THE STUDY ON

ENVIRONMENTAL SECTOR PRIORITY IN THAILAND (Phase I)

Identification of Key Environmental Issues in and around Thailand

Social Research Institute
Chiang Mai University

Submitted to:
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The Study on Environmental Sector Priority in Thailand (Phase I) –Identification of Key Environmental Issues in and around Thailand

Commissioned by
Japan International Cooperation Agency

Submitted by
Social Research Institute, Chiang Mai University

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The Study on Environmental Sector Priority in Thailand (Phase I) – Identification of Key Environmental Issues in and around Thailand

This report is commissioned by the Japan International Cooperation Agency, Thailand Office. The project objectives are:

(1) To provide input for to the revision process of the next Environmental Quality Management Plan (EQM plan), particularly with respect to "issue prioritization".
(2) To provide a basic information foundation for the Thai-Japan Environmental Collaboration to begin.
(3) By using existing information and data, to sort out environmental issues and find the interconnections between various environmental problems in Thailand, as well as regionally. This will help policy makers prioritize their points of focus within a 10-year period.

This document, the Phase I report, aims to analyze existing data and key issues in natural resources and environment in and around Thailand. The methods used in the preparation of the report are a) collection of statistical data, b) a review of existing policies, plans and similar studies, and c) identify key issues by focus group meetings and interviews with experts (appendix 1). An overview of the report was presented at a workshop on March 18, 2005 held at the IUCN Bangkok office, to hear comments from academics and practitioners.

This report is organized into five sections. The first section provides an introduction to natural resources and management systems in Thailand. The second section outlines natural resources status and issues. The third section reviews the status and the management of environmental quality. The fourth section discusses trans-border issues, and the final section links natural resources policy to national visions and goals. In the conclusion, the report gives an assessment of past policies, and the current situation. It also summarizes the issues presented in this report by an environmental problem list.

1. Management Overview

Thailand has experienced relatively vigorous economic growth during the last two decades. The agricultural sector, the main driving force behind the Thai economy before the 1970's, was replaced by the manufacturing sector in the 1980's, and since the 1990's, the latter has accounted for more than three-quarters of Thailand's export earnings. Since 1987, Thailand maintains double-digit real growth rates for three consecutive years and has emerged as one of the world's fastest growing economies. Although the 1997 economic crisis put a temporary brake on the manufacturing industry, this sector together with the tourism sector have continued to develop, providing essential support for the Thai economy.

Like other countries, economic growth and industrial development in Thailand have been achieved at a cost seen in the deterioration of natural resources and the environment. The growth in population has also put more pressure on the environment. Despite the industrialized economy, more than forty percent of the work force is still engaged in agriculture in rural Thailand. Provision of land to support the livelihood of poor people has been one of the central problems for all Thai governments during the last fifty years. The problem has been reinforced by the promotion of cash crop cultivation, causing continuing encroachment into protected forest, and other public land.

Conflicting policies of conservation and economic exploitation of forests pursued by various governments have led to frequent conflicts between the state and the people, and even among the government agencies with authority in land management under different laws. This has been further aggravated by the introduction of large-scale development projects, such as dams, gas pipelines and power plants, without adequate public participation and comprehensive environmental impact assessment. Despite the government's land reform program since 1975, a large number of farmers remain either literally landless or have insufficient land to support their subsistence living.

In addition to land resource problems, Thailand is encountering increasing water shortages in the dry season. Water conflicts have arisen frequently during the last two decades due to competing water uses among various economic sectors. Thailand is still one of the few countries which have no water law or rules for the provision of equitable and efficient water use.

Intensive and unsustainable exploitation of fisheries since the 1960's has depleted resources in the Thai seas, causing significant social impacts on the poor coastal fishing communities. The future of the overgrown Thai fishing fleet is become problematic. Over the period, the Thai agriculture sector has seen a remarkable growth but its impact on the environment has also caused much concern.

Growth in the transport sector, energy consumption and industrial production during the last four decades are also a major cause of air and water pollution. Obsolete laws and inadequate law enforcement, as well as fragmented administration, make control of point source pollution ineffective. The phenomenal increase in the consumption of manufactured goods, including electrical and electronic equipment, has raised another issue concerning the management of community hazardous waste which has significant implication for environmental preservation both domestically and internationally.

There have been new laws and policies to deal with these natural resources and environmental management problems. A number of forest laws were introduced in the 1960's based on conservation and control over resource use objectives. These are the National Park Act, the National Forest Reserve Act and the Protection of Wild Animals Act (subsequently replaced by legislation of the same title in 1992). Over the years, the Thai government has adopted several policies, mostly in the form of cabinet resolutions, to deal with the problems of people living in the forest as defined by the state. The Agricultural Land Reform Act was enacted in 1975 with an aim to distribute land to poor farmers. All these laws and policies have failed to solve the problems, with little impact on the alleviation of poverty.

The Earth Summit held in Rio de Janeiro in 1992 sparked a wave of environmental conservation awareness in Thailand, leading to the enactment of several environmental laws and policies. These include the seemingly innovative National Enhancement and Conservation of Environmental Quality Act (NEQA), the new Preservation of Wild Animals Act, the Public Health Act, the Factory Act and the Hazardous Substances Act. The Ministry of Science, Technology and Environment (now the Ministry of Natural Resources and Environment or MONRE) was established in the same year. The NEQA requires that national medium-term and long-term environmental and natural resource management plans be prepared. Provincial environmental management plans are also required in each province. However, most of these laws and policies fall short effectiveness in solving environmental problems. The NEQA introduced the polluter pays principle in Thai environmental legislation for the first time. Unfortunately, the application of the principle is still too restricted. Other principles necessary for the implementation of sustainable development, such as the precautionary principle, have rarely been discussed.

Most important in the development of environmental laws and policies is the promulgation of the 1997 Thai Constitution. Essentially, the Constitution stipulates that public participation is essential in natural resource and environmental management. The important provisions include

community rights in the conservation, management and utilization of natural resources (Section 46), the right to a decent and healthful environment and the duty of project proponents to conduct environmental impact assessment (Section 56), the right to information (Section 58), the right of stakeholders to be consulted with regard to projects and activities having adverse impact on them and their community, as well as the right to express their views through a public hearing process (Section 59). The Constitution also provides for decentralization of powers to local governments which include management of natural resources and the environment. However, the last seven years has shown that the spirit of the Constitution, especially the principle of public participation, has yet to be realized.

The most recent administrative changes that will have significant impacts on the management of natural resources and environment are public service reform and restructuring of the public service system. Although reform was initiated during the Chuan administration (1997 – 2001), it gained momentum only after Prime Minister Thaksin came into power. Three significant changes have occurred. First, the Ministry of Natural Resources and Environment was formed in 2002. Second, strategic management has been embedded into public service system and an activity-based budgeting process was replaced by performance based budgeting. Third, the citizen- focused objectives are stressed and public participation as part of governance has become mandatory.

Forming the new Ministry of Natural Resources and Environment has both positive and negative impacts. Most natural resources and environment related departments are now in the same ministry providing greater hope for a more holistic and integrated management of the ecosystems. However, land management and the Royal Irrigation Department are still left with the Ministry of Agriculture and Co-operatives. The split of the Royal Forest Department into three departments has further fragmented management into specialized lines. The split was also so unequal that the Royal Forest Department was almost paralyzed in the first stage of the separation. Although the Department of Groundwater Resources still exists, the task which is its expertise, drilling for groundwater, has been transferred to local governments. While the Department of Water Resources is full of people with expertise in road construction, the Department of Mineral Resources, separated from the Ministry of Industry, came to the new Ministry with most of the specialists but not the equipment. In the long term, this chaotic transformation will finally settle for the better. In the short term, it is difficult to say that Thailand has had more effective capacity for managing natural resources and environment.

The following sections discuss natural resources status and governance issues in Thailand.

2. Natural Resources Status and Issues

Forest Resources

Forest resources were the first to be put under state control, mainly for timber extraction, with the establishment of the Royal Forest Department (RFD) in 1896. Management of logging and reforestation were the major functions of the RFD until the logging ban in 1989.

At the turn of the twentieth century, over two-thirds of Thailand were covered with forests. By 1961, forests accounted for 53 percent (171 million *rai*) of Thailand's total areas. When logging was officially banned in 1989, forest areas were close to one-fourth of the total area. Since the logging ban, forest areas continued to decline (Table and Figure 1). By 1998, forest cover was about 25 percent of total area. Official forest statistics in the following years showed an increase to 33.15 percent in 2000. This reflects the changes in data management rather than a sweeping change in the governance or improvement in law enforcement. It is widely held among practitioners that deforestation continues. This belief has been confirmed by a drop in total forest areas to 32.67 percent in 2004.

Table 1 National Forest Area by Region, 1961 – 2004

Year	Region (% of total forest areas)					*Total* (million *rai*)	% of Total Area
	North	*Northeast*	*Central and West*	*South*	*East*		
1961	42.49	25.91	13.03	10.83	7.73	**171.0**	53.33
1973	51.24	22.85	10.81	8.32	6.78	**138.6**	43.21
1976	51.57	20.91	11.00	10.15	6.37	**124.0**	38.67
1978	54.18	17.82	11.66	10.05	6.30	**109.5**	34.15
1982	56.04	16.53	11.82	10.50	5.11	**97.9**	30.52
1985	55.76	16.96	11.72	10.26	5.30	**94.3**	29.40
1988	55.91	16.48	11.99	10.17	5.45	**89.9**	28.03
1991	56.43	15.95	12.16	9.84	5.63	**85.4**	26.64
1993	56.34	16.08	12.26	9.59	5.72	**83.4**	26.02
1995	56.19	16.17	12.39	9.47	5.77	**82.2**	26.62
1998	56.32	16.18	12.37	9.35	5.79	**81.1**	25.28
2000	57.31	15.32	12.28	10.40	4.69	**106.3**	33.15
2004	**55.04**	**16.75**	**12.59**	**10.70**	**4.92**	**104.8**	32.67

Source: Royal Forest Department, 2005

Notes: 1. *Rai* is the usual unit of measurement of land area in Thailand. 1 *rai* = 0.16 hectare = 0.395 acre. 6.25 *rai* = 1 hectare; 2.53 *rai* = 1 acre.

2. Before 1998, aerial photograph was employed with the scale of 1:250,000 or smaller. After 1998, data was collected using satellite image (such as Ikonos) which provide greater resolution. Hence, for 2000 and beyond, the scale is 1:50,000, and the area is digitally plotted. For 2004, the overall accuracy from ground verification is about 89.2 percent.

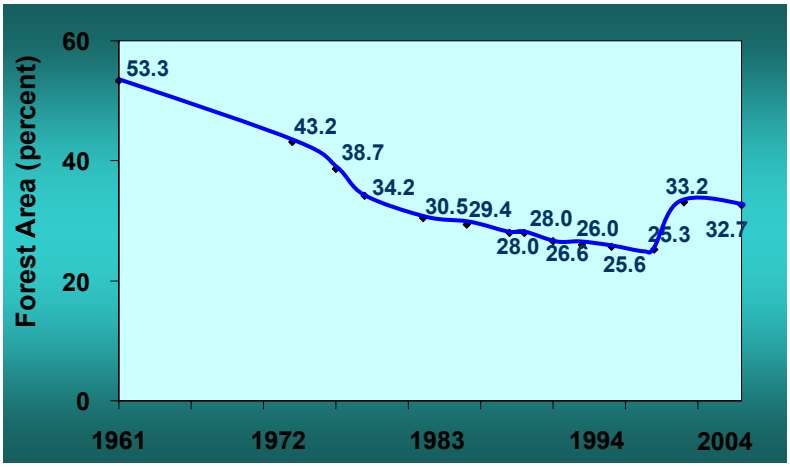

Figure 1 **National Forest Area, 1961 – 2004**
Source: Royal Forest Department, 2005
Note: see Table 1 Note 2

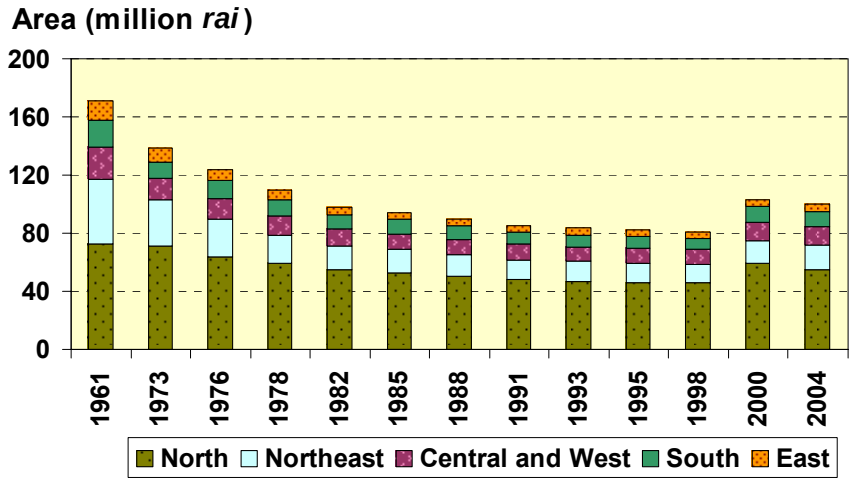

Figure 2 **National Forest Areas by Region, 1961 – 2004**
Source: Royal Forest Department, 2005
Note: see Table 1 Note 2

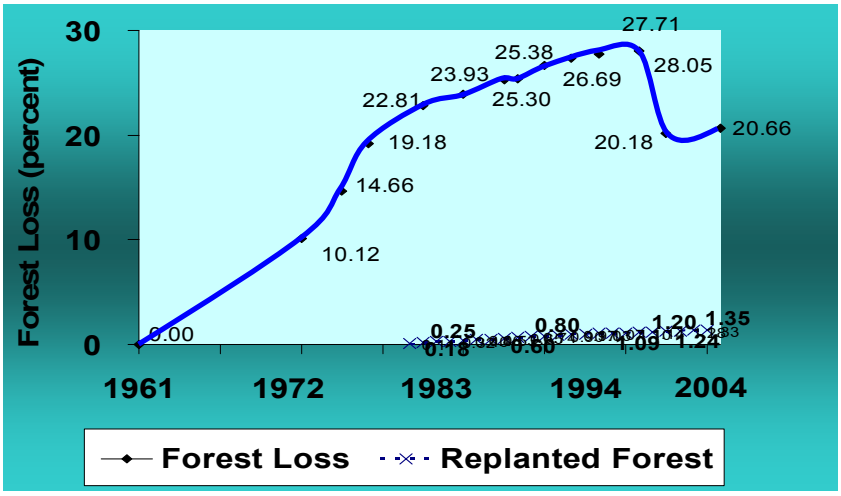

Figure 3 **Forest Loss and Replanted Forest Area, 1961 – 2004**
Source: Thailand Development Research Institute, 2005
Note: see Table 1 Note 2

From 1896 – 2004, the area of recovered forests was only 4.38 million *rai*. The 9th National Economic and Social Development Plan set the target for reforestation at an average of 2 million *rai* per annum. The most recent recovery rate is, however, 0.12 million *rai* per year. Compared to the deforestation rate, about 0.38 million *rai* per year during 2000 to 2004, the gap is unlikely to be closed within the foreseeable future.

Forest fire damage which depends on annual temperature, moisture and especially human activities, has been declining steadily in the last ten years (Figure 4), while the forest fire control area in Thailand has been increasing, along with the promotion of fire control volunteer groups. The forest fire control cost has been increasing from 7 *baht* per *rai* in 2001 to 11 *baht* per *rai* in 2003.

Figure 4 **Forest fires, 1985 – 2003 (% of total forests)**
Source: Thailand Development Research Institute, 2004

People in the public forests have always been a contentious issue in forest protection. The wilderness approach to protected areas adopted by the RFD, and now inherited by the National Park, Wildlife and Plant Conservation Department, excludes people from inhabiting protected ecosystems. Despite the fact that Thai forest laws exclude human settlements, especially in protected areas, thousands of settlements are in the forests. In 2004, official statistics indicated that over 300,000 people cultivated 1.6 million *rai* of protected forests and over 1.3 million people cultivated 5.7 million *rai* of forest reserves.[1] In the same year, 476 communities settled in 0.12 million *rai* of protected forests and 1,658 in 0.29 million *rai* of forest reserves.

Protected areas in Thailand have gradually expanded from 12.96 percent of Thailand's area in 1991 to 17.66 percent in 2002. According to the 9th National Economic and Social Development Plan, protected areas are projected to cover 25 percent or 80 million *rai* by 2006.

The impact of both deforestation and expansion of protected areas on biodiversity are less clear. However, the number of endangered species can be used as an indicator of biodiversity loss.[2] Due to the lack of law enforcement, known illegal trade of wild animals in Thailand increased from 110 cases in 1997 to 188 cases in 2003.

Management of forest resources was the responsibility of the RFD, until it was divided into three departments in 2002; the Royal Forest Department, the National Park, Wildlife and Plant Conservation Department and the Department of Coastal Resources. The level of commitment by the government to protect and conserve forest resources can be seen from the increase in the budget allocated for this purpose. The budget, which dropped after the economic crisis towards the end of the 1990s, has gradually increased by 2005 decade (Table 2).

[1] According to the National Rural Development Committee (NRDC) Village Census Data, there are 229 villages, 17,421 households, and 70,885 people living in the wildlife sanctuaries; 636 villages, 55,306 households, 229,422 people in the national parks and 9,715 villages, 893,354 households, 3,665,347 people in the national forest reserves (2004).

[2] Of 3,978 wild animal species in Thailand in 2003, 14 species are extinct, 572 species are classified as near extinction, and 63 are classified as endangered species. Compared with the year 1996, the number of critical endangered and extinct species in the wild increased one species each. The number of endangered and threatened species has increased by 22 and 4, respectively (ONEP 2003; ONEP 2004).

Table 2 Approved budget for forest resource policy 1997-2005

Sectors	Fiscal Budget (million *baht*)								
	1997	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Royal Forest Department	10,259.55	10,384.57	8,315.74	8,370.10	8,862.97	8,473.76	8,571.50	922.64	970.73
Forest Management	1,442.36	1,346.73	1,160.10	1,153.35	-	-	-		
Forest Protection	4,158.84	4,310.44	3,454.64	3,566.24	-	-	-		
Forest Promotion and Development	4,310.51	4,392.02	3,364.22	3,241.15	-	-	-		
Forest Research	347.84	335.38	275.98	409.36	-	-	297.75		
Tourism Development	-	-	60.79	66.14	-	8,067.39	200.00		
Natural Resources Protection and Development	-	-	-	-	8,862.97	406.37	8,073.75		
The National Park, Wildlife and Plant Conservation Department							(7,598.83)	7,854.19	7,947.46
Department of Coastal Resources							328.16	803.50	819.13
Total	**10,259.55**	**10,384.57**	**8,315.74**	**8,370.10**	**8,862.97**	**8,473.76**	**8,899.66**	**9,580.33**	**9,737.32**
Growth Rate		**1.22%**	**-19.92%**	**0.65%**	**5.89%**	**-4.39%**	**5.03%**	**7.65%**	**1.64%**

Source: TDRI, 2005

Notes: 1. RFD FY2003 budget includes that of the National Park, Wildlife and Plant Conservation Department
2. RFD FY1997-2004 budget were administrated by Ministry of Agriculture

There are a myriad of policies and plans, laws, ministerial regulations and cabinet resolutions for forest conservation. Table 3 lists the policies and plans for forest resources. It shows that there is no shortage of plans and regulations but their enforcement is not effective and these mechanisms have failed to stop deforestation.[3] Besides, conflicting objectives of forest policy and development policy, infrastructure development and agricultural product export promotion plans also have been recognized as adding pressure to the forest resources.

Critiques of the current forest governance including some in the RFD have raised the question of whether the current management, which rejects forest communities, is appropriate. There are examples of effective natural forests protection by local communities and these have been increasingly recognized. Finally, the RFD has taken as one of its initiatives to promote community forests. In 2004, the community forest area under the RFD is about 1.09 million *rai*. Most of these forests are in the northeast and the northern regions.[4] The obstacle to further expansion of the community forest is the lack of law that would protect local citizen volunteers who are involved in the management of community forests. The draft bill is now pending because of the unsettled debate of whether community forests should be allowed in protected area.

[3] RECOFTC (1994) A Consultative Meeting on Community Forestry Development in Thailand, Regional Community Forestry Training Centre for Asia and the Pacific Region (RECOFTC), Kasetsart University, Bangkok, Thailand. Pg. 139

[4] There are 5,196 community forests; north 1,457; central 727; northeast 2,535; south 477 (MONRE presentation on 20 December 2004)

Table 3 Forest conservation and management policies, plans and measures

Level	Policy, Plan and Measure	Responsible Agency	Implementing Agencies	Implementing Status
National	National Forest Policy 1985	- Royal Forest Dep.	- Royal Forest Dep. - National Park, Wildlife and Plant Conservation Dep.	✓
	Watershed Quality Classification and Watershed Land Use Measures (Cabinet Decree 21 February 1985	- Royal Forest Dep.	- Royal Forest Dep. - National Park, Wildlife and Plant Conservation Dep. - Department of Primary Industries and Mines	✓
	Wetlands Management Operating Plan (Cabinet Decree 23 September 1997) International and National Wetlands Conservation Measures (Cabinet Decree 1 August 2000)	- Office of Natural Resources and Environmental Policy and Planning	- Office of Natural Resources and Environmental Policy and Planning - National Park, Wildlife and Plant Conservation Dep. - Local Administrative Organization	✓
	Fire Control Strategic Plan 2004	- National Park, Wildlife and Plant Conservation Dep.	- National Park, Wildlife and Plant Conservation Dep.	✓
	Land Resources Conflicts Solving in the Forest Area (Cabinet Decree 30 June 1998)	- Royal Forest Dep.	- Royal Forest Dep. - National Park, Wildlife and Plant Conservation Dep.	✓
	National Integrated Forest Management Strategic Plan (2004-2013)	- National Park, Wildlife and Plant Conservation Dep. - Royal Forest Dep.	- National Park, Wildlife and Plant Conservation Dep. - Royal Forest Dep.	✓
	Biodiversity Conservation and Sustainable Utilization Policy, Plan and Measure (2003-2007)	- Office of Natural Resources and Environmental Policy and Planning	- Office of Natural Resources and Environmental Policy and Planning	✓
Regional	Third Policy and Master Plan on Environmental Community Development and Narcotic Area Control (2002-2006)	- Office of the National Security Council	- Office of the National Security Council - Department of Social Development and Welfare	✓
	Master Plan on Rehabilitation and Development of Vulnerable Land Slide Areas of Kor and Chun Sub-Watersheds, Phetchabun province	- National Park, Wildlife and Plant Conservation Dep.	- National Park, Wildlife and Plant Conservation Dep.	✓

Source: TDRI, 2005

Table 4 provides goals stipulated in national plans and indicators. These are the indicators chosen by Thailand Development Research Institute for monitoring the outcome of the policy to be used by the Office of Natural Resources and Environment Policy and Planning (ONEP). Owing to the lack of data or inconsistent data (such as the case of forest cover) and the fact that indicators were not designed at the time when the goals were set, the chosen indicators are often not the first best indicators. For example, percentage of protected areas measures the expansion of the areas

designated for protection but not the outcome of the effort. The indicators on community forest areas could be a good indicator if there was an auditing process. Thus, it cannot be concluded from these indicators that the national forest situation has been improving, nor are the goals being met.

Table 4 Forest Resources Indicators

National Policy/Goals	Unit	Type	1997	1998	1999	2000	2001	2002	2003	2004	Result
1. Forests cover at least 50% of the total area: Conservation forest – 30% and economic forest – 20%											
- Percentage of conservation forest area	%	R	14.82	15.30	16.38	17.30	17.46	17.66			↑
- Recovering rate of rehabilitated forest	%	R	n/a								×
- Unit cost of fire control	*baht/ rai*	R	-	-	7.07	6.86	7.03	12.04	11.11		↓
- Percentage change of domestic forest product consumption	%	P	1,233	167	240	83	885	32,262	-29		↑
2. Forested areas are to be utilized in a manner that will retain the natural balance of the ecosystem and environmental quality.											
- Community forest area	million *rai*	R	-	-	-	0.20	0.23	0.33	0.10	1.09	↑
3. Conservation and sustainable utilization of biodiversity.											

Source: TDRI, 2005

Note: The model for designing the indicator is the Pressure State Response Model. The indicators are used for monitoring and evaluating the Environmental Quality Management Plan 2002-2006

- *Indicator types*: P – pressure indicator; S – state indicator; R – response indicator
- *Indicator results*: ↑ in the same direction as the target; ↓ in the opposite direction of the target
- *Evaluation results*: (++) (+) in the same direction as the target, (–) (– –) in the opposite direction of the target

Land Resources

Of all the resources, land resource management has posed the most intractable problems for the Thai governments throughout different times. The problems concerns both physical deterioration of the land resources and the socio-economic aspects associated to the problems of poverty, landlessness and the rights for the use of state land as designated by forest laws and other laws.

Thailand enjoys abundance of land and is currently ranked the second most land abundant country in Asia. The amount of arable land per head continued to increase until the 1970's when it began a continuous decline from 2.5 *rai* per person to 2.2 *rai* per person by 1993 (Mingsarn, 2005). However, the increase in the amount of arable land has come about by deforestation. Without land tenure security, most farmers do not have incentives to make improvement on the land or engage in soil erosion control practices. Table 5 illustrates the pattern of land use in Thailand.

Table 5 Land Use, 1998 and 2000/2001

Type of Land Use	1998		2000/2001	
	Size (in million *rai*)	Percentage	Size (in million *rai*)	Percentage
Settlement	4.7	1.5	11.4	3.6
Arable Land	174.9	54.5	180.4	56.2
- Rice Field	79.9	24.9	81.8	25.5
- Plantation	50.6	15.8	45.0	14.0
- Fruit Orchards	8.0	2.5	11.2	3.5
- Other Orchards	25.9	8.1	25.2	7.8
- Others	10.5	3.2	17.2	5.4
Forest Land	105.5	32.9	114.7	35.8
Watershed	3.5	1.1	5.1	1.6
Others	32.2	10.0	9.2	2.9
Total	**320.8**	**100.0**	**320.8**	**100.0**

Source: Department of Land Development, 2000 and 2003

As far as the physical deterioration of land resources is concerned, soil erosion is among the most serious (Table 6). Most of the measures focus on rehabilitation of watershed forest and planting vetiver grass (*ya fak*) to mitigate soil erosion. The government has also allocated a budget of around 40 – 50 million *baht* a year to the Land Development Department to promote the use of biological fertilizers in agriculture instead of insecticides which are harmful to the soil resources. Currently the Department is running a volunteers program at the village level to disseminate knowledge on sustainable land use and soil improvement practices to farmers. However, despite all these efforts, the Land Development Department which is the main agency to implement land development measures is fighting a losing battle. While the areas affected by soil erosion is estimated at 108.8 million *rai*, the Department was able to carry out soil erosion mitigation measures covering only 2.56 million *rai* or 2 per cent of the affected area during 1997 – 2004 (TDRI 2004) (Figure 5). Soil quality rehabilitation achieved during the same period was about 10.76 million *rai* or 9 per cent of infertile soil which includes salinity and acid sulfate contaminated soils. The gap is getting wider as deforestation causes more lands to be affected each year.

Table 6 Depleted Land, 2002 by Region

Soil Condition	Area (million *rai*)				
	North	Northeast	Central and West	South	Total
1. Eroded Soil	53.96	17.87	26.20	10.84	108.87
2. Riddled Soil	10.20	75.70	10.90	1.90	98.70
3. Soil Inappropriate for Agriculture	71.39	75.30	37.40	25.75	209.84
3.1 Salt Affected Soil	-	17.80	1.60	2.30	21.70
3.2 Highly Acidic Soil	-	-	3.28	0.89	4.17
3.3 Acidic Soil	12.38	27.11	11.22	13.56	64.27
3.4 Organic Soil	-	-	-	0.27	0.27
3.5 Sandy Soil	0.86	2.60	2.30	1.21	6.97
3.6 Sandy-mixed Soil	1.54	30.85	4.65	2.56	39.60
3.7 Shallow Soil	13.09	15.53	9.24	3.11	40.97
3.8 Highland Soil	55.90	8.50	16.30	15.40	96.10
4. Inappropriate land use	6.20	21.20	3.90	4.30	35.60

Source: Department of Land Development, 2003

Note: More than one depleted soil types may co-exist in one area

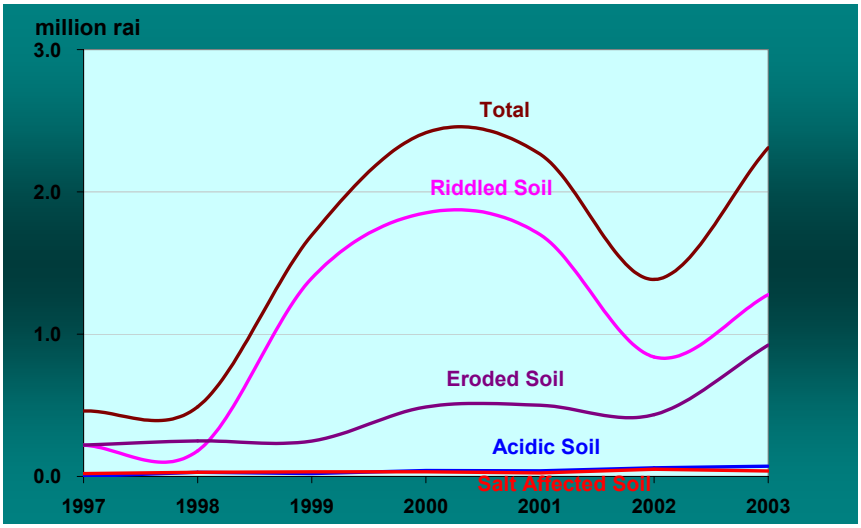

Figure 5 **Recovery of Depleted Soil**
Source: Department of Land Development, 2004

Apart from soil erosion, inappropriate land use during the past three decades has caused a large amount of agricultural land to be converted into developments. Due to economic growth, agricultural land was converted to other uses by 18,000 *rai* per year during 1984 and 1993. The continuing low prices of agricultural produce have made many farmers give up and sell their land. Agricultural plots within irrigated zones are now frequently used for developments. Reclamation of land for development has also included wetland sites, causing the loss of biodiversity and urban flood at a later stage. This pattern of land use reflects poor planning and lack of coordinated land use control among the government agencies concerned. It also means an inefficient use of the government's limited resources since the land which the state has invested substantial budget in irrigation is now being misused.

Although Thailand has a Town Planning Act which has been in force since 1975, all provincial town plans prepared under the law are only a general plan with rough zoning. Thus, there are no specific details governing land use in each zone. In any case, the town plans are generally not followed. For instance, it is not uncommon for a permit to be given to a factory establishment outside the industrial zone. Like in other governmental functions, there is little coordination in land use planning among the concerned government agencies. In addition, implementation of town plans is assigned to local governments which normally do not have the expertise to carry out the task.

Another example of inappropriate land use is the case of shrimp farming development on agricultural land in the central plains. Shrimp farming on agricultural land started in 1980 when shrimp farmers shifted their operation from coastal areas to rice plains due to the polluted environment in their original farming sites and the outbreak of shrimp disease. It has been estimated that as many as 400,000 *rai* of coastal shrimp farms are now deserted. Moving shrimp farming to agricultural plains has raised concerns over its impact on the land ecology since the use of sea water or salt in farming is likely to spread salinity in the soil. The conflict over the two groups of farmers came to a height in 1998. The government agencies concerned were split in their opinions on the development of shrimp farming on agricultural land. While MONRE viewed such operation as ecologically damaging and proposed to forbid and terminate shrimp farming in agricultural plains, the Fishery Department thought that the ecological impact could be controlled and thus it should be allowed to continue. The government's subsequent decision to terminate shrimp farming on agricultural land prompted protest by shrimp farmers. The present situation concerning shrimp farming is still left largely unclear.

Tables 7 and 8 below list land-use policies, plans and measures, the implementing governmental agencies and the indicators of soil and land use.

Table 7 Soil resources and land use policies, plans and measures

Level	Policy, Plan and Measure	Responsible Agency	Implementing agencies	Implementing Status
National	National Land Policy 1987	Department of Lands	- Department of Lands - Department of Public Works and Town & Country Planning - Royal Forest Dep. - Department of Social Development and Welfare - The Cooperative Promotion Dep. - National Park, Wildlife and Plant Conservation Dep.	✔
	9th National Economic Social Development Plan: Agriculture Development Plan (land resources management)	Land Development Dep.	- Land Development Dep. - Royal irrigation Dep. - Agricultural Land Reform Office	✔
	Land Development Department Strategy Plan 2004-2008	Land Development Dep.	- Land Development Dep.	✔
	Giant Prawn Cultivation Control Measure (Cabinet Resolution 7 July 1998)	Office of Natural Resources and Environmental Policy and Planning	- Department o Fisheries - Land Development Dep.	✔
	State Land Encroachment Operation Plan	Land Development Dep.	- State Land Encroachment Committee - Land Development Dep. - Department of Lands - Provinces	✔
	National Land Management Policy	Ministry of Natural Resources and Environment	- Ministry of Natural Resources and Environment - Ministry of Finance - Ministry of Agriculture and Cooperatives - Ministry of Interior	✔
Regional	Provincial Land Use Plan and Watershed Land Use Plan	Land Development Dep.	- Land Development Committee - Land Development Dep. - Provinces	✔
	Provincial Coastal Area Management Plan	Land Development Dep.	- Provinces	Completed

Source: TDRI, 2005

Table 8 Soils and Land Use Policy Indicators

National Policy/Goals	Unit	Type	1997	1998	1999	2000	2001	2002	2003	2004	Result
1.Effective use of land resources, based on their capacity and environmental conditions.											
2. To conserve, rehabilitate, and develop degraded soils and land for sustainable development, by accelerating rehabilitation of infertile soils, and by mitigating soil erosion in coastal areas.											
-Rehabilitation of infertile soil areas	million *rai*	R	0.46	0.49	1.70	2.15	2.27	1.38	2.31		↑
-Rehabilitation of soil erosion areas	million *rai*	R	0.22	0.25	0.25	0.49	0.50	0.43	0.42		↑
-Number of land development villages	#	R	1,205	1,390	1,587	1,795	2,058	2,334	2,631	2,829	↑
-Percentage change of forest area	%	P	-0.45	-0.45	-0.58	31.89					↓
3. To conserve and utilize areas containing unique ecosystems and geology, by maintaining the natural balance.											

Source: TDRI, 2005

Note: These indicators can be used for monitoring and evaluating the Environmental Quality Management Plan 2002-2006.

- *Indicator types*: P – pressure indicator; S – state indicator; R – response indicator
- *Indicator results*: ↑ in the same direction as the target; ↓ in the opposite direction of the target
- *Evaluation results*: (++) (+) in the same direction as the target, (–) (– –) in the opposite direction of the target

On top of the physical deterioration of the soil resources are the more complicated issues of dealing with people inhabiting forest areas and state land. In a survey conducted by the Ministry of Interior in 1990, there were an estimated number of over a million households living in the forest covering the declared forest reserves of 33,375,450 *rai*. Outsides the forest reserves, another more than 2.1 million *rai* of permanent forests (designated areas to be declared as forest reserves) and 2.6 million *rai* of public land had been occupied. To a great extent, the problem is related to the state's forest management policies which focus on declaring protected areas and ignore people who have to rely on forest resources to support their livelihood. Thus, while the relevant forest laws[5] do not allow people settling in protected areas, the state has been forced to recognize the fact that there exist a large number of people living in designated forest areas. These lands have become as what Jin Sato describes as "the ambiguous lands" or "the land in between" (Sato, 2000). The history of how the state has sought to tackle these problems is constituted in a series of policies and legal measures to deal with those living in areas classified as forest lands. These laws and policies are a mixture of compromise by conceding the rights of those who had settled in the forest before the declaration of the forest zones and the tough treatment of those living in conservation areas. Table 10 lists important policies and laws affecting people living in the forest.

One way which the state has employed in solving the problems is by providing land to the landless or those who have insufficient land to live on. A number of governmental agencies have been assigned this responsibility. The most important among them are the Public Welfare Department (now the Department of Social Welfare Development), the Cooperative Promotion Department, the RFD which used to issue land documents (Sor Thor Kor) to give usufruct rights to people living in degraded forest reserves areas and the Agricultural Land Reform Office (ALRO). According to the Cabinet Resolution issued on 22 June, 1982, all government agencies were instructed not to expand their project areas, except for agricultural land reform programs. This has left ALRO as the main agency in implementing the task of land reform and distributing lands to landless farmers.

Table 9 shows the number of landless people and those having insufficient land for living.

Table 9 Landless people and people with insufficient land

Year	Landless Households	Partially Landed and Need to Rent Additional Land	Total
1987	572,755	770,888	1.343,643 (1)
1992	538,470	772,704	1,311,174 (2)
1996	514,717	893,233	1,407,950 (3)
1999	546,942	969,355	1,516,297 (4)

Sources: (1) National Rural development Coordination Center 1988
(2) The Budget Bureau 1994
(3) The Budget Bureau 1999
(4) The Budget Bureau 2000
Cited in Sopon Chomchan : Management of Land Resources and Poverty (2001) p. 14

[5] These are namely the 1961 National Park Act, the 1964 National Forest Reserves Act and the 1992 Preservation and Protection of Wild Animals Act (substituted the former 1960 Preservation and Protection of Wild Animals Act). These laws give power to the state to declare national parks, forest reserves and wildlife sanctuaries respectively.

Table 10 Policies and Laws Concerning People in the Forest

Year	Policies and Laws	Measures
1960	First Economic Development Plan	Forest areas to cover at least 50% of the country's total land area
1961	Cabinet Resolution	50 % of the total land area (162 million *rai*) designated as "permanent forest"
1961	National Park Act enacted	The state has power to designate forest areas as national parks for conservation, educational and recreational purposes. Human settlement and exploitation of forest resources within national parks are strictly prohibited.
1964	National Forest Reserve Act enacted	RFD is given power to issue ministerial regulations designating forest reserves. No human settlement in forest reserves is allowed.
1975	Cabinet approved "forest village" (*moo bann pa mai*) project.	Establishing forest villages in degraded forest reserves to enable people to live in the forest.
	The Agricultural Land Reform Act enacted	Establishing ALRO to distribute state land and acquired private land to landless or nearly landless farmers.
1979	Cabinet approved "*Sor Tor Kor*" project.	Land rights documents called "*Sor Tor Kor*" were issued to give usufruct rights to farmers living in degraded forest reserves. The project began in 1982.
1985	Cabinet approved a proposal to revoke certain forest reserves occupied by people.	Providing different land rights to settlements in forest reserves depending on the dates of settlement.
	Cabinet approved the National Forest Policy	Stipulates forest cover to be at least 40% of the total forest areas.
1991	Cabinet approved the "*Kor Jor Kor*" project to be implented initially in the northeast.	Moving people from conservation forests into degraded forest reserves. Each household was allocated 15 *rai* in forest reserves.
1992	Cabinet abandoned the *Kor Jor Kor* project due to strong protest by affected farmers.	
1993	Cabinet approved relief plan for people occupying forest reserves.	RFD was instructed to hand over 44.28 million *rai* of forest reserves to ALRO for distribution to landless farmers.
1997	Cabinet issued three resolutions to deal with people living in conservation forests.	People settling in conservation forests were allowed to remain on their land pending the determination by RFD to prove whether they had settled there prior to the establishment of the protected areas.
1998	Cabinet revoked the 1997 resolutions.	

Source: Social Research Institute, Chiang Mai University, 2005

As a result of the Cabinet Resolution on May 4, 1993, RFD transferred 44 million *rai* of forest reserves to ALRO for distribution to landless farmers. To a certain extent, this has alleviated

the problems of land rights for those occupying land in forest reserves. However, the problems of people living in conservation forests (i.e. national parks and wildlife sanctuaries) remain unresolved.

Despite all the work of allocating land to the landless carried out by the various agencies for several years, the number of households in need of land remains high. So far, ALRO has been able to allocate about 25 million *rai* of land to 1.6 million farmers nationwide, with another 15 million *rai* going through the allocation process. For the year 2005, the goal is to distribute about 3 million *rai* to 190,000 farmers.[6] ALRO's performance in the past has indicated that it could only distribute lands to those who had already occupied land illegally while those who are without land remain landless. The land right document issued by ALRO, Sor Por Gor 4-01, does not confer land ownership. Neither is it transferable. However, family members may inherit the right provided that the land continues to be used for agriculture.

It is estimated that the available land for distribution to landless farmers at present is no more than 25.27 million *rai*. Given that around 3.9 million people have come forward to register and be listed as the poor and at least 41 million *rai* are needed to satisfy their needs, it is unrealistic to expect ALRO to carry out its mission successfully unless there is a change in the working strategy. Tables 11 and 12 show the amount of available land for distribution and the status of those listed as poor.

Table 11 Land available for distribution to landless or nearly landless farmers

Type of land	Amount (*rai*)
Forest reserves	5.79 million
State land (*Thi Radchaphatsadu*)	1 million
ALRO land	16.98 million
Cooperative estates (*Nikom Sahakhon*)	1.5 million
Total	**25.27 million**

Source: Sopon Chomchan, 2005

Table 12 Status of the listed poor

Status	No. of cases
Landless	1.2 million
Possessing land but requiring additional land	1.6 million
Renting state land	0.13 million
Occupying state land	0.27 million
Estimated amount of land needed : 41 million *rai*	

Source: Sopon Chomchan, 2005

One of the major obstacles is how to make non-farmers who are occupying state land surrender their land. Another problem is to persuade landholders who are occupying more than 50 *rai* of land to reduce their holding down to the legal limit of 50 *rai*. In an attempt to deal with the situation, ALRO has proposed that the Agricultural Land Reform Act be amended to allow land covered by Sor Por Kor 4-01 document to be transferable after 5 years' occupation provided that the area covered is no more than 50 *rai*. Another proposed amendment would allow those occupying over 50 *rai* of land up to the maximum of 1,000 *rai* to continue working on the land provided that they had occupied the land prior to 1975 when the law was passed. Both proposals have been rejected by the Cabinet.[7]

6 ***Non-farmers May get Title***, Bangkok Post, 28 February, 2005

7 ***Cabinet nixes reform land overhaul plan***, Bangkok Post, 9 March, 2005.

The social impact of the failure in land resource management is serious since a large number of poor people are those living in the agriculture sector with no or little land to support their basic living. The seriousness of the problems can be reflected in the number of conflicts between the state and the people happening continuously over the years. From 1994 to 1989, 498 public protests by people affected by land management problems were recorded, and from January to April 1990 alone, there are 57 protests associated with land problems.[8] Analysis of the demands submitted by the Assembly of the Poor protesting in front of the government house in 1997 indicated that out of the 125 demands made by the protesters, there were 93 disputes related to land, and another 8 disputes related to land in slum communities.[9]

Water Resources

Thailand is much less abundant in natural water supplies than its neighboring countries. Its annual renewable water supplies are lower than the Asian average. Its water basins provide 3,420 and 3,398 cubic meters of water per person per year during 2000-2001 and 2002-2003, respectively[10]. However, the actual water extractable is only slightly over 1,800 cubic meters per person per year in 2000-2001. This is only slightly above the level of 1,700 cubic meters per person per year which is considered to be a water stress situation (Falkenmark 1991). About 90 percent of water use is for agriculture, mainly rice which is a very water-intensive crop. Considering the fact that Thailand rice export competitors namely the United States and Vietnam are much more abundant in water supply than Thailand and that new technologies have allowed Thai farmers in the lower *Chao Phraya* Basin to grow 7 crops of rice in two years, competition for economic uses of water will continue to intensify.

Table 13 provides an overview of the water situation in the major basins of Thailand. About 34 percent of the total runoff (200,000 million cubic meters) can be stored in dams and the possibility to expand storage by building more large dams is severely limited by environmental consideration and social costs especially the cost of compensation to dam evacuees. Water availability indicator, the proportion of the water availability on the 1st of January to total water storage capacity, indicates the level of water security especially for the dry season (January to April). During 2000 to 2004, water availability indicators range from 41 to 53 percent, depending on the amount of rainfall and water use pattern (Table 15). The indicator also reflects surplus unfilled capacity in some very large dams especially the *Bhumiphol* Dam.

As arable lands expand, agricultural demand for water has continuously increased at an average rate of 2.84 percent per year. Table 14 shows the increased rate of water use from 1993, projecting up to 2006. About 52.6 billion cubic meters of water were consumed in 1993 and 70.5 billion cubic meters is predicted in 2006. With this increasing demand but not supply, water shortages at regional basins have been observed at an average increasing rate of 0.77 percent annually (Table 14).

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[8] Sayamol K*rai*yoonwong, Land Policy and Strategy to Solve the problems of Poverty, Report on Evaluation of the Government's Natural Resources and Environmental Administration during the Past Four Years, paper presented at the Seminar on Preparation of Environmental Public Policy through Civil Society Participation, the Human Rights Commission, December 8, 2004.

[9] Prapas Pintoptang, *Politics on the Street – 99 Days of the Assembly of the Poor and History of Street Demonstrations in Thai Society*, Kruek University, Bangkok, 1997.

[10] World Resources Institute 2001, 2003

Table 13 Water Resources Overview, 2001

Basin Code	Basin	Population in 2001	Basin Area	Average Annual Rainfalls	Average Annual Run-off Water	Demand	Stored Water
		(million)	(sq. km)	(mm)	(cubic meters per person)		
North							
01	Salween	0.506	17,920	1,354	16,553	257	51
03	Kok	0.678	7,895	1,478	6,163	156	58
06	Ping	2.414	33,898	1,125	3,615	1568	5,879
07	Wang	0.757	10,791	1,099	2,136	758	283
08	Yom	1.973	23,616	1,159	1,853	476	203
09	Nan	2.290	34,330	1,273	5,247	1269	4,225
	Total	**8.618**	**128,448**	**1,222**	**4,475**	**979**	**2,848**
Northeast							
02	MeKong	6.323	57,422	1,548	4,866	365	244
04	Chi	6.380	49,477	1,174	1,762	550	776
05	Mun	9.997	69,700	1,266	1,951	302	406
	Total	**22.70**	**176,599**	**1,332**	**2,710**	**389**	**465**
Central and West							
10	Chao Phraya	11.404	20,125	1,084	152	1147	2
11	Sakaekrang	0.394	5,191	1,234	2,856	1109	416
12	Pasak	1.495	16,292	1,213	1,930	281	618
13	Thachin	2.579	13,682	1,041	529	1537	123
14	Mae Klong	1.672	30,837	1,334	9,047	2584	15,959
19	Phetburi	0.549	5,603	1,064	2,523	965	1,366
20	West Coast of Thai Gulf	0.442	6,745	1,048	3,038	1007	1,278
	Total	**18.536**	**98,475**	**1,182**	**1,347**	**1251**	**1,587**
East							
15	Prachinburi	0.842	10,481	1,584	6,130	1821	59
16	Bangpakong	1.204	7,978	1,346	2,777	414	56
17	Tonle Sap	0.262	4,150	1,516	9,145	118	290
18	East Coast of Thai Gulf	1.837	13,830	2,151	7,065	224	272
	Total	**4.145**	**36,439**	**1,739**	**5,761**	**597**	**167**
South							
21	East Coast of the South	3.517	26,353	2,052	6,330	300	29
22	Tapi	0.975	12,225	2,061	10,796	154	5,906
23	Lake Songkhla	1.412	8,495	1,992	4,694	463	67
24	Pattani	0.465	3,858	1,939	5,739	187	3,022
25	West Coast of the South	1.941	20,472	2,559	11,541	129	29
	Total	**8.310**	**71,403**	**2,186**	**7,760**	**264**	**893**
Grand Total		**62.309**	**511,366**	**1,424**	**3,425**	**725**	**1,166**

Source: Royal Irrigation Department, 2003

Under the current open access regime for surface water, there are no mechanisms for curbing increasing demand. Along with water shortage, competition between users—upstream versus downstream, industrial versus agricultural, rural versus urban and so forth—often leads to over stocking and wasteful uses as well as unfair distribution between different water-use objectives.

Table 14 Water Demand and Shortage, 1993 and 2006

	Demand (million cubic meters)				% Change	% Change per year	Shortage (million cubic meters)	% Change	% Change per year
	Domestic	Industry and Tourism	Irrigation	Total					
North									
1993	242.5	7.3	7,663.9	7,913.6			141.0		
2006	289.2	40.1	12,772.6	13,101.9	65.56	5.46	419.6	197.60	16.47
Northeast									
1993	665.6	145.9	10,005.0	10,816.5			961.5		
2006	1,175.8	243.4	12,884.6	14,303.8	32.24	2.69	1543.7	60.55	5.04
Central and West									
1993	1,822.9	985.4	21,683.2	24,491.5			1,655.8		
2006	4,457.7	1442.5	22,613.1	28,513.3	16.42	1.39	1,792.5	8.26	0.69
East									
1993	164.0	95.3	3,857.4	4,116.7			748.8		
2006	330.3	227.2	5,692.0	6,249.4	51.81	4.32	756.1	0.97	0.08
South									
1993	223.2	77.5	4,962.5	5,263.2			2,195.4		
2006	343.3	201.2	7,784.4	8,328.9	58.25	4.85	1,729.0	-21.24	-1.77
Total									
1993	3,118.1	1,311.5	48,171.9	52,601.6			5,702.4		
2006	6,596.3	2,154.4	61,746.6	70,497.4	34.02	2.84	6,240.9	9.44	0.77
% Change									
	111.55	64.27	28.18	34.02			9.44		
% Change per Year									
	9.30	5.36	2.35	2.84			0.77		

Source: Siripong Hungspreug, Development of Infrastructure for Supporting the Development of Water Resources and Irrigation in Thailand, Proceedings of the Fourth Regional Symposium on Infrastructure Development in Civil Engineering, Bangkok, April 3-5, 2003

Thus it is not surprising that water shortage can lead to water conflicts, especially in the north and northeastern regions. New farming opportunities, sub temperate horticulture, mushrooms, etc. have been opened up for the highlands, uplands and lowland leading to more water demand for dry season farming. Even in the Central Plain, the land use intensity in the dry season from 1997 to 2004 indicates the high water demand for dry season crops, resulting in water shortage and conflicts between agriculture and other uses such as domestic use (pipe water) as well as ecology control (sea water intrusion).

As the possibility of building more large dams is encountered by increasing social and environmental costs, attention has been drawn to the groundwater potential. However, over-pumping of groundwater could lead to land subsidence, seawater intrusion, and contamination. This has already happened in large cities, particularly Bangkok and its vicinity. Attempts to resolve these incidents have normally been made on an ad-hoc, case-by-case basis; instant engineering solutions are usually employed.

Due to severity of the land subsidence in Bangkok and vicinity, in 2003 the government increased the penalties for illegal groundwater users as well as set up a groundwater development fund for conserving groundwater resources as well as conducting study, and research on related issues. As a result, groundwater use declined steadily (Table 15). Groundwater quality management and standards have been implemented aiming at reducing environmental and health impacts. The degree of land subsidence in Bangkok has been declining, but more impact has occurred in the vicinity area.

Thailand's capacity of providing water for consumption has lagged far behind its ability to supply electricity. While more than 98 percent of the villages are now electrified in 2003, about 77 percent of villages have access to clean water (pipe water) (Table 15). Besides, it is not possible to develop domestic water sources in 4,336 villages, 1,008 *tambon*, and 39 provinces.

Thailand's water policies concentrate on providing water for the lower *Chao Phraya* Basin. The Royal Irrigation Department formed almost a century ago only manages irrigation water. The Department of Groundwater is in charge of groundwater. Surface water is under an open access regime. The new Department of Water Resources is now making an effort to provide authority, budget and human resources to river basin committees to mange surface water but effective management will come after some learning process.

Although it is increasingly acknowledged that the water policy which stresses supply creation and management is coming to a dead end and that there is a need for allocation rule for water in the dry season, there is little understanding of how to go ahead. In order to get rid of the open access regime, the proposed water law which is being drafted aims to provide licenses to big users. This poorly drafted law has not hit the nail on the head for two reasons. First, the crux of the matter is not dividing water between the big and small users and charging a fee only for big users. The law must give guidance for prioritizing between different **economic** uses after water for livelihood and environment protection has been secured. Secondly, farms in Thailand are generally relatively small, which make them small water users. According to the draft law, they need not be licensed and thus there would not be control over their water use. However, together, they are large users of water especially the rice farmers. Waiving registration for small users may end up in losing a big account of water use.

The shift to demand management approach, either by pricing or trading of water, have been ignored by both the government and the NGOs, the former for fear of losing political support and the latter for not having confidence in the market mechanism and the process of assigning rights which has to precede the formation of the market. As a result only engineering solutions get implemented and social and economic solutions are left aside. The government has now proclaimed to establish a national water grid and a comprehensive warning system for floods and droughts.

Table 15 Water Resources Policy Indicators

Policy/Goals	Unit	Type	1997	1998	1999	2000	2001	2002	2003	2004	Result
1. To systematically develop, conserve, and rehabilitate water resources, both surface and ground water, in all watersheds in order to ensure sufficient quantity and acceptable quality, and for sustainable use.											-
- Proportion of water availability to water storage capacity	%	S			20	47	53			41	
- Proportion of villages with access to clean water	%	R	-	-	69.24	-	75.98	-	76.59		↑
- Percentage change of water used for pipe water production	%	P	5.38	-4.76	-8.99	1.65	3.00	1.57	0.73		↓

Policy/Goals	Unit	Type	1997	1998	1999	2000	2001	2002	2003	2004	Result
- Land use intensity in the dry season in Central Plain	ratio	P	1.23	1.40	1.84	1.58	1.31	1.35	1.21	1.43	↓
- Groundwater use in Bangkok and vicinity area	million m^3/day	P	1.54	1.45	1.19	0.98	0.74	0.58			↑

Source: Adjusted from ONEP (2005)

Note:
- *Indicator types*: P – pressure indicator; S – state indicator; R – response indicator
- *Indicator results*: ↑ in the same direction as the target; ↓ in the opposite direction of the target
- *Evaluation results*: (++) (+) in the same direction as the target, (–) (– –) in the opposite direction of the target

Marine and Coastal Resources

The coast of Thailand is 2,815 kilometers long with rich mangroves, coral reefs, marine animals, and sea-grasses. Coastal and fishery resources are threatened by excessive exploitation by the Thai fishery fleet. The catch per unit effort (CPUE) declined in terms of both quantities and the number of species, from 62.1 kilograms per hour in 1984 to 23.1 kilograms per hour in 2003.[11] The current marine fishery productions in 2002 was 2.64 million ton, which was slightly higher than Thailand's potential (2.5 million tons per year). This over production is probably due to catch outside the national Exclusive Economic Zone (EEZ).

Mangrove forests have been encroached and transformed for multiple uses in coastal aquaculture, residential settlement, industry and agriculture. In 1961, mangroves covered coastal areas of more than 2.2 million *rai*. In 1996, only 1.05 million *rai* remained; this is a 53 percent loss (Figure 13). Approximately one-third of this loss has been turned into shrimp farming (Figure 14). Between 1979 -1986, mangrove loss was at its peak of 81 thousand *rai* per year.

As a result of increased scientific understanding that mangrove areas are not suitable for shrimp farming,[12] the loss rate has been slowing down since then. In 2000, the total mangrove areas were estimated at 1.53 million *rai* reflecting a relatively sudden increase from 1.05 million *rai* in 1996. However, this might have been due to a change of the survey method in 1998, from aerial photographing to satellite transmission techniques. If the data in 2000 were taken as accurate, the value of 1.53 million *rai* would exceed the mangrove restoration target set by the 9th National Plan.

Although the government has taken measures to rehabilitate mangrove areas since 1991,[13] in 2003 half of the 1.53 million *rai* of mangrove forests remained in degraded condition. The total coastal aquaculture had been increasing until 2000 and then started to decline especially in 2002 at the rate of 5 percent. The major aquaculture is shrimp cultivation.

Another emerging threat to coastal resources is coastal erosion. Erosion of coastal areas occurs in every province around the Gulf of Thailand. Highest erosion (an average of more than 5.0 meters per year) occurs in the upper parts of the coastal area from *Bangpakong* delta of *Chachoengsao* province to the *Thachin* delta of *Samutsakhon* province. The government is now preparing a strategic plan for coastal area management to tackle coastal erosion.[14]

[11] The Department of Fisheries surveys CPUE by applying the same fishery instrument. This survey will be conducting every year start from 2003, for time-series data of CPUE indicating the change in fishery resource availability.
[12] Warr, P. Thailand Beyond the Crisis, RoutledgeCurzon, 2005, p. 328
[13] July 1991, the cabinet resolution to suspend all uses in mangrove forests.
[14] July 2004

On 26 December 2004 , a giant wave(Tsunami) from an earthquake (9.5 on a Richter Scale) struck the Andaman coast and destroyed 550 *rai* of coral reefs and 555 *rai* of mangrove forests were severely damaged ; 3,146 *rai* of coral reefs and 1,860 *rai* of mangrove forests were partially damaged. It was concluded by the UN Environment Program that "Those coastline with intact coral reefs, mangroves, vegetated dunes and robust coastal forests came off better than those degraded by pollution and insensitive land use".[15]

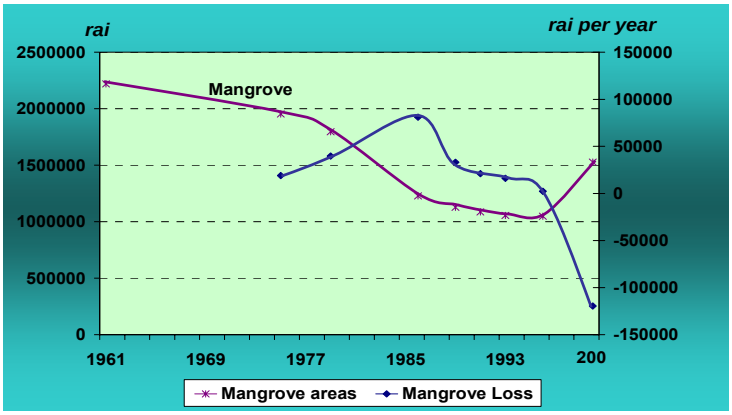

Figure 6 **Mangrove Areas and the Rates of Loss**[16]
Source: Department of Marine and Coastal Resources, 2003

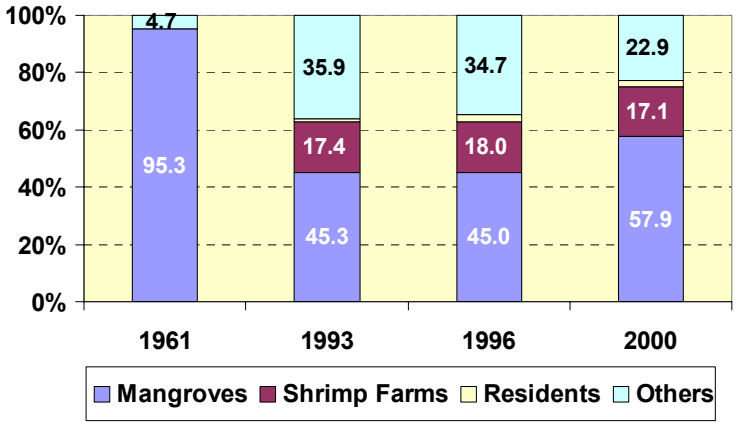

Figure 7 **Coastal Land Use Patterns**
Source: Department of Marine and Coastal Resources

Commercial aquaculture, on the other hand, has expanded rapidly (Figure 9). Thailand has been listed as one of the top ten fishing nations since 1972 and is the world's largest producer and exporter of fish and fish products at present. Moreover, since 1993, Thailand has been the largest shrimp producer and exporter in the world. Shrimp farming replaced mangroves for approximately 192 thousand *rai* in 1982. During 1982 – 1988, it expanded at an increasing rate of 13 percent per year and reached 342 thousand *rai* in 1988. The increase jumped to 445 thousand *rai* in the following year. From 1991 onwards, shrimp farming in mangrove areas has become stable at about 460 thousand *rai* and peaked in the year 2000 and subsequently slowed down.

[15] CNN News 22/02/2004 Report looks at environmental impact of Asian Tsunami
[16] Before 1998, aerial photographing technique was employed with the scale of 1:250,000 or smaller. After 1998, data was collected using satellite imageries such as Landsat or Ikonos which provide greater resolution. Hence, for 2000 and beyond, the scale is 1:50,000 and the area digitally plotted with more accuracy than previous survey methods.

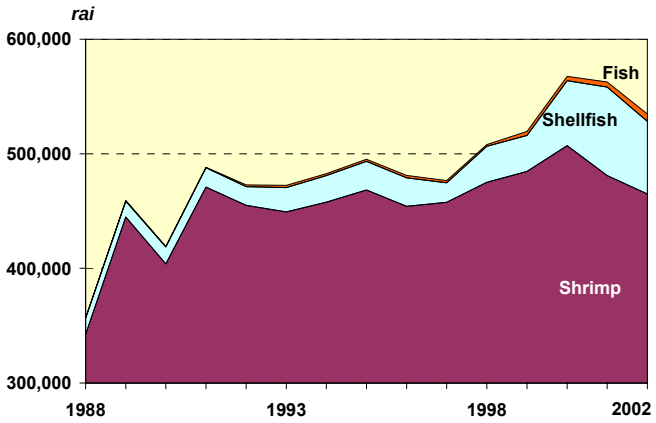

Figure 8 **Aquaculture Areas**
Source: Department of Fisheries

Along with aquaculture, marine landings in Thailand are among the highest in the world. The estimate of the potential level in Thai coasts is around 2.5 million tons per year. Starting with 1.5 million tons in 1973, marine landings increased to 2.5 million tons per year during the late 1980s, climbing up steadily and has stayed above the sustainable yield level since 1990. (Figure 10) However, over-increase in the number of fishing boats (Figure 11), destructive harvesting methods, and over-fishing resulted in rapid depletion of economically important fish. From 1989 – 2003, CPUE has been quite steady at about 24 kilograms per hour. (Figure 12)

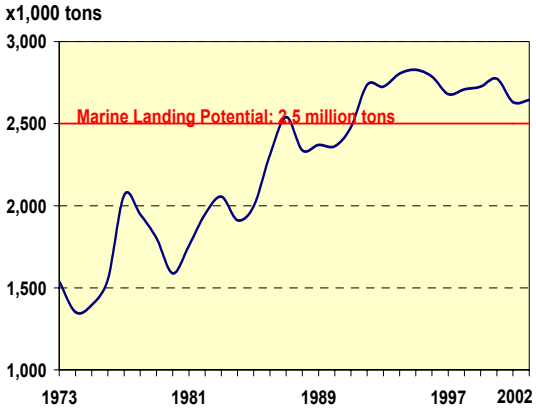

Figure 9 **Marine Landing**
Source: Department of Fisheries

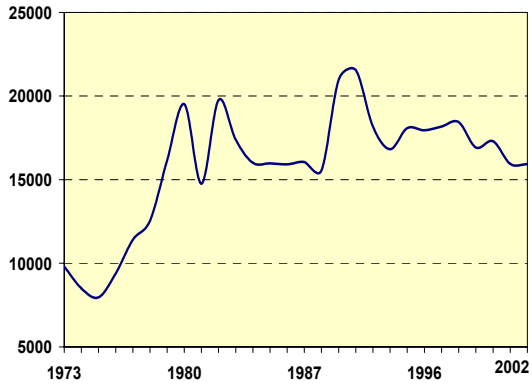

Figure 10 **Registered Fishing Boats**
Source: Department of Fisheries

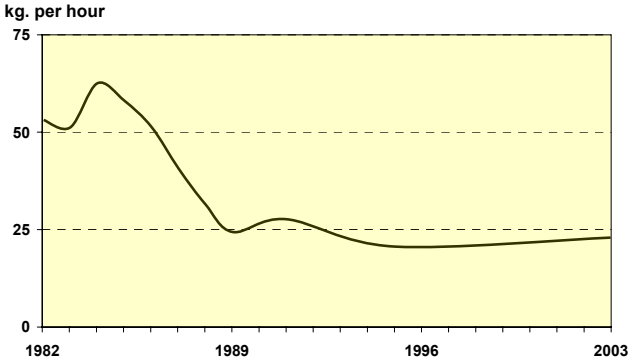

Figure 11 **Catch per Unit Effort**
Source: Department of Fisheries

Similar to mangroves depletion, coral reefs in Thai coasts—well recognized for their abundant biodiversity—have been depleted. The data surveyed during 1998 – 2002 shows that the Thai coasts were covered with 153.45 km² of coral reefs; 75 km² in Thai Gulf and 78.6 km² in the Andaman Sea. The overall condition of coral reefs was at the acceptable level; 30 percent was replete and highly replete, 30 percent fair and 40 percent deteriorated. However, when specific areas are considered, coral reefs in the Thai Gulf are in far better condition than that in the Andaman Sea. Approximately half of coral reefs in the Andaman Sea have deteriorated as compared to only one-fourth in the Thai Gulf; this is more a typical result of excessive tourism activities in reef areas and destructive fishing than natural causes. Fortunately, increased awareness in the importance of coral reef ecosystems has led to better protection and preservation behaviors.

Table 16 Coral Reef Condition, Survey during 1998 - 2002

	Area	Condition (%)				
	sq. km	Highly Replete	Replete	Fair	Deteriorated	Highly Deteriorated
Andaman Sea	78.56	4.6	12.0	33.6	26.5	23.3
Thai Gulf	74.89	16.4	29.0	30.8	10.9	12.9
- Eastern	27.69	12.0	24.6	31.6	15.3	16.4
- Western	47.20	20.2	32.7	30.1	7.1	9.9
Total	**153.45**	**10.4**	**20.3**	**32.2**	**18.9**	**18.2**

Source: Department of Fisheries

Table 17 Coastal Resources Policy Indicators

National Policy/Goals	Unit	Type	1997	1998	1999	2000	2001	2002	2003	2004	Result
1. To preserve at least 1 million *rai* (0.16 million hectare) of mangrove forests											+
- Mangrove forests	million *rai*	R	1.05	-	-	1.53	-	-			↑
- Change in aquaculture in coastal area	%	P	-0.95	6.61	2.25	9.25	-0.88	-4.95			↓
2. To conserve and rehabilitate all types of coastal resources for protection of the balance of coastal ecosystems											–
- Catch per unit effort	kg/hr	S	-	-	-	-	-	-	23.13		↑
- Proportion of good quality beaches (above standard)	%	S	-	-	-	-	-	38.46	57.14		↑

Source: Adjusted from ONEP (2005)

Note:
- *Indicator types*: P – pressure indicator; S – state indicator; R – response indicator
- *Indicator results*: ↑ in the same direction as the target; ↓ in the opposite direction of the target
- *Evaluation results*: (++) (+) in the same direction as the target, (–) (– –) in the opposite direction of the target

Mineral Resources

Mining industry in Thailand started off as an export industry bringing in a considerable inflow of foreign currency. Metal ores were heavily extracted for export until the coming of industrial expansion in the mid 1980s. Since then, mineral production has been shifted from metal to non-metal production mainly to support domestic industries, particularly construction, glass, and ceramics industries. The proportion of minerals produced for industrial use increased from 20 percent in 1984 to 50 percent in 1987 and continued to rise to 90 percent level from the mid 1990s (Figure 13). Mineral reserves at present consist of approximately 40 different mineral ores, most of which are abundant (Table 18). As of April 2003, there are 1,392 plots of operating mining concession (Figure 14).

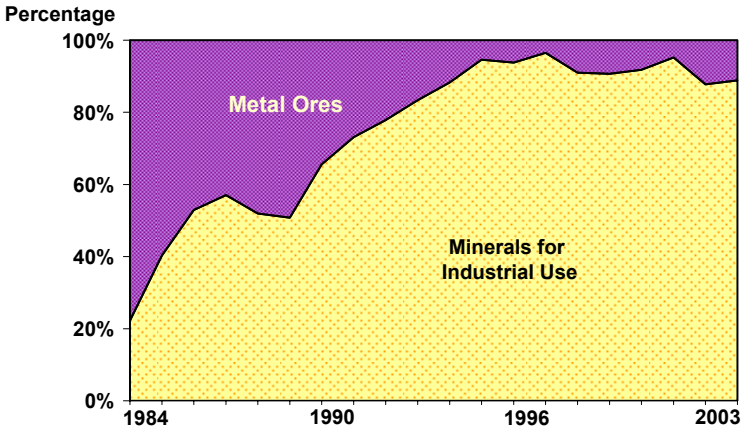

Figure 12 **Mineral Production Ratio, 1984-2003**
Source: Department of Primary Industries and Mines, 2004

Table 18 **Mineral Reserves, as of April, 2003**

Unit: Metric Ton

Mineral Ores	Concession in Operations	Primary Reserve	Total Reserves
Ball Clay	-	58,335,406	58,335,406
Barite	1,450,000	4,416,133	5,866,133
Coal	1,324,791,960	834,384,000	2,159,175,960
Copper	-	351,600	351,600
Dolomite	224,054,791	8,850,229	232,905,020
Granite, decoration grade	1,526,961,952	9,165,757	1,536,127,709
Limestone, decoration grade	354,959,025	13,500,726	368,459,751
Feldspar	12,812,750	510,000	13,322,750
Fluorite	989,500	1,095,303	2,084,803
Gold	38	60	97
Gypsum	8,835,562	14,535,792	23,371,354
Limestone, calcium grade	-	1,126,160	1,126,160
Limestone, cement grade	73,841,179	130,674,825	204,516,004
Basalt, construction grade	-	153,394,505	153,394,505
Limestone, construction grade	-	954,507,008	954,507,008
Granite, construction grade	-	70,288,567	70,288,567
Limestone, lime grade (for Sugar Industry)	-	289,428,648	289,428,648
Kaolin	166,675,887	16,115,059	182,790,946
Lead	2,367,100	10,732,718	13,099,818
Marble	667,780,634	112,779,284	780,559,918
Rock Salt	-	18	18
Potash	-	-	-
Sand	1,430,625	212,100,800	213,531,425
Tin	147,969	729,971	877,940
Zinc	920,000	1,290,094	2,210,094

Source: Department of Mineral Resources, 2003

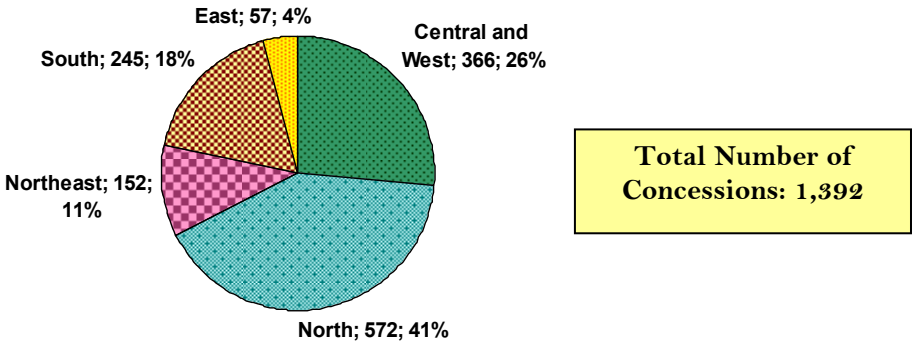

Figure 13 **Regional Distribution of Mining Concessions as of March 7, 2005 (in number and percentage)**
Source: Department of Primary Industries and Mines, March 7, 2005

Between 1987 and 2003, mineral production in all sectors continuously increased at an annual rate of 3.25 percent. Consumption of minerals, mainly by industrial sectors, rose at the rate of 5.14 percent per year. The decline in metal ore production has been the major factor in the drop in overall mineral export. Export of minerals decreased through the end of 1980s and remained quite stable during the mid 1990s and started to increase again from 1997. Export of minerals expanded from 1996 to 2003 at an annual rate of 13.69 percent.[17] From mid 1990s, Thailand started to import mineral ores of higher grade and of those not deposited locally in order to fill domestic industrial needs. These include mineral ores for the energy sector and high-grade metal ores. Since 1996, mineral import has grown at 12.15 percent per annum. (Figures 14 and 15)

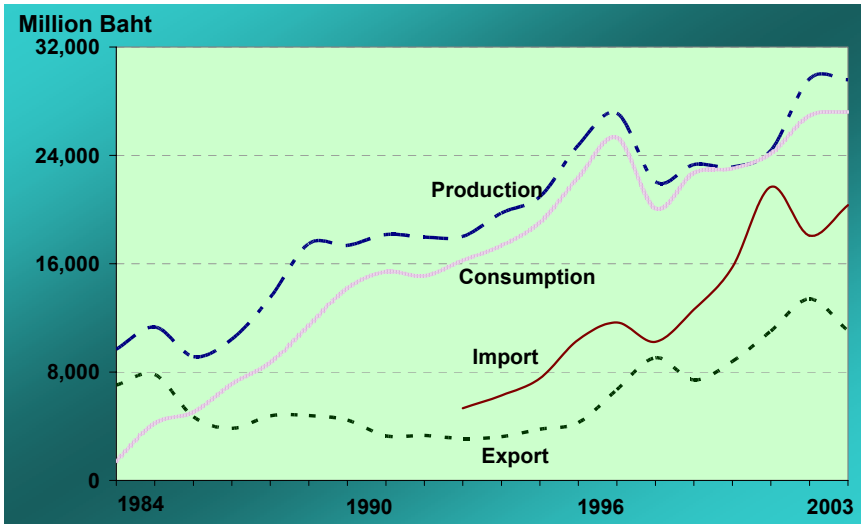

Figure 14 **Mineral Production, Consumption, Imports, and Exports Nominal Values, 1984 – 2003**
Source: Department of Primary Industries and Mines, 2004

[17] The growth rates are inflation adjusted using 1995 as the base year.

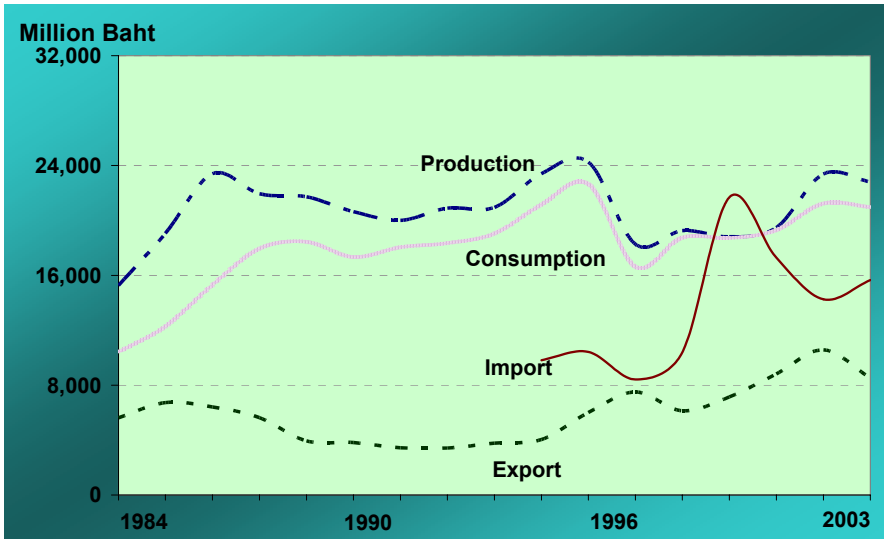

Figure 15 **Mineral Production, Consumption, Imports, and Exports Inflation Adjusted (1995 price), 1984 – 2003**
Source: Department of Primary Industries and Mines, 2004

Mineral resources policy has emphasized the development and utilization of the resources more than the consideration of environmental and health impacts caused by mineral resources exploitation. Economic, social and health impacts resulted from development activities and utilization of mineral resources are becoming a serious concern. For instance, arsenic contamination in *Ronpibun*, *Nakhon Si Thammarat* province (1987) has caused health impacts. Other instances include lead diffusion in *Klity* Creek (1998), cadmium contamination in *Mae Sod*, *Tak* province (2001), air pollution from stone grinding industry and cement industry in *Saraburi* province (2004). The recognition of the need for prevention measures for the designated risk areas has led the Department of Primary Industries and Mines to promote the use of clean technology in mineral development activities aiming to mitigate environmental impacts.

Thirty-three percent of mineral resources deposits[18] and 48 percent of potential mineral resources deposits are located in forest reserves[19]. Integrated mineral resources management has not been established due to the controversial mandate of the responsible government agencies. It requires integrated collaboration among government agencies in order to maximize social benefits from mineral resources development and conservation.

Environmental geology (landfill) and geo-hazard (sinkhole, landslide and earthquake) management are essential for mitigation of environmental impact caused by both human activities and natural disasters. Environmental impact from inappropriate landfill management could pollute the groundwater system as well as soil quality, while impacts from geo-hazard are unavoidable. Forty-six percent of the earthquake vulnerable areas are located in the forest reserves and another 10 percent is in *Muang* districts[20]. Precautionary measures supported by accurate information on geology are needed for management of the environmental geology and geo-hazard such as the setting up of early warning systems and people evacuation plans.

[18] Gold, Gypsum, Limestone, Zinc and Potash
[19] Department of Mineral Resources, 2005
[20] Department of Mineral Resources, 2005

Table 19 Mineral resources policy indicators

National Policy/Goals	Unit	Type	1997	1998	1999	2000	2001	2002	2003	2004	Result
1. To develop and conserve valuable mineral and geological for future development and for national security while integrating utilization and environmental conservation and reducing management conflicts with other natural resources.											–
- Operating mineral resources plots	#	S	-	-	-	-	-	564	970	948	
- Complaints on environmental impact caused by mineral resources development and utilization	#[1]	P									↓

Source: Adjusted from ONEP (2005)

Notes:
- *Indicator types*: P – pressure indicator; S – state indicator; R – response indicator
- *Indicator results*: ↑ in the same direction as the target; ↓ in the opposite direction of the target
- *Evaluation results*: (++) (+) in the same direction as the target, (–) (– –) in the opposite direction of the target

[1]A number of cases of complaints appear in the press but no records are collected.

Energy Resources

Accompanying economic growth is the increased consumption of energy. Energy consumption per capita which was 1.77 barrels oil equivalent per day in 1998 increased to 2.04 barrels oil equivalent (BOE) per day in 2002 (Table 20 and Figure 18). The ratio of net import to consumption had also been increasing (Table 21). The transportation and manufacturing sectors each consumes approximately one-third of the total energy.

Not being an oil producing country, Thailand obtains energy largely from lignite and natural gas, the combination of which produced more than two-thirds of the energy produced. Although the amount of lignite and natural gas reserves is considered sufficient at present, Thailand has increasingly depended on imported energy sources, especially crude oil. The proportion of net import is more than half of the total energy consumed and tends to increase over time. While the possibility of locating additional reserved is not very promising, the dependence on outside energy sources calls for consumption efficiency.

Table 20 Energy Consumption

	Energy Consumption Barrels Oil Equivalent per Day	Population	Energy Consumption per Capita (BOE)
1998	1,089,544	61,466,178	1.77
1999	1,123,266	61,661,701	1.82
2000	1,144,374	61,878,746	1.85
2001	1,203,442	62,308,887	1.93
2002	1,282,173	62,799,872	2.04

Source: Department of Alternative Energy Development and Efficiency, 2003

Table 21 Production, Net Import, Consumption, and Ratio of Net Import to Consumption

Unit: Barrels Oil Equivalent per Day

	Production	Net Import	Consumption	Net Import as Percentage of Consumption
1998	524,089	621,827	1,089,544	57.1
1999	547,787	657,303	1,123,266	58.5
2000	588,596	682,078	1,144,374	59.6
2001	594,367	754,731	1,203,442	62.7
2002	631,411	794,654	1,282,173	62.0
2003	673,512	899,144	1,369,145	65.7

Source: Department of Alternative Energy Development and Efficiency, 2004

Compared with other resource policy, energy resources policy has been better integrated with other sectoral policies such as transportation. To promote alternative bio-fuel as the energy resource utilization is necessary for all activities. In the national energy resources strategic plan (2003), targets have been set as follows: 1) to improve energy use efficiency, 2) to increase alternative energy options, 3) to increase energy resources security (electricity and natural gas), and 4) to set Thailand as energy trading hub in the region.

From 1999 to 2003, the demand for energy resources increased with an average growth rate of 5 percent per year. The Thai government has been promoting alternative sources of energy, i.e. renewable energy including fuel wood, charcoal, paddy husk, and bagasse. However, while the amount of renewable energy use has been increasing, its share in the total commercial energy use is declining. A new and renewable energy[21] target is set at 8 percent of commercial energy, but in 2003 it contributed only 0.5 percent. To meet the country requirement, Thailand needs to import energy resources. The ratio of imported energy and consumption can be used to measure the level of security in terms of energy resources. From this, the security level is slightly declining.

Energy elasticity indicators can be used to measure the energy use efficiency. From 2001 to 2003, the energy elasticity was declining which indicated the improvement of energy use efficiency. By sector, there is a rising trend of energy consumption per GDP in industrial, residential, commercial and agriculture sectors (Table 23). On the contrary, in the transportation sector there is an improvement of energy use efficiency. For instance, air pollution caused by CO_2 has been constant while that of the transportation sector has declined slightly. (Table 23)

Conflicts in energy resources development in Thailand have become more serious, especially among the local communities, government agencies and private sectors. The Thai government has not been successfully solving the conflicts such as the protest over *Boh Nok* and *Hin Krud* power plants in *Prachaub Khiri Khan* province and the Thailand-Malaysia Joint Development Area Project. This is largely due to the lack of people participation during the early stages of project planning and development.

[21] New and renewable energy means energy which exclude thermal energy from solid biomass energy in resident sector those from coal, natural gas and hydro energy by hydro power plant which installed capacity being larger than 10 MW. (Department of Alternative Energy Development and Efficiency, 2004. Thailand Alternative Energy Situation, 2003. Ministry of Energy.)

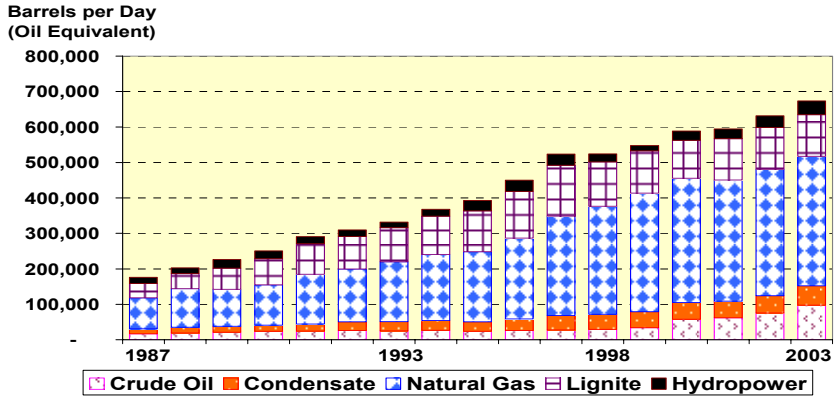

Figure 16 **Energy Production**
Source: Energy Policy and Planning Office, 2004

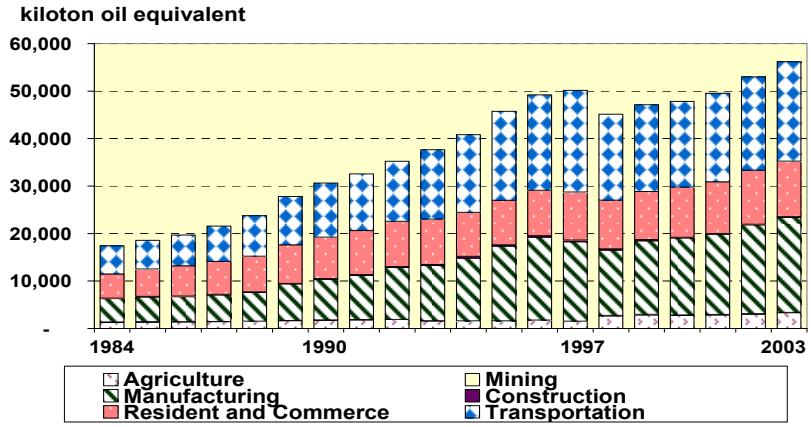

Figure 17 **Energy Consumption by Sectors**
Source: Department of Alternative Energy Development and Efficiency, 2004

Table 22 **Energy Reserves at Year End**

	Hydro Potential	Lignite	Natural Gas	Condensate	Oil Shale	Crude Oil
	(megawatts)	(million tons)	(thousand cubic feet)	(million barrels)	(million tons)	(million barrels)
1989	26,223.0	950.2	6,910.2	150.5	18,500.0	80.2
1990	36,677.0	1,149.7	7,340.0	159.7	18,500.0	96.8
1991	38,966.0	891.1	8,463.0	207.0	18,600.0	34.6
1992	38,281.0	1,513.8	5,740.2	128.0	18,500.0	50.6
1993	38,241.0	2,333.2	6,161.9	166.8	18,500.0	51.3
1994	34,589.0	2,375.4	5,900.9	157.0	18,500.0	73.8
1995	34,589.0	2,331.4	7,119.8	166.5	18,500.0	128.7
1996	37,010.0	2,315.4	6,487.8	125.8	18,600.0	115.4
1997	37,010.0	2,312.1	12,479.1	189.6	18,600.0	106.7
1998	37,010.0	2,276.4	14,825.1	242.4	18,600.0	145.9
1999	26,933.3	2,128.0	12,222.0	210.8	18,600.0	147.7
2000	26,933.3	1,617.9	12,704.7	242.7	18,600.0	272.0
2001	26,933.0	2,957.0	13,341.0	259.0	18,600.0	325.0
2002	26,933.0	1,620.6	15,578.6	327.6	18,600.0	363.8

Source: Department of Mineral Fuels and Department of Alternative Energy Development and Efficiency, 2003

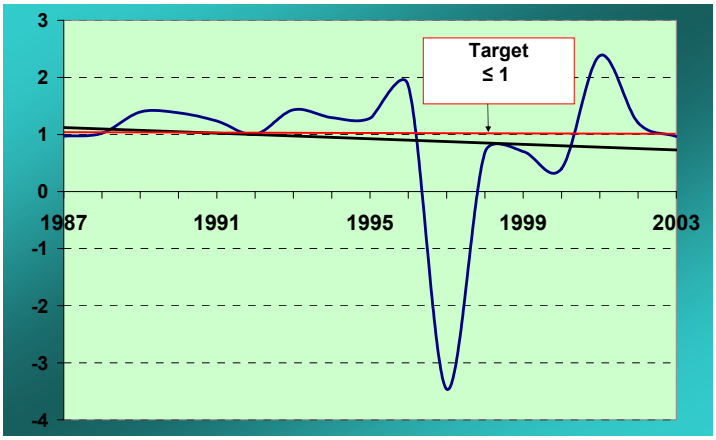

Figure 18 **Ratio of Growth in Energy Consumption to GDP Growth**
Source: Energy Policy and Planning Office, 2004

Table 23 **Energy Resources Policy Indicators**

National Policy/Goals	Unit	Type	1997	1998	1999	2000	2001	2002	2003	2004	Result
1. To generate and develop sufficient energy sources to meet requirements, taking into consideration resource conservation and the protection of the natural balance.											+
- Energy use	million barrel per day	S		1.09	1.12	1.14	1.20	1.28	1.36		↓
- Change in energy use	%	P	4.90	-7.32	3.10	1.88	5.16	6.54	6.16		↓
- Proportion of renewable energy to the total energy	%	R	16.9	17.5	17.7	18.0	17.0	17.1	17.4		↓
- Proportion of new renewable energy to the total energy	%	R							0.50		
- Import to Consumption	Ratio	R		0.57	0.58	0.59	0.62	0.62	0.66		↓
2. To utilize energy effectively and efficiently.											+
- Energy elasticity	Ratio	R	-1.01	0.86	0.96	0.22	2.23	1.27	0.88		↑
- Final energy consumption per GDP	kgoe/ 1000 *baht*	S	16.1	16.4	16.4	15.9	16.1	16.4	16.3		↓
- Final energy consumption in transportation per GDP	kgoe/ 1000 *baht*	S	76.5	71.0	67.7	61.9	60.1	59.5	60.5		↑
- Final energy consumption in industrial sector per GDP	kgoe/ 1000 *baht*	S	14.4	13.7	13.5	13.3	13.7	14.1	13.8		↓
- Final energy consumption in residential and commercial sector per GDP	kgoe/ 1000 *baht*	S	8.6	9.7	9.7	9.8	10.1	10.1	10.0		↓

National Policy/Goals	Unit	Type	1997	1998	1999	2000	2001	2002	2003	2004	Result
- Final energy consumption in agriculture sector per GDP	kgoe/ 1000 *baht*	S	4.5	8.4	9.9	9.0	8.9	9.2	9.4		↓
- CO_2 Emission per GDP	Ton^3/ million *Baht*	P	0.03	0.03	0.03	0.03	0.03	0.03	0.03		
- CO_2 Emission per GDP of transportation sector	Ton^3/ million *baht*	P		0.18	0.17	0.15	0.15	0.15	0.15		↑
- CO_2 Emission per GDP of industrial sector	Ton^3/ million *baht*	P		0.03	0.03	0.03	0.03	0.03	0.03		

Source: Adjusted from ONEP (2005)

Notes: 1. kgoe = kilogram oil equivalent

2. Renewable energy includes fuel wood, charcoal, paddy husk, bagasse;

3. New and renewable energy means energy which exclude thermal energy from solid biomass energy in resident sector those from coal, natural gas and hydro energy by hydro power plant which installed capacity being larger than 10 MW

- *Indicator types*: P – pressure indicator; S – state indicator; R – response indicator
- *Indicator results*: ↑ in the same direction as the target; ↓ in the opposite direction of the target
- *Evaluation results*: (++) (+) in the same direction as the target, (–) (– –) in the opposite direction of the target

4. Energy elasticity calculated manually using formula, $\%\Delta E/\%\Delta Y$

3. Environmental Quality

Water Pollution

By and large, inland water quality has fluctuated during these past few years.[22] Judged by the level of Biochemical Oxygen Demand (BOD), in 1999, households were the main source of polluted water generating close to 73 percent of water pollution while the industry sector generated 21 percent and the agriculture sector only 5 percent. To improve water condition, treatment of household wastewater is necessary.

Monitoring of surface water quality in 49 major rivers and 4 fresh water reservoirs in 2003 shows that 32 percent of these water sources were classified as having good water quality, 31 percent as having moderate quality, and another 31 percent as having deteriorating quality.[23] The remaining 6 percent were classified as having very deteriorated water quality. This includes the lower *Chao Phraya* river, the lower *Thachin* river, the lower *Lam Ta Klong* river and Lake *Songkhla*, where the problems have become more serious. Along the coastal areas, the water quality in the inner Gulf of Thailand (*Chao Phraya* delta, *Thachin* delta, *Mae Klong* delta and 12 *Thanwa* Canal delta (in *Samutprakan*)) has also deteriorated.

Considered by region, using Dissolved Oxygen (DO) loading, water condition in the northern rivers is comparatively the best and far above standard levels (Figure 19). In the South and Northeastern, the condition is fair and above standard (Figure 20 and 21). It is rivers in the central

[22] Pollution Control Department, 2003
[23] Pollution Control Department, 2003

region, where the water condition has deteriorated, especially in the middle *Thachin*, the lower *Thachin* and *Chao Phraya* (Figure 22). The DO loadings in these three rivers are much lower than standards. Owing to the fact that these three rivers flow through the most densely populated areas and that water pollution is generated mainly by the household sector, solutions to polluted water treatment must take into account the waste management behaviors of households. It is not sewage alone that is disposed of from households into the waterways, but rather the mix of both liquid and solid wastes. Engineering solutions such as construction of community waste water treatment facilities, which are designed to handle solely sewage treatment, will not be sufficient to solve the problem.

The deterioration of fresh water quality comes from both point source and non-point source polluters. Point source water pollution such as industry is manageable, but lack of effective enforcement is a limiting factor. Non-point source water pollution is more difficult to manage. Apart from the need for comprehensive wastewater treatment infrastructure, environmental education as well as people's participation in water quality monitoring is needed for effective management.

However, policy response to this problem in early years was to construct wastewater treatment plants for municipal areas around the country. From the total of 87 wastewater treatment plants, 68 are completed, 11 plants are under construction and 3 plants were rejected.[24] These treatment sites cover only 37 percent of total municipal areas.[25] The full potential of those facilities currently in service is about 2.8 million cubic meters per day. However, it is estimated that only 50-60 percent of the full potential has been utilized. Lack of capable staff and budget are the factors limiting the successful operation of wastewater treatment plants at the provincial level, which are the responsibility of local government organizations.[26] Water pollution management plan is now being drafted by the Pollution Control Department applying the area-function-participation and decentralization concepts.

Coastal waters have shown a clear deteriorating trend (Table 24). Moreover, 88 oil spills causing water pollution was recorded in the last 30 years. Four of them caused severe damages to the Thai coastal ecology system.

[24] Pollution Control Department, 2003
[25] Thailand Development Research Institute, 1999
[26] Office of the Auditor General of Thailand 2002. Evaluation of the Environmental Management under the provincial environment management operational Plan.

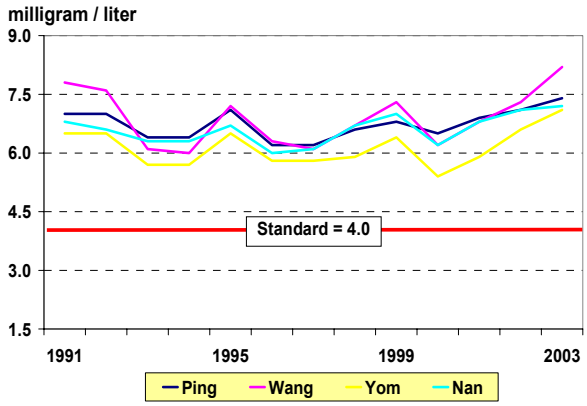

Figure 19 **Dissolved Oxygen Level: Northern Rivers**
Source: Pollution Control Department

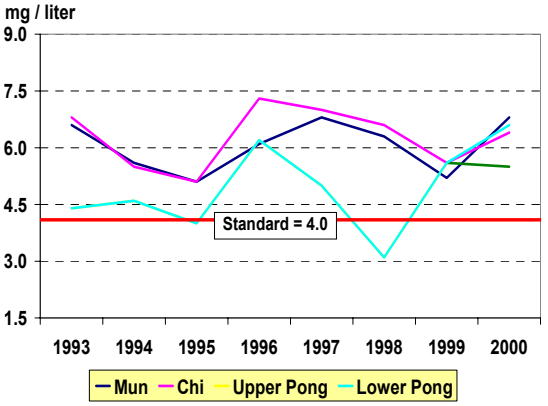

Figure 20 **Dissolved Oxygen Level: Northeastern Rivers**
Source: Pollution Control Department

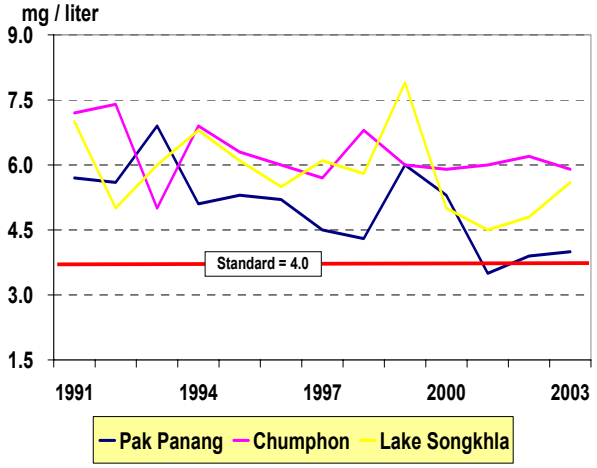

Figure 21 **Dissolved Oxygen Level: Southern Rivers**
Source: Pollution Control Department

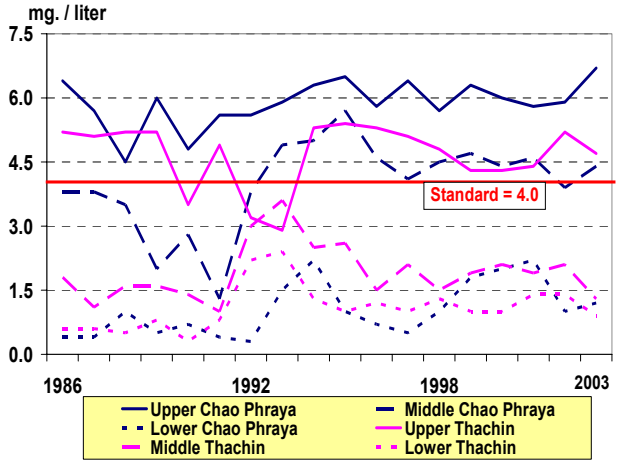

Figure 22 **Dissolved Oxygen Level: Central Rivers**
Source: Pollution Control Department

Table 24 **Water Pollution Indicators**

National Policy/Goals	Unit	Type	1997	1998	1999	2000	2001	2002	2003	2004	Result
1. Surface waterquality - The lower Chao Phraya River -DO not less than 4 mg/l, - Chao Phraya tributaries -DO of not less than 2 mg/l by the year 2006 - Water quality not to decline from existing state. - The lower Thachin river -DO of not less than 4 mg/l -Thachin tributaries –DO not less than 2 mg/l. - Main rivers flowing through urban areas- not less than designated Surface Water Quality Standards.											-
Percentage of surface water quality above standards	%	S	-	-	-	-	18	40	31		↓
2. Seawater quality- to conform to the Coastal Water Quality Standards with priority given to important tourist sites and the upper Gulf of Thailand.											-

National Policy/Goals	Unit	Type	1997	1998	1999	2000	2001	2002	2003	2004	Result
Percentage of coastal water quality above standards	%	S	-	-	-	-	-	84.00	68.00		↓

Source: Adjusted from ONEP (2005)

Note:
- *Indicator types*: P – pressure indicator; S – state indicator; R – response indicator
- *Indicator results*: ↑ in the same direction as the target; ↓ in the opposite direction of the target
- *Evaluation results*: (++) (+) in the same direction as the target, (–) (– –) in the opposite direction of the target

Air Pollution

The major problem of air pollution was particulate matter (< 10 μ)(PM10) in Bangkok, *Samutprakan*, Chiang Mai and *Saraburi* provinces (Figure 23). The increase in the volume of PM10 caused by the grinding and cements industries in *Chalermphrakiat* district in *Saraburi* province has led to the area being designated as an environmental protection area. The action taken by the government to solve air pollution include the preparation of an operational plan within the framework of the national master plan regulating the control of open burning (2004-2008), the improvement of diesel engines standards from EURO 2 to EURO 3, and the reduction of sulfur amount in diesel fuel.

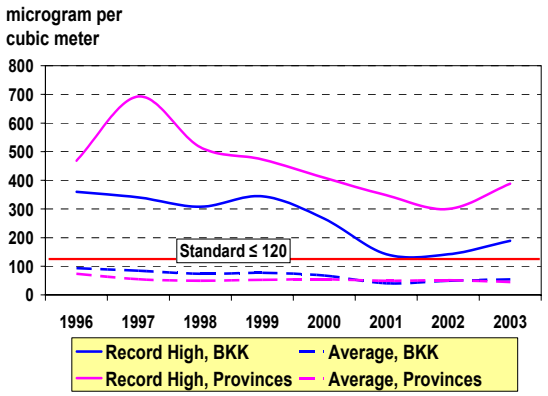

Figure 23 **Dust with average size of less than or equal to 10 micron (PM10)**
Source: Pollution Control Department

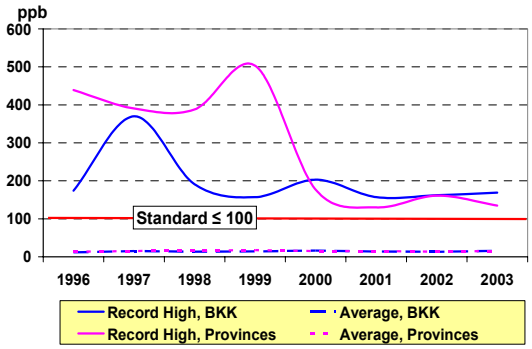

Figure 24 **Ozone level**
Source: Pollution Control Department

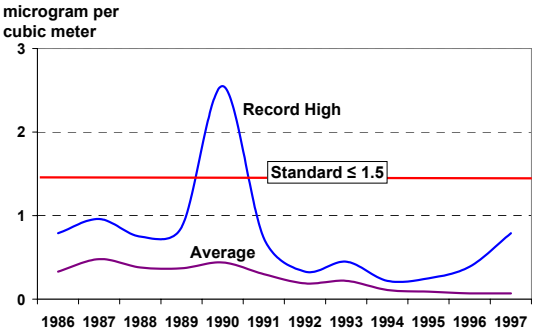

Figure 25 **Lead level in Bangkok**
Source: Pollution Control Department

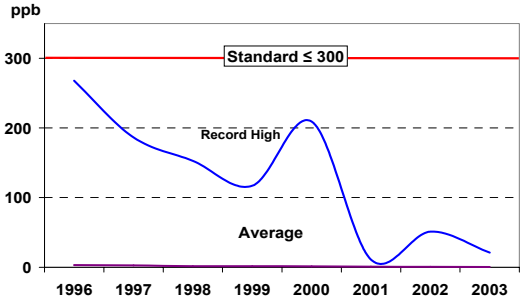

Figure 26 **Sulfur Dioxide Level, Mae Moh, Lampang**
Source: Pollution Control Department

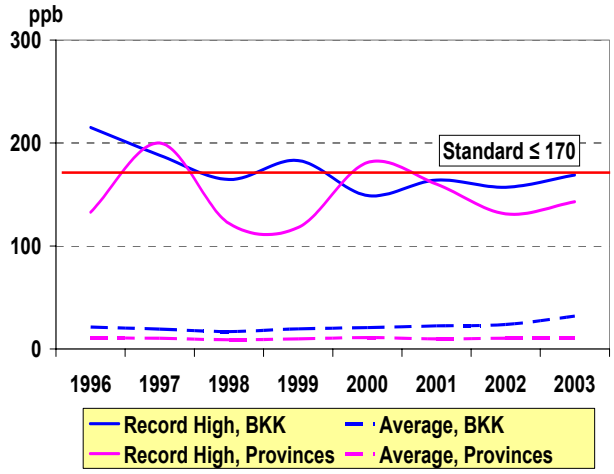

Figure 27 **Nitrogen Dioxide Level**
Source: Pollution Control Department

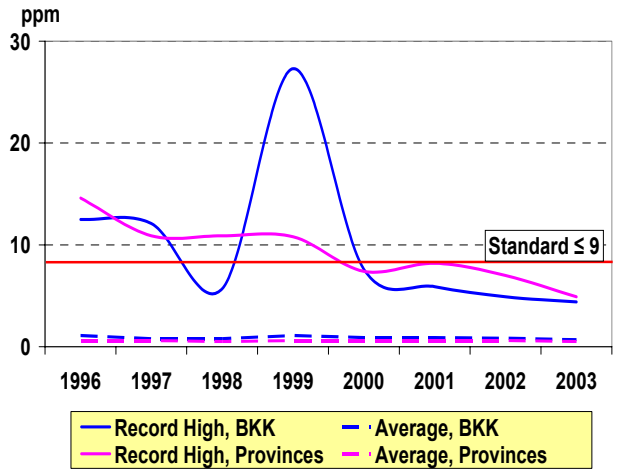

Figure 28 **Carbon Monoxide Level**
Source: Pollution Control Department

Table 25 **Air Pollution Indicators**

National Policy/Goals	Unit	Type	1997	1998	1999	2000	2001	2002	2003	2004	Result
1. Air quality in pollution control zones and urban areas, particularly dust, will be within designated Ambient Air Quality Standards. In particular, dust contamination in general areas will have an annual average of not more than 0.1 mg/m³, and dust contamination in roadside areas will have a maximum 24-hour average concentration o not more than 0.3 mg/m³.											–
- Percentage of days with PM10 level above standard in Bangkok *	%	S	-	-	8.41	12.77	9.98	3.73	5.02		↓
2. Other pollutants in ambient air will remain within designated standards, particularly carbon monoxide, beginning in the year 1997.											+
- Percentage of days with CO level above standard in Bangkok *	%	S	-	-	0.00	0.00	0.00	0.00	0.00		↑
- Percentage of days with O_3 level above standard in Bangkok *	%	S	-	-	0.00	0.02	0.00	0.01	0.05		↑
3. The concentration of air pollutants in industrial zones and general communities, particularly sulfur dioxide and nitrogen oxides, will be within designated standards.											

Source: Adjusted from ONEP (2005)

Note:
- *Indicator types*: P – pressure indicator; S – state indicator; R – response indicator
- *Indicator results*: ↑ in the same direction as the target; ↓ in the opposite direction of the target
- *Evaluation results*: (++) (+) in the same direction as the target, (–) (– –) in the opposite direction of the target

Noise Pollution

The average noise level in Bangkok is higher than the standard of 70 decibel (A), especially when packed traffic is the major source. In 2003, there were 5.48 million automobiles registered in Bangkok. Although public transportation has undergone extensive improvement, there were 514,530 automobiles newly registered during the year 2003 alone. With the traffic problem unlikely to improve in the foreseeable future, increasing number of automobiles will lead to more noise pollution. Implementation of engineering solutions such as installation of insulation in motorways will not be sufficient in the long-run. Average noise level in the provincial areas, on the other hand, was well within standard levels and has decreased in the recent years (Figure 29). Outside Bangkok and its vicinity, noise pollution is serious in *Na Phralan* district of *Saraburi* province, and *Hat Yai* district of *Songkhla* province. Table 26 shows the results of monitoring the policy and goals in controlling noise pollution.

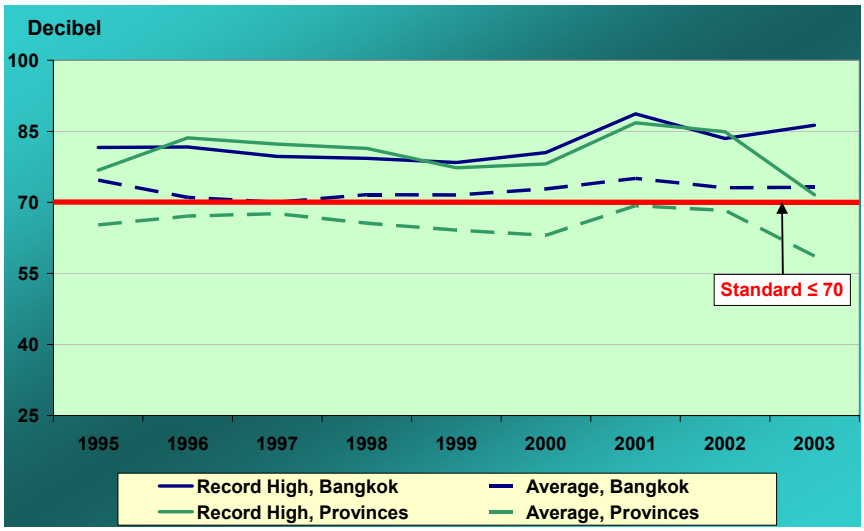

Figure 29 **Noise Level**
Source: Pollution Control Department

Table 26 **Noise Pollution Indicators**

National Policy/Goals	Unit	Type	1997	1998	1999	2000	2001	2002	2003	2004	Result
1. To control the general level of noise in all areas of the country, with an 24-hour average level of not more than 70 decibels (A)											–
- Percentage of days with noise level above standard in Bangkok and vicinity	%	S	-	-	-	-	-	96	88		↓
- Percentage of days with noise level above standard in countryside	%	S	-	-	-	-	-	10	11		↓
2. To control noise and vibration pollution at point of origin to be within standards, including noise from vehicles, noise and vibration from business premises and communities.											+

Source: Adjusted from ONEP (2005)

Note:
- *Indicator types*: P – pressure indicator; S – state indicator; R – response indicator
- *Indicator results*: ↑ in the same direction as the target; ↓ in the opposite direction of the target
- *Evaluation results*: (++) (+) in the same direction as the target, (–) (––) in the opposite direction of the target

Wastes

The volume of solid waste from households throughout the country has been increasing at the average of 1 percent per year from 1997 to 2003. In 2003, the volume of household solid waste was approximately 39,240 tons per day or 14.4 million tons per year (Figure 30). Twenty-four percent of the solid wastes are created in Bangkok and its vicinity, 31 percent from *Muang Pattaya* and municipal areas and the remaining 45 percent from non-municipal areas. Solid waste collection and disposal in Bangkok achieved 99 percent of the total volume of solid waste generated, while proper solid waste collection and disposal in municipal areas accounted for only 35 percent of the total solid wastes.[27] Proper solid waste collection and disposal is rarely found in non-municipal areas.

[27] At present there are 107 solid waste collection and disposal in the municipal areas.

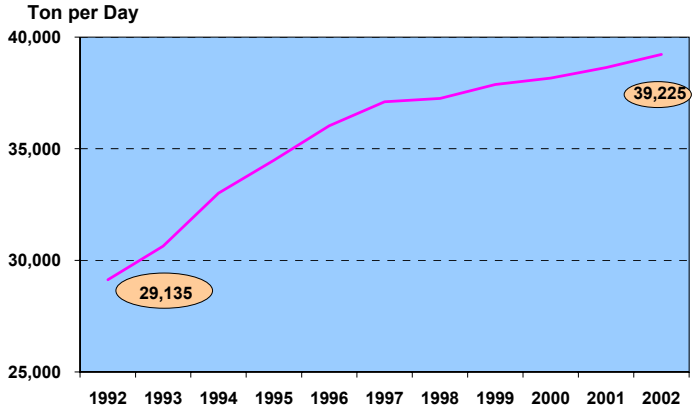

Figure 30 Annual Solid Wastes per Capita, 1992 – 2002
Source: Pollution Control Department

End-of pipe solutions for solid waste management (solid waste collection and disposal systems such as sanitary landfills) become more difficult due to land use conflicts and opposition from residents in the potential landfill sites. Alternatively, waste management at source of origin such as recycling and reuse has been promoted throughout the country. Recyclable solid waste has been increasing from 19 percent of total solid wastes generated in 1997 to 36 percent in 2003, while recyclable industrial waste increased from 29 percent in 1997 to 49 percent in 2003. In 2003, there are 31 recycle plants and 49 industrial plants which use recycled materials for production. These indicators indicate a certain level of progress in waste management. In the future, the recycle rate can be improved because of the high supply of recyclable solid wastes. Local governments usually levy user charge for wastes collection and disposal but the charges are generally too low to cover the costs for wastes management (e.g. 40 *baht* a month per household while the actual costs are at least twice as much).

As far as hazardous waste is concerned, the quantity of hazardous wastes in Thailand has increased significantly during the last two decades. The economic and social development has generated both industrial wastes and community wastes at the level exceeding the country's waste management capacity. The Pollution Control Department estimated that in 2003, there were about 1.8 million tons of hazardous wastes in Thailand. This consisted of 1.4 million tons of industrial waste or 78 per cent of the total hazardous waste and another 0.38 million tons of community hazardous waste. More than 64 per cent of the hazardous wastes or 1.07 million tons were generated in Bangkok and its vicinity.

Based on the number of registered hazardous waste treatment plants, Thailand has the capacity to manage only 0.18 million tons or approximately 11 per cent of the hazardous wastes (Pollution Control Department, 2001). A significant amount of hazardous wastes are improperly treated on site and there are occasionally instances of illegal dumping of hazardous wastes on public land.

Thailand does not have a single authorized agency to exercise an integrated control over hazardous waste management. Under the 1992 Factory Act, the Department of Industrial Works (DIW) of the Ministry of Industry has the authority to prescribe rules and regulations governing the management and disposal of industrial wastes. The Industrial Estate Authority of Thailand has the same power with respect to factories situated in the twenty-three industrial estates throughout the country. Both government agencies have developed some kinds of manifest system document aiming to control the movement of hazardous wastes from waste generating plants to waste disposal facilities.

Waste treatment and waste recycle plants are required to register with DIW. These are classified as factories typed 101, 105 and 106 out of all 106 categories of factories. This can be elaborated as follows:

(1) Type 101 consists of waste treatment plants which carry out hazardous and non-hazardous waste treatment and disposal. The methods used involve various techniques of waste treatment, incineration, stabilization and landfill. As of 2003, there were 119 factories of this category.
(2) Type 105 consists of waste separation plants. Recoverable wastes are separated from the non-recoverable wastes which are then disposed by landfill. As of 2003, this category had 54 registered factories.
(3) Type 106 consists of recycle plants which carry out recovery and recycle activities. As of 2003, there were 42 registered plants of this category.[28]

These three types of factories combined are insufficient to handle the increasing amount of hazardous wastes. Most of the laws and policies have focused mainly on the control and management of industrial wastes. At present, the measures for management of hazardous wastes from other sources are far from adequate. Clinical wastes from medical care in hospitals and medical centers are managed and treated on site by incineration under the supervision of the Department of Health while those from private clinics are collected along with ordinary solid wastes.

A significant gap exists in the management of community hazardous wastes. Community wastes are non-point source pollution and therefore are more difficult to regulate than other point source pollution such as industrial wastes. Community hazardous wastes are diverse ranging from hazardous discharges from businesses such as film processing shops, laundry facilities, garages and petrol stations to hazardous household wastes including chemicals, insecticides, paints, fluorescence light bulbs and electrical and electronic equipment disposed by consumers. Discharges from small businesses in communities are generally not subject to emission standards control and household wastes are usually collected along with ordinary solid wastes. Under the 1992 Public Health Act, local governments are responsible for collecting and disposing of solid wastes. Since household or community wastes are not separately collected, they are disposed of at the same landfill sites. Such practices are harmful to the environment since hazardous substances can seep through the soil and contaminate the water table in the long run.

Tables 27 and 28 show the estimated proportion of community hazardous wastes generated by the various regions of Thailand and the different sources of community hazardous wastes

Table 27 Community hazardous wastes generated by different regions

Region	Quantity (percentage)
Bangkok metropolitan area	31
Bangkok vicinity	6
Central region	16
Northeast region	22
Northern region	14
Southern region	11
Total	**100**

Source: Pollution Control Department, 2003

[28] DIW Information Centre, February 2004.

Table 28 Proportion of different sources of community hazardous wastes

Sources	Quantity (percentage)
Garages	48
Households	22
Agriculture activities	10
Petrol stations	9
Hospitals	5
Laboratories	1
Other sources	5
Total	**100**

Source: Pollution Control Department, 2003

The fast-growing consumption of manufactured goods by communities and households has raised attention to the problems of managing community hazardous wastes, especially in the light of tightening environmental regulations on hazardous wastes in the European Union (EU). As far as wastes from electrical and electronic equipment (WEEE) are concerned, the recent two directives issued by the EU restricting the use of certain hazardous substances in electrical and electronic equipment (EEE) and prescribing producers' responsibility in the collection and disposal of WEEE have prompted both the Ministry of Industry to study the methods for managing WEEE and the Pollution Control Department the legal measures to manage community wastes from disposed manufactured products including WEEE. Both studies have been completed but it is not clear whether they will ever be adopted by the government.

In designing a system for managing community hazardous wastes, it has been suggested that economic instruments be used. According to the study conducted by the Social Research Institute, Chiang Mai University on the laws to regulate community hazardous wastes management, it is proposed that the most appropriate model for Thailand is to introduce product charges for manufactured goods which would become hazardous wastes when discarded. The revenue from the charges can be used to set up deposit refund schemes to buy back used products from consumers. Such mechanism would help to create incentives for consumers to separate and return the wastes. Currently DIW is also proposing a draft law which would employ economic instruments in dealing with industrial point sources. Essentially, this would take the form of pollution tax levied from the amount of pollution discharge from factories.

Effective waste management depends to a great extent on a change in consumers' behaviors. Although technical solutions are most relevant for handling pollution and wastes, they require less effort to implement. To achieve behavioral changes, more effort is needed (Figure 31).

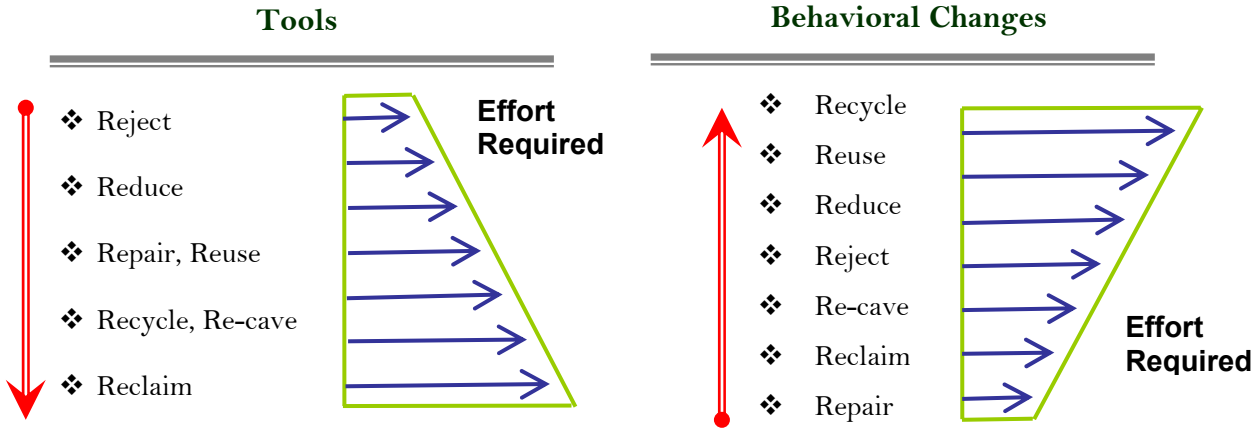

Figure 31 Efforts employed in Technical Solutions versus Behavioral Changes
Source: Dr. Thongchai Panswad, Advisor to Pollution Control Department, 2005

Table 29 Solid and Hazardous Wastes Indicators

National Policy/Goals	Unit	Type	1997	1998	1999	2000	2001	2002	2003	2004	Result
Solid Waste and Night Soil											
1. To reduce or control solid waste generation to the rate of not more than 1.0 kg/capita/day. Have Bangkok and communities throughout the country utilize waste of not less than 15 percent of the total solid waste generated.											+
- Solid waste per capita per day	kg/day/capita	P	1.96	1.82	1.86	1.83	1.19	1.20	1.18		↑
- Percentage of solid waste recycled	%	R	18.71	21.19	23.13	26.20	28.40	32.99	36.22		↑
- Percentage of industrial waste recycled	%	R	28.72	37.90	44.44	44.44	45.13	48.25	48.78		↑
- Number of recycled plants	#	R	-	-	-	-	-	25	72	80	↑
2. All solid waste left from collection in municipal districts is to be collected, and for outside municipal districts not more than 10 percent o the total solid waste is to be left.											–
3. To ensure that each province has a master plan and management plan for sanitary solid wastes and night soil disposal, and every municipality and sanitation district have proper solid waste and night soil disposal systems.											–
Hazardous Substances											
1. To reduce and control pollution from hazardous materials generated by all sources, by not allowing impacts on public health and welfare.											–
- Number of hazardous substance accidents	#	S	-	-	-	20	24	27	28		↓
- Percentage change of imported hazardous substance	%	P	-5.29	-3.42	8.36	5.04	29.66	17.21	-14.25		↑
- Percentage change of produced hazardous substance	%	P	9.11	1.03	0.71	44.17	73.86	13.18	20.36		↑
2. To formulate an emergency action plan for hazardous material accidents, especially in high-risk areas at provincial and national levels.											+
3. To establish a toxicology center and an information center for hazardous materials at the national level.											+
Hazardous Wastes											
1. To reduce and control pollution from hazardous wastes from all sources in both industrial and in domestic sectors, by not allowing impacts to the environment and public health.											–
- Hazardous wastes from industrial sector	million tons	P	1.40	1.31	1.25	1.29	1.31	1.40	1.41		↓
- Hazardous wastes from communities	million tons	P	0.32	0.34	0.35	0.36	0.37	0.38	0.39		↓
2. To collect and destroy at least 95 percent of the hazardous wastes from industrial sector and 90 percent from domestic sector.											–
3. All public and private hospitals to have proper systems to manage infectious wastes, including separating, collecting, transporting, treatment, and destroying.											–
- Infectious waste	tons	P	18,200	19,665	21,000	13,250	15,300	20,000	22,500		↓

Source: Adjusted from ONEP (2005)

Note:
- *Indicator types*: P – pressure indicator; S – state indicator; R – response indicator
- *Indicator results*: ↑ in the same direction as the target; ↓ in the opposite direction of the target
- *Evaluation results*: (++) (+) in the same direction as the target, (–) (– –) in the opposite direction of the target

4. Transboundary Environmental Issues

Natural resources and environmental management in Thailand has to be considered in the regional context according to the principle of good neighborliness. Regional cooperation among the Mekong countries, namely Cambodia, Lao PDR, Myanmar, Thailand and the *Yunnan* province of China, is important from the point of view of sustainable development and equitable utilization of the natural resources. However, environmental cooperation in the region has been limited and largely dominated by water resources issues. The discussion usually focuses upon hydropower development involving the construction of big dams. In addition, scarcity of water resources in the dry season has given rise to several projects designed especially by the Thai government to divert water from major basins in the region. Other issues such as the conservation and management of fisheries resources which are so important to the poor population of the region often receive less attention.

Water Governance

The Mekong region covers 2.3 million square kilometers and is inhabited by about 255 million people most of whom are poor. Thus water governance has important impact on the livelihood of these people. Although most debates are normally concentrated on water utilization in the Mekong basin, the same equally significant development is going on in other major basins in the region, especially in the Salween and the Chao Phraya. Although the Chao Phraya is not an international water basin, the constant dry season water shortages in Thailand have given rise to a number of inter-basin water transfer projects to feed water to the *Bhumiphol* and *Sirikit* dams and to supply water for agriculture in the lower Chao Phraya and Bangkok. All water diversion projects including the currently proposed Thailand water grid system would inevitably have impact on neighboring countries.[29]

An Agreement on the Cooperation for Sustainable Development of the Mekong River Basin was concluded in 1995 among the four lower Mekong riparian countries, namely Cambodia, Lao PDR, Thailand and Vietnam. It provides for reasonable and equitable uses of the water resources in the Mekong basin as well as a notification or consultation procedure among the riparian countries for certain intra-basin and inter-basin uses respectively. However, China and Myanmar which are also the riparian countries remain outside the Agreement. The obvious concern is over China's plan to construct a series of more than ten dams along the Mekong (or *Lancang*). Up till present, *Manwan* and *Dachaosan* dams have been completed and another dam called *Xiaowan* is under construction. It is feared that the expansion in hydropower development would cause ecological and environmental impact on the river flow and other lower riparian countries, especially Cambodia and Vietnam. However, there has not yet been sufficient study on such impact at present.

Hydropower development is also being planned by China, Thailand and Myanmar on the Salween. China has plans to construct thirteen dams and Thailand and Myanmar to construct five dams on the Salween along the Thai-Myanmar border. In addition, the Thai government has envisaged several interbasin water transfers both on the country and international scale. In northern Thailand, the *Kok-Ing-Nan* and *Moei-Salween* water diversion projects have been designed to transfer water from the Mekong and the Salween to the *Sirikit* and *Bhumipol* dams respectively. Another three projects are planned for the northeast to divert water from Lao PDR. These are the projects to divert water from *Nam Ngum* to *Huay Luang* in *Udon Thani* province, from *Sebang Fai* to *Mukdaharn*

[29] The National Water Grid System is a three-billion-baht project which would create an irrigation system consisting of about 25,000 reservoirs, 594 dams, a network of canals and pipes. It was approved by the Assets Capitalization Bureau in January 2004 and has been approved in principle by the Cabinet. The project is aimed to expand irrigation areas from 22 to 33 million *rai* and supply water to 5.79 million farming families. If implemented, the project would require inter-basin water transfer, both from other water basins within Thailand and other international basins such as the Mekong and Salween.

province and from *Sebang Hien*, to *Lum Sebai-Se Bok* in *Ubon Rachathani* province. In the east, the Thai government has a plan to divert water from *Satueng Num* in Cambodia to *Trad*, *Chantaburi* and *Rayong* provinces in Thailand. The Thai government's current plan to set up a national water grid system would also involve a significant water transfer from neighboring countries.

It is worth noting the role of politics in transboundary hydropower development in the region. The Chinese government is pushing for the country's energy industry reforms. The government wants *Huaneng*, one of the big five companies controlling the actual and potential power generation assets in China, to be the world's leading electricity producer, aiming to double its generating capacity to 60,000 megawatts by 2010.[30] *Huaneng* is the major hydropower development company in the Mekong while *Huadian*, another big enterprise, is the main player in the Salween. In Thailand, provision of water resources is high in the government's agenda in its bid to win popularity as well as to gain construction and contract benefits. None of the governments in the region have paid sufficient attention to the hydrological and environmental impact of their water development projects, many of which are a result of transboundary political negotiation of those in power. Neither has any government genuinely considered the impact which all these projects might have on affected people. There is also a lack of political commitment to allow public participation or the involvement of stakeholders in all this development. An improvement in water governance is therefore much needed in the region.

Among the issues which deserve more attention are for instance the cumulative impacts of dams to the river involved such as in the cases of the Salween and the Mekong as well as the impact to river communities which in many cases include marginal ethnic groups. More inclusion of the fishery sector in water development projects consideration is also desirable. The risks to fishery and the rights of affected people in the *Tonle Sap* present another example of the kind of needed research in an ecology which relies on the Mekong flood system.

In an attempt to fill in some of these gaps, the IUCN, in its Water and Nature Initiative Program, has formulated a water governance research agenda for 2005 – 2008.[31] Apart from research, the organization is trying to develop multi-stakeholder platforms (MSPs) as a tool to assist decision making. Some promising examples of multi-stakeholders' involvement on a country scale such as the cases of fisheries management of the *Thai Bann* group in the northeast of Thailand and the drafting of Cambodia's community fisheries sub-decree may provide a possibility to develop MSPs in a regional context. One of the mechanisms employed by IUCN is to organize Mekong Region roundtables such as the recent high level roundtable held in Bangkok in November 2004. It is believed that MSPs would enable more public discussion and debate as well as a better flow of information which could lead to a better process and outcome in decision making.

Transboundary Protected Areas

Among the countries in the lower Mekong, at least ten transboundary protected areas have been identified, five of which involve shared ecosystem between Thailand, Lao PDR and Cambodia.[32] Regional cooperation in the management of these transboundary protected areas are important for the conservation of biodiversity, both from the points of view of conservation and its economic values.

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[30] China Daily, 24 September 2003

[31] The research agenda consists of five themes, i.e. the politics of fisheries and aquaculture such as in the *Tonle Sap*, *Attapeu* and *Songkram*; the rationales for inter-basin transfers, storage and irrigation infrastructure; flood response and technical cooperation to negotiation; the political economy of hydropower; and the politics of watershed management, knowledge systems, and livelihoods in montane upper tributaries.

[32] In the North: *Doi Phu Kha* (Thailand) and *Nam Phouy* (Lao PDR); in the Northeast: *Phou Xiang Thong* (Lao PDR) and *Pha Tham*, *Kaeng Tana* (Thailand); *Phu Chong –Na Yoi*, *Kao Pra Viharn*, *Yod-dome*, *Phnom-dong rak* (Thailand), *Preah Vihear* (Cambodia), *Dong Khanthung* (Lao PDR); in the East: *Taprya*, *Huay Tabtan – Huay Samran* (Thailand) and *Banteay Chhmar* (Cambodia); *Klong Krue Wahay Chalerm Prakiate* (Thailand) and *Samlaut* (Cambodia).

A very high proportion of population in the Mekong region are rural and mountain communities which subsist on natural resources and forest products. Transboundary protected areas are also significant for the conservation of endangered species. Until recently, most cooperation in transboundary protected areas management has concentrated mainly in Europe and North America, but more effort is being made to promote cooperation in this Mekong region, especially by the International Tropical Timber Organization (ITTO) and IUCN. At an international workshop held by ITTO and IUCN in *Ubon Ratchathani* in 2003, there was discussion on the ways to improve the effectiveness and to expand the coverage of transboundary conservation areas (TBCAs). The workshop also recognized the potential of TBCAs to lessen border conflicts while also playing an essential role in the protection of endangered species, ecosystem and cultural groups.[33]

Control of Illegal Wildlife Trade

Related to the issues of protected areas is the control of international trade in endangered species. Habitat destruction and trade in wild species of animals and plants constitute another threat to the biodiversity of Thailand and its neighboring countries. Even though all countries in the Mekong region are parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), illegal trade in wildlife within the region continues to be a major concern. Reports from wildlife protection agencies, such as the World Wide Fund for Nature (WWF) and WildAid Foundation Thailand, are abundant in presenting evidence of illegal trade of wild species including items made from wildlife. This includes trade in ivory, snakes (python and cobra) and snake products, tiger products, bear products, butterflies and beetles and wild plants particularly orchids. Pangolins are also smuggled from Malaysia and Indonesia through the southern borders of Thailand for trade.

Thailand has been accused of being the source, consumer and transit country in illegal wildlife trade. The trade routes also involve Lao PDR, Myanmar and Vietnam, while China is the major destination country. Despite the Thai government's recent effort in the crackdown of illegal wildlife trade, corruption and weak law enforcement has been a major obstacle. More cooperation among the governments of the Mekong countries is badly needed to combat transborder illegal trade in endangered species.

Mitigation Measures for Climate Change

Compared to other transboundary environmental problems, the issue of vulnerability and adaptation to climate change in the regional context has received little attention. Climate change can cause impact on the distribution and productivity of forests, a reduction of crop productivity and water supply. Sea-level rise induced by climate change can exacerbate coastal erosion, bringing adverse impact on the ecosystem as well as the tourism sector. At present, all the Mekong countries are parties to the United Nations Framework Convention on Climate Change (UNFCCC) and the 1997 Kyoto Protocol. Although the Convention and the Protocol only set reduction targets of greenhouse gases for industrialized countries, the Mekong countries should be more concerned with the problems and consider cooperation in adopting adaptation measures. Forest conservation and energy demand –side management could serve as mitigation measures to climate change. In addition, more active engagement in the clean development mechanism (CDM)[34] within the framework of the Kyoto Protocol should be encouraged.

[33] ITTO News Release on the ITTO/IUCN workshop on increasing the effectiveness of transboundary conservation areas in tropical forests, *Ubon Ratchathani*, Thailand, 17-21 February, 2003, citing statement by Dr. William Jackson of the IUCN.

[34] CDM is a mechanism provided under the Kyoto Protocol to allow industrialized countries to gain credits for financing emission reduction projects in countries without emission targets (developing countries).

5. NRE Policy Linkage to the National Goals

Poverty Elimination

In his inauguration speech delivered to the Parliament on February 26,2001, Prime Minister Thaksin Shinnawatra pronounced poverty elimination, income and employment generation as national goals. In the same speech, He listed major policies most of which were economic policies to boost the economy to be undertaken by the government. Natural resources referred to in the policy declaration include water, land and marine ecosystem all lof which were linked to increase production and income. Environmental policies were not mentioned. Practitioners and environmentalists had looked for means to mainstream environmental concerns and hoped that the Prime Minister could be more interested in environmental issues. But for politicians, providing solutions is more saleable to the public than citing problems. However, the government agencies concerned have not been able to offer quick and readily discernable solutions to environmental problems.

In the subsequent national strategic framework for poverty elimination issued by the government, natural resources management was listed as one of the five main strategies. Under these strategies, stipulated measures include the establishment for natural resources conflicts resolution, amendments and drafting of laws related to access to natural resources such as the community forest bill, marine resources, water law and laws related to land holding and land use.

Among his initiative to tackle poverty elimination, registration of the poor and the conversion of assets into capital are the measures most relevant to natural resource policy. The Prime Minister got the idea of asset capitalization scheme from a book called *the Mystery of* Capital written by a Peruvian economist named Hernando de Soto who argued that the poor in developing countries are poor because because their assets have no formal legal claims. In other words, their assets are frozen. By providing formal rights to the poor and legalizing their claims, they could convert their assets into capital and become entrepreneurs. This is based on the premise that, by converting the hidden assets into legal assets, developing countries would no longer be poor.

On the basis of this concept, the government has instituted several initiatives, including converting black markets into legal ones in the case of underground lottery, legalizing claims to coastal aquaculture sites (*Chanode Nam*, as called by Minister Newin Chidchob), recognizing rights to hawking and peddling sites (*Phaeng Loy* and *Ran Kha Rim Thang*) and broadening the range of public land from forest land to include unused land under the army, navy and public enterprises.

It is too early to evaluate the success of the scheme because the implementation of the Operation Plan has only just begun since January 1, 2004. Yet, critics have already charged that the idea is a dangerous one. In the case of land, the conversion of assets into capital policy provides '*sitthi tham kin*', a new kind of usufruct right on land that can be used as a collateral to secure loans from government-owned banks. The details of the package to give usufruct rights in forest land are being worked out under the brand name "The New Forest Village" (*Moo Ban Pa Mai Phaen Mai*). It is not quite clear how different this would be from previous efforts, but it seems that farmers would be allowed to live and farm in protected areas this time.

This move seems like a partial response to critiques who have charged state forest policy as the main cause of poverty. In particular, the two major culprits are the National Park Act that prohibits the harvest of non-timber products, which are the main sources of livelihood of the forest settlers, and large scale water resource development projects which often involve evacuation of local residents.

Academics and NGOs remain skeptical to the new programs cited earlier. First, owing to lack of information and financial resources, which are the characteristics of the poor, the really poor cannot afford to register. Secondly, there is just not enough land to go round for every registered poor. According to an estimate by the Land Development Department, the land available for distribution is more than 15 million *rai* short. Past experiences have also taught us that land distribution would only benefit those who had already occupied them. Thirdly, conversion of assets into funds is seen as a stepping stone for turning public land first into the hands of the poor and subsequently to the rich because capital cannot be the only means required to sustain the poor to work out meager land into productive assets. A range of accompanying infrastructure is required, e.g. roads, technology and market information and so on. The capital to be given out by the government bank may not be enough and may be too small because the market for the collateral does not exist. The program is thus seen as a populist policy instrument.

International Competitiveness

The Thaksin government is the most business oriented government that Thailand has ever had. Among its goals is to increase Thailand's role in the international trade and political arena. The government has crafted a number of industrial visions. ***Kitchen of the World*** is one of the visions that requires back up from sound natural resources policy. The Ministry of Natural Resources and Environment has also been categorized as an economic Ministry. Departments are at wits' end on how to create new programs or to improve existing programs especially R&D support for increased competitiveness.

6. Conclusion

Thailand's economic development has been based on extraction of natural resources. Currently, more than 40 percent of its work force still live and work in the agricultural sector. Modern industrial expansion which started in the 60s added new pressure to the environment first in the form of water and air pollution followed by hazardous waste. Urbanization has further aggravated water and air pollution as infrastructure has not kept pace with the increase in the urban population growth. The increase in income has stimulated demand for new consumer goods such as electrical appliances, computers, mobile phones which require special waste management, putting greater burdens on the inexperienced local governments that are already unable to cope with solid wastes management. As this report has shown, natural resources deterioration and environmental degradation are inevitable outcome.

The current situation and problems concerning natural resources and environment as discussed in the report can be summarized by the following problem list.

Environmental Problem List

Forest Resources

- Deforestation continues even after the 1989 logging ban
- Gap between deforestation rate and reforestation rate
- People and forest. Thousands of settlements inhabit the forests although official forest laws exclude people.
- Protected areas have been expanding although the questions of people and forest remain unresolved.
- Impact of deforestation on biodiversity
- Illegal trade in endangered species continues with increased number of cases.
- Conflicting forest policies; conservation vs. development policy.

Land Resources

- Physical deterioration of land resources, especially soil erosion.
- Gap between soil erosion rate and soil rehabilitation rate.
- Inappropriate land use. Land suitable for agriculture and wetlands being converted to other uses.
- Lack of integrated land use control.
- Land speculation leads to large amount of land being left unused.
- Insufficient stock of land available for distribution to the landless or nearly landless.
- People inhabiting land designated as forests.
- Lack of land tenure security discourages farmers from engaging in land improvement.
- Land reforms have failed to distribute land to poor and landless farmers.
- No restriction on size and amount of landholding.
- No progressive tax to discourage land accumulation and land speculation.

Water Resources

- Water shortage during the dry season.
- Water demand has increased continuously while 90 percent of water is consumed by agriculture.
- Water conflicts and competition for water use among the various economic users.
- Thailand's water policy concentrates on providing water for the lower *Chao Phraya.*
- Water policies stress supply and engineering solutions
- Insufficient attention and action on demand management.
- Surface water use is still under the open access regime.
- No rules for regulating water allocation.
- Draft water law still focuses on introducing license system for big water users only. No prioritization among various economic uses and no guarantee for basic human and environmental uses.

Marine and Coastal Resources

- Over-fishing and declining catch per unit effort (CPUE).
- Encroachment of mangrove forests for aquaculture, residential, industrial and agricultural uses.
- Coastal erosion.
- Excessive tourism activities have caused deterioration of coral reefs especially in the Andaman Sea.
- Fish landings are still above sustainable allowable catch.
- Production vs. conservation policies
- Ineffective law enforcement against commercial fishing and dragnet trawlers within the three-kilometer coastal zones.

Mineral Resources

- Mineral resources policy emphasizes development and utilization more than consideration of environmental and health impact.
- Inability to control toxic contamination and diffusion from mining.
- Social, environmental and health impact from exploitation of mineral resources is becoming a serious concern.
- 33 percent of mineral resources deposits and 48 percent of potential mineral resources deposits are located in forest reserves.
- No integrated resource management among the government agencies concerned.

- Precautionary measures are needed to prevent and mitigate environmental impact form inappropriate landfill management and geo-hazard caused by both human activities and natural disasters.

Energy Resources

- Continuous increase in energy consumption by all sectors.
- Some improvement in energy use efficiency and promotion of renewable energy, but this accounts for little in the total energy demand.
- Conflicts over energy resources development are becoming more serious e.g. opposition of local communities to construction of power plants and gas pipelines.
- Lack of public participation in energy resources development project planning and decision-making.

Water Pollution

- Deterioration of fresh water quality caused by both point source and non-point source pollution. Households generate 73 percent of wastewater.
- Difficulty in managing non-point source water pollution especially from households.
- Policy response has emphasized building central wastewater treatment facilities which have so far cover only 36% of total municipality areas with no more than 50-60% of their capacity utilized.
- Local governments lack human and financial resources to manage wastewater treatment facilities.
- Reluctance of local governments to impose wastewater treatment charges.
- Need to promote environmental awareness among citizens to reduce water pollution.

Air and Noise Pollution

- CO_2 emission from vehicles remains largely uncontrolled due to continuous increase in the number of vehicles and lack of law enforcement.
- Dust of less than 10 microns (PM-10) is a big problem in big cities and industrial areas.
- Most laws and policies focus on point source air pollution.
- Air pollution caused by open burning. No effective laws to control open burning.
- Air pollution will continue to be a serious problem with the increasing number of vehicles, insufficient public transportation and worsening traffic problems.

Wastes

- Volume of solid wastes has been increasing due to economic and social development.
- Many local governments are unable to manage solid wastes disposal effectively and to find adequate sanitary landfill sites.
- User charges for waste collection and disposal are too low to cover costs.
- Inadequate capacity to manage hazardous wastes.
- Laws focus on management of industrial wastes.
- No law regulating management of community hazardous wastes.
- Economic instruments have not been used to manage community hazardous wastes, e.g. product charge, deposit-refund schemes.
- More effort needed for environmental education and changing consumers' behavior.

General Issues in Environmental Management

- Top-down approach and lack of people's participation.
- More sectoral and too little integrated policies.
- Overlapping responsibilities.
- Policy goals are arbitrary and often impractical to implement.
- Lack of coordination among government agencies concerned.
- Inadequate knowledge management to solve environmental problems.
- Environmental management should be more problem-oriented and area-specific rather than focusing on individual resources.

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During Phase 2, the above long list of environmental problems will be debated among specialists and expert judgments will be sought from interviews to shortlist it and set prioritization for each resource.

Management of natural resource and environment in Thailand has tended to emphasize end of pipe engineering solutions. Myriads of plans are made as framework for management. Government agencies have concentrated on correcting or improving the quality of natural resources and environment with little attention given to the social context. It was not until 2004 that the citizen focused goals were instituted in the Thai administration and the link between resources policy and people have become part of agencies goals but it will take some time before the goals can be transformed into reality.

Achieving the new citizen focused goals is a paradigm shift that requires substantive institutional change. Institutional and reforms in Thailand generally means creating new agencies, or merging of agencies with almost no changes in the assumptions of the policies. In fact the real institutional change in Thailand require the updating and generation of corporate or collective knowledge, integrated synthesis of new information, invitation for new perspectives to the problems, and the discussions of the pros and cons of the alternative options. The process which will enable real and effective institutional change has never existed; not to mention the long known fact that the existing management system is fragmented and territory guarding.

The shift to area based planning such as river basin and wetland management are a good beginning for integrated management although at this stage, it is only effective for synchronizing budget timing rather than infusion of management concepts and operations.

While the future of natural resources management depends on effective institutional change that could solve the current contentious issues, pollution policy seems much more straightforward as there are much less deep rooted vested interests and the problem is less complex. Certainly, there are a number of technical and legal gaps that can be identified and filled by local and international expertise. Pollution management can be enhanced by upgrading the awareness and the capacity of the local governments. The difficult part is again the ability to change public behaviors with respect to waste generation and management.

Although natural resources and environmental problems are serious and are concerned with the largest section of the population in Thailand, there is little recognition of this fact by the populist government. Global environmental changes seem to be even more far fetched and remotely related to the GDP of the country. The next step is the need to prioritize natural resources and environmental problems and put values to the damages that have occurred. This will be the task of the next report.

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Appendix 1 Meeting and Interview Reports

Meeting 1

Keynote Speaker: **Mr. John Dore, IUCN**
Coordinator for Asia
Water and Nature Initiative (WANI)
Regional Wetlands and Water
Resource Program (RWPP)

Topic; Transboundary Environment Issues in the Mekong Region

Date: March 3, 2005, 9.00 – 12.00 hr.

Venue: Thailand Development Research Institute

Participants: Out of the fifty invitations sent out to experts and practitioners, fifteen people from governmental and non-governmental organizations attended the meeting. The list of participants is provided below.

Summary of the meeting

Dr. Mingsarn Kaosa-ard introduced the forum and introduced Mr. John Dore. The presentation was conducted in a reactive manner. Mr. John Dore started by inviting participants to choose a tranboundary environmental issues which they thought most important in the Mekong region. Most participants focused on the issue of water governance in the Mekong basin. The speaker pointed out that the issue of water governance covered a wider context than the Mekong basin. The Mekong region also consists of other major river basins, namely the Irrawaddy, Salween, Chao Phraya and Red basins where issues of water governance is no less crucial.

Mr. John Dore used power-point presentation in his lecture. He introduced the IUCN Water and Nature Initiative and its action research partnerships. IUCN is working to improve water governance in the region by developing research and multi-stakeholder platforms (MSPs). The water governance research agenda for 2005-2008 is as follows:

1. Politics of fisheries and aquaculture, e.g. *Tonle Sap*, *Attapeu* and *Songkram*.
2. Rationales for interbasin transfers (e.g. in the Salween, Mekong and Chao Phraya) and storage and irrigation infrastructure , e.g. in northeast Thailand and northwest Cambodia)
3. Flood response and technical cooperation to negotiation e.g. in Vietnam, Cambodia and Thailand
4. Political economy of hydropower e.g. Myanmar/Burma, Lao PDR, Yunnan, and Vietnam.
5. Politics of watershed management, knowledge systems and livelihoods in montane upper tributaries.

The speaker gave a brief discussion of the politics in water and energy in the region. In China, the water and energy sector is dominated by five big companies including *Huaneng and Huadian* which control the actual and potential power generation assets in the Mekong and Salween respectively. Apart from the two completed dams and another one under construction in the Mekong, China is planning to build 13 dams in the Salween. In Thailand, the Thai government has been engaging in negotiation with neighboring countries to develop several diversion dams along the Myanmar-Thailand border and to transfer water from Lao PDR to Thailand. Many projects are designed to supply additional water to the *Bhumipol* and *Sirikit* dams, agriculture and Bangkok in the Chao Phraya basin. Currently, the Thai government is also planning a national water grid system which would involve construction of dams, reservoirs, and a network of canals and water pipes. If implemented, Thailand will need to divert a large amount of water from neighboring countries.

Despite all these water development projects, there has been little attention given to natural resources and environmental issues which are the possible impacts of dams and inter-basin transfers. For instance, there is a need to study the cumulative impacts of dams on the river flow and affected river communities which include many marginal ethnic groups. Another example is to study the risks to fishery and the effect on people whose livelihood depends on the shrink and expand ecology of the Mekong.

At the open discussion session, the participants discussed the process of environmental cooperation in the region. It was recognized that although there are a number of environment issues such as the creation of protected area and fishery, these issues have often been missed out in the negotiation. The development of MSPs that IUCN is engaging in such as the Mekong region roundtables could provide a forum for public discussion and participation of multi-stakeholders which would enable a better process in decision making.

List of Participants

No.	Name	Position	Organization
1.	Mr. John Dore	Coordinator for Asia Water &Nature Initiative (WANI)	Regional Wetlands&Water Resources Program (RWWP) The World Conservation Union : IUCN Asia Regional Office 63 Sukhumvit Soi 39 Sukhumvit Rd., Wattana Bangkok 10110
2.	Dr.Magnus Torell	Senior Advisor	The Southeast Asian Fisheries Development Center (SEAFDEC) P.O. Box 1046, Kasetsart Post Office Bangkok 10903
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12.	Dr.Monthip Sriratana Tabucanon	IUCN Regional Councillor Asia	MONRE
13.	Acharee Sattarasart, Dr.sc.agr.	Researcher,	Natural Resources and Environment Program, TDRI 565 Soi Ramkhamhaeng 39, Ramkhamhaeng Road, Wangthonglang, Bangkok 10310
15.	Prof.Mingsarn Kaosa-ard	Director	Social Research Institute, Chiang Mai University, Chiang Mai 50200

Interview Report 1

Resource Person : Professor Dr. Thongchai Panswad,

Advisor to Pollution Control Department

Date: March 4, 2005

Venue: Pollution Control Department, MONRE

Participants:

1. Dr. Mingsarn Kaosa-ard
2. Dr. Kobkun Rayanakon
3. Ms. Kridtiyaporn Wongsa

Summary of the Interview: The interview focused mainly on the status of environmental quality in Thailand, problems and obstacles in improving the environment and opinions on prioritizing brown issues. The content of the interview can be summarized as follows:

1. Pollution status or the "brown issues" is area-based and should not be generalized. For instance, air pollution is more serious in some areas where power plants and industries are located, such as *Mae Moh* in *Lampang* province, *Saraburi*, and *Maptaput* areas, whereas water pollution is most serious in the industrial area of *Samutprakan*. Wastes disposal is more of a concern in big cities and urban areas than in rural provinces. Without an area-based framework, it is difficult to prioritize issues and design policies.

2. Likewise, technological capability in dealing with pollution is issue as well as area-specific. For instance, management of water pollution in Bangkok has been improving, while in some areas such as *Mae Tao* and *Klitty* creek in *Tak* province, there is simply no infrastructure or technology to deal with the pollution. In some cases, such as arsenic contamination from mining activities in *Rongpibul* district in *Nakhon Sithammarat*, it may be more advisable to relocate local communities in other areas than trying to invest in a cleaning up operation. As far as hazardous waste management is concerned, Thailand still lacks the expertise in managing hazardous wastes from heavy metals although the country possesses some recycle technology. In such a case, it may be necessary to import technology from more

technologically advanced countries. However, Thailand has sufficient capability in tackling air pollution from point sources.

3. While technical solutions are most relevant to the brown issues, prevention is the better way. An important strategy to manage pollution is to induce a change in people's consumption behavior. For behavioral changes, more effort is needed to educate people on the concepts of waste reduction, i.e. to reject, reuse, and reduce. At present, the government has focused much more on technical solutions than on raising environmental awareness or improving law enforcement. For the next 5-10 years, the main mission is how to change public behaviors and attitudes towards waste management.

4. Apart from technology, tackling brown issues need good management. Lack of data makes it difficult to make an accurate assessment on the situation. Ineffective law enforcement in areas such as air pollution from the transport sector is another major obstacle. There is a lack of political will among politicians and high level executives to deal seriously with pollution problems.

5. In assessing pollution problems, achievement in solving water pollution stands the highest. Despite reports about corruption concerning construction of wastewater treatment facilities, the government has taken concrete measures and made substantial investment in this area. Comparatively, less has been done for air pollution where law enforcement has also been lax. Wastes management remains a big problem both in terms of the difficulty in finding adequate sanitary landfill sites and the lack of technology in dealing with hazardous wastes disposed along with ordinary solid wastes. At present, there are no specific legal measures for dealing with community hazardous wastes. As far as solid wastes are concerned, more technologically advanced incinerators are needed.

Interview Report 2

Resource Person : **Dr. Sopon Chomchan**
Land Development Expert
Land Development Department

Date: March 7, 2005

Venue: Thailand Development Research Institute

Participants:
Dr. Mingsarn Kaosa-ard
Dr. Kobkun Rayanakorn
Dr. Jin Sato, JICA
Dr. Acharee Steinmueller
Ms. Pornpen Vijukpraset
TDRI staff

Dr. Sopon made a presentation on the government's land policy and land resources management. Interviews were conducted along with his presentation. The following is the summary from the interview.

The problems concerning land resources management can be classified into six major issues as follows;

(1) Disputes over land demarcation among the various government agencies concerned. At present, different departments do not possess the same set of GIS information. Land maps are based on different scales. Although the government has instructed that all government agencies use the same scale of 1: 4,000, some departments still have difficulty in implementing this.

(2) There is not enough available land for distribution to the landless or nearly landless farmers. At present, the Agricultural Land Reform Office (ALRO) is the core agency in land distribution, but there is insufficient stock of land to allocate to those in need. It is estimated that while the available stock is 25.24 million *rai*, there are about 3.9 million farmers listed as the poor and they would require around 41 million *rai*. The problem of people living in the protected areas remain unresolved.

(3) The physical deterioration of land resources continues to be a big problem. The increase in the areas affected by soil erosion is expanding much faster than the capacity of the Land Development Department to rehabilitate. So far, the department has concentrated on land rehabilitation in watershed areas. Their activities include cultivating vetiver grass to mitigate soil erosion and recruiting land resource village volunteers to disseminate information on soil erosion control.

(4) Lack of integrated land use policy causes land suitable for agriculture to be converted for other uses. This includes large amount of already irrigated areas. A more effective zoning law and more coordinated policy on land use control are badly needed.

(5) Thailand does not have laws to discourage land accumulation and speculation. There is a need to introduce progressive tax for those who hold large amount or several plots of land as well as special tax to impose on landowners who leave their land vacant.

Apart from discussion and interviews on land resources problems, questions were also asked about the status of the suspended *Kong-Chi-Mun* project in the northeast. The Land Development Department has also been involved in detecting salinity in the soil both in and outside the project areas. At present, there is no complete report to enable the designation of lands for the project to resume.

Further questions concerned the clarification of different cabinet resolutions with respect to people settling in conservation forests. The procedure for proving people's rights to remain in protected areas as set by the Cabinet is still in force to allow people who claim to have settled there prior to the demarcation of the forest reserves or protected areas to remain.

Questions were asked about the problems between the Royal Forest Department (RFD) and ALRO concerning the 44 million *rai* of forest reserves transferred from RFD to ALRO to distribute to landless farmers in 1993. The land transferred included fertile forest land which needs to be excluded from distribution. The RFD has not been cooperative in working with ALRO to demarcate the land. This has obstructed ALRO's work in land distribution.

Dr. Sopon also elaborated on other aspects of the work of his department. The Land Development Department is now the focal point agency for Thailand to implement the UN Convention to Combat Desertification. Data from nine monitoring stations has revealed that some provinces in Thailand including *Kanchanaburi*, *Tak*, *Suphanburi* and *Prachuab Kirikan* are being threatened by desertification.

Meeting 2

Resource Persons: Dr. Acharee Steinmueller, senior researcher, TDRI

Dr. T.P. Singh, Coordinator of the Ecosystems and Livelihood Program, IUCN.

Date: March 18, 2005.

Venue: IUCN Asia Regional Office, Bangkok

Participants: Out of the 50 invitations sent out, sixteen people participated in this one-day meeting. Their names and organizations are listed below.

This meeting was held for two purposes:

(1) To present information and evaluation of past policies in environment management which is the major component of this report to experts and practitioners in environment issues. Reviews and comments from the meeting were to be taken into account for revision of the report.

(2) To update participants on issues concerning forestry and climate change.

In the morning session, Dr. Acharee Steinmueller presented a study on evaluation of past policies, plans and measures for management of natural resources and pollution in all sectors. Her presentation was followed by a general discussion. The discussion can be summarized as follows:

(1) The major problem in environmental management is the lack of integration among the government agencies, each having mandates under different laws and having been slow to change.

(2) Environmental management needs to be issue or problem-oriented and area-specific instead of designing plans for individual resources.

(3) After the public sector reform, all government agencies including MONRE needs to be more people-focused. Government agencies have to adjust their mandate. For instance, the Irrigation Department should give more attention to demand-side management and rely less on engineering solutions in dealing with water shortage.

(4) The present draft water law only introduces a license system for big water users and thus would not be able to solve the problem of equitable and efficient allocation of water. To be more effective, the draft law should prioritize economic uses of water and give guarantee to supply water for basic human needs and for sustaining the ecology system.

(5) The ways environmental management plans are prepared at present are more like a budget list than thinking out strategy which would lead to actual goals and action.

In the afternoon session, Dr. T.P. Singh made a presentation on "Climate Change and Forestry". The presentation was divided into three parts as follows:

(1) International response to climate change

(2) Climate change and forests

(3) A case for clean development mechanism (CDM) and sinks?

Dr. Singh described the response of the international community to the problem of climate change and how the UN Framework Convention on Climate Change (UNFCCC) and the 1997 Kyoto

Protocol were concluded. The Kyoto Protocol prescribes the reduction targets of greenhouse gases emission for industrialized countries at the average of 5% from the level they emitted in 1990. The Kyoto Protocol provides for flexible mechanisms, i.e. emission trading (allowing industrialized countries to buy and sell emission credits), joint implementation of projects (allowing industrialized countries to gain credits for financing emission reduction projects in other industrialized countries) and CDM (allowing industrialized countries to gain credits for financing emission reduction projects in countries without targets, i.e. developing countries). There was much discussion on the implementation of CDM in developing countries.

In the latter part of the afternoon, Dr. Singh presented the Indian experiences in using joint forest management as a strategy under which the Indian government, represented by the Forest Department, and the village community enter into an agreement to jointly protect and manage forest land adjoining villages and to share responsibilities and benefits. Such experiences may serve as useful examples in designing forest management strategy in Thailand.

List of Participants

No.	Name	Position	Organization
1.	Asst Prof. Dr.Soparatana Jarusombat	Lecturer, Thammasat University and Secretary of GSEI	Faculty of Political Science, Thammasat University, Bangkok 10200 GSEI
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15.	Prof.Mingsarn Kaosa-ard	Director	Social Research Institute, Chiang Mai University
16.	Asst Prof.Dr.Kobkun Rayanakorn	Deputy Director	Social Research Institute, Chiang Mai University

Appendix 2 GMS Data

Table A2.1 Economic Growth in the Greater Mekong Sub-Region, in Percentage

	1999	2000	2001	2002	2003
Cambodia	6.9	7.7	6.3	5.5	5
Lao PDR	7.3	5.9	5.7	5.8	5.9
Myanmar	10.9	13.7	13	9.7	-
Thailand	4.4	4.6	1.9	5.4	6.7
Vietnam	4.7	6.1	5.8	6.5	7.1
Yunnan	7.2	7.1	6.5	7.7	10.1

Source: ADB, 2004

Table A2.2 Production Structure in the Greater Mekong Sub-Region, in Percentage

	Sector	1999	2000	2001	2002	2003
Cambodia	***Agriculture***	44.91	39.65	37.56	35.58	37.15
	Industry	19.16	23.27	25.62	27.98	26.81
	Service	35.93	37.08	36.82	36.44	36.04
Lao PDR	***Agriculture***	53.71	52.54	51.24	50.35	48.57
	Industry	22.63	22.89	23.69	24.69	25.94
	Service	23.65	24.57	25.07	24.96	25.50
Myanmar	***Agriculture***	59.91	57.24	57.15	-	-
	Industry	9.00	9.69	10.50	-	-
	Service	31.09	33.07	32.35	-	-
Thailand	***Agriculture***	9.39	9.02	9.12	9.37	9.76
	Industry	40.93	41.97	42.12	42.67	43.97
	Service	49.68	49.01	48.76	47.96	46.27
Vietnam	***Agriculture***	25.43	24.53	23.24	23.03	21.83
	Industry	34.49	36.73	38.13	38.49	39.95
	Service	40.07	38.73	38.63	38.48	38.22
Yunnan	***Agriculture***	22.04	22.45	21.74	21.08	20.33
	Industry	44.62	42.86	42.51	42.60	43.50
	Service	33.33	34.69	35.75	36.32	36.18

Sources: ADB, 2004 and Bank of Thailand, 2004

Table A2.3 Arable Land Scarcity Index (ha per capita) in the Greater Mekong Sub-Region, 1961, 1990 and 2025

	1961	1990	2025
Cambodia	0.43	0.35	0.16
Lao PDR	0.38	0.20	0.09
Myanmar	0.47	0.27	0.13
Thailand	0.43	0.41	0.31
Vietnam	0.17	0.10	0.05
Yunnan	n/a	n/a	n/a

Source: Engelman and LeRoy, 1995

Table A2.4 Water Resources of the Greater Mekong Sub-Region, 2002-2004

	Annual Renewable Water Resources			Annual Water Withdrawals					
	Total Internal Renewable Water Resources (IRWR) (km^3)	Natural Renewable Water Resources		Total (million m^3)	Per Capita (m^3 per person)	As a % of Renewable Water Resources	Sectoral Share (%)		
		Total (km3)	Per Capita (m3 per person)				Agriculture	Domestic	Industry
Cambodia	121	476	34,561	520	60	0	94	5	1
Lao PDR	190	334	60,318	990	259	0	82	8	10
Myanmar	881	1,046	21,358	3,960	103	0	90	7	3
Thailand	210	410	6,371	33,132	605	10	91	5	4
Vietnam	367	891	11,109	54,330	822	7	84	4	10
Yunnan	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Source: World Resources Institute, 2002-2004