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## Industrial Policy and Industrial Waste Countermeasures in Thailand

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### I. ECONOMIC DEVELOPMENT AND STRUCTURAL CHANGES IN THAILAND'S ECONOMY

In the 30 years since 1961, Thailand has achieved economic development that boasts an annual growth rate of over 7%. The annual growth rate for the period of the Sixth Five-Year Plan (1987-91) recorded an annual growth rate of 10.5%. The factors behind this high economic growth were exports, investment, and tourism. Growth in exports during the Sixth economic plan came to an average 24.5% annually. Direct investment from Japan, Taiwan, and other NIEs rapidly increased, sparking an investment boom in Thailand itself. Tourism had been an important source of foreign currency, but in this period tourism revenues jumped by an average of 27.5% annually.

During this long economic development, the industrial structure also underwent a great change. In terms of changes in domestic production by industry, the weight of the manufacturing sector, which accounted for 12.5% in 1960, steadily increased, outstripping the agricultural, forestry, and fishery sector in 1981. Manufacturing accounted for 28.2% in 1991. On the other hand, the weight of the agricultural, forestry, and fishery sector, which was approximately 40% in 1960, fell to 12.8% by 1991. With respect to trade, enormous changes took place in the export structure. A transformation from a typical primary product exporting country to a manufactured product exporting country was achieved. The share that manufactured products accounted for in total exports surpassed that of agricultural products in 1985 and by 1991 had grown to 76.2%.

Changes in the export structure also affected the make-up of the main export products. In 1960 four products alone—rice, rubber, tin, and teak—accounted for 70% of exports. After that diversification in agricultural products exported—maize, tapioca, sugar, etc.—proceeded apace, and from the latter half of the 1970s into the 1980s exports of industrial products increased remarkably. The first export increases were seen in textiles and garments and these were followed by canned seafood, canned fruit, frozen shrimp, frozen squid, frozen chicken, and ICs. Then industrial products such as jewels, precious stones, woodwork, furniture, shoes, and plastic products increased. This was the time when Thailand's industrialization, led by processed agricultural and fishery products and light industry products, drew attention under the term NAIC (Newly Agro-Industrializing Country).

The appreciation of the yen after 1985 and rise in the NIEs' currencies, and the subsequent concentration of investment by foreigners, greatly changed the export structure. Growth in electrical/electronics-related industries was especially impressive. After 1990 computers and computer parts occupied second place in exports after clothing, and new products have appeared such as televisions, VTR and audio equipment, rubber products (tires, gloves, etc.), watches and watch parts, telephones and their parts, airconditioners and their parts, automobiles and their parts, and travel gear.

## II. DEVELOPMENT OF INDUSTRIAL POLICY

I will now explain the phases that Thai industrial policy has gone through. The first phase, from 1953 to 1958, was a time of government-led industrialization. The periods that followed featured industrialization led by the private sector, and they are grouped according to the type of industrialization strategy they embodied and by the foreign investment policy. The second phase, from the end of 1958 to October 1972, was a period of import-substitution industrialization and vigorous introduction of foreign investment, while the third phase, from the end of 1972 to May 1977, was a period of change-over to export-oriented industrialization and strengthening of controls on foreign investment. The fourth phase, from 1977 to 1982, was the period of the heavy and chemical industry import substitution (a second import substitution) plan and of selective reintroduction of foreign capital, while the fifth phase, from 1983 to the present, has been a period of all-out development of export-oriented industrialization with foreign investment as the lever.

In the 1950s under Prime Minister Pibun, industrialization led by state-run industries was pursued. The State Enterprise Law was established in 1953 and the Industrial Promotion Act, in 1954. Investment promotion was under the jurisdiction of the Ministry of Industry and a ministry notification of 1955 based on the law provided for private management except for four government projects and eleven projects that required contracts with the government. More and more types of industry eligible for benefits were added by ministry decree. However government-led industrialization was not successful. State-run industries fell into the red due to corruption and inefficient management. Also because of intricate procedures and strict permit standards, industrial promotion got nowhere under the Pibun regime, and only two companies were actually licensed.

A change in this situation was brought about by a report issued by a World Bank investigating team. The Thai government let the team in order to be eligible to receive economic assistance from the U.S. and the World Bank. This World Bank report made recommendations on the organizations needed for economic development, distribution of public development funds, and policies. Prime Minister Sarit, who seized power in a coup d'etat, pursued economic development and industrialization in line with these World Bank recommendations. A switchover to private-sector-led industrialization was made, and the role of the government was restricted to providing such industrial foundations as industry financing, transport and communications, electric power, and irrigation. In the first economic development plan, implemented from 1961, the greatest emphasis was placed on infrastructure, and 45% of the development budget was allocated for transport and communications and for electric power.

With respect to industry incentives, the Board of Investment was launched in 1959, and in October 1960 the Industrial Investment Promotion Act was established, centralizing

investment promotion policy in the hands of the Board of Investment. In order to accelerate the introduction of foreign investment, revisions were made in the above-mentioned law to broaden incentives and streamline procedures. At the beginning 123 types of industry were eligible for incentives, but by July 1971 the number had expanded to 190 (these included 26 categories for which the subsidies temporarily did not apply, such as tin refining, corrugated steel sheets, automobile assembly, spinning, and weaving).

Through these investment promotion policies Thailand opened wide the doors to foreign investment. But at the end of the 1960s the nation faced a decline in Vietnam War special procurements, stagnation in exports of primary products, and a drop in direct investment as import substitution came full circle, and trade and the international balance of payments worsened. Japan was considered the main culprit. Japan, whose direct investment balance was small compared with the U.S., did not deserve the charges of "economic imperialism" that were leveled. Nevertheless the impression given was that Japanese enterprises were "controlling the Thai economy," as Japanese investment was the main cause of the trade deficit and was concentrated, moreover, in the consumer goods sector.

Leading Thai officials sharply criticized the management practices of Japanese companies and the imbalance of trade with Japan. Spurred on by these criticisms, an anti-Japanese student movement grew and in November 1972 developed into a movement to boycott Japanese goods. The Thai government praised the student movement as "patriotic" and used it for its own ends. In October 1972 an Investment Promotion Act was established, in November of the same year, a Law to Control Business Run by Foreigners (referred to as the Alien Business Law), was enforced. In February 1973, the Alien Occupation Law was revised. These were all aimed at effecting a switchover from open-door introduction of foreign capital to selective introduction and strengthening of controls over foreign companies and the activities of foreigners.

The 1972 Investment Promotion Act set out to encourage a two-pronged growth by cutting existing incentives and by adding incentives for export industries or companies locating in 11 investment promotion regions designated by the Board of Investment. There were only 67 industry types eligible for incentives as announced in January 1973. Furthermore under this law, various work permit regulations under the Alien Occupation Law were applied to regulate entry of foreign technicians, and with respect to reduction or exemption of import taxes on machinery and business taxes, new measures were taken to deal with companies defaulting on the conditions for subsidy licenses; furthermore, the exemption period for corporate tax was selectively set from three to eight years.

The Alien Business Law divided the type of business into three categories. Category A business, confined to existing companies, were permitted to operate for two years from the enactment of the law. Category B business, already existing companies, had unlimited permits, but annual sales growth rate was held down to 30%. Category C business, new companies would be allowed to set up but needed to be licensed by the head of the Commercial Registration Department, and annual sales growth was to be held down to 30%. The 30% stipulation was clearly aimed at restricting activities by foreign enterprises, but because it met with strong objections and was, furthermore, unrealistic, it was suspended at the end of 1976. The foreign companies referred to in this law fell into three categories, and the first category, i.e., companies with 50% or more stock ownership, became the legal basis for subsequent investment ratio regulation.

The Alien Occupation Law was originally aimed at regulating the activities of ethnic Chinese and stipulated the occupations that were reserved for Thai people. The original law was enacted in 1948, but at the height of nationalist sentiment in the 1970s other

occupations from which foreigners in general were excluded were newly stipulated. No fewer than 39 occupations in construction, accounting, intermediary and agent businesses, and manufacturing were designated on the March 1973 list. However the occupations in manufacturing were largely related to handicrafts and thus foreign companies were little effected.

The policy behind the Third Five-Year Plan, which started in October 1971, was to introduce heavy and chemical industry, and to foster export industry, agro-industry, and labor-intensive industry. The above-mentioned Board of Investment incentive target industries are in line with this policy. The first half of this period, from 1972 to 1974, witnessed an investment boom, and big, heavy industry projects in petrochemicals and construction of integrated steel ironworks were planned. Applications to the Board also poured in from import-substitution industries like textiles seeking to switch to export industries through plant expansion.

But the investment climate changed dramatically with the first oil crisis of 1973, the upheaval in the political scene following the October uprising, and the end of the Vietnam War in 1975. Construction plans for petrochemical and steel plants were put on hold, foreign investors were scared off by the vigorous student and workers movements, and one company after the other pulled out. At one point after the fall of Saigon, the ethnic Chinese capital in Thailand was also fleeing the country.

In order to pull the economy out of stagnation, the Fourth Five-Year Plan added "economic recovery" to the objectives of previous plans. In the overview of the plan the heavy and chemical industry regressed to be stated merely as "adjusting the conditions." There were seven industrial development policy items. The first takes up government capital participation in steel, fertilizer, paper/pulp, and resource development, incentives for siting agro-industry in the provinces, fostering of export industries, and promotion of small industry. The second deals with fostering export industries, trade and financing reforms, and incentives for construction of export processing zones, and promotion of intermediate goods and capital goods import substitution industries. The third adds incentives to industries that locate in the provinces and withdraws them from industries locating in the capital, in order to promote decentralization of industry throughout the country.

Furthermore, 1977-1978 was designated as an economic recovery period, with investment recovery the main issue. Attention was called to the necessity of specifying industries reserved for Thai nationals, on the one hand, and those in which foreign investment was welcome, on the other. Metal refining, petroleum, petrochemicals, fertilizer, and paper/pulp were among the latter, and the need of improving operations related to foreign investment incentives was also taken up. After the October 1976 coup, Prime Minister Thanin promised a relaxation of regulations for foreign companies and the establishment of a new investment promotion law. These policies were realized in the 1977 Investment Promotion Act and the Alien Work Permit Act (in 1978, covering 39 occupations) which took the place of the Alien Occupation Law.

Under the new Investment Promotion Act, the powers of the Board of Investment were strengthened and the position of the government with respect to foreign capital introduction clarified, the prime minister taking over from the minister of industry as board chairperson. However there was no change in the basic policy of selective introduction of foreign capital. Abstract expressions were used for the industries eligible for incentives, such as "export-oriented production," "capital-, labor-, and service-intensive industries," "industries using agricultural products," "industries where domestic production is insufficient or industries with outmoded production process." There were 63 types of industry eligible for incentives announced in 1977.

In the "plan" heavy and chemical industries were given short shrift, but at the end of the 1970s a heavy and chemical industry development project making use of natural gas in the Gulf of Thailand emerged, the development plan for the Eastern Seaboard Industrial Zone. The development of this area was looked to contribute to the decentralization of industry, promotion of export industry, development of petrochemicals and steel and other basic industries, and creation of jobs, and it was linked up with the development of Thailand's poorest region, the northeast.

But the large-scale investment in infrastructure to stimulate the economy, as well as large outlays for defense in the wake of sharp cuts in U.S. military aid resulted in a burgeoning deficit and accumulation of foreign debt. With the second oil crisis the trade deficit increased. The fifth development plan rested on an understanding that this bleak economic picture had been brought about by the inability of Thailand's economic-social structure to come to grips with changes in the international situation. In the coming five-year period, during which Thailand was to make the transition to a semi-industrial country, improvement in the economic-social structure and participation of the private sector in development was seen as essential. The three key features of the plan were improvement of the economic structure, redistribution of income and prosperity to the provinces, and alleviation of poverty in the backward rural areas.

With respect to development of the industrial sector, the plan calls for rectifying the industry's dependence on imports, incentives for export-oriented production, decentralization of industry, creation of employment, energy conservation and development of basic industries. Promotion of export industries is given particular emphasis. Construction of the Eastern Seaboard Industrial Zone was begun under this plan.

With the above development policy in view, in January 1983 the Board of Investment issued announcement regarding authorization standards for investment incentives. With regard to rates of foreign shareholding, (1) operations geared to the domestic market were required to have 51% Thai shareholding; (2) those in the areas of agriculture, livestock, fishery, mining, and services, 60% or more; and (3) while for those in which exports account for 50% or more, foreign shareholding of over 50% was allowed, and for operations in which exports account for 80% or more, 100% foreign shareholding was permitted. The third standard in particular contributed greatly to the flood of investments that followed. This is clear from the fact that between the years 1986 and 1992 the percentage of export-type operations (where 80% or more of output was for export) of total operations approved were between 55% and 77%.

But during the fifth plan economic recession continued, the growth rate target was lowered, the development budget reduced by 25%, and infrastructure construction reassessed. This was the situation that prevailed while the sixth plan was being drawn up. The trade and the current account deficit, the budget deficit, and the foreign debt accumulation were pinpointed as factors holding down economic recovery, and the pessimistic view given was that it would take into the 1990s for it to recover. For this reason the sixth plan was regarded as a period of adjustment, during which economic stability was to be given priority along with improvement in development efficiency, reform of the economic-social structure, and participation of the private sector in development.

But the economic picture changed greatly, 1987 being the turning point. In the midst of high economic growth, government finances started showing a favorable balance from fiscal 1988, and the service rate on public foreign debt dropped to 10%. The trade deficit was increasing greatly, but most companies receiving investment incentives were export-oriented, a future improvement in the trade balance was expected, and the outlook had become quite rosy.

Taking advantage of this change in the situation, decentralization of industry and selective introduction of foreign capital to foster industry types needed by Thailand were vigorously pursued. To promote decentralization, the delineation of regions targeted for investment incentives was redrawn in September 1987 and adjustments made in the system of privileges. The regions were redefined again in January, 1989 and in October, 1990. This districting divided the country into three parts, and the farther out in the provinces that industries located the greater the incentives. Also, priority industry types, apart from those on the industry type list, were decided on. In 1989, for example, these were electronics parts, auto parts, chemicals, and agro-business. The first two types are foreign firm inducement priority industries, and at the end of 1989 an incentive policy to foster the electronics industry and to upgrade industry was introduced.

With the 1990s Thailand's industrial promotion policy began to show great changes. This was because the country introduced the principle of competition into its industry policies in place of protection in order to strengthen the country's international competitiveness. In May 1990 Thailand moved into the country under IMF Article 8th and decided to liberalize the movement of capital. In October of the same year import tariffs on machinery categories were reduced to 20%, and in July, 1991 tariffs were greatly lowered on automobiles and computers. With a view to expansion into the NIEs, improvement in technical level began to be seriously considered by introducing foreign companies' standards to Thailand's smaller supporting industries.

The Seventh Five-Year Plan began in October 1991. It was aimed at maintaining continuous and stable economic growth, decentralizing income and the fruits of development, and developing human resources, quality of life, environmental conservation and natural resources. This plan differed from previous ones in giving environmental issues the same emphasis as other goals. As far as industrial development policy is concerned, the plan affirmed the policy changes from the 1990 one such as maximum reduction of tariff rates and establishment of a tariff scheme to foster intermediate goods and material industry. It also designated six priority industry types: agro-industry, textiles and garments, metal processing, electronics, petrochemicals, and steel. It also dealt with the issue of relocating industries that adversely effected people's lives and the environment.

In April 1993 the Board of Investment came out with further measures to encourage capital to move into the provinces. Five incentive priority fields were designated, the third being projects that "preserve and/or restore the environment." Furthermore, 160 categories of seven fields of industry were designated for incentives.

### **III. PROGRESS IN INDUSTRIALIZATION**

Let us look at changes in average annual growth and component ratio by industry. Industries with a growth rate of 10% or more in the 1970s were textiles, garments, paper and paper products, printing and publishing, chemicals and chemical products, rubber and plastics, machinery, electrical machinery and transport machinery. In the 1980s industries enjoying this growth rate were garments, leather/footwear, furniture, rubber and plastics, non-metal minerals, metal goods, machinery, electrical machinery, and transport machinery.

A look at the changes in component ratio over the 20 years from 1970 to 1990 reveals that the three categories of foods, beverages, and tobacco decreased by one-half, while three other categories, machinery, electrical machinery and transport machinery, doubled, surpass-

ing the three former groups. Sectors with a high rise in component ratio were high export growth rate industries like textiles, garments, leather/footwear, furniture, machines geared to domestic demand, transport machinery, non-metal minerals, and electrical machinery sustained by both domestic and overseas demand. Sectors with a particularly large component ratio in the latter half of the 1980s were leather/footwear, furniture, machinery, electrical machinery, and transport machinery.

## 1. Petrochemicals

In the 1970s the government promoted the development of natural gas and related industries through the Petroleum Authority of Thailand. The laying of submarine pipelines from the gas fields was completed in 1981. Plans called for using the natural gas first for electricity generation and as fuel for cement factories, then for LPG and automobile fuel, and then developing it as material for petrochemical products. The first natural gas separation plant was completed in November 1984 and started production in April 1985.

In November 1981 the Eastern Seaboard Development Committee decided to construct a petrochemical plant. The Olephins plant was a government-private sector joint venture with government participation by Petroleum Authority of Thailand (PTT, 49%) and the Crown Property Bureau, and private sector participation by four companies who planned to produce PE, PP, and VCM. The venture was launched in February 1984 as the National Petrochemical Corporation (NPC). The four private sector companies received privileges from the Board of Investment from 1984 to 1986. NPC began production in June 1990.

In 1988 plans were made to construct a second petrochemical plant to meet the rapidly growing demand for plastics, synthetic fibers, detergents, synthetic rubber, etc. that was sparked by the high economic growth since 1987. The upstream sector of production consists of the Thai Aromatics Company (TAC) and Thai Olephins Company (TOC). PTT has 40% capital participation in TOC and 49% in TAC. Production is targeted to begin in 1994-95. At midstream VCM, SM, LAB, EG, PTA, and PA will be produced and downstream, PE, PVC, PP, PS, AS/ABS, and SBR/BR. Ten midstream and downstream private companies received approval from the Board of Investment in 1988 and some of them are importing raw materials and have begun production.

## 2. Steel

The Thai steel industry began in the 1960s with secondary processing of steel materials such as galvanized sheets, tin plates, steel pipes, bars, and light gauge steel, and in 1968 developed electric furnace steel using scrap as materials. As of 1992 electrical furnaces at nine companies had a 1-million-ton crude steel production capacity and were authorized by the Ministry of Industry to expand their capacity to 1.5 million tons on the product base. Almost all materials for secondary processing of steel, mainly steel sheets, has to be imported. The government announced incentive policies for ironworks in 1971 and 1973 but these were never carried out. After that the government was less than enthusiastic about construction of ironworks, because of the enormous investments required to build the infrastructure and because equipment was laying idle at the time due to a construction slump.

But demand soared with the investment/construction boom in the latter half of the 1980s. Steel imports grew 3.4 times from 1.83 million tons in 1985 to 6.15 million tons in 1991. From around 1987 a situation emerged of shortages of products made from bar and

sheet steel and prices soared. In 1988 the Board of Investment announced promotion of domestic production of steel sheets. The Ministry of Industry approved new construction and expansion of electric furnaces which had previously been banned and approved expansion by five companies to increase production of bar steel. In October 1989 the Board of Investment approved construction of a steel sheet plant by the Sahaviriya group. Construction is now underway with a view to production of 1.8 million tons of hot rolled sheets (to start in 1994), 670,000 tons of cold rolled sheets (1997), and 135,000 tons of galvanized steel sheets (1994).

### 3. Paper/Pulp

In Thailand there are two private pulp manufacturers and one state-owned company with a combined annual production capacity of 153,000 tons. The raw materials used in pulp are *kenaf*, bamboo, eucalyptus, *bagasse*, and straw. Paper companies had been producing their own pulp, but in 1982 the Phoenix Company began producing pulp (100,000 tons) as a specialized manufacturer.

The demand for pulp in 1991 was 363,000 tons, 135,000 tons of which was long fiber pulp, all of which was imported. As of 1992 the domestic production capacity was 250,000 tons, but demand has been growing by a rate of 12-13% annually. The Board of Investment has awarded privilege to 13 companies, and total production capacity in 1994 will be 738,000 tons.

The weak points in pulp production in Thailand are a materials shortage due to the fact that non-wood materials are used (decline in *kenaf* production, and competition with the feed industry for *bagasse*), inadequacy of pulpification technology from wood, and foreign dependency on long fiber pulp. Two private companies are now building new plants that will use eucalyptus as the main material. The Phoenix, meanwhile, was ordered to halt operations for six months because of damage caused to the fresh water fishing industry from its waste discharge.

### 4. Electrical/Electronics Industry

The Thai electrical/electronics industry got started in the 1960s as an import-substitution industry. Production of radios and televisions began in 1961. In the 1960s there were six major private sector electronics producers, five of which were Japanese. Three U.S. companies (100% owned) moved in the 1970s and production of ICs for export began. Exports of ICs grew such that from the mid-1970s they were among the top 10 export items. In the 1980s the Thai electrical/electronics industry achieved an explosive growth with increase of capital from foreign corporations.

Five electrical/electronics companies were approved for privilege by the Board of Investment in 1960-70, 29 companies in 1971-81, 58 from 1982-86, and 432 from 1987 to September 1990. The arrival of Japanese companies, which regarded Thailand as an export base, began in 1983. Japanese companies' share of investment in Thai's electrical/electronics industry up until 1990 accounted for 64%, and more than half of this investment was in the three years starting 1988.

According to the Thailand Development Research Institute (TDRI), the balance of trade for electrical/electronics goods was in the red up until 1987 but went into the black in 1988. ICs accounted for over half of exports of electronics goods until 1986, but other goods outdistanced ICs from 1987. At present computers and computer parts are the second-rank-

ing export items, and as we have already seen, exports of video and audio equipment and radios and televisions are growing.

#### **IV. DEVELOPMENT OF ENVIRONMENT POLICIES**

##### **1. Present State of Industrial Pollution**

In the first half of the 1970s there was pollution caused by discharge from food-related factories and steps began to be taken to deal with water pollution, but in general there was not a high level of interest in the problem. And as can be seen in the case of air pollution in Bangkok, victims did not organize. Public concern over pollution has only grown since the end of the 1980s. With growing industrialization and the concentration of the population in urban areas, air and water pollution in the capital, as well as general waste and industrial waste are problems that can no longer be ignored.

Industrial pollution is a particularly big problem in the capital. Over 50% of all the factories in the country are located in the Greater Bangkok area and these discharge 75% of the nation's industrial waste. The manufacturing industry is the largest polluter and accounts for 90% of the total.<sup>1</sup>

According to statistics of the Department of Industrial Works on pollution-producing factories, as of 1989 there were 20,221 factories responsible for water pollution and 8,120 responsible for air pollution, making for a total, excluding duplications, of 26,235 factories (51% of all factories, excluding rice mills), and of these 17,056 factories discharged a moderate or large volume of hazardous waste.<sup>2</sup> Furthermore, pollution-producing factories are on the increase.

Air pollution (21% of sulfur dioxide, 12% of nitrogen oxide, and 56% of suspended particulate matter) is caused largely by industry (manufacturing, construction, mining).<sup>3</sup> The main polluting types in the manufacturing industry are non-metal minerals, (including cement, glass, and ceramics), food processing, paper/pulp, and textiles, the first two being particularly bad. Under the Factories Act, industries are divided into 99 types, and 58 of these are air pollution producing ones. Fish flour processing, lead processing, battery manufacturing, metallurgy, and the chemical industry are particularly considered to be large sources of pollution. In terms of scale, generally speaking it is the small- and medium-sized factories which fail to take measures to control pollution, particularly factories in densely populated areas.

The fuel used at factories is another reason for the pollution caused by the industrial sector, particularly the coal and brown coal that account for 15% of the total. The government's policy of holding down the price of brown coal as part of its domestic energy promotion policy is responsible for this. The percentage of brown coal used in thermopower generation will increase further in the future, burdening the environment even more. The same thing can be said with respect to the fuel used for transportation. Because the price of diesel oil for industrial use has been held down relative to the price of gasoline, diesel oil, which emits large amounts of nitrogen oxide, accounts for a whopping 50%. The main culprit responsible for air pollution in the Greater Bangkok area is the automobile.

And with the progress of industrialization and urbanization, water pollution has also become a serious problem in the Greater Bangkok area. Upstream, midstream and downstream of the Chao Phraya River are rated 2, 3, and 4, respectively, in terms of the water type environmental standard. But none of these areas meets the standard for dissolved oxy-

gen (DO), with pollution in the downstream area being especially bad. And because of the total inadequacy of the sewer system and of waste treatment facilities, untreated filthy water flows into the canals, making them so polluted that they can sustain no living matter.

Households are the main source of pollution in the Chao Phraya River (75%) and the Maeklong River (93%). Factories account for the rest. Factories used to be the main source of pollution in the Chao Phraya River, but the installation of waste water treatment equipment, which has become obligatory, brought about improvement. At present 70% of factory discharge is treated. On the other hand urbanization has resulted in the rapid increase in pollution from households, with the results cited above.

Nevertheless most small- and medium-sized factories do not have the space or the funds to provide waste treatment equipment. Even if they have such equipment, because of a shortage of officers to inspect they may be operating it only on the rare occasion when an inspection is made by the Department of Industrial Works. According to data from the Department of Industrial Works, there are approximately 20,000 factories causing water pollution, and the industry types that cause the most pollution are food processing, distilling, paper/pulp, rubber products, tanning, etc. The largest sources of water pollution in the rural areas are agricultural waste and agricultural chemicals.

There is also the problem of hazardous and toxic wastes. Changes in the industrial structure have brought about an increase in industries which produce hazardous and toxic wastes. According to the Thailand Development Research Institute (TDRI), between 1979 and 1989 the number of factories producing moderate amounts of hazardous waste (spinning, dyeing, electroplating) increased from 6,600 to 16,000 and the number of those producing large amounts of hazardous waste (chemicals, fertilizers, pesticides, etc.) increased from 625 to 936. And an analysis of the industries promoted by the Board of Investment shows that the percentage of the investment incentive industries that produce hazardous wastes rose from 25% in 1986 to 55% in 1989.

In 1991 the total amount of hazardous waste was 2 million tons, and it is estimated that this will reach 6 million tons in 2001. Large factories have their own disposal equipment and industries located in industrial zones can make use of the treatment facilities of the zone. But small- and medium-sized factories generally do not have waste treatment equipment and either bury their waste on the factory grounds or just leave it as it is. Pollution from heavy metals is increasing and metals such as chrome, copper, mercury, nickel, and lead have been detected in rivers and canals.

## **2. Development of Industrial Pollution Measures**

In 1975 a national environmental quality act (the Improvement and Conservation of National Environment Quality Law) was enacted (later revised in 1992). Under this law the National Environment Board was established, and its secretariat was set up as its administrative organ. Various environmental standards were set up and a system of environmental impact assessment introduced.

However the authority of the Environment Board under the old law was weak. The secretariat was concerned mainly with planning, environmental impact assessments, and coordination, and it lacked the authority to make on-site inspections. Implementation of environment policy was left up to the various ministries, and the Department of Industrial Works of the Ministry of Industry was in charge of industrial pollution measures, which it carried out under separate laws, the Factories Act and the Poisonous Substance Act. Under a 1975 amended Factories Act, the obligation to prevent pollution was spelled out, and the

Department of Industrial Works was authorized to make on-site inspections to prevent pollution, to issue directives for improvements and to order shutdown of operations. With further revisions of the law in 1979 and 1992, punitive measures were strengthened. And under the Poisonous Substance Act, 367 items were designated as harmful substances as of 1988.

*a. Environmental impact assessment system*

An environmental impact assessment system was introduced in 1981. The same year the following manufacturing industries were designated by the Ministry of Science and Technology as falling under the system: petrochemicals, oil refining, natural gas separation and/or treatment, chloroalkali, steel, cement, refining other than that of iron, and paper and pulp.

*b. Air pollution*

In 1971 a factory exhaust gas emissions standard was promulgated to deal with air pollution, but this applied only to black smoke. In 1981 Ambient Air Quality Standards were set for six substances and the same year monitoring of air pollution in Bangkok was started. Monitoring in Samut Prakan, which is an industrial city, began in 1989.

*c. Water pollution*

Ambient water (surface water) quality standards were recognized by the National Environment Board in 1985 and the standards were established for 28 items like organic pollutants and harmful chemical substances. These standards were made the national norm (the Domestic Effluent guidelines) by the Ministry of Science, Technology and Environment in 1989 and were adopted as standards in areas outside Bangkok and as standards for factory approval by the Department of Industrial Works and the Industrial Estate Authority. In 1970 26 items, from household environment items to heavy metals, were made subject to factory waste standards and applied for companies subject to the Factories Act. Furthermore, in 1989, the area of 350 square kilometers along the Chao Phraya River was designated by cabinet decision as an area where factories that discharge harmful substance or one kilogram of BOD per day cannot be built. These measures were aimed at protecting the water source for Bangkok.

*d. Hazardous waste materials, solid waste materials*

Administrative involvement in the problem of industrial waste has been slow in coming. The Hazardous Waste Treatment Facility, completed in 1988 (capable of treating 110,000 tons annually), is the only treatment center that exists. This center accepts water contaminated with heavy metals and solid wastes from some 300 small- and medium-sized factories, many of which are electroplating factories. In 1990 the plant reportedly treated 50,000 tons of hazardous and toxic waste from 270 factories. A private company is contracted to carrying out the treatment.

### **3. Strengthening of Environmental Measures under the Seventh Development Plan**

The seventh development plan takes a serious view of environmental issues, specifies the principle of "polluter pays," and sets up the following concrete goals:

*Water pollution*

The plan aims to decrease the amount of organic matter in waste water to 4 mg or less of BOD load. The area for which this standard applies extends (i) 100 km from the mouth

of the Chao Phraya River, (ii) 50 km from the mouth of the Tha Chin River, (iii) in coastal regions, and (iv) the water sources of the main cities in the provinces.

#### *Air pollution*

The aim is to hold air pollution down below standard (for suspended particulate matter, carbon monoxide, sulfur dioxide, and lead) and ban the sale of leaded gasoline by the end of the seventh plan.

#### *Waste*

The aim is to control the amount of waste produced in Bangkok and the main cities in the provinces up to 0.8kg/person/day.

#### *Hazardous substance*

The aim is to provide an adequate hazardous waste treatment system, and to keep down the amount of harmful chemicals used in the agricultural and industrial sectors.

Let us look next at the development of concrete policies carried out since 1992 and the plan for the future. In 1992 the National Environment Quality Act was thoroughly overhauled and a new law enacted in June. The first point of note about the new law is that it called for a reorganization of the environmental administration. The authority of the National Environment Board was strengthened, the functions of the Board's secretariat was absorbed by and integrated into the Ministry of Science, Technology and Environment, and the Pollution Control Committee was set up. Secondly, supervision and control functions were strengthened, giving the Ministry of Science, Technology and Environment the authority to make on-site inspections and apply punitive measures. Thirdly, through the establishment of an environment fund (October 1991) loans are to be made for pollution prevention equipment and environment purification facilities. A fourth point worth noting is expansion of cooperative relations, particularly with NGOs. The law also calls for participation by industry in advertising about environment problems. Under the fourth point, with the transfer of some administrative powers to the local government, specific plans appropriate to each district (particularly with respect to water treatment and waste treatment facilities) are to be drawn up, and the government is to provide financial support for these.

Plans presently being carried out or under consideration are as follows. To deal with air pollution, the Department of Industrial Works is planning to add other items besides black smoke to the factory emissions standards list and to issue an Industrial Ministry decree. The banning of new facilities by air polluting industries in Central Bangkok and the banning of coal and brown coal as fuel in heavily populated areas are being considered. Desulfurization equipment is to be installed at the Maemoh thermoelectric power plant. And to deal with water pollution, consideration is being given to banning new facilities of water polluting factories from being built in the Bangkok area, the banning of new facilities and expansion of facilities of water polluting factories in the northern part of Bangkok (to preserve the source of the city's drinking water), encouraging factories to relocate in industrial zones, relocation of pollution industries of Samut Prakan to other areas, etc.

With respect to construction of integrated treatment centers for waste products, at present two treatment centers for non-harmful waste are under construction, and after they are completed another two are being planned. Also, although there is only one center in suburban Bangkok for treatment of harmful wastes, three centers are being planned for the provinces.

#### 4. New Moves by Japanese Companies

From 1992 to 1993 new initiatives by Japanese companies operating in Thailand with respect to environmental problems were reported. One of these was the drawing up of an action plan by 30 Japanese companies and 12 U.S. companies to completely eliminate the use of flon and trichloroethane, substances that destroy the ozone layer. A second was the setting up of a committee on environmental issues within the Japanese Chamber of Commerce which plans to carry out a study of harmful and toxic wastes and to recommend to the Thai government concrete measures to counter pollution.

These steps show not only the spread of awareness of environmental issues but also how serious the pollution problem has become in Thailand.

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#### Notes

1. "Thailand Country Report to the United Nations Conference on Environment and Development (UNCED)," June 1992, p. 18. The description of pollution in this report is a summary of the report on a TDRI seminar held at the end of 1990. In particular, see Vol. 5, "The Greening of Thai Industry: Producing More and Polluting Less."
2. *Ibid.*, p. 121. And p. 120 explains that the number of polluting factories increased from 211 in 1969 to 26,235 in 1989. These figures appear in the report on the 1990 TDRI seminar, but the total number of factories given there is too small, and therefore the number of polluting factories in 1969 is also too small. Here, therefore, I have used only the 1989 figures.
3. *Ibid.*, p. 121.