

THAILAND



1. GENERAL INFORMATION ABOUT THAILAND

1.1 Geographical

Thailand, a tropical land in the center of Indochina Peninsula, is bordered on the north by the Lao People's Democratic Republic (Lao PDR), on the east by the Lao PDR and Cambodia, on the south by the Gulf of Thailand and Malaysia, and on the west by Union of Myanmar and the Andaman Sea. The total land area is about 513,00 km² with the present population of about 60 million inhabitants.

Rainfall during the southwest monsoon, i.e. May to October, accounts for 85 to 90 per cent of the annual rainfall and varies significantly over the different parts of the country. The annual rainfall is about 1,200 mm in the northern mountainous region, 1,300 mm in the central plain, below 1,000 mm in the western strip of the north-east plateau and increases to 1,600 mm towards the far east end of the north-east plateau. The east coast peninsula receives additional rainfall from the northeast monsoon during November through January and annual rainfalls of 1,800 mm and 2,500 mm are observed over the eastern and western coasts of the peninsula respectively.

1.2 Agricultural Sector

Thailand in fact is today recognised as one of the world's most important and diverse food producers. Year - round sunshine regular rainfall, fertile soil, and mile upon mile of open coastline have given the kingdom a long tradition of agriculture and fishery, while a rich cultural heritage has evolved a highly distinctive cuisine.

Total agricultural area is about 265,200 km² , where only 49,600 km² (18.70%) has been irrigated. The main agricultural products are :- rice, rubber, maize, cassava, sugarcane fruits and vegetables. The utilization of farm holding land of about 51% is paddy land with yield 44 tons/ha of rice.

In 1998, Thailand can produce 20 million tons of rice from the whole country

2. WATER RESOURCES INFORMATION

2.1 Surface water resources

Thailand, with an area of about 513,000 km² , can be divided hydrologically into 25 river basins. The average annual rainfall for all over the country is about 1,700 mm. The total volume of water from the rainfall in all river basins in Thailand is estimated at 800,000 million m³, of which 75 per cent or around 600,000 million m³ is lost through evaporation, evapotranspiration and infiltration and the remaining 25 per cent of 200,000 million m³ constitutes the runoff that flows in rivers and streams. While the population of Thailand is around 60 million. Therefore, the availability of water resources is 3,300 m³ per person each year which is statistically considered to be highly adequate. The data on surface water resources in Thailand are as shown below :

Regions in Thailand	Catchment areas (km ²)	Average annual rainfall (mm/year)	Amount of rainfall (million m ³)	Amount of runoff off (million m ³)
Northern	169,640	1,280	217,140	65,140
Central	30,130	1,270	38,270	7,650
Northeastern	168,840	1,460	246,500	36,680
Eastern	34,280	2,140	73,360	22,000
Western	39,840	1,520	60,560	18,170
Southern	70,140	2,340	164,130	49,240
Total	512,870	-	799,960	198,880

2.2 Groundwater resources

Groundwater is an important source of water supply in Thailand. Public water supplies for one - fifth of the nation's 220 towns and cities and for half of the 700 Sanitary Districts are derived from groundwater. It is estimated that 75 per cent of domestic water is obtained from groundwater sources. Groundwater system in Thailand is mainly recharged by rainfall of about 40,000 million m³ and seepage from the rivers. It was estimated from previous hydrological balance studies that about 12.5 to 18 per cent of rainfall would infiltrate the soils and about 9 per cent of rainfall would reach the aquifers. However, this estimate is valid only for the basins under favorable geologic conditions such as those in the Northern Highlands, the Upper Central Plain and along the Gulf Coastal Plain. For the other basins such as those in the Lower Central Plain including Bangkok and in the Khorat Plateau, it was estimated that only 5-6 per cent of rainfall reaches the aquifer.

More than 200,000 groundwater well projects were undertaken by both government and private with total capacity of about 7.55 million m³/day. (2,700 million m³ /year) It is estimated that 75 per cent of domestic water is obtained from groundwater sources which can be served approximately 35 million of people in villages and urbans area.

2.3 Water Provision and Water Demand

The average annual rainfall of the whole country is about 1,700 mm. ranging from 1,200 mm annually in the north and central plain up to 2,000 - 2,700 mm. in the western part of the south and the eastern part of the country. About 29% of the surface runoff, approximately 70,770 mcm. annually, is kept in various sizes of about 650 large and medium scale together with 60,000 small

scale water resources development projects all over the kingdom covering about 31 million rai (4.96 million ha.) irrigable area.

Although the water resources development programme has been implemented continuously for more than 80 years, but rapid rural development, industrialization, tourist development and income growth raise the water demand for domestic use, agriculture and other purposes drastically. Inefficient use of water by various sectors and deteriorating water quality due to excessive use of fertilizer and pesticides, urban sewage and industrial wastes also create more serious problems to availability and adequacy of water resources. The present water demand for irrigable areas and other uses for the whole country is estimated to be 68,000 mcm./year and expected to be 86,000 mcm./year in 2006. Hence, the nation is facing serious supply constraints to further growth due to various impacts problems in the water resources development scheme. Water provision and water demand in each river basin are as shown in the table :

2.4 Water Resources Management in Thailand

Thailand's past three decades of sustained and rapid economic development stimulated an explosive expansion of demand for water services:- for power, irrigation and domestic and industrial water supply. The Government devoted significant resources to meeting these demands, and an approach toward water management in Thailand emerged with emphasis on expansion of access to services - electricity, irrigation, water supply for domestic purposes.

This approach was successful in giving millions of Thai access to potable drinking water, water to produce cheap and abundant food, and to generate hydroelectricity. However, as water has become increasingly scarce, this approach is no longer appropriate. The Government now faces a different and more complex set of challenges, comprising both supply and demand-side questions:

- Is the resource base, including both water and watersheds, being managed in a sustainable manner?
- Are there opportunities for more effective management of existing sources of supply?
- Who will be allocated the water and how will it be allocated?
- Who will provide and deliver services and who will pay for them?

3. CHALLENGES FACING WATER SECTOR

3.1 National level

In the past, Thailand had paid not much attention to water resources management because water was abundant, anyone could get the required amount of water from rivers, lakes, canals or directly from rainfall. Most of water programs were dedicated to water development during that time. Even when population and economic activities have increased, there was still lack of water resources management practice. This was due to some reasons which can be identified as follow :

- **Government Policy.** Government policy had no sufficient clear-cut on water resources management to be adopted as guidances for practice. Emphasis was placed only on development or provision of water and there was no master plan in water resources management in river basins.
- **Structure of Organization and Centralization.** Problem of fragmentation prevails in water sector management. There are more than 30 agencies in 9 ministries work in water resources development and furthermore, 7 national committees involved in this field. This

makes things complicated and even confused. Local administrations have no role in management of their own sources of water.

- **Budgeting.** At present, budget is allocated to each agency considering their requests. In such process, it lacks the method for problem-solving in each area as a whole and causes less effective in implementation. This is also the problem facing water resources management.
- **Legal Framework.** There are several acts concerning water resources but not even one directly relates to water resources management. Therefore, it is necessary to draft such a law that can react properly to increasing problems or requirements.
- **Available Information.** Because of too much implementing agencies, information on water resources development scatters all around. This makes it difficult to plan for efficient programs in water development. In addition, it is hard to formulate new projects under such circumstance.

3.2 Basin level

The unclear policy, legal and institutional framework governing basin areas makes it difficult to effectively implement basin management. Inadequate and sometimes conflicting legislation is a problem. Also, there are multiple agencies involved in basin management, and none of them have clear responsibility for basin management and development.

Forest cover in the northern river basins has declined from 28% to 18% over the past 25 years, and continues to be under pressure despite a logging ban. Forest loss is due to the combined effects of illegal logging operations and the increasing population pressures on land resources, the latter fueled by the need to provide food, income and shelter for increasing highland populations. Traditional shifting cultivation rotations have become shorter under the influence of high hilltribe population growth rates (3.8% per annum), increased competition for land from the lowland Thai communities and the inward migration from neighboring countries. The combined effect of declining land productivity and increasing population results in further forest encroachment, usually on land forms that are unsuitable for cropping activities. The problem has been aggravated by the financial crisis faced by Thailand since July 1997 which has caused large scale urban unemployment. Many of these unemployed workers have returned to their home villages for subsistence support. This has caused increased need to expand the land area under cultivation, and increased forest fires have resulted from the increased land clearing.

Loss of forest cover and inappropriate land-use practices have detrimentally affected the hydrology of these basins, and resulted in topsoil erosion (1250 tons/ha), sedimentation of waterways and storage structures, and is also thought to contribute to increased wet season runoff and consequent downstream flooding, and reduced dry season stream flows. Thus, improved management of these upper watersheds is of vital importance.

4. NATIONAL VISION ON WATER FOR FOOD AND RURAL DEVELOPMENT

56% of Thai population are farmers. Water becomes basic material for agricultural production. 71% of total amount of available water is allocated to agriculture. However, water is greatly needed for other purposes such as domestic (4.6%), industrial development (2%), ecological balance (22.4%) hydropower, fishery, and recreation which are the basic elements for economic and social development of Thailand.

With the recognition of water usefulness, Thailand has established the national vision on water for food and rural development including as follows :

1. to build water sources , from large to small scale, in the productive river basins in order to support the demand of water for agriculture in the rainy season and drought season. The target is to increase irrigated area from the current 5,000,000 ha to 7,023,000 ha within 15 years
2. to reduce the water leakage (waste) rate in the irrigation system to the international standard and to raise the capacity of distribution system for an efficient use of water in agricultural sector.
3. to promote crop diversification by turning to crop that needs less of water as the means to cut down water use in agriculture.
4. to find the solution to shortages of water for consumption in remote areas by emphasizing the provision of sufficient and good quality of water for people
5. to reserve water for the healthy functioning of ecosystems which is the basic element of the production of food, reduction of flood risk and filtering of harmful pollutants

5. APPROACH TOWARD PROBLEM SOLVING

The mechanisms or methods to achieve the national vision have to be undertaken and incorporated in the development as well as the management plans for water resource in order to utilize this finite resource for its ultimate purpose and in sustainable manner. The mechanisms or methods suggested are :

5.1 Water Resources Development

- **Increase of Storage Capacity.** In the past 50 years, Thailand's water resources development focused on establishing large, medium, and small - scale irrigation projects which can store about 70,700 mcm. of water, out of 244,400 mcm of average annual runoff . Although the country's average availability of storage water is relatively high, many river basin such as the Chao Phraya River Basin have experienced water shortage. The current water resources development should hence emphasize increasing water storage as well as the use of transbasin diversion system and it should be immediately implemented.
- **Rainfed Area Development.** To solve the problems of water shortage outside the irrigated area or the rainfed area where the natural water sources are scarce, small- scale water sources such as farm pond, shallow well, deep well, and rain harvesting tank should be developed extensively so that there will be sufficient water for domestic consumption and for farming.
- **Groundwater Development.** Groundwater, one of an important source of water is developed for domestic uses and for industry because of insufficiency of surface water. Moreover the usage of groundwater increase considerably, resulting from the city expansion and industrial growth. In some area such as rainfed area, groundwater is widely use in supplementary for agricultural purpose.

The studies of groundwater potentials and impacts on groundwater exploitation have already been performed but focused on some specific area and the result of the study has not clearly shown the groundwater potential. Therefore, the study shall be executed urgently in order to determine the groundwater resource potential, the groundwater usage, hydrogeology, the impact of groundwater utilization and a study of conjunctive use of surface water and groundwater in order to control groundwater development activity and to prevent the environmental impacts.

**Water Provision and Water Demand
Description of 25 River Basins in Thailand**

Basin No.	Name of River Basins	Catchment Average Area	Runoff (mcm.)	Storage capacity (mcm.)	Irrigation Area (rai)	Water Requirement (MCM./year)				
						Domestic Consumption	Tourism Industry	Ecological Balance	Irrigation Agriculture	Hydropower
1	Salawin	17,920	8,571	24.00	188,948.00	11.96	4.46	1,027.81	616.93	-
2	Mae Khong	57,422	19,362	1,551.00	1,692,333.00	132.57	1.98	1,145.69	4,323.33	-
3	Kok	7,895	5,279	30.00	520,767.00	14.90	0.43	680.00	401.39	-
4	Shi	49,477	8,752	4,246.00	1,863,173.00	195.17	49.62	573.33	3,052.82	2,156.00
5	Mun	69,700	26,655	4,255.00	1,819,785.00	337.88	94.30	956.63	2,628.85	591.30
6	Ping	33,898	7,965	14,107.00	1,942,927.00	75.26	1.00	457.27	2,428.20	3,623.00
7	Wang	10,791	1,104	197.00	472,350.00	20.21	1.00	48.00	487.42	45.00
8	Yom	23,616	3,117	98.00	994,205.00	53.87	0.08	315.36	859.13	-
9	Nan	34,330	9,158	9,619.00	1,780,637.00	66.29	0.32	315.36	2,870.80	2,583.00
10	Chao Phraya	20,125	22,015	33.00	5,731,375.00	1,594.40	646.05	1,250.00	8,768.59	-
11	Sakaekrang	5,191	1,297	162.00	436,410.00	8.62	-	3.35	878.75	-
12	Pasak	16,292	2,820	124.00	661,120.00	72.32	23.28	158.00	927.38	-
13	Thachin	13,682	22,300	416.00	2,385,259.00	94.94	310.25	1,000.00	4,292.11	-
14	Mae Klong	30,837	7,973	26,690.00	3,400,000.00	20.34	-	1,577.00	4,323.33	4,670.00
15	Prachinburi	10,481	5,192	57.00	733,862.00	8.08	2.78	377.00	838.32	-
16	Bang Pakong	7,978	3,713	74.00	1,353,263.00	14.18	9.05	946.00	2,243.60	1.94
17	Tonglesap	4,150	6,266	96.00	123,720.00	12.60	-	9.80	197.00	-
18	East Coast	13,830	11,115	565.00	427,000.00	129.10	83.50	74.70	578.46	79.00
19	Phetchaburi	5,603	1,400	750.00	562,688.00	14.30	2.90	67.00	1,110.00	693.00
20	Prachuap Khiri Khan Coast	6,745	1,420	537.00	327,015.00	18.00	2.97	39.10	1,383.00	-
21	South East Coast	26,353	23,270	5.00	1,780,481.00	56.40	8.70	161.70	1,129.10	2,577.00
22	Ta Pi	12,225	12,513	5,865.00	245,970.00	25.90	10.00	3,085.20	144.60	2,596.00
23	Songkhla Lake	8,495	4,896	28.00	905,550.00	56.45	37.50	312.00	2,994.70	-
24	Pattani	3,858	2,738	1,420.00	337,878.00	31.20	2.44	670.80	441.11	1,152.00
25	South West Coast	21,172	25,540	20.00	339,273.00	53.20	18.90	74.80	253.00	-
	TOTAL	512,066	244,431	#####	#####	3,118.14	1,311.51	15,325.90	48,171.92	20,767.24

- **Rehabilitation and Modernization of the Irrigation Project.** Many irrigation projects have been intensively developed to increase agricultural production within the basin, particularly in the Chao Phraya basin. However, not only agricultural sector, but also urban and industrial sectors have rapid development and raised water demand. Therefore, in order to achieve the water management goals, the most urgent activity is to improve the water delivery system performance. However most irrigation projects are relatively old and having poor operational performance. Through, the process of implementation plan are :
 - To formulate criteria for prioritizing and ranking the existing irrigation projects which needed the rehabilitation and modernization.
 - To prepare an in-depth feasibility study including engineering design on rehabilitation and modernization to increase operational efficiency in water delivery system.
- **Upper Watershed Development :** Loss of forest cover and inappropriate land use changes in highland areas are detrimentally affecting hydrology of river basins. The impacts include decreased infiltration, increased runoff, erosion and downstream sedimentation. The development which reducing these impacts by protecting the headwaters of the river basin are :
 - **Reforestation.** At present, Thailand's forest cover has dwindled to only 25 percent, estimated at about 1.3 million ha of the country's total land area. The forest land is expected to be 40 percent by reforestation for the next 20 years.
 - **Check dams.** Small weirs need to be built to raise the water level and direct the water along ditches towards crop lasts on both sides of the stream. The retained water will seep into the groundy spreading moisture along both sides of the stream.
 - **Vetiver grass.** A living barrier conserving and returning nature to the land. Using vetiver grass for soil and water conservation by : preventing damage to step terraces and hillside ditch, solving the problem of gully erosion, conserving soil moisture.

5.2 Water Resources Management

- **Integrated water resources management.** Development and conservation of water of resources on various scales, comprise of potential, coordinate public and private sector efforts in management and maintenance of existing water resources. According to the guidelines in the 8th National Plan (1996-2001) the development and conservation of both surface and groundwater resources will be a systematic river basin approach with regard to economic and social factors as well as environmental impact.

There are a number of agencies dealing independently with water resources management resulting in work duplications and lack of cooperation among themselves, therefore, in 1996 the Office of the National Water Resources Committee was established in order that it will work as apex body for the management in all regions, the river basin committees are also planned to established in 25 river basins all over the country in the near future.

Since there is no comprehensive act on water resources and moreover the existing regulations being used by various government agencies are differently there fore, it is essential to have a new water resources act for the common practice for all agencies concerned. Presently, the draft on water resources act has been formulated and being on the proceeding of submission to the cabinet.

The master plan on water resources development, water allocation, water conservation, flood mitigation and water quality will be formulated for all 25 river basins. It is planned to set up the uniform measures and analytical methods to assess data and establish a data network system for possible exchanging and disseminating of the information.

People's awareness in natural resources and environmental conservation has been increasing considerably. Public and private sectors' participation in natural resources management has also been mentioned in the new Constitution. Besides, environmental consideration has been taken into account in all water sources development as imposed by the law that the feasibility study of any project must include the Environmental Impact Assessment (EIA) and its solutions to the problem.

- **Policy issues in the economical use of water.** Due to serious shortage of water resources, there is an urgent need for a comprehensive policy reform to improve the efficiency of water utilization. To reduce the leakages in urban water supply systems from about 40 to 25 percent requires a large amount of investment. Therefore, the Metropolitan Water Authority (MWA) and the provincial Water Authority (PWA) are privatized in some areas. Increasing the potential of water saving in irrigated agriculture through rehabilitation and modernization of Department in the Chao Phraya Basin. At the same time, the changes agricultured system from high water consumption crop to lower consumption crop may be one of an important strategies to reduce water use in agriculture. Water charge is considered to be used as the economic instrument. However, the careful consideration about the rate used among the various economic sector is needed to avoid resistance and bias. Public relations and campaign to water user group for realization and participation on the economical use of water are also needed.
- **The River Basin Water Resources Management Master Plan .** The objective of the study and formulation of the river basin master plan is to formulate the plan that represents the framework for operational agencies to adopt and implement to fulfill the need for management of water resources in the river basin. It will state the exact relationship between water resources and other resources in each area of the river basin which can be considered with consistency and as a system. Interest is also placed on demand for water in each river basin which will affect water resources development projects. People participation is another important factor in establishing the plan.

The river basin water resources management master plan will be divided into 5 aspects :

- Master plan on water development
- Master plan on water allocation and usage
- Master plan on water conservation
- Master plan on flood mitigation
- Master plan on polluted water treatment
- **The Draft Water Resources Law.** The drafted water resources law which is at present under the procedure to be enforced, aims at managing and coping all the problems in water sector created by lack of systematic development in the past. It is, therefore, expedient to formulate measures to manage and control activities concerning water resources and other related resources. In this draft water resources law, water resources management at national and local level are established as the agencies to manage this sector for the whole country. Principles and measures for water allocation are determined and also flood control, mitigation and water conservation and development.

Institutional Framework. There are a number of agencies dealing independently with water resources management resulting in work duplications and lack of cooperation among

themselves. Therefore, it is essential that central agency in water sector had been established to work as apex body for the management of water resources.

- **Information Network.** It is important to create and develop water resources information system which now scatters and unstandardizes in different agencies. Information needed in water resources management includes the information of other related resources and activities such as land and land use, forest land, some other social and economic information etc. Network of information is necessary for planning and its implementation.

6. CONCLUSION

In the past 50 years, water resources management in Thailand has put more emphasis on water sources development resulting in many small, medium and large-scale construction projects.

At present, the situation has changed as environmental impact has emerged as a limitation of water sources development approach.

However, there is growing demand of water use for domestic consumption and agricultural and industrial development, Therefore, the Government of Thailand has taken initiative in adopting integrated water resources management principle for implementation at a river basin level. Under this approach, the Government will attach equal importance to both development and management aspects of water resources in Thailand