CHAPTER II

LITERATURE REVIEW

2.1. Economic Instruments

Traditionally, government regulation has focused on so called "command-and-control" (CAC) instruments, which determine emission standards for every polluting source, either uniformly for all sources or differentiated by source. In either case, the polluter has no choice but to comply with the mandated emission standard. In contrast, economic instrument (EI) or market-based instruments (MBI) change the incentives of polluters without determining a specific level of required pollution control for each polluting source (Amsberg, 1995).

The traditional form of pollution control, namely regulation – which for water has been primarily through the issue and enforcement of permits ('discharge consents') to those who discharge effluent – has delivered considerable improvements. However:

- They may not meet environmental objectives at lowest cost;
- They may not make those responsible for pollution pay fully for the effects of their activities;
- They may not necessarily encourage dischargers to go beyond the minimum requirements in their consents.

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

The main feature of an economic instrument is to make clear to polluters the wider cost of their polluting activities. In short, they aim to demonstrate the price of environmental damage and make the polluters pay accordingly. Polluters then have a choice between paying that price or taking action to reduce their pollution. Where this is cheaper, firms can be expected to take such action. The economic instruments are the cost-effective pollution control techniques.

The potential benefits from the use of economic instruments are:

- Greater efficiency in achieving quality objectives. Under the current system, the costs of action to reduce pollution may not fully taken into account in setting discharge consents. Different polluters may face very different costs for reducing pollution. If those differences in cost can be better reflected, the pattern of discharge control can be changed so that overall costs are reduced.
- More cost effective improvements in water quality, for example, the polluter might be required to pay charges based on an estimate of the costs to others.
- Improved implementation of the Polluter Pays Principal. Currently, the costs faced by polluters may poorly reflect the wider costs of the pollution that they cause. An economic instrument may better reflect these cost.

In theory, economists have shown very significant cost savings that can be achieved by using EI instead of CAC regulation. The key saving from EI results from the fact that EI can more easily achieve equal marginal abatement costs across pollution sources. This means that sources, which can reduce pollution at a lower cost, will reduce pollution more than those sources which would occur higher cost for reducing pollution by the same amount. Clearly, if pollution is reduced at the sources where the costs are lower, total social costs of pollution control will be less. EIs leave the polluters with choices about the level of pollution abatement at the individual source and about the technology used to achieve pollution control (Amsberg, 1995).

The basic objective to use economic instrument is to change the relative prices to ensure that the scarcities of the various uses economies make of the environment are fully reflected in the price system of market economies (Hartje, 1995).

2.1.1 Terms and Definitions

Following to the Organization for Economic Co-operation and Development (OECD, 1999), the categories of economic instruments are as following:

2.1.1.1. Emissions charges/taxes: Under an emission charge/tax system, a price would be set on each unit of pollutant discharged, and the polluter would be pay to government an amount equal to the quantity of pollutant times the unit price. The basic rule would be that the more harmful pollutants discharged, the more a company would pay. The less pollutants discharged, the less company would pay.

2.1.1.2. User charges: User charges are payments for the cost of collective services, and are primary used as a financing device by local authorities e.g. for the collection and/or treatment of solid waste or sewage water.

2.1.1.3. Product charges/taxes: This system use to ensure that products that cause toxic problems during use and disposal pay their own way. One of the primary purposes of such system has been to raise funds to deal with disposal problems created by the product.

2.1.1.4. Deposit/refund systems: Under deposit/refund systems, people pay a deposit when they purchase an article. The deposit is refunded when the article is returned for proper reuse, recycling, or disposal. Such systems can be particularly effective at ensuring the return and proper handling of environmental cost of their actions. On the other hand, the refund creates a direct economic reward for those who return things for proper handling.

2.1.1.5. Tradable or marketable permits: Under this system, a total amount of allowable pollution would be calculates for a region, and permits totaling that amount would be issued to polluting industries. The permits would be tradable, so that firms with relatively cheap clean-up costs could cut emissions, then sell their unused permits for a profit to firms that would have higher clean-up costs. Later on, the government could reduce the volume of pollution allowed under the permits. This would cause higher permit prices, and thus create sustained economic pressure to reduce pollution.

2.1.1.6. Non-compliance fees: Non-compliance fees are imposed on polluters which do not comply with environmental requirements and regulations. They can be proportional to selected variables such as damage due to non-compliance, profits linked with reduced (non) compliance costs.

2.1.1.7. Performance bonds: Performance bonds are payments made to authorities in expectation of compliance with environmental requirements. The bonds are refunded when compliance is achieved.

2.1.1.8. Liability payments: Liability payments are made to compensate for the damage caused by a polluting activity. Such payments can be made to "victims" (from chronic or accidental pollution) or the government. They can operate in the context of specific liability rules and compensation schemes (e.g. funds). Neither non-compliance fees, nor liability payment can be constructed as fines which are lump sum legal sanctions.

2.1.1.9. Subsidies: Under the term "subsidies" all forms of financial assistance to polluters or users of nature resources is understood, e.g. grants, soft loans, tax breaks, accelerated depreciation. National/Regional/Local Environmental Funds and their support instruments (grants, soft loans, interest subsidies etc.) are not subject to this term.

Largely following the EU approach to classification of such instruments has made a distinction between charges and taxes. The term "***charge***" is applied when the revenue from the instrument is earmarked for environmental expenditure. If the revenue is not earmarked for environmental expenditure, the term "***tax***" is used.

2.1.2 Review of Economic Instrument Implementation in Foreign Countries

A report of OECD, 1999, provided a comparative analysis of the efficiency and effectiveness of water pollution charges in the three countries studied: France, Germany, and the Netherlands as shown in ***Table 2.1***.

Table 2.1 Comparison of Economic Efficiency

France	Germany	Netherlands
- There is no relationship between the charge rate and (marginal) environmental damages - The rate is too low for incentive effects and charge revenue is earmarked. The achievement of economic efficiency is not an official objective of the charge.	- The charge was never intended to be allocativelly efficient. It was meant to address the implementation deficit of direct regulation policies, by serving some incentive functions while keeping the financial impact on polluters to a minimum.	- The charge rate is derived entirely from effluent treatment costs. - Only the emissions of larger sources are actually measured – so for other sources there is no incentive effect. The charge has induced industry to reduce its effluent, while at same time financing an expansion of sewage treatment capacity. There are no solid indications that there has been a coordination failure here: over capacity of sewage treatment capacity has remained limited.
- The charge rate = 3.92 ECU[1] per inhabitant equivalent (1993)	- The charge rate = 25.9 ECU per toxicity unit (1993)	- The charge rate = 25.9 ECU per inhabitant equivalent (1993)

Note: 1 ECU was approximately equivalent to 1.526 US dollars.

Sources: Lohman, 1995.

As a World Bank Policy Research Report, 1999, the developing countries have also used charges to regulate pollution. Colombia, Philippines, China and Malaysia are for the examples.

Colombia began by charging only US$ 28 per ton for BOD, as well as $12 per ton for SS. Even though the analysis of abatement cost concluded that a charge of US$ 100 per ton would reduce industry's organic emissions to waterways by 80 percent. These charges were considered high enough to levy industry, but not so costly as to encourage the respond from industry. The program will expand to include other pollutants based on the environmental and economic results of the first phase.

In Philippines, polluters had very little incentive to take regulators seriously because the inspection rate was low, legal enforcement was time consuming, and most ensuing fines were minimal. To provide new incentives and restore the water quality, the authority instituted an "environmental user fee" (EUF) for industrial pollution in 1997. The system has two parts: a fixed charge determined by discharge volume designed to cover administrative costs, and assessment for emissions. The latter includes one charge per unit of emissions that meet the legally permissible standard, and a higher unit charge for emission above the standard. After two years of implementation, the BOD discharges from the pilot plant have dropped 88 percent. Plant managers have moved quickly to reduce pollution to the point where the marginal cost of abatement is equal to the pollution charge.

China instituted pollution charge in 1979. Some 300,000 factories have paid for their emissions and more than 19 billion yuan have been collected. The Chinese charge differs greatly from idealized charge system. Plants are charged only for pollution in excess standards, and the charge is levied only on the single air or water pollutant that most seriously violates regulatory standards for each medium. The charges also provide insufficient economic incentives for compliance, since they are often too low to induce abatement to the legally required level.

Although it has weakness, this system has proven highly potent in fighting pollution and cutting pollution intensity. While industrial output has doubled, organic water pollution has remained constant, and even declined in some areas. The record of responsiveness suggests that as the levy rises, Chinese industry could reduce pollution far faster than anticipated.

In Malaysia, the economic instrument has also implemented. Because of the declining of rubber prices in the 1960s, the government of Malaysia began encouraging palm oil production. With very fast growth rates, Malaysia became the world's largest producer of crude palm oil. However, by 1975, crude palm oil had become the country's worst source of water pollution. Pollution caused by the organic wastes from crude palm oil mills was equivalent to the pollution generated by a population of more than 10 million. Production of crude palm oil increased three-fold between 1975 and 1985. Extrapolating from the 1975 pollution load, the population-equivalent of the industry's pollution would thus have increased to 33 million if no policies had been implemented to abate pollution. The fact that the population-equivalent of the pollution actually fell to 0.08 million people by 1985 shows the success of Malaysian policies in that sector.

The case of palm oil in Malaysia has been cited as an example where a trade-dependent industrializing nation moved decisively against pollution in a key export industry. Pollution control in the palm oil industry has been considered far from satisfactory in terms of compliance. The industry did incur additional costs as a result of the implementation of the regulation. Capital costs accounted for most of the costs associated with treatment systems. However, relative to the industry's total production costs, treatment costs were low: only 0.2 per cent in 1983 (Chooi, 1984, Cited in World Bank Policy Research Report, 1999). As a result of the nature of the world market structure for fats and oils, it was not possible to shift the increased costs of production onto the consumers. Instead, two-thirds to three-fourths of the costs were shifted upstream and ultimately born by oil palm growers, who had no outlet for palm oil fruits aside from sales to the palm oil mills (Khalid, 1991; Khalid and Braden, 1993, Cited in World Bank Policy Research Report, 1999). The Malasia regulation caused prices of fresh fruit bunches to be much lower than they would otherwise have been due to the oligopsonistic nature of the market. Thus, environmental protection did not necessarily impair the overall competitiveness of the industry in the open economy, and the industry continued to expand even when the regulations were more stringent. However, it is significantly changed the distribution of the returns to trade, affecting in particular producers of primary inputs.

2.1.3 Review of Economic Instruments Implementation in Thailand

For Thailand, the waste management is at end-of-pipe method, and most of the regulations of command and control are the type of approach.

Under Thai laws, waste management control requires a large amount of budget to operate. The government has to spend money on collecting wastes and constructing central treatment plants for both domestic and industrial wastes to recover the environmental quality. Furthermore, the government has not enough manpower to control and monitor the industries. To be able to solve the environmental problems more effectively, the Enhancement and Conservation of National Environmental Quality Act B.E 2535 has been implemented. This Act emphasizes on the Polluter-Pays-Principle (PPP) and more corporations from the private sector in order to solve the environmental problems. The government also requires more investment in waste management area including subsidies and loans providing to the private sector (Department of Industrial Works [DIW], 1997).

The types of economic instrument used in Thailand today are described as below:

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

2.1.3.1. Production charge on benzene and diesel gases: the unleaded benzene has lower charge (in the form of sales tax) than the leaded one. Similarly, the low sulfur-dioxide-content diesel has a lower charge than the high sulfur-dioxide-content diesel.

2.1.3.2. User charges on wastewater: in particular Pattaya, Phuket and industrial estate areas, the service for collecting and treating wastewater is charged.

2.1.3.3. User charges on solid waste and night soil: a service charge for collecting solid wastes and night soil in the cities, municipalities, and sanitary districts.

2.1.3.4. User charges on industrial waste and hazardous waste: the charge is collected by the wastes treatment plant in Bangkhuntein, Bangkok for collecting and treating industrial and hazardous wastes.

2.1.3.5. Tax exemption: the exemption of import taxes on waste treatment machines and equipment, or income tax exemption for foreign technicians transferring technologies.

2.1.3.6. Liability Payments in term of fine and/or imprisonment: the factory will be fined not more than Bath 200,000 if it pollutes the environment according to the Factory Act B.E. 2535.

2.1.3.7. Subsidies: the government provide subsidies by loans or grants for the industry implement such as cleaner technology, energy saving, research and development.

2.1.4 Incentive-based Strategy of Emission Charge

When an EC is put into effect, industries responsible for emissions must essentially pay for the services of the environment: transportation, dilution, decomposition of waste, etc. as they must pay for all other inputs used in their operations. They have always had incentive to conserve on scare labor and other conventional production inputs. They will now have an incentive to conserve on their use of environmental services. The EC leave polluters free to determine how best to reduce emissions, or play their own desire to minimize costs, to find the least-cost way of reducing emissions. It could be any combination of treatment, internal process changes, changes in inputs, recycling, shifts to less polluting outputs, etc. The essence of the charge approach is to provide an incentive for the polluters themselves to find out the best way to reduce emissions, rather than having a central authority determine how it should be done.

The essential mechanics of an EC are depicted in ***Figure 2.1***. A factory has a marginal abatement cost (MAC) representing by a MAC line. When EC is imposed, the charge sets at C Baht/unit of emission. Following the marginal abatement cost, the factory continues to reduce emissions as long as the charge rate is higher than the marginal abatement costs. The rule for the factories to follow is, thus: Reduce emissions until the marginal abatement costs are equal to the emission charge rate" (Field, 1994). The charge leads the factory to reduced emissions exactly to minimum cost. Under the EC system, the firm's total cost equals its abatement costs plus the charge payments to the taxing authority.

The assumption in an emission charge program is that competitive pressures will lead firms to do whatever they can to minimize their costs. Thus, when there is competition in the industry subject to the emission charge, it will lead factories to reduce emissions in response to the tax. By the same taken, however, it must recognize that if competition is weak, factories may not respond in this way.

For competitive factories, the amount of the response will depend on several factors. The higher the tax, the greater the reduction. Also, the steeper the marginal abatement cost function, the less emissions will be reduced in response to a charge (Field, 1994).

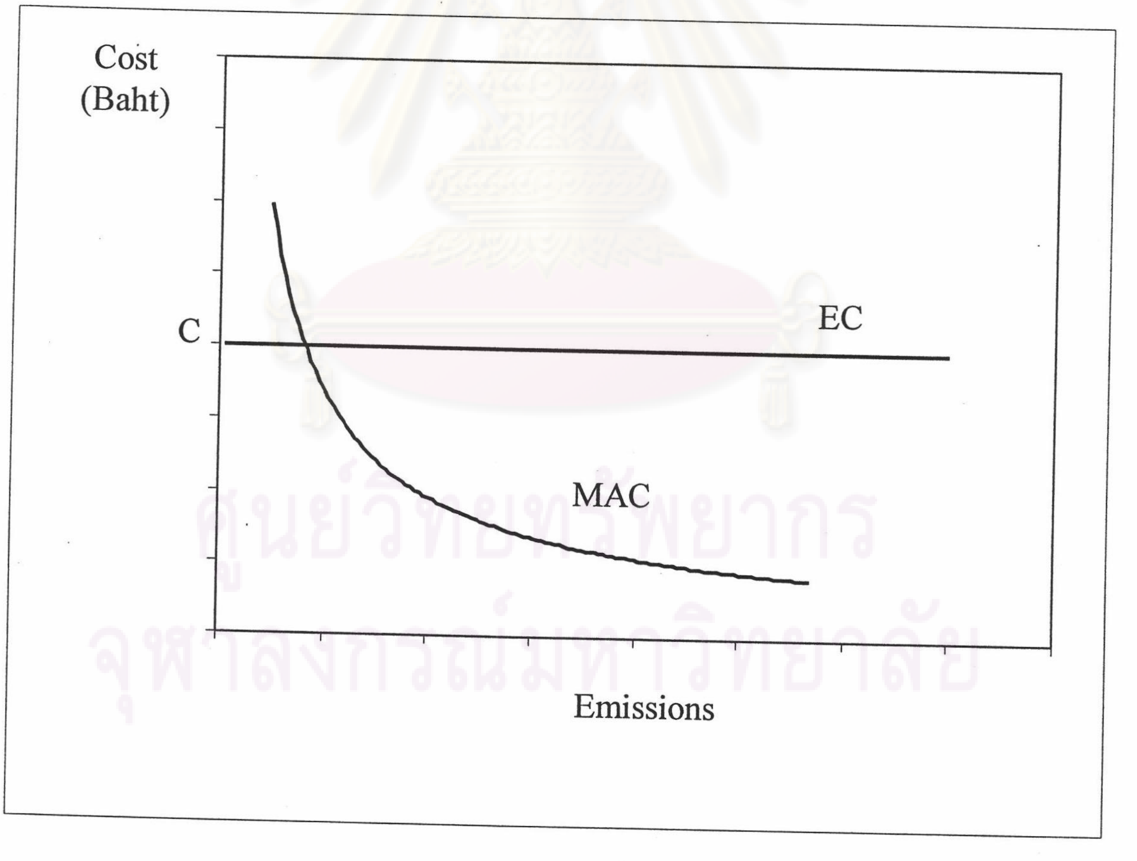


Figure 2.1 an Emission Charge

2.1.5 Emission Charge System for Thailand

Department of Industrial Works (DIW, 1997), with supporting of GTZ have studied and planned for an implementation of economic instrument. Up to now, the studies concluded that Emission Charge (EC) and Pollution Management Fee (PMF) are the suitable schemes that should be applicable for abatement of pollution in Thailand.

Emission Charge (EC) is the system that will impose factories base on the pollutant load discharged. The more pollutant load factories emits, the higher charge would be paid. Factories under this charge system would be the dischargers who generated wastewater containing BOD load (a parameter that levied on in the first stage of implementation). From DIW's Information Center, there are 38 industrial sectors (out of all 104 industrial sectors) generated wastewater containing BOD load.

After a review of an implementation plan of Emission Charge system from final report (DIW, 2002), it could be summarized the important issues as below:

2.1.5.1 Definitions and Classifications

The definitions and classifications for the Emission Charge system are as follows:

2.1.5.1.1 Wastewater: Wastewater includes all discharges from manufacturing processes, wastewater from workers and wastewater from washing and all run-offs from the factory area, excluding rainfall.

2.1.5.1.2 Discharge of Wastewater: Four types of discharge are defined;

- Direct discharge: Direct discharge is defined as the discharge of wastewater from a factory's outfall directly into open surface water bodies. This type of discharge will be covered under EC.

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

• Indirect discharge: Indirect discharge is defined as the discharge of wastewater from a factory's outfall to a sewer system leading to a central wastewater treatment plant for purification. This type of discharge will not be covered under EC. However, the central wastewater treatment plant receiving this type of discharge will be covered by EC.

• Zero discharge: A zero discharge is defined as the discharge of no wastewater whatsoever outside the factory's premise. Zero discharge, if confirmed and certified by responsible government agencies, will not be covered by EC.

Dry season storage and discharging in wet season is not considered a zero discharge and EC will be applied based on estimated load discharged.

• Land application: Land application is the application of effluent discharged from the factory's wastewater treatment facility to land for irrigation of crops. The wastewater percolates through soil. During this process, the organic undergo biological degradation. Crops will utilize organic substance in wastewater. Land application of all effluent from a wastewater treatment facility, if confirmed, approved, and certified by responsible government agencies, will not be charged under EC.

2.1.5.1.3 Pollution Reduction Measures: Pollution reduction measures include integrated waste management measures such as cleaner production including reduction in process water consumption, reduction raw materials consumption, energy conservation as well as end of pipe wastewater treatment technology.

2.1.5.2 Types of Factory Charge Rate

To allow the most practicable and cost effective monitoring of factories, the factories are separated in two groups of flat and variable rate type. The raw wastewater BOD load $\geq$ 100 kg/day for variable rate type factories and < 100 kg/day for flat rate type factories, is therefore recommended as selection criterion, which directly represents the magnitude of environmental impact by the industry.

2.1.5.2.1 Flat Rate: Flat rate type factories have relatively low pollution load and are small to medium size. They are not required to do wastewater monitoring. The EC is calculated by using established sector specific pollution load coefficients i.e. kg BOD per production input or output of a factory. However, these sector specific pollution load coefficients have to be established and updated regularly by DIW.

2.1.5.2.2 Variable Rate: Variable rate type factories have relatively high and fluctuating pollution load, and are large size. They are required to do wastewater monitoring by 'EC third party'. The EC is calculated by using actual measured pollution load, which is established by regular and frequent monitoring.

2.1.5.3 Emission Charge Equation and Calculation

In the first stage of EI implementation, the parameter taken into consideration for EC collection is only BOD Load. The EC equation is

$$EC = f * c * B$$

Where f = arbitrary coefficient (for rate adjustment based on policy)
c = coefficient of basic charge rate per BOD load (Baht / kg BOD)
B = BOD load (kg/year)

2.1.5.3.1 *f* coefficient

The f coefficient is a policy tool for the government to ensure sustainable industrial development. It uses to adjust the EC rate for all variable and flat rate type factories to a suitable level at the different stages of EI implementation. In addition, this coefficient would be used to adjust the EC system according to the economic situation.

2.1.5.3.2 Basic Charge Rate (*c*)

The coefficient ***c*** is the basic charge rate reflecting the abatement cost. The basic charge rate is determined from the actual cost details of central wastewater treatment plants in industrial estates and municipalities. 35 Baht per kgBOD is an assigned basic charge rate by using 90 percentile of the cost figures (Baht per kg BOD removed) collected from the sample treatment plants as shown in ***Appendix A***.

2.1.5.3.3 BOD load (B)

The BOD load estimations are divided into two methods according to the type of factories: flat rate type or variable rate type. The equations are as below:

BOD load estimation for flat rate type factories:

BOD load (kg/yr) = A x B

When A = Sector specific BOD load coefficient (kg BOD per standard production unit)

B = Production Capacity per year (standard production unit)

BOD load estimation for variable rate type factories:

BOD load (kg/yr) = average BOD load per day x working day per year

When BOD load per day = BOD concentration (mg/l) x Effluent Flow (m^3/d). Average BOD load per day is calculated from all actual BOD concentration and wastewater flow that measured by third party monitor. The minimum sampling frequencies should be 6 times/year.

2.2. Palm Oil Mill Industry Characteristics in Thailand

Palm oil mill industry is an agriculture-base industry. In Thailand, oil palms were grown in area of 1,540 rais for business since 1968. The palm oil plantation area and the palm oil industry production capacity increased rapidly in the 1980's. The plantation area, and fresh fruit brunches (FFB) yield in early 90's was 950,000 rais and 1,530,000 tons, respectively. In 2000, the crude palm oil output was 3,485,00 tons from the plantation area of 1,777,000 rais.

Palm oil industries are divided into two types: wet and dry process. Both standard wet process and standard dry pressing process, the palm oil is extracted and purified by physical methods. The standard wet process differs from the dry pressing process at the oil extraction stage. The standard wet process applies large amount of hot water and stream to convert palm fruits into a homogeneous oily mash before feeding them into the continuous screw press to extract palm oil.

There were 48 crude palm oil mills, which are mostly located in the southern region: Krabi, Surat Thani, Chumporn, Trung, Satun and Songkla province. Among all the palm oil mills, 28 factories are utilizing dry pressing production process. The product is mixture of palm oil and palm kernel oil, which is of lower commercial value than that of pure palm oil. These factories are usually of small investment and low production capacity.

The remaining 20 palm oil mills are utilizing standard wet process or modified process based on it, which consume large amount of fresh water and generate various wastes during the production process. These factories have drawn attentions since late 1980's due to its intensive pollution. Overall pollution load of palm oil mills in Thailand in term of BOD is equivalent to wastewater produced by three million people per day, among which palm oil mills using standard wet process account for over 90% of the total wastewater generated (DIW, 1999). ***Table 2.2*** shows a list of wet process palm oil mills in Thailand.

หอสมุดกลาง สถาบันวิทยบริการ
จุฬาลงกรณ์มหาวิทยาลัย

Table 2.2 List of Wet Process Palm Oil Mills in Thailand

No.	Factories Name	Production Capacity (ton/hr)
	Krabi Province	
1	Univanich Palm Oil (Aoluk)	30
2	Univanich Palm Oil (Plaiphraya)	60
3	Asian Palm Oil	45
4	United Palm Oil	50
5	Srijaroen Palm Oil	50
6	Siam Modern Palm	45
	Surat Thani Province	
7	Southern Palm (2521)	45
8	Southern Palm Oil Industry	60
9	Thai Tallow and Oil	45
10	Unipalm Industry	45
11	SPO-Agro	45
	Satun Province	
12	Thai Development Palm	25
	Trung Province	
13	Lumsoon (Thailand)	45
14	Trung Palm Oil	25
15	Otago	45
	Chumporn Province	
16	Chumporn Palm Oil Industry	55
17	Vichitphan Palm Oil	45
18	Sawee Palm Oil Industry	45
19	Tung Tong Palm Oil	30
	Songkhla Province	
20	Pure Plant Oil	20

Source: Department of Inland Trade, Ministry of Commerce and updated by site survey on June 2002.

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

2.2.1 Environmental Management

Palm oil industry is one of high pollution industries that DIW has been introduced and implemented cleaner technology to abate pollution released to environment. From palm oil industry survey report in 1999, it was found that raw material consumption rate and production capacity of crude oil were ranged of 10,000 - 20,000 ton FFB/day and 2,000 – 4,000 ton/month, respectively. Water consumption rate was found in range of 10,000-30,000 m^3/month. Wastewater generated from each process is combined and then pumped to anaerobic pond system for further treatment (DIW, 1999).

In general, palm oil wastewater is mainly from the sterilization and oil extraction process. The effluent is often acid and hot stream with high content of organic pollutants, which mainly from oil extraction process. The characteristics of palm oil mill wastewater are shown in ***Table 2.3***.

Table 2.3 Characteristics of Palm Oil Mill Wastewater

Parameters	Institutes		
	DIW, 1999	MOSTE,2000	TRF, 2001
Influent (from oil trap pond)			
Oil & Grease (mg/l)	15,600	37,568	6,527
Oil & Grease Load (kg/tonFFB)	4	N/A	N/A
BOD_5 (mg/l)	35,200	64,849	25,927
BOD_5 Load (kg/tonFFB)	12	N/A	N/A
Effluent (from final pond)			
Oil & Grease (mg/l)	20	68	30.2
Oil & Grease Load (kg/tonFFB)	0.01	N/A	0.02
BOD_5 (mg/l)	140	128	98.8
BOD_5 Load (kg/tonFFB)	0.06	N/A	0.145

Note: N/A = Not Available

From DIW project impact assessment in 1999, the average water consumption rate is 0.87 m^3/ton FFB, and the average wastewater generation rate is

0.39 m^3/ton FFB. The comparison of surveys against mass balance is indicated the variation figures as shown in ***Table 2.4***.

Table 2.4 Wastewater Generation Characteristics from Palm Oil Industry

Description		Average Value
Effluent/Water Consumption Rate Ratio	Mass Balance	0.55
	DIW, 1999	0.56
Water Consumption Rate/FFB (m^3/t)	Mass Balance	0.68
	DIW, 1999	0.87
Effluent/FFB (m^3/t)	Mass Balance	0.47
	DIW,1999	0.39
	DIW, 1997	0.69

2.2.2 Economic Performance

The structure of Thai palm oil industry is shown in ***Figure 2.2***. The upstream is from the FFB harvested by palm growers in form of cooperatives, companies, private owners, and transported to palm oil mills with maximum capacity of 842,000 tonFFB/year (Palm and Oil Association of Thailand, 1999). The extraction ratio of crude oil to FFB typically is 14-20:100. The product from mills, crude oil, needs to refine further for households and restaurant consumption or for being intermediate of the other industries.

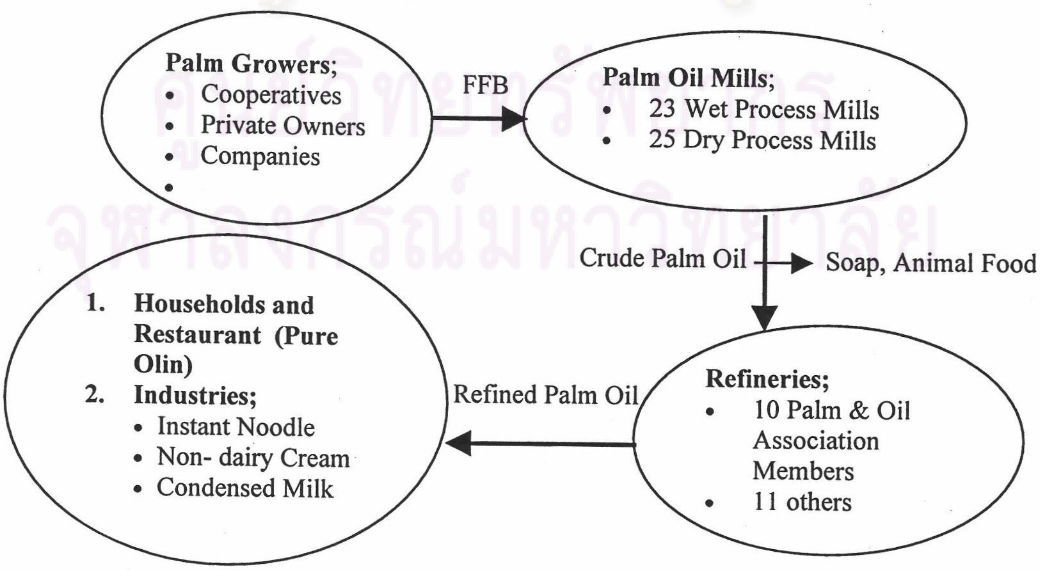


Figure 2.2 Structure of Thai Palm Oil Industry

The proportions of palm oil growers in Thailand are shown in ***Table 2.5.***

Table 2.5 Proportion of Palm Oil Growers in Thailand

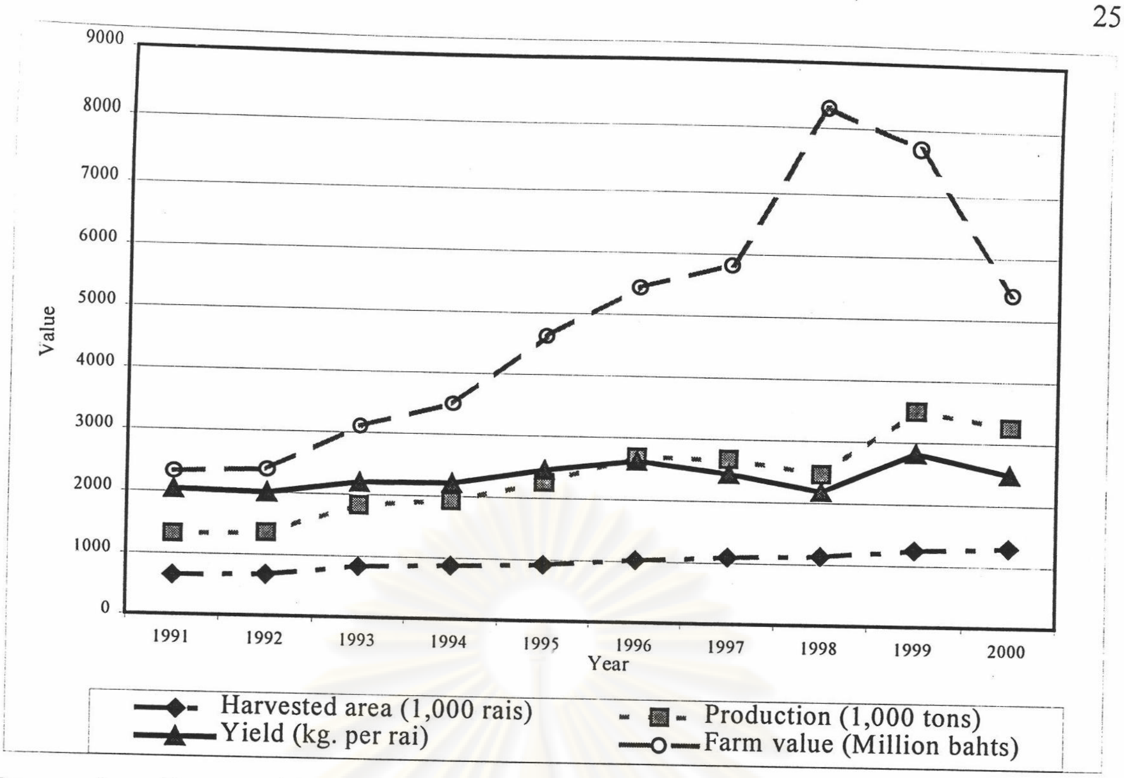
Categories	**Palm Oil Growers**		**Plantation Area**	
	Amount	**%**	**Rai**	**%**
Companies	174	0.7	533,419	36.3
Private Owners	16,639	68.2	703,695	47.9
Cooperatives	7,593	32.1	232,481	15.8
Total	**24,406**	**100**	**1,469,595**	**100**

Source: The Thailand Research Fund, 1999.

The crude palm oil (CPO) produced by Thai palm oil industry is mainly for domestic market demand. When compared to the other palm oil producers like Malaysia, Thai industry still has higher production cost. Therefore, it is difficult to compete in world market.

From 1991-2000, Although the palm oil production rate is increased, the farm value of last 2 years is opposite. The reasons for this are the declining of world market price of palm oil and induce to the declining of FFB price. The production, yield and farm prices during 1991 to 2000 are shown in ***Figure 2.3***. The lessening of FFB price from 3.45 to 1.19 Baht/kg during 1998 to 2001 is a major problem for oil palm growers. Average costs of FFB and CPO are shown in ***Table 2.6***.

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย



Source: http://oae.go.th/statistic/yearbook/2000-01/Index.html, July 10, 2002.

Figure 2.3 Palm Oil Production, Yield, and Farm Value, 1991 – 2000

Table 2.6 FFB and CPO Average Costs

Year	Domestic FFB Cost (Baht/kg)	Domestic CPO Cost (Baht/kg)	World CPO Cost (Baht/kg)	Different Cost (Baht/kg)
1990	1.89	12.49	6.65	5.84
1991	1.92	12.26	7.76	4.50
1992	2.1	14.84	9.02	5.82
1993	1.83	13.17	8.76	4.41
1994	1.82	13.69	12.37	1.32
1995	2.05	15.87	14.52	1.35
1996	2.04	15.4	11.9	3.50
1997	2.23	16.60	15.52	1.08
1998	3.45	26.47	25.09	1.38
1999	2.36	18.99	14.25	4.74
2000	1.66	12.92	10.49	2.43
2001	1.19	10.86	10.80	0.06

Resource: Office of Agricultural Economy, Ministry of Agriculture and Cooperatives, 2001.

The factors effected to the decreasing of palm oil price are:

- The deterioration of palm oil world market price making lower cost palm oil from Malaysia stock enter to Thai market.
- The market share competition from soybean oil.

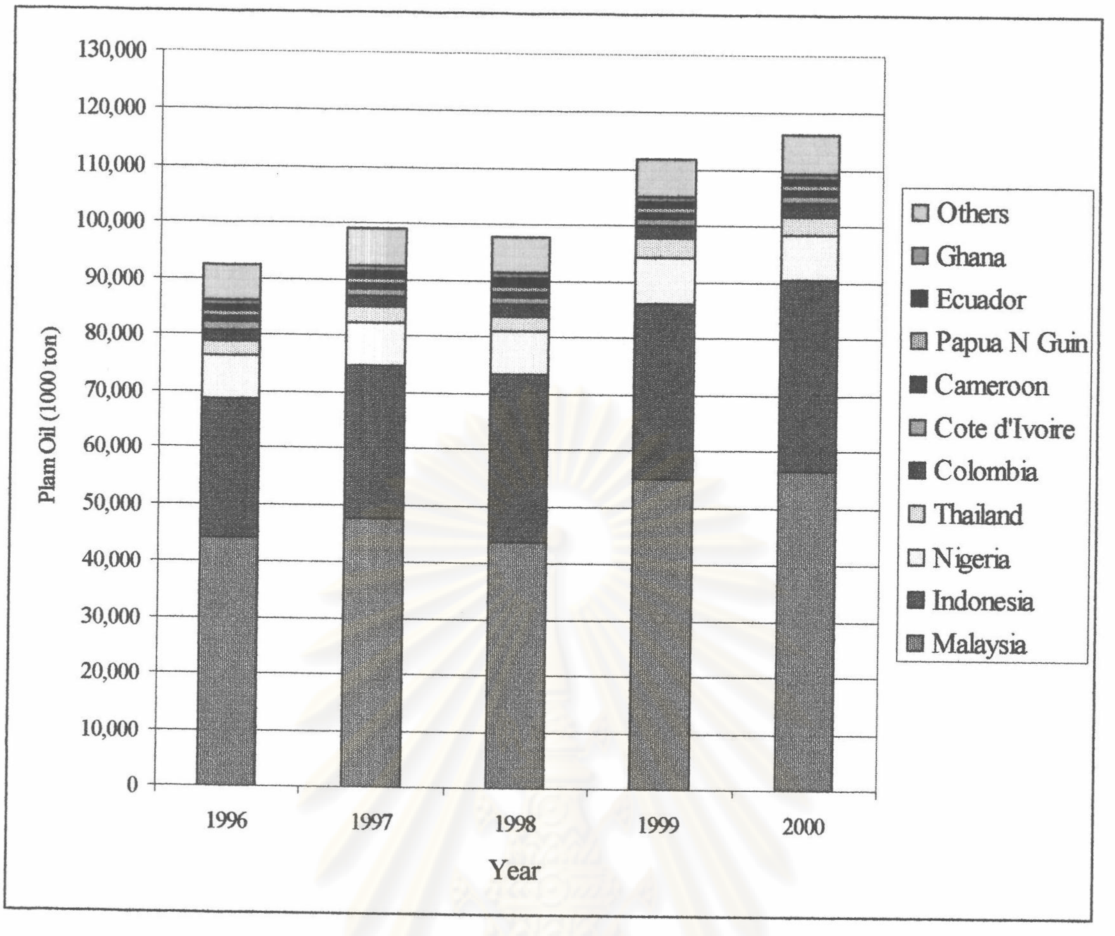
To produce 1 kg of crude palm oil, factories have production costs about 12.94 Baht for large factories and 12.82 Baht for small factories (TEI, 1997). The structure of cost for producing crude palm oil in 1990 is shown in ***Table 2.7***.

Table 2.7 Cost Structure of Crude Palm Oil Producing, Year 1990

Cost/Expense	**Large Factories**		**Small Factories**	
	Total Cost (Baht/kg)	**%**	**Total Cost (Baht/kg)**	**%**
Materials	10.01	77.36	8.74	68.17
Production				
1. Labor	0.13	1.00	0.35	2.73
2. Fuel	0.09	0.70	0.46	3.59
3. Other (overhead cost)	0.31	2.40	0.26	2.03
4. Maintenance	0.17	1.31	0.11	0.86
5. Interest	0.87	6.72	0.86	6.71
6. Other	0.07	0.54	0.01	0.08
Office Expenses	0.61	4.71	0.28	2.18
Cost of distributing	0.68	5.26	0.69	5.38
Cost of selling	-	-	1.06	8.27
Total	**12.94**	**100**	**12.82**	**100**

Source: DIW, 1997.

Imported palm oil value increased during 1989-1992 due to policy of plantation area reduction in unsuitable zone. Imported crude oil and refined oil are mainly from Malaysia. The world market palm oil production during 1996-2000 is shown in ***Figure 2.4***.



Source: http://oae.go.th/statistic/yearbook/2000-01/Index.html, July 10, 2002.

Figure 2.4 Palm Oil Production of Thailand and Selected Countries, 1996 – 2000

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย