7. Situations and Trends of the Physical Environment

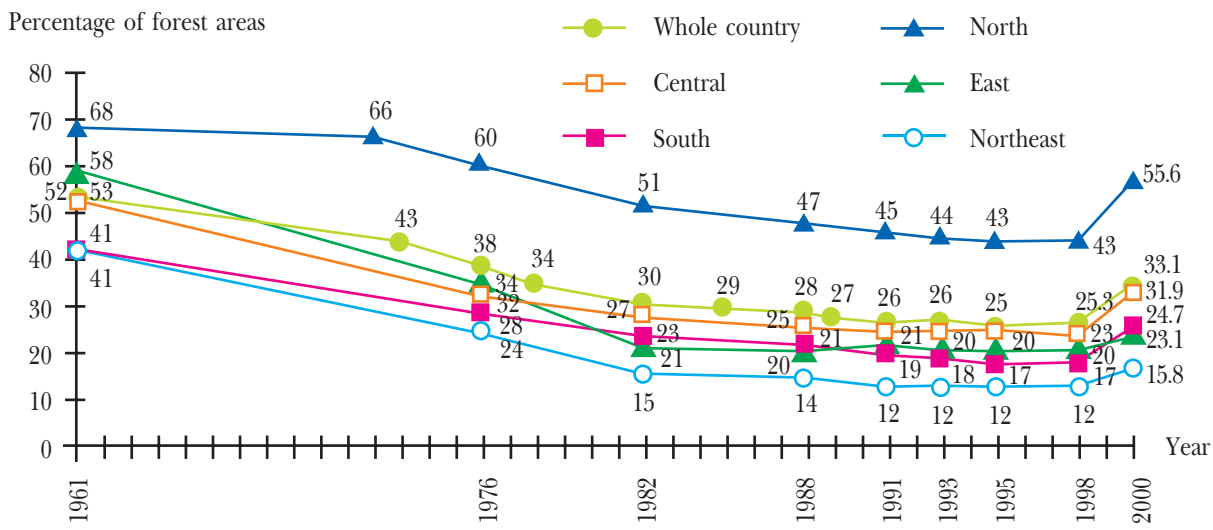
7.1 Natural Resources and Biodiversity

7.1.1 Forests and Wildlife

The previously fertile forest areas in Thailand have rapidly diminished from 171.0 million rai (1acre = 2.53 rai) in 1961, covering 53.3% of the nation's total land area, to only 81.0 million rai or 25.3% in 1998. However, in 2000 the total forest areas have increased to 107 million rai or 33.1% of the total land area (Figure 4.31); that is still lower than the 40% minimum requirement for a suitable ecological system. Major factors related to the increase in forest areas include reforestation policy, designation of more conserved forests, more reforestation efforts, such as reforestation in honour of His Majesty the King, and raised aware about forest conservation.

The number of wild animals has also declined rapidly. As many as four species of wild mammals and nine species of wild birds have become extinct; and thus another 100 species of vertebrates have been designated as endangered species.

Figure 4.31 Proportion of Forest Areas, 1961-2000



Source: Royal Forest Department, Ministry of Agriculture and Cooperatives.

Note: In 2000, the new forest mapping system was introduced using satellite images on a scale 1:50,000 rather than 1:250,000 resulting in the limitation in making comparison with previously available information.

7.1.2 Land Resources and Land Use for Agriculture

Thailand's total territory covers an area of approximately 320.69 million rai (625 rai = 1 sq.km.). In 1975, 112.2 million rai of land was used for agricultural purposes and the agricultural land areas increased to 131.3 million rai in 1999 or 41.0% of entire country's territory. Most of the agricultural areas are paddy fields, field-crop plantations, orchards and other plantations. Of all cultivable land, **about 3 million rai is left unused.**

Since 1991 the area of land used for agricultural purposes has been declining; rice fields have declined from 69.2 million rai to 65.2 million rai in 2001, field-crop land down from 33.5 million rai to 28.2 million rai, and orchards/plantations rising from 20.2 million rai to 26.6 million rai, and residential areas rising from 3.5 million rai to 3.6 million rai over the same period.

7.1.3 Mineral Resources

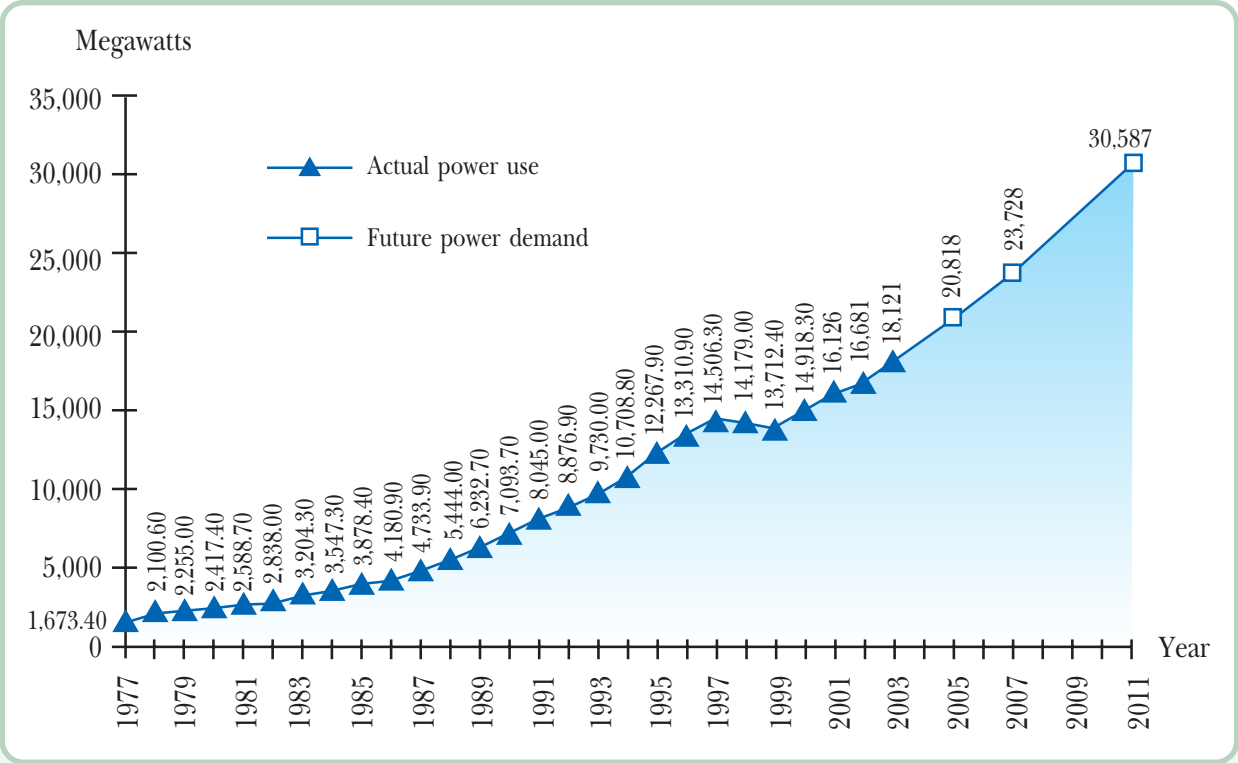
Mineral production tends to be increasing in response to the country's demand. In 2003, the top five minerals produced include lignite, limestone, gypsum, gold and basalt. However, mining concessions without proper control measures may lead to the deterioration of other natural resources and health of the people in the vicinity. Significant examples include rock mining with stone dust affecting lung functions and the discharge of lead-contaminated wastewater from Klity mines to the Klity creek in western Thailand. In 1999, according to the Department of Health's study on blood-lead level examinations and cumulative lead contamination in the environment, villagers in the Klity village had a higher blood-lead level than the general public, particularly in children aged 0-6 years. Yet, apparent symptoms of lead poisoning were not detected. The lead contamination was detected in certain stretches of Klity creek and in some aquatic animals such as prawns, crabs and fish; the contamination levels unacceptable for human consumption.

7.1.4 Energy Resources

Thailand's energy consumption has a rising trend and more electrical power has to be generated. In 2003, fuels for electricity generation include natural gas (78.9%), coal and lignite (17.8%), bunker oil (3.1%) and diesel (0.2%). The use of lignite and bunker oil as fuels with a high sulfur content results in air pollution with sulfur dioxide and suspended particles. Other pollutants also include those generated from fuel use in transportation and industrial operations.

During the economic crisis, in the beginning the power demand dropped by 2.2% and 3.2% in 1998 and 1999, respectively. But in 2001-2003, the demand went up by 6.7% annually and is projected to keep rising despite a lot of efforts on energy conservation (Figure 4.32). In the future, as the demand will be rising, it is necessary that other sources of energy be sought for substitution such as solar, wind and nuclear energy.

Figure 4.32 Trends in Electrical Power Requirement, 1977-2011



Source: Electricity Division, Office of the National Energy Policy Commission.

7.1.5 Fisheries

Due to the expansion of fishery industry, inappropriate use of fishing technology and depletion and deterioration of natural water resources, species and quantities of aquatic animals have declined. In response to such changes, aquaculture expansion is needed, but inevitably affecting the environment. For example, giant tiger prawn farming along the coasts and freshwater basins results in the deterioration of mangrove forests and paddy fields, respectively.

7.1.6 Biodiversity

Biodiversity includes marine ecosystem, animals and plants. Thailand, formerly regarded as the land of natural resource abundance, has lavishly exploited such biological and other natural resources on account of a demand for national development, such as agricultural land expansion, urbanization and large dam construction. Without proper restrictions and management, the biodiversity has been destroyed and certain ecosystems have immensely deteriorated.

At the same time, some foreign countries try to import Thailand's natural plants/animals for research purposes and, sometimes, for property right registration. This has a great impact on Thailand's long-term benefits. Therefore, relevant laws have been enacted to get Thailand prepared prior to entering into the international biodiversity agreement; i.e. **Protection and Promotion of Thai Traditional Medicine Act of 1999, Plant Protection Act of 1999 and Community Forest bill under the legislation process.**

7.2 Pollution

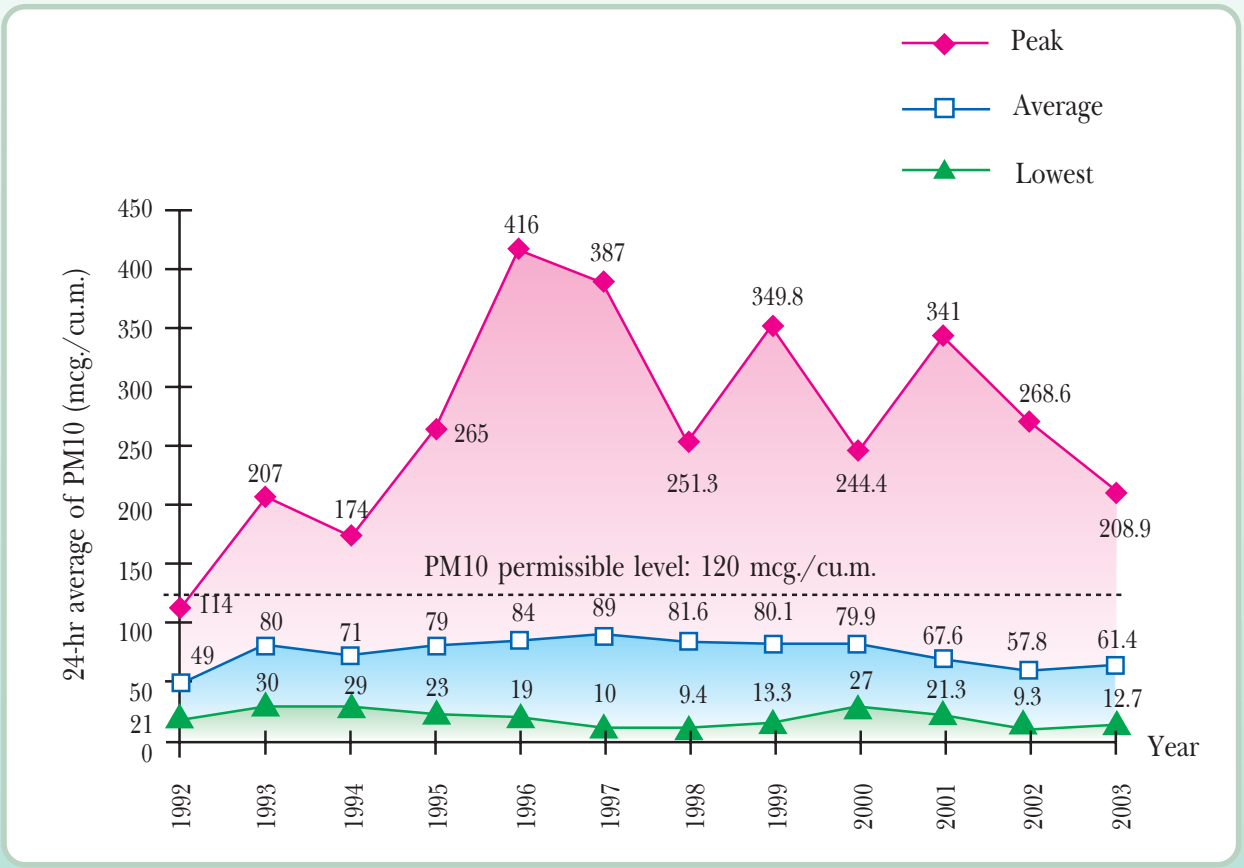
7.2.1 Air Pollution

(1) Air Quality

According to the Air Quality Monitoring programme conducted in Bangkok Metropolis and its vicinity, and in other major cities, it has been found that dust is still a major problem, and the levels of carbon monoxide and ozone are occasionally higher than the maximum permissible levels. The levels of other pollutants such as lead and sulfur dioxide are within the allowable limits.

As the major cause of air pollution problem in Bangkok, dust or suspended particulate matter is particularly dispersed every where and near the roads; the problem seems to be more serious at places near the sources of pollution, i.e. motor vehicles and construction sites. In 2003, it was found that the 24-hr total average amounts of dust particles on the roadsides in Bangkok had been declining since 1997 due to decreased industrial and construction activities resulting from the economic crisis. During 1992-2003, the 24-hr average concentrations of particulate matter of less than 10 microns (PM10) on the roadsides of Bangkok were higher than the maximum permissible level at all monitoring stations (Figure 4.33), while the levels of carbon monoxide, sulfur dioxide and lead were found to be lower than the maximum allowable levels.

Figure 4.33 24-hr Average Concentration of <10-micron Particulate Matter on Roadsides in Bangkok, 1992-2003



Source: Pollution Control Department, Ministry of Natural Resources and Environment.

In other provincial cities, the Pollution Control Department conducted the air quality measurement in 31 stations covering 15 provinces nationwide in 2003 and found that the 24-hr average peaks of PM10 detected were higher than the maximum permissible level in almost all areas (maximum permissible concentration for 24-hr average PM10 is 120 mcg./cu.m.). The highest PM10 pollution was detected at 388.5 mcg./cu.m. in Saraburi province, but the concentrations of nitrogen oxide, sulfur dioxide and carbon monoxide are still within the maximum permissible levels.

The major air pollutant in the area of Mae Moh, Lampang Province, is sulfur dioxide from lignite combustion in the electricity generation process. During 1996-1998, the number of times of the 1-hr average sulfur dioxide concentration found over the maximum permissible level declined from 51 to 16. In particular, during 1999-2003 no air samples were found to have the 1-hr average sulfur dioxide concentration over the permissible level, as the sources of pollutant had been under control. However, the PM10 pollution was still a problem, at 154.7 mcg./cu.m. in 2003.

(2) Acid Rain

The accumulation of sulfuric and nitric acids in the atmosphere with clouds will finally become "acid rain" which is the cause of transboundary air pollution. Thus, Thailand may be affected by acid rain from within the country and other countries, particularly industrialized countries such as Japan, Korea and China. A monitoring of acid rain as measured by the pH values of rainwater in 1996-2002 in certain provinces revealed that the rainwater in Bangkok and Kanchanaburi tended to be more acidic (Table 4.34), which has resulted in high levels of acidity in water sources and land, damaging plants, animals and human's respiratory system. The severity of the effects varies with the individual's sensitivity to sulfur dioxide; an individual with asthma will be more severely affected than normal individuals.[7]

Table 4.34 Average pH Values in Rainwater, 1996-2002

Study area	1996	1997	1998	1999	2000	2001	2002
Bangkok	6.4	5.6	5.2	5.2	5.0	5.0	5.1
Pathum Thani	*	*	*	4.8	5.3	5.1	5.33
Kanchanaburi	*	6.0	5.8	5.6	5.6	5.8	5.64
Samut Prakan	*	*	*	*	4.8	*	**
Chiang Mai	*	*	*	*	*	5.7	5.72

Source: Pollution Control Department, Ministry of Natural Resources and Environment.

Note: * No measurements.

** Data incomplete.

[7] Acids in the Atmosphere: Borderless Pollution. Department of Pollution Control.

7.2.2 Water Pollution

At present, the quality of various waterways tends to be deteriorating, but the water is still usable for agricultural and industrial purposes, except for the lower stretches of the Chao Phraya and Tha Chin Rivers in the Central Plains, where the water is heavily polluted and the rivers can be used only for transportation purposes.

A report on water quality surveillance on 49 waterways and four stagnant water reservoirs (Kwan Phayao, Boraphet, Nong Han and Songkhla Lakes) in 1992-2003 revealed that overall the water quality is better than before; the proportion of samples with good water quality has risen from 6.25% in 1992 to 36.67% in 2002, but fallen slightly to 32.0% in 2003; the proportion of those with satisfactory quality has risen from 18.75% in 1992 to 31.0% in 2003 - the water from such sources can be used for human consumption after being properly treated and disinfected (Table 4.35).

For the Chao Phraya River, during 1992-2003, the water quality was at the good and satisfactory levels, rising from 11.68% in 1994 to 57.0% in 2003 (Table 4.35). However, the problems encountered were the higher contents of coliform and faecal coliform bacteria, high levels of pollution in terms of organic chemical substances, and low levels of dissolved oxygen.

Table 4.35 Percentage of Water Samples with Various Water–Quality Levels from the Chao Phraya and Other Rivers, 1992-2003

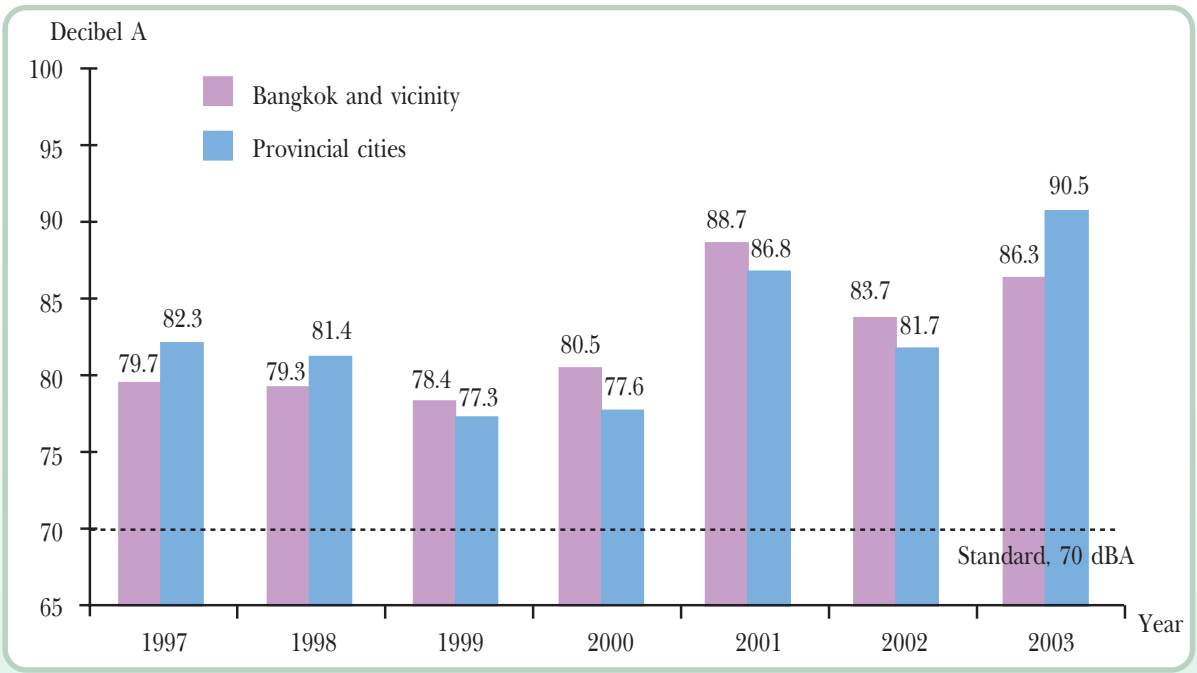
Year	Quality of other rivers				Quality of Chao Phraya River			
	Good	Satisfactory	Poor	Very poor	Good	Satisfactory	Poor	Very poor
1992	6.25	18.75	75.00	0.00	0.00	5.88	17.65	76.47
1993	8.33	19.44	61.11	11.11	0.00	12.50	50.00	37.50
1994	4.35	32.61	60.87	2.17	3.65	8.03	33.58	54.74
1995	10.87	21.74	56.52	10.87	4.17	15.28	36.11	44.44
1996	9.43	30.19	56.60	3.77	0.00	15.28	31.94	52.78
1997	20.75	35.85	37.74	5.66	3.70	16.67	31.48	48.15
1998	30.19	49.06	15.09	5.66	19.44	26.39	27.78	26.39
1999	20.75	35.85	39.62	3.77	12.04	24.07	34.26	29.63
2000	27.78	38.89	27.78	5.56	15.63	31.25	31.25	21.88
2001	18.52	40.74	33.33	7.41	31.94	22.22	26.39	19.44
2002	36.67	20.00	40.00	3.33	8.33	31.94	27.78	31.94
2003	32.0	31.00	31.00	6.00	25.00	32.00	13.00	30.00

Source: Pollution Control Department, Ministry of Natural Resources and Environment.

7.2.3 Noise Pollution

The most serious source of noise pollution is motor vehicles, especially those on major roads in Bangkok, its vicinity and other major cities with traffic congestions. A report on noise level monitoring in 1997-2003 of the Pollution Control Department revealed that, at 32 air quality and noise monitoring stations in 15 provinces, almost all stations had 24-hr average continuous equivalent noise levels (Leq)[8] higher than the maximum permissible level (Figure 4.34).

Figure 4.34 Noise Levels (Leq 24-hr) on Roadsides in Bangkok, Its Vicinity and Major Provincial Cities, 1997-2003



Source: Pollution Control Department, Ministry of Natural Resources and Environment.

7.2.4 Pollution from Hazardous Substances

Hazardous substances are imported mostly for industrial and agricultural applications; during 1994-2003, 60.3% and 38.5% of the substances were used for industrial and agricultural purposes, respectively; only 1.2% for household use. In 2003, 6.7 million tons of the substances were imported for industrial use and another 4.7 million tons for agricultural use (Table 4.36). Such substances could be released to the environment, causing pollution problems. A report on groundwater examinations (54 samples from three Northeastern provinces, 2001) revealed that eight samples (14.8%) were found to be contaminated with pesticides.

Besides, in 2003 there were 28 incidents of chemical disasters resulting in 35 injuries (no fatalities) and 150 million baht worth of damages.

It is noteworthy that after the 1997 economic crisis, the imports of chemical substances tended to be declining, but they were rising again soon after the crisis was over (Table 4.36).

[8] Noise level in Leq 24-hr is an average value of continuous noise or sound energy for a 24-hr period.

Table 4.36 Amounts of Imported Chemical Substances, 1993-2003

Chemical substance	Imported amount (tons)										
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1. For industrial use	**n.a.**	**4,874,115**	**5,020,611**	**5,164,181**	**4,822,042**	**4,602,197**	**5,006,919**	**6,031,927**	**5,547,467**	**6,356,872**	**6,785,320**
❑ Inorganic chemicals	n.a.	839,228	966,346	961,009	1,050,327	836,241	1,080,753	1,777,212	1,200,203	1,331,981	1,527,059
❑ Organic chemicals	n.a.	2,152,448	2,391,862	2,442,034	2,159,141	2,275,283	2,280,271	2,362,797	2,313,657	2,640,466	2,866,077
❑ Colouring agents	86,813	111,468	99,302	100,270	100,151	68,971	87,427	107,855	104,806	125,674	137,679
❑ Paints and vanishes	21,265	47,112	29,628	29,716	37,624	21,051	24,866	32,018	133,258	37,672	87,632
❑ Anti-knock additives	38,217	42,843	49,016	48,345	44,878	33,058	36,785	34,066	35,157	35,984	38,608
❑ Plastic pallets	515,378	692,895	656,835	718,958	622,876	571,376	712,857	787,681	744,459	875,167	947,317
❑ Films, foils and plastic tapes	45,406	54,564	58,399	58,755	64,307	51,666	91,401	82,987	80,682	91,422	104,951
❑ Other chemicals	n.a.	933,557	769,223	805,094	742,738	744,551	692,559	847,311	935,245	1,218,506	1,075,997
2. For agricultural use	**3,291,022**	**3,047,576**	**3,188,235**	**3,482,195**	**3,033,190**	**2,905,710**	**3,610,583**	**3,378,739**	**3,510,837**	**3,736,767**	**4,787,320**
❑ Pesticides	25,140	29,718	32,248	42,198	42,240	32,197	48,995	50,272	54,428	67,414	69,732
❑ Fertilizers	3,265,882	3,017,858	3,155,987	3,439,997	2,990,950	2,873,513	3,561,588	3,328,467	3,456,409	3,669,353	4,717,588
3. For household use	**66,873**	**90,562**	**84,515**	**81,296**	**95,225**	**68,475**	**89,595**	**116,333**	**139,078**	**132,490**	**159,910**
❑ Medicines	6,109	7,886	9,732	10,072	10,592	6,929	10,574	13,726	13,240	19,239	19,958
❑ Vitamins and hormones	2,961	3,282	3,752	3,257	3,763	2,938	3,844	5,223	5,397	5,590	5,783
❑ Other medical and pharmaceutical products	5,394	15,747	4,734	5,205	5,018	3,253	4,235	6,557	18,043	6,069	6,517
❑ Soap and detergents	40,440	48,934	54,308	51,116	55,700	43,010	55,563	67,381	80,376	75,163	94,774
❑ Cosmetics	11,969	14,713	11,989	11,646	20,152	12,345	15,379	23,446	22,022	26,429	32,878
Total imports	**n.a.**	**8,012,253**	**8,293,361**	**8,727,672**	**7,950,457**	**7,576,382**	**8,707,097**	**9,526,999**	**9,197,382**	**10,226,129**	**11,732,550**
Increase from previous year (percent)	n.a.	n.a.	+3.5	+5.2	- 8.9	- 4.7	+14.9	+9.4	-3.4	+11.2	+14.8

Source: Department of International Trade Negotiations, Ministry of Commerce

Note: n.a. = Data not available

For 2001, the data were adjusted, according to the most recent report of the Department of International Trade Negotiations.

7.2.5 Pollution from Hazardous Wastes

The amount of hazardous wastes in Thailand has increased from 0.9 million tons in 1990 to 1.8 million tons in 2003; of this amount, 1.4 million tons (77.8%) were released from the industrial sector and 0.4 million tons (22.2%) from residential communities. The amount of such industrial wastes is on the rise, whereas the capacity for hazardous waste treatment is only 16% of the total amount.

In 2002, only 0.22 million tons of hazardous waste were sent for disposal at in-country waste treatment plants and another 330 tons were sent for disposal abroad. However, large amounts of such waste were kept in the industries or illegally dumped into the environment.

7.3 Environmental Sanitation

7.3.1 Housing Sanitation

The number of Thailand's slum communities has risen from 1,587 in 1994 to 1,802 in 1997 and 2,265 in 2000, an increase of 13.5% and 25.7%, respectively. In 2000, there were 442,525 slum households, of which 53.9% (1,220 slums) were located in Bangkok Metropolis, 20% (452 slums) in Bangkok's vicinity, and 26.1% (593 slums) in provincial areas. The number of slums in all regions of Thailand has increased significantly, particularly in Bangkok by 44.7%, except for the Northeast where the trend is declining (Housing Information Division, National Housing Authority).

Regarding rural households, according to the 2004 survey on basic minimum needs (BMN), more households have had a better environmental condition. The number of durable households has risen from 90.6% in 1993 to 97.9% in 2001, but fallen slightly to 96.6% in 2004. The number of households with a hygienic condition has risen from 69.4% in 1992 to 89.3% in 2001, and to 93.5% in 2004.

7.3.2 Food and Water Supply

(1) Food Safety

At present, people's food consumption culture has shifted from eating home-cooked food to eating out and eating pre-cooked or semi-cooked or ready-to-eat food. Cooking food rapidly in large quantities may involve unhygienic practices and inappropriate use of ingredients or utensils, resulting in food contamination with pathogens. The 2002 study on conditions of food establishments nationwide revealed that only 27.1% (14,999 out of 55,311) of the restaurants inspected, 16.9% (2,344 out of 13,844) of fresh markets, 16.0% (3,170 out of 19,844) of school cafeterias, 55.8% (382 out of 684) of hospital cafeterias met the food safety requirements. And the 2001 analyses of 235 samples of food sold in the market, conducted by the Department of Medical Sciences, revealed that 40.4% (95 out of 235) of the ready-to-cook food samples were unhygienic due to bacterial contamination. Besides, the Department of Medical Sciences has monitored the food safety conditions of 56 large restaurants and hotels by inspecting 225 samples of food as well as swabs of utensils and hands of food handlers and found that 63.1% (142 out of 225) of the samples were unhygienic and 4.9% (11 out of 225) were contaminated with food-poisoning pathogens. This problem has resulted in the consumers being at risk of eating unhygienic and substandard food.

(2) Water Supply Safety

Based on the Survey of Water Supply Situations of Thai People during 1986-1995, most Thai people preferred rainwater for drinking, followed by artesian-well water and tap water. And in 2001, a similar preference was also found, i.e. urban residents preferred bottled water, rainwater and tap water in a comparable proportion, whereas rural residents preferred rainwater, artesian-well water and tap water (Table 4.37).

Table 4.37 Percentage of Drinking Water Sources of Thai People by Residential Area, 1986-2001

Source of drinking water*	1986	1995			2000			2001		
	Whole country	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
No. of surveyed households	3,181	809	3,260	4,069	5,291,871	10,645,933	15,937,804	27,183	143,904	171,087
Bottled water	n.a.	23.4	8.2	11.2	40.6	9.2	19.5	35.5	9.7	13.7
Tap water	15.8	27.6	9.4	13.0	36.4	16.8	23.2	26.1	16.1	17.7
Rainwater	39.2	42.2	52.2	50.2	16.1	51.0	39.6	27.5	51.3	47.6
Artesian wells, public & private	26.2	27.0	52.5	47.4	6.7	21.9	16.9	9.7	21.8	19.9
Natural water sources	19.0	0.9	2.7	2.3	0.2	1.1	0.8	0.2	0.6	0.5

Sources: 1. Data for 1986 and 1995 were derived from Reports on the 3rd and 4th National Nutrition Surveys. Department of Health, MoPH.
2. Data for 2000 were derived from the Population and Household Census. National Statistical Office.
3. Data for 2001 were derived from the Provincial Health Status Survey, 2001. Bureau of Policy and Strategy, MoPH.

Note: * More than one answer can be made.

With regard to the quality of drinking water in Thailand, the survey conducted by Department of Health, MoPH, during 1995-2003, reveals that most of tap water samples do not meet the drinking water standards, except for those of the Metropolitan Waterworks Authority, about 70% of which meet the standard. In 2001, a campaign on drinkable tap water in rural and urban areas led to improved quality of tap water, but in 2002-2003 the quality of rural tap water was worse than before. For rainwater, artesian-well water and shallow-well water, the findings show that their quality is still unacceptable. This is mainly because of contamination with bacteria and chemicals such as cadmium, iron, lead and manganese, including unacceptable physical quality, i.e. turbidity and color levels being higher than maximum allowable standards (Table 4.38).

Regarding the quality of bottled water, based on a survey conducted by the Food and Drug Administration and some Provincial Public Health Offices during 1995-2003, 71% of water samples tested met the drinking water standards; no differences in terms of contamination were found among the water with and without FDA-licence logo. It was also found that only 57% of ice cubes samples tested met the standard (Table 4.38).

Table 4.38 Quality of Drinking Water in Thailand, 1995-2003

Water type	1995		1996		1997		1998		1999		2000		2001		2002		2003	
	Samples tested	Samples meeting standard	Samples tested	Samples meeting standard	Samples tested	Samples meeting standard	Samples tested	Samples meeting standard	Samples tested	Samples meeting standard	Samples tested	Samples meeting standard	Samples tested	Samples meeting standard	Samples tested	Samples meeting standard	Samples tested	Samples meeting standard
- Tap water, MWA	45	38	27	NA	75	56	118	81	81	70	-	-	-	-	-	-	-	-
		(84.4)				(74.7)		(68.6)		(86.4)								
- Tap water, PWA	129	95	547	276	1,470	713	1,568	1,397	532	294					120	92		
		(73.6)		(50.4)		(48.5)		(89.1)		(55.3)						(76.7)	131	74
- Tap water, municipality	8	3	68	10	68	-	51	18	161	89	900	442	570	504	203	171		(56.5)
waterworks		(37.5)		(14.7)				(35.3)		(55.3)		(49.1)		(88.4)		(84.2)		
- Tap water, sanitary	43	22	327	90	496	232	370	164	51	18					-	-	-	-
district waterworks		(51.2)		(27.5)		(46.8)		(44.3)		(35.3)								
- Tap water, village	209	102	1,683	399	465	108	3,925	1,103	5,041	2,039	4,246	1,507	2,673	2,297	1,318	760	633	165
waterworks		(48.8)		(23.7)		(23.2)		(28.1)		(40.4)		(35.5)		(85.9)		(57.7)		(31.0)
- Shallow-well water,	NA	NA	365	37	222	28	191	78	125	54	26	7	-	-	-	-	-	-
private				(10.1)		(12.6)		(40.8)		(43.2)		(26.9)						
- Artesian-well water,	65	27	438	377	355	15	258	62	277	112	280	102	-	-	174	50	-	-
public		(41.5)		(86.1)		(4.2)		(24.0)		(40.4)		(36.4)				(28.7)		
- Rainwater	65	23	495	98	121	6	298	104	90	27	69	19	-	-	-	-	-	-
		(35.4)		(19.8)		(5.0)		(34.9)		(30.0)		(27.5)						
- Bottled water	1,462	968	407	286	3,225	2,837	4,496	3,167	3,766	2,329	1.033	788	3,551	2,383	2,996	2,121	2,743	1,925
		(66.2)		(70.3)		(88.0)		(70.4)		(61.8)		(76.3)		(67.1)		(70.8)		(70.2)
- Ice cubes	32	9	42	30	187	170	401	203	335	174	285	138	299	156	273	170	250	150
		(28.1)		(71.4)		(90.9)		(50.6)		(51.9)		(48.4)		(52.2)		(62.3)		(60.0)

Sources: (1) Department of Health, MoPH.

(2) Planning and Technical Administration Division, FDA, MoPH.

Notes: The figures in ( ) mean percent.

7.3.3 Solid Waste and Sewage

In 2003, there were an estimated 14.33 million tons of solid wastes nationwide, of which about 3.41 million tons (23.8%) were generated in Bangkok, 4.42 million tons (30.8%) in municipal areas, and 6.5 million tons (45.4%) in non-municipal/sanitary district areas. Between 1992 and 2003, the total amount of solid wastes increased on average by 2.4% each year, mostly in Bangkok Metropolis and municipalities nationwide. Since 2001 the increase rate in non-municipal areas is slightly higher than that in municipal areas (Table 4.39). Solid waste disposal capacity is still limited; the Bangkok Metropolitan Administration is able to collect almost all of its solid wastes, but municipalities and non-municipal areas can collect only half of their wastes. Such conditions have an impact on the quality of life of provincial residents as they are offended by the putrid smell of such wastes; and a lot of such residents have health problems.

Table 4.39 Amount of Solid Wastes, 1992-2003

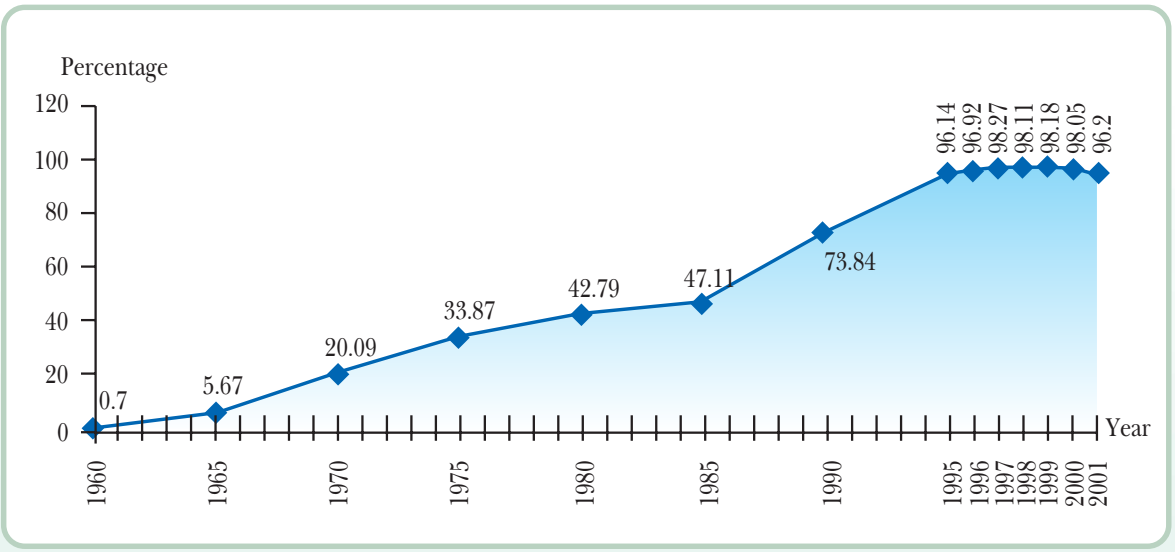
Area / Year	Bangkok		Municipal areas including Pattaya City		Sanitary districts		Outside municipal/sanitary district areas		Total	
	Amount (million tons)	Change (percent)	Amount (million tons)	Change (percent)	Amount (million tons)	Change (percent)	Amount (million tons)	Change (percent)	Amount (million tons)	Change (percent)
1992	2.19	-	1.16	-	1.62	-	5.81	-	10.78	-
1993	2.57	+ 17.3	1.25	+ 7.7	1.51	- 6.8	5.85	+ 0.7	11.18	+ 3.7
1994	2.56	- 0.4	2.05	+ 64.0	1.53	+ 1.3	5.91	+ 1.0	12.05	+ 7.8
1995	2.63	+ 2.7	2.30	+ 12.2	1.69	+ 10.5	5.96	+ 0.8	12.58	+ 4.4
1996	2.95	+ 12.2	2.43	+ 5.6	1.78	+ 5.3	5.97	+ 0.2	13.13	+ 4.4
1997	3.26	+ 10.5	3.0	+ 23.4	1.75	- 1.7	5.5	- 7.9	13.51	+ 2.9
1998	3.10	- 4.9	2.71	- 9.7	1.74	- 0.6	6.04	+ 9.8	13.59	+ 0.6
1999	3.28	+ 5.8	4.50	+ 66.0	-	-	6.04	-	13.82	+ 1.7
2000	3.33	+ 1.5	4.3	- 4.44	-	-	6.3	+ 4.3	13.93	+ 0.8
2001	3.40	+ 2.1	4.34	+ 0.9	-	-	6.36	+ 1.0	14.10	+ 1.2
2002	3.51	+ 3.2	4.37	+ 0.7	-	-	6.43	+ 1.1	14.31	+ 1.5
2003	3.41	- 2.8	4.42	+ 1.1	-	-	6.50	+ 1.1	14.33	+ 0.1

Source Toxic Substance and Solid Waste Management Bureau, Pollution Control Department.

Note: In 1999, all sanitary districts were upgraded to municipalities; since then only the figures for municipal areas appear.

Regarding human waste or night soil from urban households, problems are found to be related to its transportation and disposal. In 2000, 98.05% of rural households had sanitary latrines; the proportion dropped to 96.2% in 2001 as shown in Figure 4.35. Nationwide, 61.3% (46 provinces) of all 75 provinces had 100% of their households with sanitary latrines (Department of Health, 1999). However, a survey on latrine use of Thai people in 2001 revealed that 97.9% of them regularly used a sanitary latrine while at home; but the rate dropped to only 38.0% when they had to go out and work in plantations or paddy fields (Table 4.40).

Figure 4.35 Percentage of Households with Sanitary Latrines, 1960-2001



Sources: (1) 1960-2000 from the Department of Health, MoPH.
(2) 2001 from the Provincial Health Status Survey. Bureau of Policy and Strategy, MoPH.

Table 4.40 Latrine Use Behaviour of Thai People, 2001

Behaviour	Sample size (N)	Number using latrine (%)		
		Regularly	Occasionally	Never
(1) Use sanitary latrine while at home	14,162	13,845 (97.9)	156 (1.1)	147 (1.0)
(2) Use sanitary latrine while working in plantations or paddy fields	14,055	5,345 (38.0)	3,216 (22.9)	5,489 (39.1)

Source: Report on the Evaluation of the Helminthic Disease Control Programme in Thailand at the End of the 8th Plan, 2001. Department of Disease Control.

Such physical environmental changes have an impact on human health as follows:

(1) Pollution and illnesses resulting from environmental pollution such as allergies, respiratory diseases, cancer and chemical poisoning.

(1.1) Air pollution with PM10 is the cause respiratory diseases including chronic bronchitis among residents in Bangkok and other major cities. According to the 2002 environmental situation report (The World Bank, 2002), PM10 pollution is positively associated with the number of outpatients with respiratory diseases in Bangkok. This is consistent with NSO's surveys in 1991-2003 which revealed that 38-50% of patients had respiratory diseases; more patients were found in municipal areas than in non-municipal areas and the number was highest in Bangkok.

Besides, a study conducted by Pope and colleagues (2002) revealed that exposure to PM10 for a long period of time was a fatal risk for diseases of the heart and lung, especially lung cancer. An increment of every 10 mcg./cu.m. of PM10 may result in 6% and 8% increases in mortality from diseases of the heart and lung reports lung cancer, respectively.[9]

(1.2) An extremely high healthcare expenditure due to air pollution in Bangkok.

The World Bank (2002) estimated that healthcare spending due to PM10 exposure in six major cities in Thailand (Bangkok, Chiang Mai, Nakhon Sawan, Khon Kaen, Nakhon Ratchasima, and Songkhla) was US$643.9 million or 28,009.6 million baht as a result of 2,330 premature deaths and 9,626 cases of bronchitis. The spending was 1-1.6% of GDP for 1996-1999 or 2,000 baht per capita per year, 65% of which incurred in Bangkok alone (Table 4.41).

Table 4.41 Estimated Impact on Health and Spending Resulting from Air Pollution with PM10 in Six Major Cities in Thailand, 2000

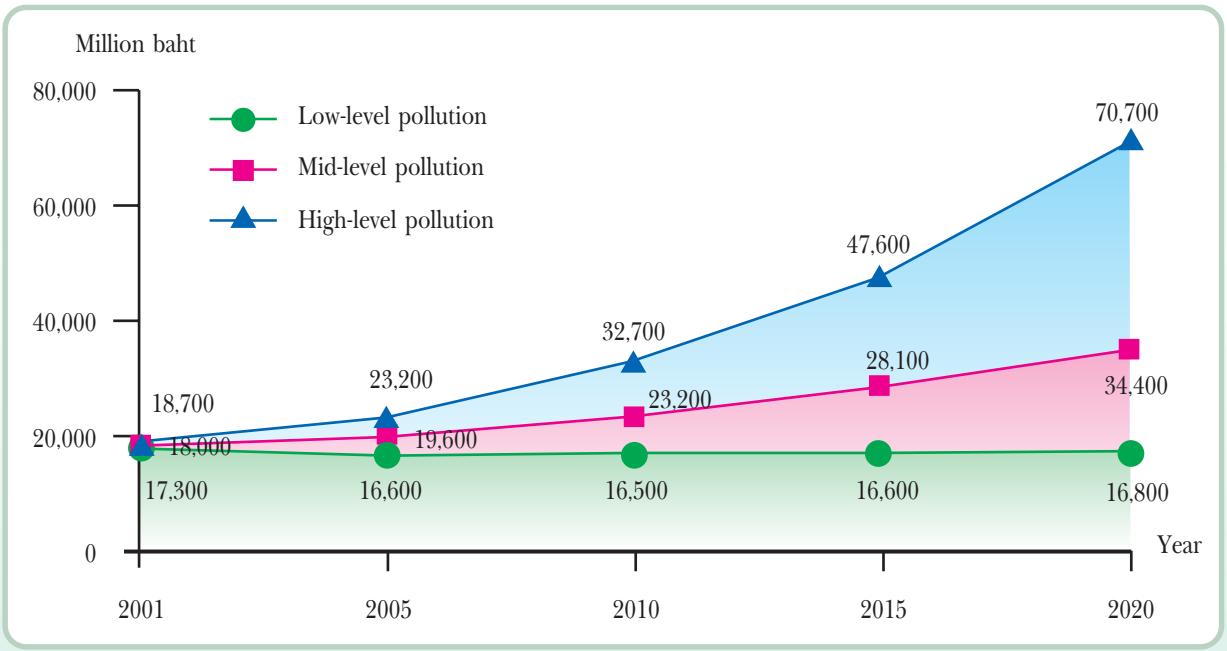
City	PM10 (mcg./cu.m.)	Population (millions)	Death rate (percent)	Premature deaths (number)	Chronic bronchitis (cases)	Health spending	
						US$ million	Baht million
Bangkok	64	5.7	0.0065	1,092	4,550	424	18,444
Chiang Mai	57	1.6	0.00985	390	1,080	56.8	2,470.8
Nakhon Sawan	51	1.1	0.0058	134	630	26.1	1,135.35
Khon Kaen	66	1.8	0.006	324	1,476	59.2	2,575.2
Nakhon Ratchasima	51	2.6	0.0055	286	1,426	56.8	2,470.8
Songkhla	41	1.2	0.0061	104	464	21	913.5
Total		**14**		**2,330**	**9,626**	**643.9**	**28,009.6**

Sources: Report on Environmental Situation in Thailand, 2002. The World Bank, 2002.

[9] Pope, C. Arden, et al. (2002). "Lung Cancer Cardiopulmonary Mortality, and Long-term Exposure to Fine Particulate Air Pollution". Journal of American Medical Association, 287(9), pp. 1132-1141.

For Bangkok, in which the air pollution problem is most serious, the World Bank estimated that healthcare spending due to PM10 exposure under three scenarios (high, moderate and low levels of exposure)[10] ranged from 17,300 to 18,700 million baht and would increase to 16,800-70,700 in 2020. At the low level of pollution, the health spending would slightly drop until 2010; then it would gradually increase as the PM10 concentration would decline at a higher rate in the beginning phase, compared with the GPP growth rate. After 2010, the income expansion and life values would increase more rapidly, compared with the drop in PM10 concentration (Figure 4.36).

Figure 4.36 Health Spending Related to PM10 Pollution in Bangkok, 2001-2020



Source: Report on Environmental Situation in Thailand 2002. The World Bank, 2002.

[10] Low-level pollution: GDP growth 2% per annum and GPP for Bangkok 1.5% per annum.
Moderate-level pollution: GDP growth 2% per annum and GPP for Bangkok 4.5% per annum.
High-level pollution: GDP growth 5% per annum and GPP for Bangkok 7.5% per annum.

(1.3) Noise pollution tends to be more serious resulting in hearing impairment. According to a study of Dr. Andrew W. Smith,[11] noise of over 80 decibels had an adverse effect on hearing; and Schultz (1978)[12] has shown that noise of over 70 decibels will badly annoy 22-95% of the people.

(2) Increased chemical contaminations of food due to use of chemicals without scientific principles and illegal use of certain hazardous substances in the food production processes have a detrimental effect on human health.

(2.1) Toxic chemical residues are found at a level higher than the maximum allowable concentration in plants, vegetables, fruit and fresh food; such foods are unsafe and hazardous to consumers. According to the routine reports of the Department of Medical Sciences (1993-2003), residues of pesticides and growth stimulant salbutamol are detected in all kinds of food such as vegetables and fruit. The contamination rate has risen from 16.2% in 1993 to 63.9% in 2002. High levels of growth-stimulant residues are also found as shown in Table 4.42. Thus, food safety campaigns have been undertaken against the use of six prohibited substances in fresh food. As a result, it has been found that all kinds of contamination tend to be declining. But high levels of pork-reddening substance and pesticides are still detected in meats and agricultural products (Table 4.43).

Besides, reports on safety surveillance of vegetables and fruit (1994-2002) reveal that 3.5-14.9% of food samples have toxic substance residues higher than the maximum permissible levels. For vegetables claimed to be pesticide-free, 9.7% of samples tested have the residues higher than the maximum allowable levels (Table 4.44). So, it is clear that the people have to consume the foods that are unsafe and hazardous to their health; if such chemicals are accumulated up to a high level, they may cause cancer.

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[11] Referred to in Thailand Health Profile 1999-2000, pp. 113-114.

[12] Referred to in Thailand Health Profile 1999-2000, pp. 113-114.

Table 4.42 Results of Food Testing for Pesticide Residues and Growth Hormones on a Regular Basis, 1993-2003

Chemical	1993		1994		1995		1996		1997		1998		1999		2000		2001		2002		2003	
	Samples tested	Samples with residue	Samples tested	Samples with residue	Samples tested	Samples with residue	Samples tested	Samples with residue	Samples tested	Samples with residue	Samples tested	Samples with residue	Samples tested	Samples with residue	Samples tested	Samples with residue	Samples tested	Samples with residue	Samples tested	Samples with residue	Samples tested	Samples with residue
1. Pesticide residues in food such as vegetables, fruits, milk, salted fish and dried fish	218	53 (24.3)	201	95 (47.3)	269	60 (22.3)	476	93 (19.5)	160	18 (11.2)	218	86 (39.4)	487	191 (39.2)	209	79 (37.8)	219	77 (35.2)	334	146 (43.7)	413	105 (25.4)
2. Growth hormone "salbutamol" in pork and pig's kidneys and livers	108	-	55	-	50	-	34	3 (8.8)	10	4 (40.0)	42	9 (21.4)	59	13 (22.0)	26	5 (19.2)	146	33 (22.6)	347	289 (83.3)	2,074	182 (8.8)
Total	326	53 (16.2)	256	95 (37.1)	319	60 (18.8)	510	96 (18.8)	170	22 (12.9)	260	95 (36.5)	546	204 (37.4)	235	84 (35.7)	365	110 (30.1)	681	435 (63.9)	2,487	287 (11.5)

Source: Department of Medical Sciences, MoPH.

Note: Figures in ( ) are percentage.

Table 4.43 Results of Testing for Chemical Contaminants in Food from Fresh Markets Nationwide under the Food Safety Project, 2003

Contaminant	Before project implementation		After project implementation (as of 31 Dec 03)		
	Samples tested	Sample contaminated (percent)	Samples tested	Samples contaminated	Sample contaminated (percent)
1. Pork-reddening agent	2,132	96	1,111	115	10.4
2. Bleaching agent	3,256	10.0	4,812	83	1.7
3. Fungicides	2,099	7.2	4,315	206	4.8
4. Borax	3,184	42.0	6,695	46	0.7
5. Formalin	2,471	10.0	3,800	46	1.2
6. Pesticides	2,268	20.3	8,437	508	6.0

Source: Food Safety Centre, MoPH.

Table 4.44 Results of Safety Surveillance on Fresh Vegetables and Fruit, 1994-2002

Type of food	Testing for	Samples tested	Test results	Testing agency	Year of testing
1. Fresh vegetables and fruit of farmers	Pesticides	3,115	Residues were detected in 1,127 samples (36.2%), 190 of which (61%) exceeded maximum permissible levels	Department of Agriculture	2002
2. Fresh vegetables and fruit from Si Mum Mueang markets	Pesticides	1,753	Residues of sulfate and carbamate compounds were detected in 89.1% of samples; 3.5% of which were at unsafe levels	Department of Agriculture	2002
3. Food safety surveillance: pesticide-free vegetables					
- Vegetables	Pesticides	262	Residues were detected in 170 samples (64.8%); 39 samples (14.9%) exceeding maximum permissible levels	FDA and DMSc	1994-2002
- Pesticide-free vegetables	Pesticides	319	Residues were detected in 155 samples (48.6%) 31 samples (9.7%) exceeding maximum permissible levels	FDA and DMSc	1994-2002

Sources: - Stop Using Pesticides in Agriculture for Thai Public Health. A paper presented at the National Health Assembly, 2003.

- Food Safety Surveillance Project: Pesticide-Free Vegetables. Food and Drug Administration, 2003.

(2.2) More people are ill with chemical poisoning and have food- and water-borne diseases. Health impacts from chemical use in both agricultural and industrial sectors are on the rise. Most of the people affected by chemical poisoning especially pesticides are farmers (see section 3.4.1 on poisoning from pesticides). In the future, it is possible that there will be more patients with accumulated chemical poisoning and illnesses or symptoms such as disorders of the neurological, immunological, and gastro-intestinal systems, and cancer.

Besides, consuming unsafe or substandard food and water may cause water- and food-borne diseases. The morbidity rate of food poisoning has risen to 204.29 per 100,000 population in 2003.

(3) A rapid increase in urban slums has caused slum dwellers to suffer from environmental problems such as a lack of safe drinking water, affecting health. In 1998, it was found that approximately 43 million Thai people did not have good-quality drinking water. The largest proportion of people at risk were those drinking rainwater (Chatchawal Chantaravijit. Situation of Drinking Water and Health Risk, 2000). Coupled with unhygienic behaviours, the morbidity rate per 100,000 population due to diarrhoea has risen during the part 20 years, particularly among children under 5 years, from 3,031.25 in 1984 to 7,242.3 in 2003.

(4) More people lodge complaints about pollution affecting human health. An analysis of complaints on pollution during 2002-2003 revealed that the number of complaints had increased from 9,168 to 11,033, most of which were related to air and noise pollution.