how an

adaptable and successful IPM system for various crops has to be designed. Only when adaptable IPM systems are developed successful implementations can be expected. Additionally, effective training and extension methodology is needed in this area to spread the possibilities already available. Further research is an essential need for improved crop protection policies. However, improvements in the current design can also contribute substantially to limit the ongoing support of pesticides in Thailand.

It may be possible that the amount of money spent on the outbreak budget would be much more farmers supportive if spent on alternative uses like for example farmers training. This could be an effective method to prevent pest outbreaks without the need of emergency stocks provided by the outbreak budget. Therefore, the outbreak budget should be critically reviewed and alternative use for the money spent should be discussed. Tools for cost benefit assessment should be reconsidered and should be integrated in the risk benefit assessment of pesticide use.

Strong support of farmer field school concepts and their adaptation to Thai conditions can reduce pesticide use effectively. As biased information has been identified as a major shortcoming in the current situation, efficient training methods can enable the farmer to use pesticides in a more economic way. For this concern, increasing support for non chemical alternatives would be desirable.

A stronger role of other than agricultural producer interest groups in the registration process would be a desirable step towards more unbiased decision making. As shortcomings in the current conduction of pesticide legislation have been identified as pesticide supportive, a critical assessment of forces and structures within the governmental procedures can be regarded as a useful step. A critical review of the incentive structure for pesticide use would therefore be helpful.

Higher regard to the incorporation of economic instruments in crop protection policy is an essential need to limit the pesticide use towards the social optimum.

9 References

Agne, S., G. Fleischer, F. Jungbluth, H. Waibel (1996): Guidelines for Pesticide Policy Studies - A Framework for Analyzing Economic and Political Factors of Pesticide Use in Developing Countries. Pesticide Policy Project, Publication Series No. 1, GTZ/University of Hannover, Hannover, Germany.

Agne, S. (1996): Economic Analysis of Crop Protection Policy in Costa Rica. Pesticide Policy Project, Publication Series No. 4, GTZ/University of Hannover, Hannover, Germany.

BAAC (1994): Annual Report 1993. Bank of Agriculture and Agricultural Cooperatives, 1 April 1993- 31 March 1994, Bangkok, Thailand.

Bagoglu, N. (1996): Unternehmerbriefe - Thailand. Bundesstelle für Außenhandelsinformationen, October 1996, Köln, Germany.

Bangkok Post (1993): Farmers Encouraged to Switch Crops. Bangkok Post, October 16, 1993, Bangkok, Thailand.

Bangkok Post (1995): Bangkok Post Economic Review Year End 1994. Bangkok Post, Bangkok, Thailand.

Bank of Thailand: Quarterly Journal, various issues, Bank of Thailand, Bangkok, Thailand.

Boon-Long, J. (1995): Chemical Legislation and Infrastructure in Thailand. Paper presented at the Conference on International Trade of Dangerous Chemicals, Brussels, 5-7 July 1995.

CIRAD (1990): Regional Agro-Pesticide Index. Vol.1, Asia, ARSAP/CIRAD, Bangkok, Thailand.

Customs Department (1995): Customs Tariffs. Ministry of Industry, Bangkok, Thailand.

Division of Entomology and Zoology (1994): Annual Report 1993. Department of Agriculture, Bangkok, Thailand.

East Asia Analytical Unit (1994): Subsistence to Supermarket: Food and Agricultural Transformation in South-East Asia. Department of Foreign Affairs and Trade, p. 120-134, Australia.

Epidemiological Division: Annual Epidemiological Surveillance Report. Ministry of Public Health, various issues, Bangkok, Thailand.

FAO: FAO Production Yearbook , various issues

FAO (1994): Economic Situation in Thailand. Regional Office for Asia and the Pacific, Bangkok, Thailand.

FAO-JICA (1995): Survey of Japan-FAO Association Projects, March 1995.

Farah, J. (1993): Pesticide Policies in Developing Countries. Do They Encourage Excessive Pesticide Use? World Bank Discussion Paper 238, World Bank, Washington D.C., U.S.A.

GIFAP (1996): Thailand-Product Quality Monitoring Programme. In: ASWG Newsletter, Jan. 1996, Safe Use Project, GIFAP.

Grandstaff, S. (1992): Pesticide Policy in Thailand. Thailand Development Research Institute, Bangkok, Thailand.

IRRI (1994): Integrated Pest Management - The IRRI Perspective. IRRI Information Series No. 3, IRRI, Los Baños, Philippines.

Jourdain, D.J. and C. Rattanasatien (1995): An Analysis of Pesticide Use in Vegetable Farming: the Case of Thailand. In: Agro-Chemicals News in Brief, Vol. XVIII, No. 2, April-June 1995.

Khuankaew, O. (1995): IPM and Women. Report on Short Term Consultancy, Integrated Pest Management in Selected Fruit Trees Project, Thai-German Plant Protection Programme, Department of Agricultural Extension, Bangkok, Thailand.

Landell Mills (1994): Consultant Report on Pesticide Use in Various Countries, London, United Kingdom.

Ministry of Agriculture (1994): Production Restructuring Program. Office of the Board of Structural Adjustment in the Agricultural Sector, Ministry of Agriculture, Bangkok, Thailand.

Office of Agricultural Economics: Agricultural Statistics of Thailand. Various Issues, Ministry of Agriculture and Agricultural Cooperatives, Bangkok, Thailand.

Ooi, P.A.C., G.S. Lim, T.H. Ho, P.L. Manalo, J. Waage (1992): Integrated Pest Management in the Asia-Pacific Region. Proceedings of the Conference on Integrated Pest Management in the Asia-Pacific Region, 23-27 September 1991, Kuala Lumpur, Malaysia, CAB International, Asian Development Bank.

Palakool, S., S. Sukamak, B. Deenruy (1995): Pesticide Residues in Fruit and Vegetables. Proceedings of the First Technical Conference of the Agricultural Toxic Substances Division. Agricultural Toxic Substances Division, Department of Agriculture, 23-25 August 1995, Bangkok, Thailand.

Pimentel, D., H. Acquay, M. Biltonen, P. Rice, M. Silva, J. Nelson, V. Lipner, S. Giordano, A. Horowitz, M. D'Amore (1993): Assessment of Environmental and Economic Impacts of Pesticide Use. In: D. Pimentel and H. Lehmann (eds.): The Pesticide Question - Environment, Economics and Ethics, Chapman & Hall, New York, London.

Poapongsakorn, N. (1994): Transformation in the Thai Rural Labor Market. In: B. Koppel, J. Hawkins, W. James (eds.): Development or Deterioration? Work in Rural Asia, Lynnes Riemer Pub., Boulder, London, United Kingdom.

Regulatory Division: Pesticide Statistics. Various Issues, Agricultural Regulatory Division, Department of Agriculture, Bangkok, Thailand.

Regulatory Division (1994): Registration of Hazardous Substances in Thailand. Department of Agriculture, Bangkok, Thailand.

Seitz, W.D., G.C. Nelson, H.G. Halcrow (1994): Economics of Resources, Agriculture, and Food. McGraw-Hill, New York, U.S.A.

Setboonsarng, S. (1993): Environmental Constraints to Thai Agriculture. In A.M. Rae and A.D. Meister (eds.): Environmental Constraints to Pacific Agriculture, p. 83-101, Center for Agricultural Policy Studies, Massey University, New Zealand.

Siamwalla, A., D. Patamasiriwat, S. Setboonsarng (1992): Public Policies Towards Agricultural Diversification in Thailand. In Barghouti et al.: Trends in Agricultural Diversification, World Bank Technical Paper, No 180, Washington, D.C., U.S.A.

Siamwalla, A. (1994): Rural Credit Markets in Thailand. TDRI Quarterly Review, Vol. 9, No. 5, p. 3-5, TDRI, Bangkok, Thailand.

Sinchaisri, N. (1988): Pesticide Resistance in Thailand. In: Teng, P.S., K.L. Heong (eds.): Pesticide Management and Integrated Pest Management in Southeast Asia, USAID.

Sinhaseni, P. (1990): Regional Pesticide Review - Thailand. International Development Research Center, Chulalongkorn University, March 1990, Bangkok, Thailand.

Sinhaseni, P., D. Phantumvanit, P. Sivabut, S. Foongvidya, R. Sachasinh (1992): Reducing Pesticide Hazards in Formulating/Repacking Plants in Thailand. Thailand Development Research Institute, Bangkok, Thailand.

Sinhaseni, P. (1994): Toxicological Concepts, Regulatory Provision and Appropriate Technology for Pesticide Safe Use: an Experience in Thailand. Pesticide Safe Use Unit, Faculty of Pharmaceutical Sciences, Chulalongkorn University, June 1994, Bangkok, Thailand.

Songsakul, T. (1991): Effects of Urbanization and Environment on Vegetable Cultivation: a Case Study of Village No. 3 Ban Mai Sub-District, Pathum Thani Province. Master Thesis, Asian Institute of Technology, Bangkok, Thailand.

Tayaputch, N. (1988): Pesticide Residues in Thailand. In: Teng, P. and K.L. Heong (ed.): Pesticide Management and Integrated Pest Management in Southeast Asia, USAID.

Tayaputch, N. (1992): Fate of Pesticides in Tropical Environments of Thailand. Ph.D. Thesis, University of Agriculture Tokyo, Tokyo, Japan.

Tayaputch, N. et al. (1994): Pesticide Residues in Rice Paddy Environment in Selected Villages in Central Thailand. Toxic Substances Division, Department of Agriculture, Bangkok, Thailand.

TDRI (1995): Agricultural Diversification/ Restructuring of Agricultural Production Systems in Thailand. Thailand Development Research Institute, August 1995, Bangkok, Thailand.

Thai-German Plant Protection Programme (1993): Project Presentation. Department of Agricultural Extension, Bangkok, Thailand.

Thailand in Figures (1995/96): Published by Alpha Research Co. and Manager Information Service Co., 3rd Edition 1995-1996, Bangkok, Thailand.

Thongsakul, S., D. Wechakit, J. Ek-Amnuay, P. Ratanasien (1990): A Survey of Tangerine Growers Concerning Application Spray Equipment and their Problems. Pesticide Application Research Section, Entomology and Zoology Division, Department of Agriculture, Bangkok, Thailand.

Waibel, H: (1990): Pesticide Use and Pesticide Policy in Thailand. Paper presented at the Workshop on Environmental and Health Impacts of Pesticide Use in Rice Culture, 28-30 March 1990, Los Baños, Philippines.

Waibel H., S. Setboonsarng (1993): Resource Degradation Due to Chemical Inputs in Vegetable-Based Farming Systems in Thailand. In: Journal of Asian Farming System Association, Vol. 2, p.107-120.

Waibel, H. (1994): Towards an Economic Framework of Pesticide Policy Studies. In: Proceedings of the Göttingen Workshop on Pesticide Policies, ed. by S. Agne, G. Fleischer and H. Waibel, Göttinger Schriften zur Agrarökonomie, Vol. 66., Institute of Agricultural Economics, University of Göttingen, 1994, Germany.

Waibel, H., G. Fleischer (1996): Nutzen-Kosten-Untersuchung zur Produktion, Distribution und dem Einsatz chemischer Pflanzenschutzmittel in Deutschland und in ausgewählten Weltwirtschaftskulturen (Benefit-cost analysis of production, distribution and use of chemical pesticides in Germany and selected world crops). Draft report to the Federal Agricultural Ministry of Germany, July 1996.

Whangthongtham, S. (1990a): Economic and Environmental Implications of Two Alternative Citrus Production Systems - A Case Study from Pathum Thani Province. Master Thesis, Asian Institute of Technology, Bangkok, Thailand.

Whangthongtham, S. (1990b): Brown Planthopper Outbreak in Thailand 1989 to 1990. Report on the seminar of “BPH and Rice Ragged Stunt Virus“, June 28, 1990 Department of Agriculture, Bangkok, Thailand.

WHO/UNEP (1990): Public Health Impact of Pesticides Used in Agriculture. World Health Organization, Geneva, Switzerland.

Wongpanich, M. et al. (1985): Pesticide Poisoning among Agricultural Workers: a Research Report. Mahidol University, Bangkok, Thailand.

Wood Mackenzie (1993): East Asian Agrochemical Markets. Consultancy Report.

World Bank (1994): Thailand - Impact Evaluation Report. Second Tree Crops Project, June 1994, Rep. No. 13244 - TH, World Bank, Washington, D.C., U.S.A.

Annex I - Map of Thailand

Source: Thailand in Figures, 1995

Annex II - Characteristics of Thailand's Economy and the Agricultural Sector

Table 2.1: Economic Indicators of Thailand, 1994

Population:	59.1 million	
Area:	513,115 km	
GNP per capita:	2110 US$	
Agriculture:		
Share of Agriculture in GDP	11.3%	
Agricultural Land	40.3% of total land area	
Employment in Agriculture in Percent of Total Employment	79.3% (1970)	63.9% (1990)
Population Growth Rate:	2.9%	(1970-1975)
	1.6%	(1980-1993)
GDP at Market Prices (mill. US$):	1992	1993
Agriculture:	340,2	315,0
Manufacture:	792,1	899,4

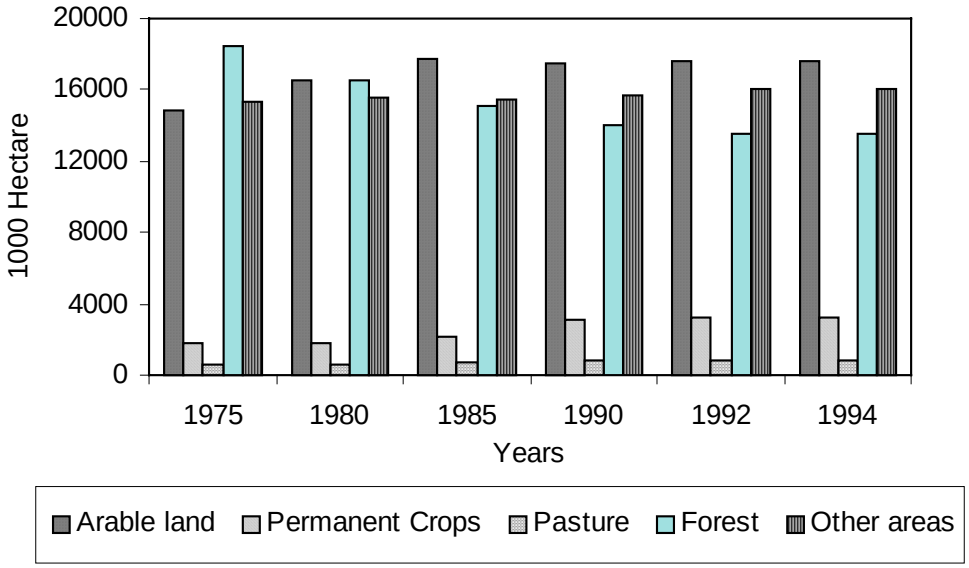
Source: World Bank, World Tables 1995, Social Indicators of Development, 1995

Table 2.2: Composition of Exports and Imports by Group of Product, 1993 & 1994

Exports	1994	1993	Imports	1994	1993
Agriculture	16.6 %	17.0 %	Consumer	3.1 %	3.1 %
Agro-industry	9.3 %	9.1 %	Raw and semi-raw material	38.2 %	39.0 %
Mineral	1.3 %	1.6 %	Fuel	6.8 %	7.8 %
Manufacture	72.0 %	70.8 %	Machinery and manufacture	40.6 %	38.0 %
Others	0.7 %	1.5 %	Transportation equipment	9.9 %	9.8 %
Total (million Baht)	1,129,539	940,863	Total (million Baht)	1,364,215	1,170,746

Source: Thailand in Figures, 1996

Figure 2.1: Patterns of Land Use



Source: FAO Production Yearbook , various issues

Table 2.3: Development of Land Utilization (1000 rai)

Year	Paddy	Cassava	Rubber	Coconut	Cotton	Sugar Cane	Oilpalm
1970	47,799	1,403	7,976	1,880	193	968	10
1975	56,110	2,969	8,786	2,467	188	2,482	35
1980	60,110	7,250	9,615	2,363	949	3,074	227
1985	63,422	9,230	10,288	2,593	519	3,450	514
1990	61,910	9,525	11,091	2,552	461	4,979	928
1991	59,671	9,274	11,108	2,432	621	5,791	915
1992	60,453	9,100	11,139	2,427	483	6,267	958
1993	59,251	8,817	11,625	2,426	328	5,355	954
1994	60,677	8,268	12,007	2,206	355	5,887	1,122

Source: Office of Agricultural Economics, Agricultural Statistics of Thailand, various issues

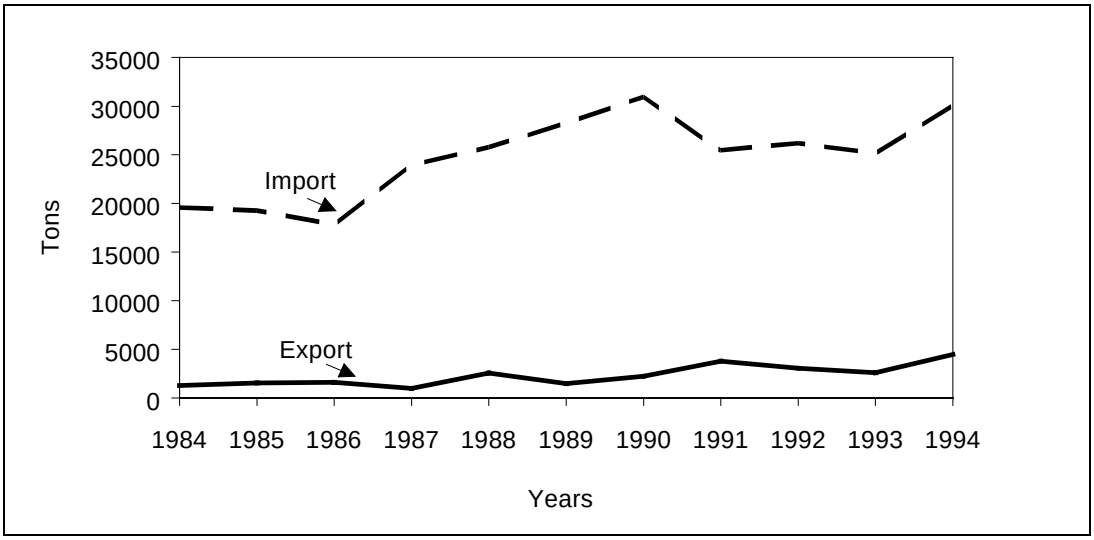
Annex III - Background Data on the Pesticide Sector in Thailand

Table 3.1: Quantity of Pesticide Imports (tons, a.i. and form. products)

Year	Insecticide	Fungicide	Herbicide	Acaricide	Rodenti-cide	Fumigant	Plant Gr. Reg.	Mollusci-cide
1976	5,960	1,299	2,293					
1977	6,967	2,024	4,429					
1978	10,809	2,906	5,741					
1979	10,571	3,051	5,603					
1980	10,045	3,025	7,002					
1981	6,625	2,864	9,442	577	4			
1982	5,588	2,220	6,466	745	50	119		
1983	6,718	3,904	6,109	812	17	232		
1984	8,233	3,923	6,208	831	17	360		
1985	7,284	3,717	6,378	450	26	584		
1986	8,299	3,710	4,081	331	34	813		
1987	6,673	6,524	5,864	936	86	457		
1988	8,034	6,382	8,273	423	362	777		
1989	9,068	5,865	10,600	517	232	507	108	
1990	9,356	4,243	14,518	442	294	323	286	
1991	7,233	5,112	12,372	466	123	401	353	
1992	7,903	5,192	15,227	544	121	626	444	
1993	7,330	5,651	15,386	469	129	217	476	37
1994	7,708	7,065	16,108	404	98	345	500	46
1995	10,560	6,937	19,954	520	86	50	611	36

Source: Pesticide Statistics, Department of Agriculture, various issues

Figure 3.1: Pesticide Export and Import Trends (1984-1994)



Source: Agricultural Statistics, various issues

Table 3.2: Insecticide Use in Various Crops (in order of intensity)

Crop	Quantity of Insecticide (ton)	Planted area (rai)	Quantity of Insecticide (kg/rai)
Grapes	510	20,708	24.630
Tomato	255	37,624	6.780
Tangerine	1,967	399,868	4.920
Vegetables	919	194,351	4.730
Tobacco	996	360,000	2.770
Cotton	592	441,000	1.340
Chili, Pepper	328	277,494	1.180
Onion, Garlic	241	311,832	0.770
Durian	388	529,413	0.730
Rambutan	272	444,697	0.610
Mango	316	1,151,342	0.270
Rice	9,075	65,218,000	0.140
Soybean	335	2,897,000	0.120
Peanut	80	818,000	0.098
Green Beans	140	3,149,000	0.040
Sugar cane	78	4,298,000	0.020
Oilpalm, Coconut	53	3,701,752	0.014
Maize	130	12,357,000	0.011

Source: Thai-German Plant Protection Programme, 1993

Table 3.3: Amount of Pesticide Use in Various Crops (kg)

Crop	1987	1988
Rice	8,755	18,220
Maize	812	953
Tapioca	1,239	1,486
Sugar Cane	1,343	1,988
Soybean	1,164	1,353
Other beans	477	577
Cotton	1,171	1,539
Orchid	223	274
Pineapple	760	882
Para Rubber	1,211	1,751
Oil Palms	807	1,217
Onion	465	570
Chili	1,140	1,149
Tobacco	1,141	1,337
Garlic	313	402
Vegetables	1,334	1,744
Oranges	3,616	4,220
Tropical Fruits	3,906	4,468
Coffee	356	484
Ornamental Plants	630	779
Other Crops	1,216	1,691

Source: Regulatory Division, Pesticide Statistics 1987 and 1988; no more recent data available

Table 3.4: Main Importing Manufacturers and Their Products (1995)

Manufacturer	Product
ICI	paraquat, cyhalothrin
Monsanto	glyphosate, butachlor
Ciba-Geigy	monocrotophos, atrazine, pretilachlor
Du Pont	methomyl, bromacil, bensulfon-methyl, benomyl
AgrEvo	endosulfan
TJC	benthiocarb, fernitrothion, fenvalerate, cartap
Bayer	propineb, metamidophos
Rhone Poulenc	carbaryl, fosetyl
F.E. Zuellig	BPPS
ACC	carbofuran, azadorin

Source: FAO-JICA, 1995

Table 3.5: Main Pesticides Imported to Thailand by Quantity (1995)

Common Name	WHO-Class	Quantity (ton)	cif - value (mill. Baht)	Origin
glyphosate	IV	8,407	645	Taiwan, China, Malaysia, Singapore, Hungary, Denmark, U.S.A.
2,4-D	II	3,071	170	Hungary, India, Poland, Australia, U.K., China, Germany, Malaysia, Austria
atrazine	IV	1,920	181	Croatia, Italy, Israel, S. Africa, U.S.A., Netherlands
methamidophos	Ib	1,667	105	China, U.S.A., Taiwan
ametryn	III	1,415	208	U.S.A., Israel, Italy
monocrotophos	Ib	1,292	157	Taiwan, Switzerland, China, India, Israel
sulfur	IV	1,299	29	India, France, Germany, Netherlands, Hungary
copper oxychloride	III	1,112	40	Germany, Italy, Poland, Switzerland, Hungary
carbofuran	Ib	1,016	86	Indonesia, Taiwan, Germany, Japan, Italy, U.S.A.
methyl parathion	Ia	938	74	China, Denmark, India, Israel

Source: Pesticide Statistics, 1995

Annex IV - The Institutional Framework of Pesticide Regulation

Table 4.1: Constitution of the Hazardous Substances Board

- the Permanent Secretary of the Ministry of Industry as the chairman
- the Directors General of :
    - the Department of Internal Trade
    - the Department of Medical Services
    - the Department of Public Works
    - the Police Department
    - the Department of Agriculture
    - the Department of Agricultural Extension
- the Secretaries General of:
    - the National Environmental Board
    - the Food and Drug Administration
    - the Office of Atomic Energy for Peace
    - the Industrial Standards Institute
- representatives from the Ministry of Defense
- other experts (not more than seven)
- the Director General of the Department of Industrial Works as member and secretary
- representatives from the Department of Civil Engineering, the Department of Industrial Works, the Department of Agriculture, the Office of Atomic Energy for Peace and the Food and Drug Administration.

Appointed experts must have high knowledge and experiences related to chemistry, engineering, agriculture, or law.

Table 4.2: Constitution of the Sub-Committee for the Registration of Agricultural Hazardous Substances

The Director General of DOA, the Deputy Director, the Directors of the Divisions of Entomology and Zoology, Plant Pathology, Agricultural Toxic Substances, Botany and Weed Science, Regulatory and Horticulture, Representatives from the Ministry of Public Health, the Department of Fisheries and the Director of the Pesticide Regulatory Division.

Source for both tables: Hazardous Substances Act, B.E. 2535

Figure 4.1: Organizational Chart of the Department of Agricultural Extension and the Department of Agriculture

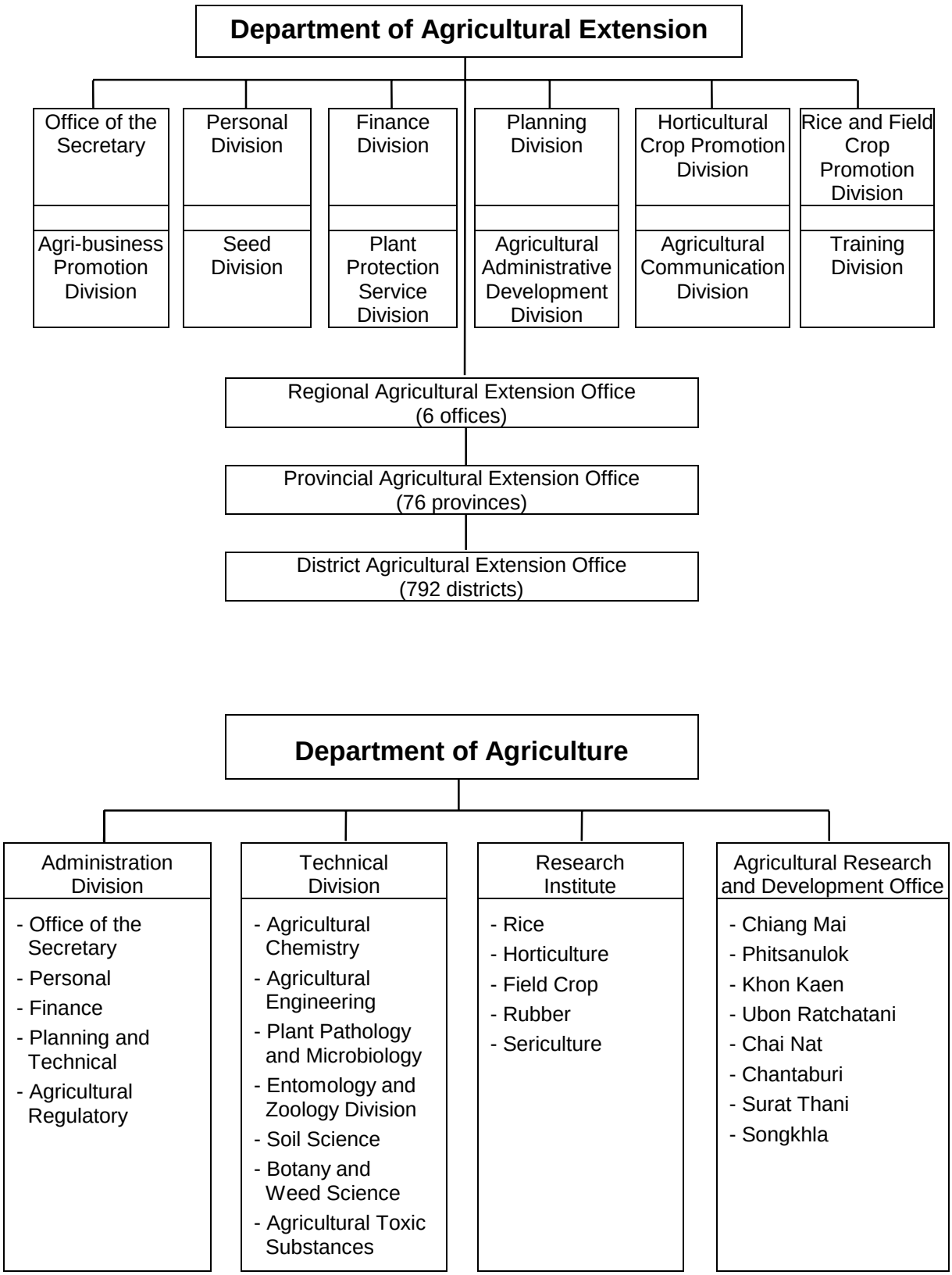


Table 4.3: List of Banned Pesticides in Thailand

Pesticide Name	Effective Date forbidden	Reason
chlordimeform	Apr 1977	- Carcinogenic effect risk level
leptophos	Apr 1977	- Carcinogenic effect risk level (The manufacturer withdrew the product from the market)
BHC	Mar 1980	- Long lasting residual effect risk level - Carcinogenic effect risk level
sodium arsenite	Jan 1981	- Long lasting risk level of accumulation in soil - fetotoxicity effect risk level
endrin	Jul 1981	- Long lasting residual effect risk level - Highly toxic to fish
MEMC	Jun 1981	- Long lasting residual effect of mercury which may cause danger to humans and environment
DDT	Mar 1983	- Carcinogenic effect risk level - Long lasting residual effect risk level
toxaphene	Mar 1983	- Carcinogenic effect risk level - Long lasting residual effect risk level
2,4,5-T	Sep 1983	- Long lasting residual effect risk level - Carcinogenic and fetotoxic effect risk level
TEPP	Jun 1984	- Extremely hazardous substance which may cause danger to user
EDB	Jul 1986	- Carcinogenic and teratogenic effect risk level
sodium chlorate	Oct 1986	- A strong oxidising agent which easily flames; difficult to keep in storage condition
dinoseb	Nov 1986	- Carcinogenic and teratogenic effect risk level
captafol	Apr 1987	- Carcinogenic effect risk level
fluoroacetamide	Jul 1987	- Extremely hazardous substance which may cause danger to user
sodium fluoroacetate	Jul 1987	- Extremely hazardous substance which may cause danger to user
cyhexatin	May 1988	- Teratogenic effect risk level in mammal (The manufacturer withdrew the product from the market)
ethyl parathion	May 1988	- Extremely hazardous substance which may cause danger to user
dieldrin	May 1988	- Long lasting residual effect risk level
aldrin	Sep 1988	- Long lasting residual effect risk level
heptachlor	Sep 1988	- Long lasting residual effect risk level
daminocide	Apr 1989	- Carcinogenic effect risk level
binapacryl	Feb 1991	- Carcinogenic and teratogenic effect risk level
pentachlorophenol	Aug, 1993	- Extremely hazardous substance which may cause danger to user, quick dermal absorption - Long lasting residual effect risk level
pentachlorophenate sodium	Aug 1993	- Extremely hazardous substance which may cause danger to user, quick dermal absorption - Long lasting residual effect level
mercury compounds	Aug 1993	- Highly toxic - Long lasting residual effect risk level - toxic to fish and aquatic organisms
ethylene chloride	Sep 1994	- Carcinogenic effect risk level
aminocarb	Sep 1994	- low ADI, high risk to user
bromophos	Sep 1994	- low ADI, high risk to user
bromophosethyl	Sep 1994	- low ADI, high risk to user
demeton	Sep 1994	- low ADI, high risk to user
fentin	Sep 1994	- low ADI, high risk to user
nitrofen	Sep 1994	- low ADI, high risk to user

Source: Regulatory Division, 1994, since Sep.1994 no further pesticides banned

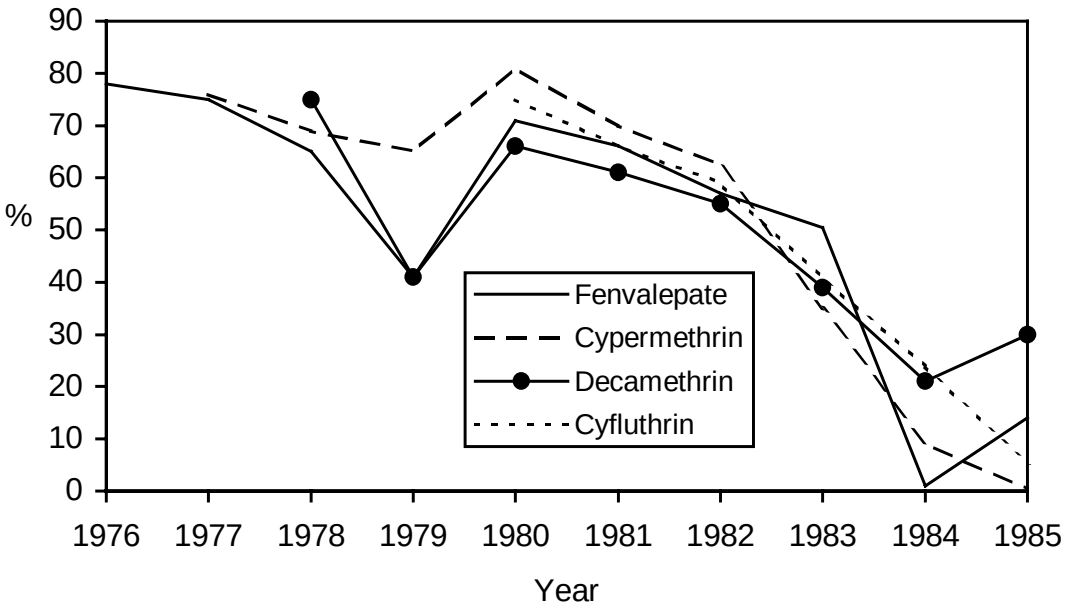
Annex V - External Effects

Table 5.1: List of Compounds Analyzed for Residues

aldicarb	Chlorpyrifos	endosulfan	methomyl
aldrin	2,4-D	endrin	methyl parathion
atrazine	DDD	fenitrothion	mevinophos
BHC	DDE	fenvalerate	monocrotophos
benomyl	DDT	heptachlor	parathion
captan	Dizinon	lindane	permethrin
carbaryl	Dichlorovos	malathion	phorate
carbendazim	Dicofol	mancozeb	propineb
carbofuran	Dieldrin	maneb	tetradifon
chlordane		methamidophos	zineb

Source: Tayaputch, 1992

Figure 5.1: Efficacy Development of Pyrethroids in Cotton in Controlling *Heliothis armigera* (Bollworm) in Thailand



Source: Sinchaisri, 1988

Table 5.2: Estimation of External Costs Related to Pesticide Use

I Health Costs

1)	Official number of pesticide poisoning cases 1994 (EPIDEMIOLOGY DIVISION)	3165
Derived from study in Pathum Thani Province (WANGTHONGTHAM, 1990):		
2)	Estimated health costs per day and poisoning case including lost labor days	328.5 Baht
3)	Surveyed poisoning cases	2121
4)	86% due to insecticides	1824
Derived from pesticide market data (LANDELL MILLS, 1994):		
5)	Volume of insecticide market	93.5 million US$
Derived from pesticide market data and agricultural statistics:		
6)	Intensity of insecticide use in citrus	235 US$/ha
Calculated from 3), 4) and 5):		
7)	Total poisoning cases due to insecticides	29118
Assumptions made (refer to Figure 11) and 7):		
8)	64% of total poisonings due to insecticides	29118
9)	36% of total poisonings due to other pesticides	10482
Following from 8) and 9):		
10)	Total number of pesticide poisoning cases	39600
Calculated from 2) and 10):		
Total amount of annual health costs		**13 million Baht**

II Residue Costs

1)	Farm value fruit and vegetable	50,170 million Baht
Assumptions made (PALAKOOL, 1995):		
2)	10% of fruit and vegetable exceeding MRL	
3)	product over MRL cannot be marketed	
Following from 1), 2) and 3):		
4)	Production loss in fruit and vegetable	5,017 million Baht
Assumption made on costs of residue control:		
5)	Budget of Toxic Substances Division	48.47 million Baht
Derived from 4) and 5):		
Total annual residue costs		**5065 million Baht**

III Costs of Resurgence

Assumption made on resurgence:	
1) Strong BPH outbreak like 1989/90 takes place every ten years	
Cost related to BPH outbreak 1989/90 (WHANGTHONGTHAM, 1990a):	
2) Additional support of rice farmers	500 million Baht
3) Supply of rice seeds	74 million Baht
Derived from 2) and 3):	
4) Total costs of additional governmental assistance for BPH outbreak	574 million Baht
Additionally, considering 1):	
Total annual costs of resurgence	**57.4 million Baht**

IV Governmental Spending Related to Pesticides

Governmental spending on budgets of DOA and DOAE concerning pesticide issues:	
1) Budget Regulatory Division	46.00 million Baht
2) Budget Entomology Division (only pesticide relevant research is considered)	25.29 million Baht
3) Budget of PPSD	284.64 million Baht
4) Budget of Toxic Substances Division	48.47 million Baht
Total of 1), 2), 3) and 4):	
Total governmental spending on budgets	**404 million Baht**

The Pesticide Policy Project

The Pesticide Policy Project began in April 1994 as a project of GTZ (Deutsche Gesellschaft für Technische Zusammenarbeit), sponsored by the BMZ (Ministry of Economic Cooperation and Development) and is being carried out under the supervision of Prof. Waibel, Institute of Horticultural Economics, University of Hannover. The project includes four country studies in Latin America, Africa and Asia which follow the "Guidelines for Pesticide Policy Studies".

The overall hypothesis of the project states that the current use of pesticides in many cropping systems exceeds a level which is acceptable from the society's point of view. This seems to be largely a result of ignoring economic considerations in pest management. The objective of this project therefore is to augment the use of economic instruments in pesticide policy. This is expected to lead to increased agricultural productivity and ecologically benign pest management.

Within the five year duration of the project a series of publications will be published informing about the latest findings of the project as well as related topics. The series is titled "Pesticide Policy Publication Series" and is available on request through:

Prof. Dr. H. Waibel
Institut für Gartenbauökonomie
Universität Hannover
Herrenhäuser Str. 2
30419 Hannover
Germany

Tel.: +49 - (0)511 - 762 - 2666
Fax: +49 - (0)511 - 762 - 2667
E-Mail: Waibel@ifgb.uni-hannover.de

Dr. T. Engelhardt
Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH, Abt. 423-4
Postfach 5180
65726 Eschborn
Germany

Tel.: +49 - (0)6196 - 791430
Fax: +49 - (0)6196 - 791115
E-Mail: thomas.engelhardt@gtz.de

Also available in this series:

AGNE, S., G. FLEISCHER, F. JUNGBLUTH and H. WAIBEL (1995): Guidelines for Pesticide Policy Studies - A Framework for Analyzing Economic and Political Factors of Pesticide Use in Developing Countries. Pesticide Policy Project, Publication Series No. 1, Hannover.

MUDIMU, G.D., S. CHIGUME and M. CHIKANDA (1995): Pesticide Use and Policies in Zimbabwe - Current Perspectives and Emerging Issues for Research. Pesticide Policy Project, Publication Series No. 2, Hannover.

WAIBEL, H. & J.C. ZADOKS (1995): Institutional Constraints to IPM. Papers presented at the XIIIth International Plant Protection Congress (IPPC), The Hague, July 2-7, 1995. Pesticide Policy Project, Publication Series No. 3, Hannover.

AGNE, S. (1996): Economic Analysis of Crop Protection Policy in Costa Rica. Pesticide Policy Project, Publication Series No. 4, Hannover.