

CHANGING COURSE: A STUDY ON WATER SHORTAGE
IN THAILAND AND INTERBASIN WATER TRANSFER
FROM THE SALWEEN BASIN

by

ATIYA ACHAKULWISUT

A THESIS

Presented to the Interdisciplinary Studies Program:
Individualized Program
and the Graduate School of the University of Oregon
in partial fulfillment of the requirements
for the degree of
Master of Arts

December 1996

"Changing Course: A Study on Water Shortage in Thailand and Interbasin Water Transfer from the Salween Basin," a thesis prepared by Atiya Achakulwisut in partial fulfillment of the requirements for the Master of Arts degree in the Interdisciplinary Studies Program: Individualized Program. This thesis has been approved and accepted by:



Chair of the Examining Committee

2 December 1996
Date

Committee in charge: Dr. Carolyn Cartier, Chair
Dr. Gerald W. Fry

Accepted by:



Vice Provost and Dean of the Graduate School

An Abstract of the Thesis of

Atiya Achakulwisut

for the degree of

Master of Arts

in the Interdisciplinary Studies Program: Individualized Program

to be taken

December 1996

Title: CHANGING COURSE: A STUDY ON WATER SHORTAGE IN THAILAND
AND INTERBASIN WATER TRANSFER FROM THE SALWEEN BASIN

Approved: _____

Dr. Carolyn Cartier

Rapid economic growth and population increase in Thailand have heavily strained the country's natural resources, particularly water resources. Limited supplies, especially during the dry season, trigger spatial competition between upstream and downstream users as well as sectoral conflicts among agricultural, urban and industrial consumers. This thesis seeks to analyze and contextualize the many explanations about the causes of water shortage problems. The research specifically addresses how the water shortage problem has been framed, by the use of language, interpretation and repetition of particular problems, to derive or justify different solutions. As goals of social equity, public participation and ecological sustainability are emerging as key parameters in the successful practice of water resources management, this thesis holds these principles, together with the more traditional goals of economic efficiency, as the main criteria for analysis.

CURRICULUM VITA

NAME OF AUTHOR: Atiya Achakulwisut

PLACE OF BIRTH: Samutsakhon, Thailand

DATE OF BIRTH: 19 July 1970

GRADUATE AND UNDERGRADUATE SCHOOLS ATTENDED:

University of Oregon
Chulalongkorn University

DEGREES AWARDED:

Master of Arts in Environmental Studies, 1996, University of
Oregon
Bachelor of Arts, 1990, Bangkok, Thailand

AREAS OF SPECIAL INTEREST:

Politics of the Environment and Development in Southeast Asia

PROFESSIONAL EXPERIENCE:

Feature Writer, Outlook Section, Bangkok Post newspaper,
Thailand, 1991-1994

AWARDS AND HONORS:

Second-Class Honor, Chulalongkorn University, 1990.

GRANTS:

Fulbright Grant, 1994-1996

Kenneth S. Ghent International Student Award, 1996

PUBLICATIONS:

Atiya Achakulwisut. "Why Farmers Bear the Brunt" *Bangkok Post*, 2 November, 28.

Atiya Achakulwisut. "The Official Answer" *Bangkok Post*, 3 November, 28.

ACKNOWLEDGMENTS

The author is grateful to Dr. Carolyn Cartier and Dr. Gerald Fry for their advice and guidance. Dr. Richard P. Gale has been not only helpful but also patient during the conceptualization of this thesis. To him, special thanks are due. I must thank my parents, Mr. Anan and Mrs. Sawong, and my siblings, Aor, Ji, Lai and Ed, who have been supporting me in every possible way. Darin Pradittassanee and Eric Braswell for their valuable comments and assistance in the preparation of the manuscript. Nong, Thee and Phi Te sacrificed their work and study to accompany me to the remote Poo Pae village, the Moei River and the Thai-Burmese border in search of the elusive Huai Khanaeng Stream. Their help and dedication made the entire fieldwork possible. To them, I owed deepest and sincerest thanks. The investigation, which was conducted in Tak, Chiang Mai and Mae Hong Son Province, Thailand, was partially sponsored by a Fulbright scholarship.

TABLE OF CONTENTS

Chapter	Page
I. BACKGROUND AND INTRODUCTION	1
II. SCARCITY AND ABUNDANCE	6
Demand from Agriculture	17
Demand from the Industrial Sector	21
Demand from the City	25
III. THE OFFICIAL ANSWER.....	28
Diverting the Lifelines	32
IV. DEPENDENT AND UNEQUAL.....	61
Dispositional and Allocative Bias	61
Efficiency and Equity	65
Intersectoral Bias and Government Failure	68
Rural-Urban Migration	73
Analyzing the Solutions	75
V. TABLING THE OPTIONS	86
Retrieving What is Lost	87
The Power of Perception	92
Conclusion.....	98
APPENDICES	
A. WATERSHED CLASSIFICATION IN THAILAND	100
B. FROM ELECTRICITY TO WATER: A HISTORY OF DEVELOPMENT PLANS IN THE SALWEEN BASIN	102
C. COMPONENTS OF THE UPPER PAI AND NAM MOEI-MAE SONG DIVERSION PROJECTS	106

D. ANNUAL RAINFALL DATA AT TAK METEOROLOGICAL STATION (1961-1991)	108
E. LIST OF ACRONYMS, ABBREVIATIONS AND THAI LANGUAGE TERMS	109
REFERENCES	110

LIST OF TABLES

Table	Page
1. Major River Basins in Thailand	7
2. Harvest Area, Production and Farm Value of Major Rice and Second Rice in Thailand (1977 to 1986)	19
3. Water Pricing and Water Use in Metropolitan Waterworks Authority Area	27
4. Sub-basins in the Salween Basin (EGAT, 1984)	38
5. Summary of the Project Features of the Optimum Diversion Routes of the Moei-Salween-Chao Phraya Diversion Project	47
6. Preliminary Plan for Water Management and Distribution	63
7. Government Agencies Involved in Water Resources Development	95

LIST OF FIGURES

Figure	Page
1. The Chao Phraya River, Tributaries and Location of the Bhumibhol and Sirikit Dam	10
2. Volume of Water Flow into Bhumibhol and Sirikit Dam in 1992	11
3. Accumulated Irrigated Areas in Various Regions	20
4. Location of the Salween River and Major Tributaries	37
5. Diversion Routes of the Moei-Salween-Chao Phraya Diversion Project	45
6. The Area Where the Dam Structure Will be Located. (Picture Courtesy of Mr. Choolit Vatcharasinthu and Panya Consultants Co., Ltd.).....	54
7. The Huai Khanaeng Dam's Reservoir Area. (Picture Courtesy of Mr. Choolit Vatcharasinthu and Panya Consultants Co., Ltd.).....	54
8. Huai Khanaeng Stream At the Beginning of the Rainy Season, 1996	55
9. <i>Sob Huai Khanaeng</i> , The Place Where Huai Khanaeng Stream Flows Down to the Moei River, Tak Province, Thailand	56
10. The Moei River, Which also Serves as the Border Between Thailand and Myanmar, at Tak Province, Thailand	57
11. The Author's Estimate of the Flood Area (1:50,000, Approved by Mr. Choolit Vatcharasinthu Who Supervised the Study)	58

12. Elevation Marks Found at the Proposed Dam Site.
The Normal High Water Level of Huai Khanaeng Reservoir,
According to the Pre-Feasibility, is 198.0 m. MSL59
13. Soil Study Marks Found at the Proposed Dam Site.
The Normal High Water Level of Huai Khanaeng Reservoir,
According to the Pre-Feasibility, is 198.0 m. MSL60

CHAPTER I

BACKGROUND AND INTRODUCTION

If a Thai finds himself driving through a forest, he should turn back: he has probably entered another country (*The Economist* 1993, 36).

Between the southward-spreading Yunnan Knot mountain systems and the South China Sea lies a small depression area in the middle of which Thailand is located. The country is bound on the north and west by Myanmar (formerly known as Burma), on the northeast by Lao PDR, on the east by Cambodia and on the south by Malaysia. Its southern peninsula is flanked by Andaman Sea on the west side and by the Gulf of Thailand on the east. Thailand is geographically divided into six regions: the North, the Central Plain, the West, the Northeast, the East and the South. Several mountain ranges are present in the North, providing catchment and headwaters for many important rivers. Flowing Southward, Ping, Wang, Yom and Nan rivers converge in Nakhon Sawan province to form the Chao Phraya River — the largest river basin in Thailand. Mae Kok and Ing rivers, together with their tributaries, flow up north to converge with the Mae Khong River, whereas such Northwestern-oriented river systems as Moei and Yom rivers run down to the Salween River (Anat 1987, 14).

The Chao Phraya and Ta Chin river basins form the Central Plain of Thailand. The region features mostly flood plains and lowlands, suitable for rice production. Fed by water from the north, the region has seen a vast expansion of agricultural activities and

is aptly called the ricebowl of Thailand. It is by far the most populous and prosperous region. Bangkok, the country's capital and most urbanized city, as well as most industries, are located here.

Much touted as an emerging newly industrialized country (NIC), Thailand has widely promoted market-oriented, export-led economic policies. As a result, the country's economy has grown at an annual rate of 8.2 percent from 1984 to 1994, leading Asia in terms of sheer economic expansion, even outperforming South Korea's 7.8 percent rate of growth (*Asiaweek* 1996). The economic take-off, however, is largely subsidized by the depletion and degradation of natural resources and environmental quality. A rapid decline of the forest cover, from 53 percent in 1961 to officially less than 20 percent at present, made Thailand one of the world's "hot spots" of deforestation (Park 1992, 39-41). The Thai government issued a nation-wide ban on logging in 1989, after a disastrous typhoon, unearthing and hauling with it masses of illegal logs, wrecked the southern peninsular. The National Forestry Policy, developed during 1982 to 1987 to be a master plan for forest management, aims at expanding the forest cover to 40 percent. One-third of the area would be conservation or protected forest, the remainder commercial forest. This aspect of the policy, together with the Forestry Department's reliance on replantation by the private sector, have been much contested whether they are appropriate means to save the remaining forest (Hurst 1990, 216-217). Despite the ban and the new policy, Thailand continues to lose its forest area. Among the chief reasons

cited are inadequate cooperation among departments, an obsolete legal framework, poor land use planning and the lack of an effective enforcement program (Hurst 1990, 216).

Rapid economic growth and population increase place water resources under heavy strain. Shortages of water have occurred across the country during the past two decades, increasing both in frequency and intensity. Of all the affected areas, the scarcity in the Central Plain, especially the Chao Phraya basin, attracts most attention from the government and media due to its status as the country's political and economic center. The limited dry-season supply unravels an unprecedented competition and conflicts among user groups, mainly those from the agricultural, industrial and urban sectors. To bolster a shift in the macro-economy that favors the rise of industries, the Thai government gives water access priority and distribution to urban and industrial sectors, usually at the expense of agricultural users suffering extreme scarcity.

Thai culture reserves a high place for rivers and water, not only as providers of staple food of rice and fish, but also as cultural symbolism, predominantly represented in rites of passage (Theeraphap 1992, 15; Iam 1994; Iam 1995). Life at such proximity to rivers lures many Thais to regard fresh water as an abundant resource, endless and infinite. The misguided perception, prevalent among city dwellers who have an easy access to low-priced piped water, contributes to a continued misuse of fresh water which complicates and aggravates the scarcity.

In the global context, an increase in population and the need for economic growth are revealing the limits of natural resources and raising questions about the carrying

capacity of ecosystems. Competition over such limited resources as water is a common problem in many countries. As Jonathan Rigg pointed out, “although the details of Thailand’s water debacle are singular and atypical, the discourse is not” (Rigg 1995, 24). By analyzing how different groups of users and planners view, interpret and solve the water shortage problems in smaller-scale locales, in this case the Central Plain of Thailand, I wish to illustrate how, in a wider and more abstract sense, a discourse on resource scarcity and development is constructed and used to achieve certain sets of goals.

Thailand’s water shortage problem may not be as provocative a topic should the government not plan to alleviate it by building more large-and-small-scale dams and initiating an ambitious interbasin transfer of water from the Salween to the Chao Phraya basin. The proposed solution highlights an increasingly internationalized struggle for resources, which may not be restricted in the “nation state” scale. Central to this thesis is an attempt to dissect the creation of the issue of “water scarcity” — how the issue is framed, when there is not enough for everyone, who has to go thirsty and why. The discussion will also focus on ecological, political and economic implications of the transboundary solution. As the Thai government concentrates its effort in rectifying the shortage in the Chao Phraya basin, the thesis is primarily confined to the boundary of this region. The analysis is conducted with the view that the concepts of social equity, public participation and ecological sustainability, together with the widely-held goals of

economic efficiency, are emerging as principal parameters in successful water resource management (United Nations 1993).

CHAPTER II

SCARCITY AND ABUNDANCE

In the time of Father King Ram Khamhaeng this land of Sukhothai is good. In the waters are fish; in the fields are rice. (Seni 1990, 17)

The stone inscription dated back over 700 years ago to Sukhothai — an ancient kingdom of Thai people— thoroughly captures the people's perception of their natural resources. Cradled in a mosaic of lush valleys, the land presently known as Thailand was often referred to as *Suwannaphum* or the Land of Gold. Green rice fields, nourished by overflowing water, was a common scene. Never have the Thai imagined that the abundance would decline — that one day the cornucopia of fish and rice will be a mere myth and that the water will run dry.

Statistically, Thailand should have plenty of freshwater. The country is nurtured by 25 major rivers (Table 1). From May to mid-October, the Southwest monsoon blows across the country, carrying with it moisture and rain from the Indian Ocean. Thailand receives an average of 800 billion cubic meter per year rainfall, which is enough to keep a 1.7 meter high flood throughout the country provided that the rain did not evaporate or is not absorbed (Anat 1987, 5). With an annual run-off of 219 billion cubic meters per year, each Thai is theoretically entitled to a luxurious amount of 12,600 liters of water per day.

Table 1. Major River Basins in Thailand

Basin Code	Basin Name	Annual Runoff (Million cubic meter)
01	Mae Nam Salween	8,156
02	Mae Nam Mekong	15,800
03	Mae Nam Kok	7,700
04	Mae Nam Chi	8,035
05	Mae Nam Mun	29,800
06	Mae Nam Ping	9,546
07	Mae Nam Wang	1,430
08	Mae Nam Yom	4,870
09	Mae Nam Nan	11,011
10	Mae Nam Chao Phraya	30,300
11	Mae Nam Sakae Krang	550
12	Mae Nam Pa Sak	2,708
13	Mae Nam Ta Chin	2,815
14	Mae Nam Mae Klong	13,400
15	Mae Nam Prachin Buri	4,500
16	Mae Nam Bang Pakong	9,400
17	Tonle Sap	1,193
18	East Coast Gulf	25,960
19	Mae Nam Petchaburi	1,410
20	West Coast Gulf	1,013
21	Peninsula-East Coast	35,610
22	Mae Nam Tapi	17,380
23	Thale Sap Songkhla	7,300
24	Mae Nam Pattani	3,020
25	Peninsula-West Coast	9,920

Source: Adapted from Anat 1987, 51.

In the face of ostensible abundance, however, the country suffers repeatedly from shortages of water. In the dry season, the Central Plain has had to import a considerable amount of water from the northern region. Only 30 percent of the irrigable area in the Chao Phraya basin is adequately irrigated. News about a severe lack of water supply in such tourist towns as Pattaya, located on the east coast, is widely and frequently reported in the mass media. In the town, water selling and trucking emerges as a lucrative

business: drinking water is even more expensive than gasoline.¹ With the supply being limited, sectoral competition among such user groups as agriculture, industries and cities as well as spatial conflicts between upstream and downstream users emerge. The conflicts are normally heightened during a period from November to May, when the rain gives way to a long, dry season.

Despite the prevalent nature of scarcity, the Thai government pays most attention and resources to alleviating the shortage in the Central Plain, specifically, the lower Chao Phraya basin. The place where extensive paddy fields, industries and such highly urbanized city as Bangkok are clustered, the Chao Phraya basin is the most likely setting for the dry spell to produce its most visible and dramatic effects. The scarcity in this area leads to a complex conflict of interest and setting of priorities. The region's status as a financial, industrial and administrative hub further accentuates the water deficit since a major water shortage hampers foreign investment and reins in the fast-growing economy.

The inadequacy of water in the Chao Phraya basin has been most strongly felt by paddy farmers and fruit growers who have lost a significant amount of income from dry-season cropping during the past two decades (Atiya 1992b, 28). In 1991, the water behind Bhumibhol and Sirikit dams, which provide and regulate water supply in the Chao Phraya basin, fell to a critical low after a reportedly prolonged drought (Figure 1). During the period, the amount of water that the two dams could release to farmland under its

1 In Thailand, a one-liter bottled drinking water is sold for 10 baht while one liter of gas costs 9 baht. (25 baht is approximately one dollars.)

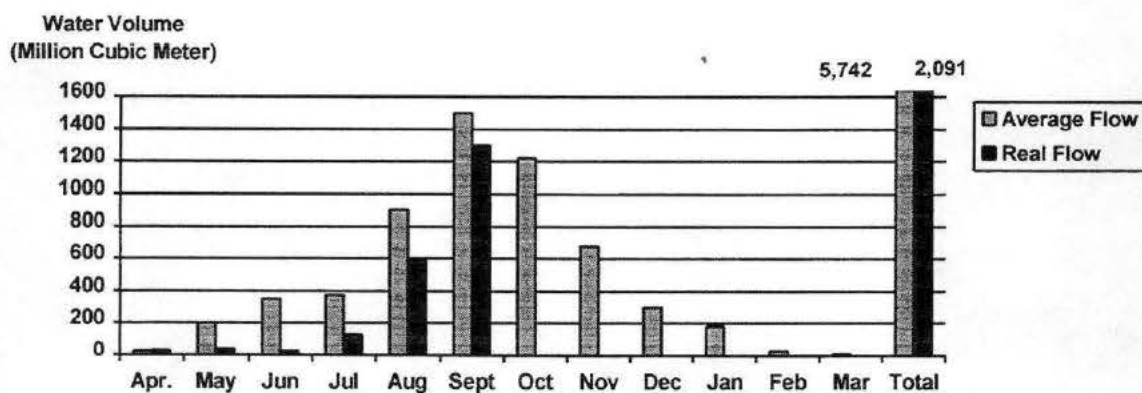
irrigation was cut by half — from 30 million m³ per day to 15 million m³ (Anita 1992, 106). In 1992, the volume of water in the two dams combined was expected to total 4,000 million m³ at the beginning of the dry season — the lowest level since the dams were built (RID 1992). Rice farmers and fruit growers in the Chao Phraya basin were coerced not to grow their crops during the dry season because the Royal Irrigation Department (RID) could not possibly allocate enough water for them (RID 1992).

By 1994, the water crisis continued to loom large. That year's shortage was said to be the most severe in 30 years. The water level in the Bhumibhol and Sirikit dams was reduced to only a third of the normal level, even lower than the record low in 1992² (Figure 2). Mr. Thonglueng Sakum, a rice farmer in Suphan Buri province in the Central Plain, told *Far Eastern Economic Review* that he had planted rice twice a year for more than ten years (Fairclough 1994, 25). Months of drought in 1994, however, ruined his paddy fields. "There used to be so much water that there were floods. Now there's not enough to grow rice," the perplexed farmer said. Mr. Thonglueng had to substitute paddy with less water-intensive sugar cane. Even so, he was worried that the crop would not survive the aridity. During that while one million *rai* was badly affected in the second phase of farming. A few second crops that survived produced low quality rice, sold for less than 3,000 baht a ton. Many farmers went into debt because they had invested about 3,500 baht for a ton of paddy (Prasong 1996, 17).

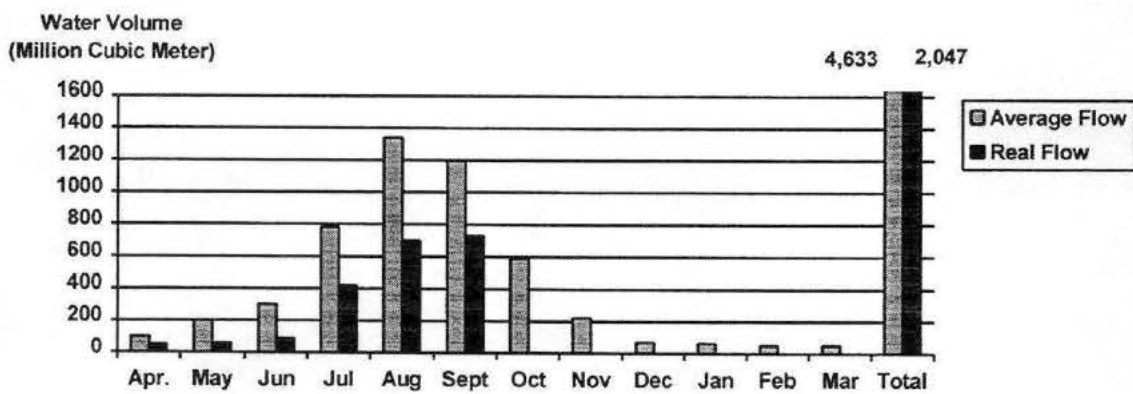
2 Bhumibhol Dam has a total storage of 13,462 million m³, of which 3,800 million m³ is a dead storage. Sirikit dam has total storage of 9510 million m³: 2850 million m³ is a dead storage.

Figure 2. Volume of Water Flow into Bhumibhol and Sirikit Dam in 1992

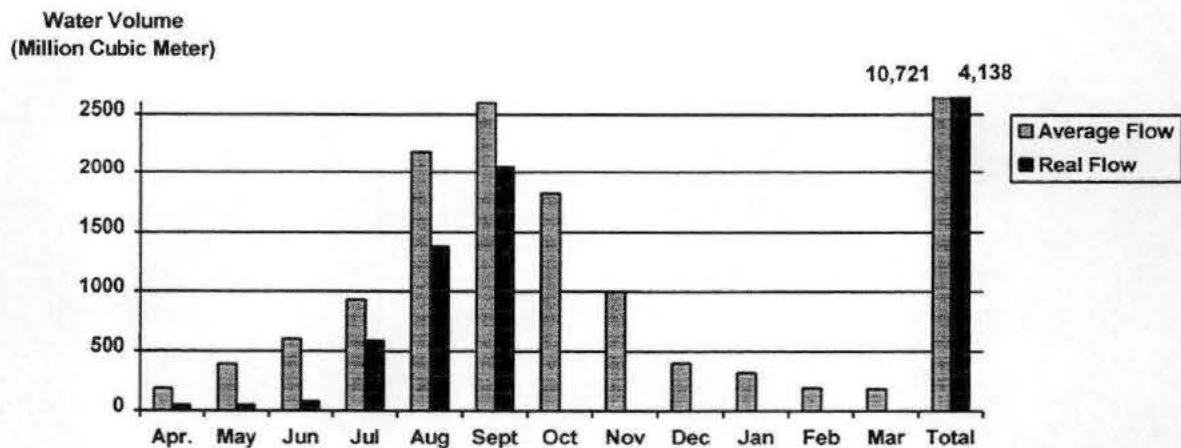
Bhumibhol Reservoir



Sirikit Reservoir



Bhumibhol and Sirikit Reservoirs



Source: RID 1992.

Insulated from scarcity for almost two decades, Bangkok finally faced an impending severe water crisis in 1992 (*The Economist* 1994, 35). The Metropolitan Waterworks Authority (MWA) was forced to lower the water pressure and reduce tap water distribution, especially in outlying areas. Less water was released from the two dams. The reduction of an in-stream flow in the Chao Phraya resulted in a surge of sea water from the estuary which threatened to intrude as far as Samlae, Pathum Thani province. Sam Lae is the place where the MWA pumps up raw water for its production. The increased salinity would disrupt piped water supply in Bangkok and surrounding

areas. The city's massage parlors, which offer a form of massage reliant on bathing and showering, were targeted as the first business to have their water rationed (*The Economist* 1994, 35). A grim prospect of water rationing in Bangkok was widely publicized. The *Bangkok Post*, a Bangkok-based English-language daily newspaper, published in its editorial: "If you wash your car frequently, if you hose down your porch or water your garden, if you hum a tune while you enjoy a nice, long shower . . . then you are the problem" (quoted in *The Economist* 1994, 35).

Where has all the water gone? To understand the situation better, one may have to look beyond the basic demand/supply equation. Naturally, the rain in Thailand is concentrated both in space and time. The southern region receives twice as much rainfall as the northern region. Likewise, 85 percent or more of rain falls from May to October, with almost no rainfall in between. The large volume of rain that falls in a short period of time has a strongest impact on the Central Plain. Geographically, the Chao Phraya River delta has a relatively flat terrain and heavy clay soil. Coupled with an inefficient drainage capacity, the region suffers from a cycle of flood and drought which occasionally causes disastrous damages. Yoshikazu called the hydrologic pattern in the area an "amphibious environment" (Yoshikazu 1987, 7).

In the rainy season, the delta receives not only *in situ* rainfall but also water flowing in from upstream. Because the delta has virtually no slope, this water cannot immediately drain away but accumulates steadily and by the height of the rainy season most of the delta is covered by from fifty centimeters to one meter of water. . . when the dry season reaches its peak, all the water has disappeared.

The rainfall pattern, prevailing both in deltaic areas and catchment basins, is one of the reasons why the flow of many important Thai and Southeast Asian rivers is highly seasonal in nature (Small 1973, 4). A high percentage of a river's annual discharge occurs within a few months, resulting in regular flooding. The annual flooding prompted such Southeast Asian deltaic areas as the Red River delta in Northern Viet Nam, the Irrawaddy delta of Myanmar or the Chao Phraya delta of Thailand to be devoted almost exclusively to wetland (lowland) rice cultivation.

Notably, there is a change in how Thai people view the seasonal ebb and flow. Evidence from architecture suggests that in the recent past, Thai people treated flood as a part of life. Contrary to the modern-time dread of flood, people of the past generation simply learned to live with the conditions. Most houses in the delta around Bangkok were amphibious, being built on knolls or stilts. Some villagers carried their adaptation further by building an aquatic house on a bamboo raft or pontoon, which can be moored near a river's bank or floated along the river. Old engravings, prints, photographs and town plans suggest that the floating house or *ruen phae* was a typical form of accommodation for people living along the Chao Phraya River during the last century (Jumsai 1988, 96). More floating houses were discerned than those on land and Bangkok was mostly a floating city (Jumsai 1988, 169). Khlong Chao Chet, west of Ayutthaya, was one of the *ruen phae* villages until the 1980s (Van Beek 1995, 72). The most intriguing aspect of life with a high tide could be seen in a town called Bang Li in Song

Phi Nong district of Suphan Buri province in the central plain. The whole village was designed for dual functions, operational either rain or dry.

Bang Li . . . was built on two levels. During the dry season, its shops were at ground level. When the annual floods inundated the bottom storey, the townspeople moved their goods to the upper floor. Walkways linked the verandahs, creating a dry passageway above the flood water (Van Beek 1995, 72).

An adoption of European land-based life-style and technology as a model for development during the colonial period of 1980s necessitated that Bangkok metamorphose into a land-based city (Jumsai 1988, 170). Canals were filled in and replaced by roads and drain pipes. The first road was opened to the public in 1857, followed by the introduction of trams in 1887 and railways in 1890. Drainage programs initiated in the early 1980s kept the annual flooding under control. Once the ground was dry all year round, the two-season housings were abandoned. Gone, too, was the perception of flooding as a natural circumstance. Flood is not seen as a regular visitor. While no longer contextualized, it is stigmatized as a damaging intruder to be prevented and conquered, everywhere, at all cost. A series of dam projects built for flood control in the 1980s testify to the paradigm shift (Van Beek 1995, 72).

Generally, the rainfall pattern is accepted as a possible cause of the dry-season water deficit but other explanations as to why the shortage is here to stay are under debate. Given an assumption that water scarcity can be either supply or demand driven, the RID is inclined to cite irregularities on the supply side as major causes of the

shortage (RID 1992, 8). On the other hand, members of non-governmental organizations (NGOs) and academia who study and follow the issue, tend to believe that the deficit is caused by excessive demands, inefficient management and misuses of water.³ According to the RID, major causes of the water shortage in the Chao Phraya basin are:

1. Reduced rainfall beyond Bhumibhol and Sirikit Dam — the major provider and controller of water in the Central Plain.
2. Increased consumptive and non-consumptive use of water upstream above the two dams.
3. Rising demands downstream especially during the dry season.
4. Lack of reservoirs to store water during the rainy season. The huge amount of water from Chao Phraya River and its tributaries, then, flows into the Gulf of Thailand, useless (RID 1992, 6).

The first argument about the drop in volume of rainfall has been seriously contested between RID's officials and such NGOs as Project for Ecological Recovery (PER)⁴. PER believes that the phenomenon merely reflects a transient fluctuation in weather patterns and, therefore, should not be taken as an immediate cause of the reduced supply. To prove this point, however, would be a major study in itself and, for that reason, is beyond the scope of this paper. A chart showing rainfall data from Tak meteorological station during a 30-year period, from 1961 to 1991, is provided in

3 Witoon Permphonngsachareon, Director of Project for Ecological Recovery, is an outstanding proponent of the scarcity as demand-driven.

4 Project for Ecological Recovery (PER) works to support local communities within Thailand in protecting rivers, forests, land and livelihoods. (Summarized from Watershed: People's Forum on Ecology (1995) 1 no. 1: 1.

Appendix D. According to the data, the amount of rainfall received at the station fluctuates, with no upward or downward trend. Nonetheless, 30 years is a short period of time and likely to be inadequate in detecting or determining changes in the weather pattern.

Demand from Agriculture

Over 90 percent of the demand for the country's fresh water comes from the agricultural sector which, as noted earlier, constitutes a major industry of the central region. With deep rich alluvial deposit of sediment from the Chao Phraya river, the flood-prone basin encompasses 4.4 million hectares of agricultural land out of the country's total area of 7 million hectares. The region's well-developed irrigation systems — the most extensive in Thailand — constitute 25 percent of the total irrigated areas in the country (Anat 1987, 52). Major crops, besides the predominant wetland rice and transplanted rice, include corn, soybean, mung bean, sugar cane and pineapple. In this area, a second crop of rice or *na prang* can be cultivated in the dry season where irrigated water is available: mainly an area of about 0.5 million hectares under the Chao Phraya Irrigation Project (Anat 1987, 59).⁵

5 The Greater Chao Phraya Irrigation Project provides water for the areas under Chao Phraya Dam. The project to put a barrage in Chao Phraya river at Chai Nat Province to provide water for irrigation, was first proposed in 1900's but was deferred indefinitely due to high cost. It was reconsidered again after World War II. It was completed in 1957, supported by a \$ US 18 million loan from the World Bank. It was the largest irrigation project in east Asia at that time. (summarized from Anat, 56-57.)

The development of irrigation systems and rapid expansion of paddy cultivation in the Central Plain are interrelated. During world grain shortages after World War II, Thailand saw in the Chao Phraya basin an enormous potential for paddy culture. The government revived the suspended Greater Chao Phraya Project, an irrigation scheme proposed fifty years earlier by Homan van der Heide, the first Director General of the then Department of Canals (presently, the Royal Irrigation Department). The resulting Chai Nat dam and canal systems that convey water to the old and young deltas of the Chao Phraya river greatly contributed to the country's success as one of the world's top rice exporters, generating substantial income for Thailand (Montgomery and Warren 1994, 232).

As dry-season paddy gives higher yields and fetches higher prices than *na pi* or first-crop paddy, an increasing number of farmers sow paddy onto their fallow during the dry seasons (Table 2). The expansion is due in part to heavy promotion and support by the export-oriented government as well. The Ministry of Agriculture and Co-operatives recorded that the area where second-crop rice is planted increased by 55 percent in the 15-year span from 1976 to 1991 (MOAC 1980; MOAC 1991; MOAC 1992). The RID reported in 1992 that the real *na prang* areas in Phitsanulok and Greater Chao Phraya Project was as high as 2.4 million *rai*— six times in excess of the 0.4 million *rai* that the agency can adequately irrigate (RID 1992, 5). A *Bangkok Post* report claimed an even higher figure, stating that there were about 5.5 million *rai* of second crop farm lands in the Central Plain in 1992 (Prasong 1996, 17).

Table 2. Harvest Area, Production and Farm Value of Major Rice and Second Rice in Thailand (1977 to 1986)

Year	Major Rice (A)			Major Rice (B)		
	Harvest Area (10 ⁶ rai)	Production (10 ⁶ tons)	Farm Value (10 ⁶ Baht)	Harvest Area (10 ⁶ rai)	Production (10 ⁶ rai)	Farm Value (10 ⁶ rai)
1977	48.3	13.7	25,218	2.7	1.4	2,644
1978	51.8	12.3	28,652	2.9	1.6	3,399
1979	51.9	15.2	33,256	3.9	2.3	4,898
1980	52.1	14.6	38,217	2.0	1.1	2,827
1981	54.3	15.4	47,263	3.2	2.0	6,270
1982	53.3	15.8	44,691	3.6	2.0	5,766
1983	52.0	14.8	43,378	3.9	2.1	6,108
1984	55.6	16.9	46,847	4.4	2.6	7,741
1985	55.8	17.3	42,842	4.4	2.6	6,572
1986	57.5	17.9	41,579	4.0	2.3	4,344

Notes: (A) : Wet Season

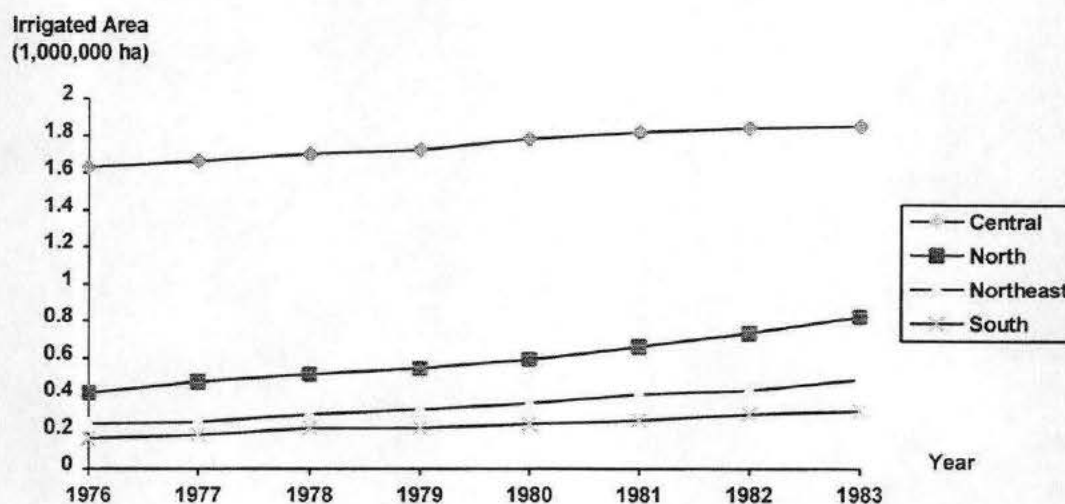
(B) : Dry Season

Source: Anat 1987, 29.

As a result of the over-expansion, only 30 to 35 percent of the irrigable area in the Greater Chao Phraya Project has adequate water for irrigation during the dry season (Anat 1987, 56). When the land begins to parch, farmers have to depend almost entirely on water left-over from the north that flows down to the Bhumibhol and Sirikit reservoirs. Having a provider-and-dependent relationship in resource terms, the fast growing north and central regions feature a pattern of agricultural expansion with a competitive overtone (Figure 3). According to *Thailand Natural Resources Profile*, the irrigated area in the north is increasing at a faster rate than that in the central region (Anat 1987, 57-58). If this trend continues, a point will be reached in the future when the water released from

the north after satisfying its requirements will be even less than the present rate. A supply deficit in the Central Plain would, then, be considerably exasperated.

Figure 3. Accumulated Irrigated Areas in Various Regions



Source: Anat 1987, 59.

Since Thailand has chosen to follow a model of export-oriented industrialization, the Thai economic structure has seen a shift of competitive edge from agriculture to manufacturing industries. The share of agricultural activities in the economy continues to drop. Having fewer fields to irrigate, however, does not necessarily mean that there will be more water for other activities. Indicating that migration from the agricultural sector tends to originate from rain-fed rather than irrigated areas, Sacha, Theodore and Vute

argued that the remaining farmers would continue to use water wastefully regardless of its growing scarcity because it is provided free of charge. Non-agricultural demands for water will also rise without corresponding decline in agricultural water use (Sacha, Theodore, and Vute 1990, 12).

Either in the local or global context, agriculture is usually susceptible to blame as a major cause of water shortages. Being the largest consumer of the world's water, agriculture takes more than two-thirds of the water withdrawn from the earth's rivers, lakes and aquifers (United Nations 1993, 2). Furthermore, it is a relatively low-value, low-efficiency and highly subsidized water user. As competition, conflicts, shortages and degradation of the water resource intensify, policy-makers look increasingly to agriculture as the system's safety valve (United Nations 1993, 4).

Demand from the Industrial Sector

Bent on industrialization, Thailand promotes economic modernization. Politically and economically centralized, the country has seen rapid yet highly concentrated industrialization. Bangkok, its capital, has become one of the most urbanized, densely populated and affluent metropolises in Southeast Asia. It is a hub of commerce, industries, transportation, administration as well as entertainment.

While most of Thailand's industries are located in the Chao Phraya basin, 50 percent of factories are located in the Bangkok Metropolitan Area (BMA). Their

combined production accounts for 72 percent of the industrial gross domestic product (GDP) (Sacha et al. 1990, 14). Although the demand for water from the industrial and urban sectors is relatively small compared to that of agriculture, it is by no means insignificant. The quality of water and uses that are made of it do matter, especially when one party's use reduced the quality of water available to other users (TDRI 1994, 5). Sacha listed four reasons why the industrial sector played a part in the creation of the water shortage.

1. The industrial sector has been and is projected to continue to grow at double-digit growth rates, while the growth of the agricultural sector is leveling off. Because of the geographic concentration of industries, water demand is concentrated in a limited area while agricultural demand, being geographically dispersed, can be met from a variety of sources.
2. Because of the proximity of industry to the country's largest urban area, the urban demand for water is added into that of industry. Concurrently, the availability of suitable raw water diminishes as a result of urban pollution, and the cost of treatment rises.
3. While there are economies of scale and savings from the concentration of users in water distribution, the conveyance cost of raw water from distant places may outweigh such economies.
4. Industries, by its own very concentration and waste mismanagement, reduces the availability of acceptable-quality water not only to itself but also to other sectors (Sacha et al. 1990, 14).

Although attempts are made to develop a more appropriate waste and sewage treatment, at this stage Thailand remains one of the most lenient countries as far as waste discharge is concerned (Paichitr 1993, 220). Christensen and Boon-long stated that

Thailand has no comprehensive data base on industrial waste water, making it impossible to track down industrial pollution (Christensen and Areeya 1993, 4). According to private estimates of nine agro-based industries, 525,000 tons of biochemical oxygen demand (BOD) loading were discharged in 1991 and the amount is expected to double by the year 2001. A study by Engineering Science Inc. estimated that there were one million tons of hazardous waste dumped in 1989; about 71 percent of the discharge is produced by the BMA (quoted in Christensen and Areeya 1993, 4). By 2001, the production in that area alone is expected to triple (Manida 1991). In this light, the Chao Phraya River is no different from an open sewers. Unsurprisingly, the level of dissolved oxygen (DO) in some parts of the river is measured at zero (Paichitr 1993, 222).

Aside from discharging waste water into public waterways, in the process reducing the availability of fresh water for other users, industries (and housing estates) are largely responsible for groundwater depletion. For industries that are located in the BMA, it is estimated that less than 0.5 percent of the water they consume daily is purchased from the Metropolitan Waterworks Authority (MWA). Ground water pumping fills up the 95 percent balance while other sources such as rivers and canals constitute the remaining 4.5 percent (JICA 1989).

The MWA, which is in charge of piped water supplies in Bangkok and outlying areas, also used about 43.8 million m³ of groundwater — amounting to 4.7 percent of its total production — in 1989 (Christensen and Areeya 1993, 4). Sacha argued convincingly that the private sector's preference for ground water is more motivated by

cost consideration than accessibility to or sufficiency of piped water. Of the 2,126 operating wells inspected by the MWA in 1988, 1,871 wells (or 88 percent) were within the MWA's distribution systems; of these 1,345 wells (or 72 percent) belong to the MWA's customers (Sacha et al. 1990, 15)

The cost of extracting ground water (both capital and operating cost) is one to two baht per cubic meter while the average charge of piped water is seven baht per cubic meter. Well water is relatively cleaner, thus, obviating treatment costs incurred in water derived from other sources. The Ground Water Act of 1977 stipulates that a permit be required for ground water pumping and the Deep Well Notification No. 7 of 1985 requires the installation of a flow meter on all wells deeper than 15 meters. In practice, unfortunately, the Department of Mineral Resources, which is in charge of the ground water extraction, does not have enough manpower or infrastructure to enforce the regulations (Sacha et al. 1990, 15).

Ground water is a last resort for farmers who have to deal with the dry season shortage of irrigation water as well (Thitinan 1994, 132-258). Concerning this issue, the government's policies are apparently less than coordinated. On the one hand, the farmers are encouraged to switch to less water-intensive crops during the dry season since the RID has not been able to guarantee sufficient water for rice growing. On the other hand, farmers are subsidized to sink shallow wells as an alternate water source. The "free goods" soon dried up (TDRI 1994, 25).

In the Central Plain, farmers complain that wells that were thought to be deep enough to meet their water needs are no longer sufficient, and farmers are being forced to sink even deeper and

increasingly expensive wells in order to meet their water needs. The reason is that the combined effects of the pumping of all farmers depletes the aquifer and lowers the level of the water table.

The pumping rate in the Greater Bangkok area has far exceeded the ability of the aquifer to recharge — exceeding an estimated safe yield by at least 0.5 million per day (Anat 1987, 63). The cost, borne communally by the society, is paramount. The depleted aquifer causes land to subside. Eastern Bangkok is reported to have been sinking about 5 to 10 centimeters per year (Anuchit 1989). Flood damages have been estimated at billions of baht each time it occurs. The sinking land also exacerbates salt-water intrusion, which requires that more water be released to push it back before the salinity ruins farmlands, orchards and the MWA's raw water supply.

Demand from the City

Similar to industries, the urban sector currently withdraws a small amount of water from the total supply. Still, it is crucial to analyze its demand pattern. First, it is the well-being of people in this sector that is a cornerstone for most of the government's relief efforts. Second, as a result of policies that favor industrialization and urbanization, the demand from the urban sector is growing exponentially. The situation in Bangkok illustrates well how scarcity can be imposed by an excessive demand.

During the past decade, a demand for MWA's water grew from 286 million m³ in 1980 to 628 million m³ in 1989 (Table 3). That is a growth rate of 8 percent per year

(Sacha 1990, 13-14). Considering such factors as a faster growth rate in the 1990s, structural changes that favor an expansion of the MWA's clients and an imminent depletion of aquifer, Sacha calculated that the demand for piped water from the MWA is likely to grow more than 8 percent per year during the 1990s (Sacha 1990, 13). A conservative estimate has it that the demand for MWA water will increase at an annual rate of 10 percent, reaching 1,762 million m^3 by the year 2000. It will grow at an annual rate of 8.5 percent during the second decade, to exceed 4,052 million m^3 in the year 2010. By that time, the demand for raw water would be 2.6 billion m^3 and 5.8 billion m^3 (Sacha et al. 1990, 13; Christensen 1993, 4).

Relying on a much lower estimate of 3.4 percent increase in water demand per year (substantially lower than a moderate projection of economic growth), the MWA expects the demand of water to double in thirty years, reaching 2.26 billion cubic meters per annum by the year 2017 (Chaunpit 1989). Its demand for surface raw water is projected to triple by the year 2017. By that time, the MWA will need 7.78 million m^3 of water per day while the RID can allocate a maximum of 5.18 million m^3 per day from the Chao Phraya irrigation system. With the phasing out of its groundwater source, the MWA expects to reach the RID's limit by the year 1997. Unless more water was fed into the system, a water supply deficit will be inevitable.

Faced with the ominous threat, a solution the RID has in mind is to build more dams to store water. A longer-term solution is to find more water to feed the Central region. Large-scale dams and interbasin water transfer projects which will include a

construction of a series of dams, huge pumps and water tunnels, for the RID, are inevitable to secure the future of Thailand.

Table 3. Water Pricing and Water Use in Metropolitan Waterworks Authority Area

Year	Nominal Effective Rate (B/m)	Real Effective Rate (B/m)	Minimum Rate (B/M)	Maximum Rate (B/m)	Nominal Prod. Cost B/cu.m	Users Thousands (percent)	Growth	MWA Water Production (Million cu.m)	Water Sales (Million cu.m)
1976	1.449	3.295	0.50	2.50	n.a.	317	n.a.	431	n.a.
1977	1.487	3.223	0.50	2.50	n.a.	329	3.7	430	234
1978	1.494	2.987	0.50	2.50	n.a.	341	3.7	460	240
1979	1.534	2.819	0.50	2.50	2.29	356	4.3	485	252
1980	1.597	2.661	0.50	2.50	4.56	387	8.9	575	<u>286</u>
1981	2.198	3.055	0.50	2.50	5.01	423	9.2	625	327
1982	3.029	3.712	1.50	5.50	5.40	445	5.2	630	342
1983	3.059	3.557	1.50	5.50	4.97	468	5.1	627	370
1984	3.190	3.587	1.50	5.50	4.63	519	11.1	731	423
1985	4.926	5.501	4.10	8.75	5.64	602	15.9	802	477
1986	6.142	<u>6.646</u>	<u>4.10</u>	8.75	5.63	660	9.5	821	485
1987	6.092	6.482	4.05	8.70	5.64	721	9.4	841	523
1988	6.102	6.328	4.00	8.70	5.65	790	9.5	860	570
1989	6.118	<u>6.118</u>	<u>4.00</u>	8.70	5.35	867	9.7	934	<u>628</u>

Source: Sacha et al. 1990, 13 (Emphasis Added).

CHAPTER III

THE OFFICIAL ANSWER

If we can divert water from the Salween, we will be basking in comfort for the next ten lifetimes. (Dr. Prates Sutabutr, Director General of Department of Energy Development and Promotion quoted in Kinghor 1995, 3).

In 1992, the cabinet approved several short and long-term measures to solve the repeated water shortages in the Chao Phraya basin.⁶ Deliberations were made on the basis of the four causes of water shortage in the Chao Phraya basin as delineated by the Royal Irrigation Department. The five short-term measures to be implemented until the dry season of 1993 are:

1. Artificial rain project
2. Plans to increase the amount of water stored in Bhumibhol and Sirikit reservoirs
3. Plans to adjust crop patterns in irrigable areas. Promoting cultivation of short-lived plants in highlands during the 1993 rainy season
4. Campaigns for water conservation
5. Subsidizing a purchase of water pumps for farmers

The eight longer-term measures are:

⁶ The package was proposed on behalf of Ministry of Agriculture and Cooperatives which houses the Royal Irrigation Department.

1. Adjusting farming methods in irrigable areas
2. Augmenting the efficiency of existing irrigation projects (to be completed in 1997).
3. Developing ground water utilization, especially shallow wells, in such central provinces as Phitsanulok, Phichit and Chainat.
4. Excavating natural ponds and canals that become silted over time
5. Promoting a construction of farm ponds in areas where dam-building or excavation work is impossible
6. *Building more dams on the tributaries of Chao Phraya river. To be urgently implemented are Kaeng Sua Ten Dam in Phrae Province, Pasak Dam in Lop Buri Province, Kwai Noi Dam in Phitsanulok and Haew Narok Dam in Khao Yai National Park.*
7. *Diverting water from other rivers in the country to the Chao Phraya basin; Mae Klong diversion, Bang Pakong diversion, Kok-Yom or Ing-Yom diversion via Kaeng Sua Ten Dam and Pai diversion are among those listed for consideration.*
8. *Initiating an interbasin transfer of water from such international rivers as the Mekong and Salween River to Bhumibhol and Sirikit reservoirs (RID 1992, 8: emphasis added).*

The official reaction echoed heavily of the supply-side strategies of management: trading a demand check for finding a greater amount of water. It can be argued that the RID did incorporate some aspects of demand-side management in its proposition, as seen in such measures as campaigns for water conservation and efficiency booster but the agency did not put much effort in implementing these measures. Mr. Pramote Maiklad, the RID's Senior Expert for Operation and Maintenance, said that although the RID did not know how much water would be retrieved from water-saving campaigns and an adjustment of farming methods, they were sure it would not be an adequate amount (Atiya 1992a, 31).

The RID cited the inadequacy of small-and-large-scale water storage as the most significant cause of shortage problems, demanding immediate attention and remedy. The stance can be essentially summarized in the words of Mr. Thawat Wichaidit, secretary of Prime Minister Chuan Leekpai⁷ and member of the government-appointed Special Water Task Force Committee (Thitinan 1994, 247).⁸

Figures in the last eight to ten years indicate that rainfall has been abundant in Thailand, averaging around 800 billion cubic meter per year, but the country has not been able to keep and use all of it. . . . We have only been able to keep 200 bcm. Our long-term plans must allow us to store an additional 100-plus bcm, which makes it inevitable for the construction of large dams or even small dams which can be coordinated. In any case, we must be able to store another 160 bcm and then we will never have water problems again.

Since 1992, the RID has placed on its list of urgent projects these three dam projects, which have become centers of controversy.

1. Kaeng Sua Ten Dam: Planned to be built in the midst of Mae Yom National Park in the northern province of Phrae, the Kaeng Sua Ten dam project is a part of the Kok-Ing-Yom-Nan scheme. Conceived by the Electricity Generating Authority of Thailand (EGAT) in 1980, the dam will block the Yom river, a major tributary of the Chao Phraya. Ambitiously designed, the plan consists of a network of dams to store and divert water from the four northern rivers into the Chao Phraya basin. The original 4,550-million-m³ reservoir will flood a vast area of natural teak forest in Mae Yom

7 Mr. Chuan Leekpai served as a Prime Minister from 1993 to 1995.

8 Mr. Pramote Maiklad from Royal Irrigation Department directed this task force which is to open 24 hours a day. Its advisory body comprises the deputy permanent secretaries of the Ministries of Interior, Industry, Science, Technology and Environment, and Agriculture & Cooperatives.

National Park — itself the watershed of the river to be dammed — and displace as many as 5,100 households (Kaeng Sua Ten 1995, 10).

The Kaeng Sua Ten dam project was forwarded to the RID and kept dormant for more than ten years. It was reconsidered in 1992 and redressed as a single small-scale dam. The adjusted 1,175-million-m³ reservoir, however, will still inundate more than 4,800 hectares (34 square kilometers) of teak forest which is equal to 38 percent of the area where the best species of teak in Thailand grow. The government headed by Prime Minister Banharn Silpa-archa was eager to see the dam built (Kaeng Sua Ten 1995, 10). News about the advent of the dam plan aggravates already severe illegal logging in Mae Yom National Park. Several demonstrations have been held in the past two years by both supporters and opponents of the dam.

2. Pasak Dam: Although Pasak dam is believed to have less effect on the environment, it will involve a mass relocation of people. Interviewed in 1992, Mr. Pramote refused to reveal the number of families to be evicted to make way for this project, saying only that "there are many communities there, many". He added that an estimate by the RID showed that the cost of land purchase and of compensation to possible ousts was five times more than the cost of the construction of the dam itself (Atiya 1992a, 28).

In the RID's view, however, benefits from the Pasak dam will be worth the cost. Before any discussion about the dam was released, the situation transcended the mundane plane when the highly-revered King Bhumibhol explicitly said during his Birthday

speech in 1994 that he would like to see the Pasak dam completed before his 72nd Birthday in 1999. The construction of Pasak dam is currently underway across Pasak river in Lop Buri province.

3. Haew Narok Dam: In engineering terms, an ideal site of Haew Narok dam is 800 meters from Haew Narok Fall (Ravine of Hell) in the middle of Khao Yai National Park. The first forest reserve in Thailand, Khao Yai is known for its diversity of fauna and flora. It is an important habitat for such endangered species as wild elephants, red gores and Hornbills. With the dam there, more than 1,600 hectares of lush forest would possibly be flooded. The threat to plants and wildlife would be immeasurable. Dr. Somsak Sukwong from Kasetsart University viewed that the area has a high degree of humidity. Water in small streams in the forest is very clean. He believed that the area is an important propagation center for plants and animals rarely found at present (Atiya 1992a, 28).

Diverting the Lifelines

The quest for water goes on, within and beyond the national boundary. Domestically, news about a proposal to divert the Mae Klong River to enhance piped water production in the BMA (the West Side Piped Water Project) infuriated Mae Klong residents who have organized and staged a number of seminars, public hearings and protests. The plan, dated back to 1985, envisaged building a linkage canal between the

Chao Phraya and the Mae Klong and Tha Chin basins. When completed, the 106-km canal was supposed to keep Bangkok well-supplied until 2017 (Thitinan 1994, 244-5). The provincial chambers of commerce from Kanchanaburi, Rajburi and Samut Songkram provinces, which depend on the Mae Klong water, opposed the plan on ground that the river's supply had sharply declined over the last ten years. To ensure a sufficient provision domestically, the residents of the Mae Klong basin cannot afford to share it with others. Others, including NGO representatives, community leaders and academics, commented that Bangkok should not compel other provinces to shore up its own problems. Thitinan reported that the then RID's deputy permanent secretary made a point that water, like petroleum or natural gas, is the kingdom's resource (*sombat phaendin*) for which no one can claim property rights (Thitinan 1994, 246). The secretary claimed that Kanchanaburi residents would gain religious merits from the diversion because it is tantamount to alms giving.

Faced with strong opposition, the RID turns to put more effort to plans to undertake a diversion from such international rivers as the Mekong⁹ or Salween rivers to satisfy domestic needs. As evident in the Mae Klong debate, the official shift towards an international transfer of water is partly a result of a strengthened organization and

9 The now-defunct Mekong Committee or Secretariat of the Interim Committee for Coordination of Investigations of the Lower Mekong Basin is an intragovernmental organization consisting of representatives from Laos, Thailand, Cambodia and Vietnam. It was set up by United Nations in 1957 "to promote, coordinate, supervise and control the planning and investigation of water resources development projects in the Lower Mekong Basin." The committee is developing a massive complex of dams for the Mekong and its tributaries. The Plan, known as the "Mekong Cascade" or the cascade of seven dams on the Mekong mainstream blueprint may involve a resettlement of ten of thousands of people in Thailand, Laos and/or Cambodia depending on how the structure is designed and located (Fahn C1).

networking in local enclaves. Following a rapid boost and expansion of the environmental movement in Thailand, seen by Philip Hirsch as “a product of incorporation of social and spatial peripheries within an increasingly differentiated society, polity and economy,” an anti-dam chorus grows louder and stronger, substantively delaying, even barring, the Electricity Generating Authority of Thailand (EGAT) or Royal Irrigation Department (RID) from advancing with new dams (Hirsch 1993, 3-5). In a desperate attempt to fulfill their assigned duty of finding more water supply and in response to the changing trend, the EGAT and RID have come up with plans to transfer water from other basins to fill in the existing reservoirs. In this case, the Bhumibhol and Sirikit reservoirs, as the major regulators of water flow in the Chao Phraya basin, were the pivotal points for every diversion route. Chainarong reported that in 1979, the EGAT initiated 14 international diversion projects: seven from the Mekong and the rest from the Salween (Chainarong 1993,13). To replenish the reservoir of Sirikit dam, a Kok-Ing-Nan¹⁰ diversion scheme was reportedly developed to draw water from the Mekong (Malee 1995, A10). The project was adapted from the Kok-Ing-Yom-Nan scheme which was indefinitely postponed by uncertainty over Kaeng Sua Ten dam — supposedly the main storage along the route. For Bhumibhol reservoir, the Salween and Moei rivers were targeted as exporting sources. According to the Pre-feasibility Study of the Moei-Salween-Chao Phraya Diversion Project, the two rivers have plenty of water but topographical complexities drastically limit a chance of water use expansion in their

10 Kok and Ing rivers flow down to the Salween river while Nan river is a major tributary of the Chao Phraya.

basins. The potential for water transfer development is, thus, very high (Panya Consultants 1995, 5).

Comparing the Sirikit with the Bhumibhol diversion, Mr. Choolit Vatcharasinthu, a project engineer from Panya Consultants who handled the pre-feasibility study of the Salween Diversion project, said that both routes would require water tunnels of similar length. The strength of the route that ends at Sirikit reservoir, however, relates to the Nan River being the lowest of all the rivers involved in the scheme. Subsequently, the diversion can be operated by gravity which will considerably reduce the cost. One inferior point is the smallness of Sirikit reservoir. With an active storage of 6,660 million m^3 to contain an average inflow of about 5,000 million m^3 , the slight extra space is hardly enough for engineers to manipulate the diversion (Choolit 1996).

Controversial as it is, the attempt to exploit the Mekong and international bickering and tangled politics around it has attracted an attention of the mass media as well as environmental organizations worldwide. While a spotlight was bright on the Mekong basin, on the western front, a scheme to transfer water from the Salween to the Bhumibhol reservoir was quietly gaining ground.

The Basin # 01

From their origins in the snow-capped Tibetan Plateau, several hundred kilometers north of the Tibetan capital Lhasa, the Mekong and Salween rivers flow along

southwardly before diverging near Yunnan. The Mekong River arches to the east and discharges into the South China Sea in Vietnam while the Salween River flows westward to form a part of the Thai-Burmese border before draining into the Andaman sea in Moulmein, Myanmar (Figure 4). The two rivers literally share many common ground. Both are great rivers of Southeast Asia. Their high banks are livelihood of peoples from various ethnicities and a backdrop for inter-racial conflicts and warfare.¹¹ Both have been eyed for “development potential” which, more often than not, is translated into mega-and-mini dam projects.

The portion of the Salween basin in Thailand is located in the northwestern part of the country, from latitude 16° 15' to 19° 45' north and longitude 97° 20' to 99° 0' east. Accounting for 6 percent of the whole basin or approximately 17,920 sq. km., the basin area covers the whole of Mae Hong Son Province and some parts of Chiang Mai and Tak provinces (AIT 1994, 2-1)¹². For the sake of study, the EGAT divided the Salween basin into 18 sub-basins as shown in Table 4. The major tributaries of the Salween discussed in this analysis are:

- Nam Mae Pai: Originated from the Dan Lao range, Pai river flows westward through Nam Phiang Din, Mae Hong Son Province and converges with the Salween river in Myanmar's Kayah state.

11 More than 11 groups of minorities live along the course of Salween river. Among them are Tai, Wa, Karen, Karenni, Arakan, Pa-O, Palong (or Dara-ang), Padong, Akha, Leesu and Inle.

12 The capital of Mae Hong Son is about 360 km from Chiang Mai, the Northern Provincial Center, and 1,000 km from Bangkok, the capital of Thailand.

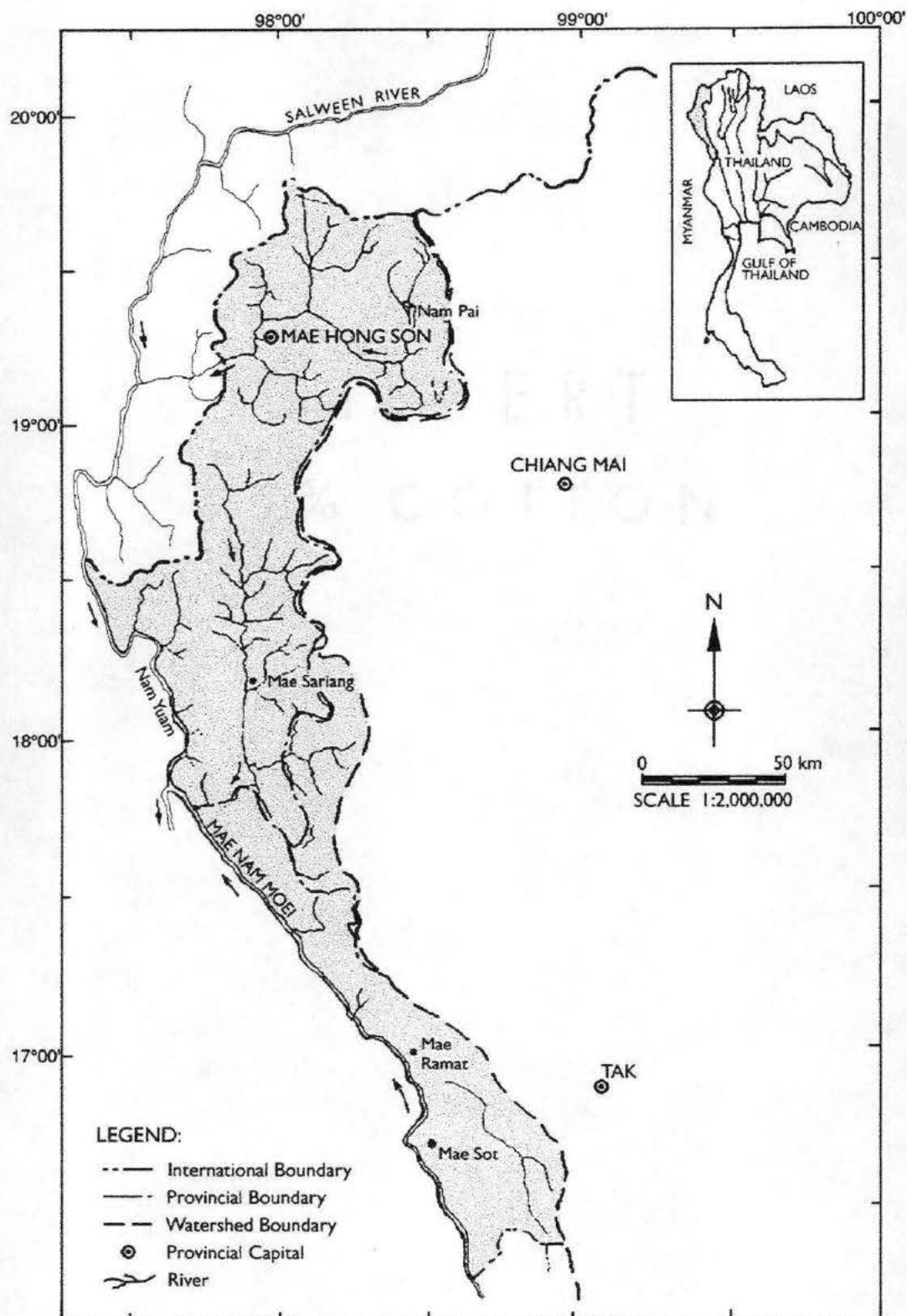


Figure 4. Location of the Salween River and Major Tributaries.
Source: Asian Institute of Technology (AIT) 1994, 2-2.

Table 4. Sub-basins in the Salween Basin (EGAT, 1984)

Sub-basin Name	Area (sq. km.)
Mae Nam Salween (main river)	17,920.19
Upper Part of Nam Mae Pai	1,111.05
Huai Mae Sa	478.00
Nam Khong	627.48
Nam Mae Pai	2,008.35
Nam Mae Samat	1,004.15
Nam Mae Surin	484.27
Upper Part of Mae Nam Yuam	1,221.65
Nam Mae La Luang	477.35
Lower Part of Mae Nam Yuam	1,892.48
Nam Mae Sariang	377.7
Nam Mae Rit	1,129.33
Nam Mae Ngao	831.05
Upper Part of Mae Nam Salween	1,201.92
Nam Mae Ngae	657.73
Upper Part of Mae Nam Moei	1,143.17
Huai Mae Lamao	1,567.26
Lower Part of Mae Nam Moei	2,084.18

Note: Adapted from AIT 1994, 3-2.

- Mae Nam Moei: The curious north-flowing Moei river has its origin in the Tenasserim Range in Tak Province. Its northwest-bound course forms thousands of kilometers of the Thai-Burmese border. Nam Moei joins the Salween at a small village called Sob Moei.¹³

- Mae Nam Yuam or Khun Yuam: Mae Nam Yuam flows southward from Mae Hong Son province to join Nam Moei before it flows down to the Salween river.

¹³ "Sob" in Thai means convergence. It is usually used for converging of rivers such as Sob Pai or Sob Moei.

The Study of Potential Development of Water Resources in the Salween River

Basin conducted by Asian Institute of Technology (AIT) for the Office of the National Economic and Social Development Board (NESDB) described the general topography of the Salween basin as consisting of longitudinal folded mountains and small, long and narrow river valleys divided by steeply rising uplands with considerable variation in elevation (AIT 1994, 2-1). The complex geography has resulted in similarly complex networks of river systems and flow directions of the main river. For example, Nam Mae Pai generally flow east-west, and Nam Mae Yuam mostly flows north-south and east-west just before it meets Mae Nam Moei. Mae Nam Moei itself flows from southeast to northwest direction to eventually meet the main Salween river which is flowing from north to south (AIT 1994, 2-1).

Thanks to arduous access and internecine wars among ethnic groups in Myanmar, the Salween remains one of the least explored and exploited rivers in Southeast Asia. Unlike some other river basins in Thailand where a number of studies have been conducted, limited studies in the Salween River basin were available. On almost all aspects, data and information collection and analysis had to start from scratch (AIT 1994, 1-1). As far as the author is concerned, there exists no comprehensive, up-to-date inventory of the Salween area. At this moment, the river's ecology is best portrayed by piecing together remnants of old and current data. A "Report on Biological Value of Salween Wildlife Sanctuary" which is a part of the *Master Plan for Management of*

*Salween Wildlife Sanctuary*¹⁴ suggested that this closed book of forests had a wealth of knowledge to offer (Forest Research Center 1991). Archaeologically, the discovery of such pre-historic evidence as rock-breaking tools, pieces of terra cotta, plant fibers (possibly used as robe), fish nets and some remains of crops at the "Spirit Cave" (*Tham Phee*) in the Salween sanctuary on the Thai side gave rise to an assumption that the area was possibly one of the world's earliest agricultural communities. The spirit-cave finding is also considered a crucial link in the study of Southeast Asia history since it might counterbalance the century-old assumption that Southeast Asian civilization was born exclusively from Chinese and Indian diffusion. (Coedes 1971; Forest Research Center 1991). Ecologically, the Salween basin is a mosaic of Indo-Burmese and Indo-Malayan faunal regions, composing mainly of tropical rainforest, hill evergreen rainforest, mixed deciduous forest and dry dipterocarp forest. Combining almost every subsystem of the world's tropical ecology, the basin is believed to be one of the most ecologically secured areas in mainland Southeast Asia (Thara 1993, 21-28).

Old records and sightings of wildlife compiled by British colonists and a few studies by Thai foresters indicated that the Salween basin, especially its estuary, is one of the last homes to a number of rare and endangered species. Wild elephants, tigers, red gores and such rarely-found birds as oriental darters, Green Peafowls as well as several

14 The Thai side of Salween Wildlife Sanctuary, covering a total area of 875 square kilometers, is located in Mae Hong Son province.

species of Hornbills are believed to still roam the forests (Chainarong 1993, 21-23; Thara 1993, 7-8).

The NESDB's report forewarned that any attempt on water resource development in the Salween basin is likely to be constrained by such conditions as a fragile nature of the watershed;¹⁵ a lack of good sites for a construction of dam/reservoir due to the combined presence of conservation forests, national parks and wildlife sanctuaries and topographical complexities; and concerns over the right to unilaterally make use of the international rivers as Thailand covers only small parts of the catchment areas, mostly near the downstream. Despite of the caution, Bangkok still looks west to the Salween as a potential cure of its chronic dearth of water.

From Electricity to Water

China, Myanmar and Thailand share 42, 53 and 5 percent of the Salween River's catchment area respectively. Although Thailand holds the least natural right to the river, it is the most aggressive party in attempts to exploit the river (Nantiya 1994b, 10-11). Echoing Prime Minister Chatichai Choonhavan's from-battlefield-to-marketplace policy, Thai Ambassador to Rangoon Mr. Veerasak Futrakul told the *Bangkok Post* that the Thai-Burmese legacy of distrust and border of conflicts needed to be changed. "It is time the

¹⁵ The watershed is classified as classes 1 and 2 (see Appendix A for a classification of forests in Thailand).

Salween River was turned from the river of conflicts into the river of cooperation which would provide both Thailand and Myanmar with mutual benefits,” he said. (*Bangkok Post* 1994d, 5).

The potential of the Salween as a resource base is enormous¹⁶. The concept of “river of cooperation” was extended to the very endowment of the Salween craved by Bangkok — the water. In 1979, EGAT conceived seven diversion projects for the Salween and its tributaries (Chainarong 1993, 14).

1. Mae Lamao - Mae Tun Project (*Status: Abandoned*)
2. Mae Jarao - Mae Tun Project
3. Upper Pai - Mae Tang Project
4. Lower Pai - Mae Jaem Project
5. Nam Ngao - Mae Tun Project
6. *Nam Moei - Mae Tun Project*
7. Upper Salween - Mae Tang Project [Emphasis added].

The final destination for every route is Bhumibhol reservoir. The smallest project (Mae Lamao - Mae Tun) would divert 380 million m³ per year while the largest one (Upper Salween - Mae Tang) would fill the reservoir with approximately 10,000 million m³ per year. Other projects would divert about 500 million m³ yearly (EGAT 1993).

¹⁶ See Appendix B: From Electricity to Water: History of Development Plans in the Salween Basin.

These dam and diversion projects had been suspended for almost a decade because of environmental concerns but were resurrected after the increasingly persistent water shortages threatened to crumble the Chao Phraya basin. Bruised by criticism about environmental effects caused by many of its dams, the beleaguered EGAT forwarded these projects to the newly-promoted Department of Energy Development and Promotion (DEDP) for further study and implementation in 1992. Interestingly, the DEDP's Director General Dr. Prates Sutabutr is also an active member of the Joint Working Group for the Development of Hydropower Projects on Bordering Rivers. Time and again, the Salween diversion plan is seen as a magic wand by top Thai politicians and planners. Former Prime Minister Chuan Leekpai told the press during a tour of drought areas in the northern province of Chiang Mai in 1993 that the Salween Project is the key to solving the water shortage (Walakkamon 1995, C8). In 1995, the then newly-appointed Minister Science, Technology and Environment Yingphan Manasikarn announced on his inauguration day that he would give national and international water development and diversion projects a high priority. Mr. Yingphan gave special attention to the potential to tap water from the Salween basin (*Bangkok Post* 1995b).

From the seven options, the DEDP singled out two projects for pre-feasibility study: the Nam Pai and Tributaries of Nam Moei and the Moei-Salween-Chao Phraya diversion projects. Since the chosen route under the Moei-Salween-Chao Phraya diversion is on the first phase for implementation,¹⁷ this thesis will examine this route as

17 According to Dr. Prates, DEDP will seek for money from the 1996 national budget for further study of this project.

the only case study. The optimum options under the Nam Pai project would require a construction of a tunnel more than 40 km long through mountains which would incur a high cost. Hence, it is unlikely they would be implemented soon¹⁸ (Appendix C: Components of the Upper Pai and Nam Moei-Mae Song Diversion Projects).

In 1994, the DEDP selected a group of consultants comprising Panya Consultants Co.Ltd., Snowy Mountains Engineering Corporation Limited and Chiang Mai University to conduct a pre-feasibility study of the Moei-Salween-Chao Phraya Diversion Project to solve the water shortage in Chao Phraya basin. Using the information and studies made by the EGAT as a base data, the pre-feasibility study commenced in September 1994 and was finished five months later in February 1995. The five main diversion routes under investigation, shown in Figure 5, are:

1. Salween-Upper Yuam Dam-Bhumibhol reservoir
2. Moei-Salween-Mae Lama Luang-Bhumibhol reservoir
3. *Moei-Huai Khanaeng (Khi Thoe)-Bhumibhol reservoir*
4. Moei-Mae Lamao-Bhumibhol reservoir
5. Moei-Ping River at the far side of Bhumibhol reservoir (Panya Consultant 1995, 1: emphasis added).

The study team named the third diversion route from Moei river to Huai Khanaeng dam and Bhumibhol reservoir and the second route from Salween to Mae Lama Luang Dam and to Bhumibhol reservoir the first and second priority for further

¹⁸ See Appendix C: Components of the Upper Pai and Nam Moei-Mae Song Diversion Projects.

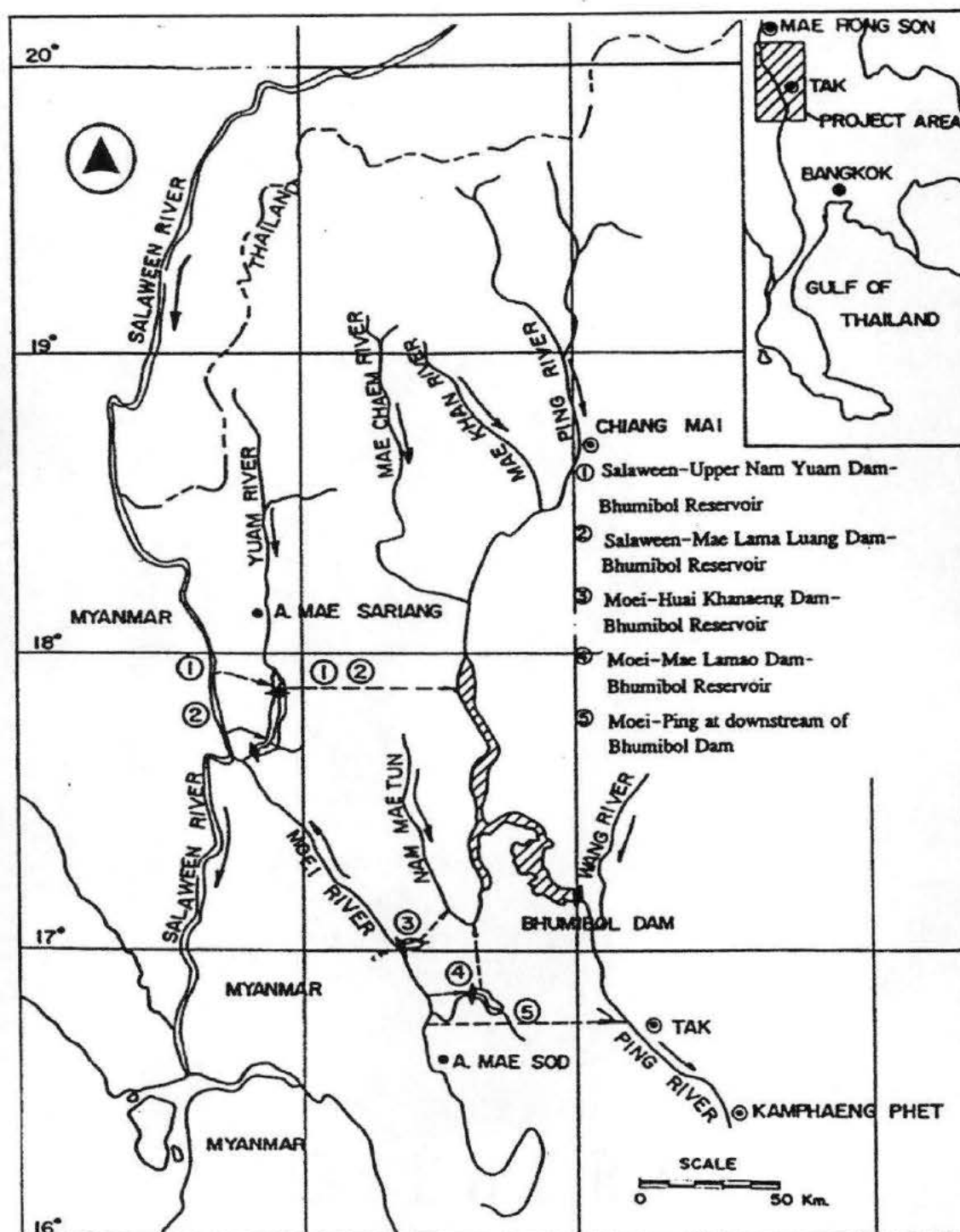


Figure 5. Diversion Routes of the Moei-Salween-Chao Phraya Diversion Project.
 Source: Panya Consultants Co., Ltd., Snowy Mountains Engineering Corporation Limited and Chiang Mai University 1995.

study respectively. The Huai Khanaeng diversion was deemed the optimum diversion in terms of cost/benefit analysis. The DEDP is apparently interested in this route because it is small-scale and likely to be less expensive (Prates 1995). According to the pre-feasibility report, the scheme would have a capacity of diverting an average of 1091.4 million m^3 of water annually: 1079.6 million m^3 from Moei River and 11.8 million m^3 from Huai Khanaeng-Khi Thoe. The annual mean runoff of Moei River is about 6,000 million m^3 . A schematic diagram of the route is shown in Table 5. Major components of the project are:

- a) A 1.4-km diversion canal from Moei River to Moei Pumping Station No. 2

The 1.4-km canal will be dug along the course of Huai Khanaeng Khi Thoe, beginning from its confluence with the Moei River.

- b) Moei Pumping Station No. 2

Two 24-MegaWatt pumps, operated by an annual average of 144 GigaWatt per hour, will be installed at the toe of Huai Khanaeng Dam to pump up water from the diversion canal to Huai Khanaeng reservoir.

- c) Huai Khanaeng Dam

The concrete face rockfill Huai Khanaeng dam would block Huai Khanaeng Khi Thoe at about 1.4 km upstream of Moei and Huai Khanaeng Khi Thoe confluence. The 41-meter-high dam would take up features studied by the EGAT in the Feasibility Study of Bhumibhol Inflow Augmentation Project Phase II in 1993. The normal high water

Table 5. Summary of the Project Features of the Optimum Diversion Routes of the Moei-Salaween-Chao Phraya Diversion Project

PROJECT DESCRIPTION	UNIT	DIVERSION ROUTE 1 Salaween-Upper Nam Yuam Dam-Bhumibol Reservoir			DIVERSION ROUTE 2 Salaween-Mae Lama Luang Dam-Bhumibol Reservoir			DIVERSION ROUTE 3 Moei-Huai Khaeng-Bhumibol Reservoir		DIVERSION ROUTE 4 Moei-Mae Lamo-Bhumibol Reservoir		DIVERSION ROUTE 5 Moei-Ping at downstream of Bhumibol Dam
		Salaween- Upper Nam Yuam Dam	Upper Nam Yuam Dam- Bhumibol Reservoir	No Diversion from Salaween	Salaween- Mae Lama Luang Dam	Mae Lama Luang Dam- Bhumibol Reservoir	No diversion from Salaween	Moei-Huai Khaeng	Huai Khaeng- Bhumibol Reservoir	Moei-Mae Lamo Dam	Moei-Mae Lamo Dam- Bhumibol Reservoir	Moei-Ping at downstream of Bhumibol Dam
		A.Sob Moei, Mae Hong Son	A.Sob Moei, Mae Hong Son	A.Sob Moei, Mae Hong Son	A.Sob Moei, Mae Hong Son	A.Sob Moei, Mae Hong Son	A.Sob Moei, Mae Hong Son	A.Mae Lamat, Tak	Huai Khaeng-Khi Thoe/Moei A.Mae Lamat, Tak	A.Mae Sod, Tak	Huai Mae Lamo/Moei A.Mae Sod, Tak	A.Mae Sod, Tak
1. Tributary / Main river basin												
2. Location												
3. River												
- Normal Water Level	m.MSL	50.0	-	-	40.0	-	-	148.5	-	169.0	-	175
4. Project Description												
4.1 Hydrology												
- Catchment Area	sq.km	295,688	4,860	4,860	295,655	6,030	6,030	6,261 (Moei)	6,261 (Moei)	5,808 (Moei)	1,395	5,444.0
- Mean Annual Runoff	MCM	112,629.38	1,371	1,371	122,629.38	2,765.8	2,765.8	4,261.1 (Moei)	4,261.1 (Moei)	3,975.2 (Moei)	457.4	3,744.3
- Design Flood	m ³ /sec	-	3,000	3,000	-	5,200	5,200	-	-	-	3,094	-
4.2 Reservoir												
- Normal High Water Level (NHWL)	m.MSL	-	155.0	155.0	-	155.0	155.0	-	189.0	-	250.0	-
- Surface Area at NHWL	sq.km	-	2.3	2.3	-	12.35	12.35	-	1.018	-	6.7	-
- Reservoir Capacity at NHWL	m.MSL	-	10.0	10.0	-	344.0	344.0	-	10.83	-	94.3	-
4.3 Dam and Spillway												
- Type		-	Concrete	Concrete	-	Rockfill with Impervious Core	Rockfill with Impervious Core	-	Concrete Face Rockfill	-	Concrete Face Rockfill	-
- Crest Elevation	m.MSL	-	159.0	159.0	-	160.0	160.0	-	192.0	-	253.5	-
- Height/Length of Crest	m	-	24/75	24/75	-	100.0/330.0	100.0/330.0	-	42.0/270.0	-	60.0/203.0	-
- Spillway Gate	m	-	4 x 9.0 x 10.5	4 x 9.0 x 10.5	-	4 x 10 x 18	4 x 10 x 18	-	2 x 6.0 x 6.73	-	3 x 100 x 10.1	-
4.4 Turbine												
- Type		-	-	-	-	Vertical Shaft Francis	Vertical Shaft Francis	-	-	-	-	-
- Installed Capacity	kw	-	-	-	-	2 x 49,500	2 x 49,500	-	-	-	-	-
- Design Discharge	m ³ /sec	-	-	-	-	150.35	150.35	-	-	-	-	-
- Design Head	m	-	-	-	-	76.0	76.0	-	-	-	-	-
4.5 Average Annual Energy Generated	GW.h	-	-	-	-	225.1	225.4	-	-	-	-	-
4.6 Irrigation Area	rai	-	-	-	-	-	-	-	-	-	-	-
5. Diversion System												
5.1 Optimum Diversion Capacity	m ³ /sec	Diversion from Salaween	Diversion from Yuam	Diversion from Yuam	Diversion from Salaween	Diversion from Yuam	Diversion from Yuam	Diversion from Moei	Diversion from Moei	Diversion from Moei	Diversion from Moei	Diversion from Moei
5.2 Average Annual Water Diversion Volume	MCM	100	100	70.0	100	100.0	100.0	100.0	100.0	80	100	70
5.3 Water Conveyance												
- Canal Width	m	-	-	-	-	-	-	-	-	-	-	-
- Canal Length	km	-	-	-	-	-	-	-	-	-	-	-
- Average Water Level	m.MSL	50.0	154.2	154.23	40.0	150.76	150.76	147.20	188.69	166.0	243.6	175.0
- Pumping Station		1	1	1	1	1	1	1	1	2	1	1
- Pump Type		Radial Flow Vertical Shaft	Radial Flow Vertical Shaft	Radial Flow Vertical Shaft	Radial Flow Vertical Shaft	Radial Flow Vertical Shaft	Radial Flow Vertical Shaft	Radial Flow Vertical Shaft	Radial Flow Vertical Shaft	Radial Flow Vertical Shaft	Radial Flow Vertical Shaft	Radial Flow Vertical Shaft
- Pump Capacity	kw	151,000	204,000	142,000	156,000	208,000	208,000	48,000	162,000	38,000/49,000	96,000	19,000
- Total Pumping Head	m	136.53	184.45	183.42	141.05	188.07	188.07	43.4	146.5	42.95/55.38	86.80	24.5
5.4 Conveyance Tunnel												
- Diameter	m	4.7	4.7	4.1	4.7	4.7	4.7	5.0	4.7	4.3/4.3	4.7	4.1
- Length	m	720	940	940	910	94.0	94.0	230.0	540.0	95.0/150.0	450	18.0
- Outlet Level	m.MSL	177.0	328.0	328.0	170.0	328.0	328.0	188.69	331.64	205.0/247.48	322.0	193.0
5.5 Storage Tank												
- Diameter	m	25.3	25.3	21.2	25.3	25.3	-	-	25.0	20.0	25.0	-
- Height	m	21.2	21.2	18.2	21.2	21.2	-	-	20.0	20.0	20.0	-
- Water Level	m.MSL	183.0	334.0	333.28	176.0	334.0	334.0	-	331.64	208.0/253.0	328.0	-
5.6 Diversion Tunnel												
- Diameter	m	7.5	7.5	6.6	7.5	7.5	7.5	-	7.5	6.9	7.5	6.6
- Length	km	21.2	67.4	67.4	14.5	67.4	67.4	-	15.85	2.80	23.35	47.8
- Outlet Elevation	m.MSL	155.0	260.0	260.0	155.0	260.0	260.0	-	316.0	250.0	293.0	140.0
6. Average Annual Pumping Energy	GW.h	634.2	1,393.5	450.9	513.07	1,414.92	730.81	144.0	491.1	106.29/137.06	270.69	27.5
7. Transmission Line												
- Route		Salaween Pump No.1- Nam Yuam Pump	Nam Yuam Pump- Chiang Mai Substation 3	Chiang Mai Substation 3- Nam Yuam Pump	Salaween Pump No.2- Mae Lama Luang Dam	Mae Lama Luang Dam- Chiang Mai Substation 3	Mae Lama Luang Dam- Chiang Mai Substation 3	Moei Pump 2- Huai Khaeng Pump	Huai Khaeng Pump- Tak Substation 2	Moei Pump 3/1- Mae Lamo Pump	Mae Lamo Pump- Tak Substation 2	Moei Pump 4- Mae Sod Substation
- Distance	km	33	175	175	17	200	230	85	5	12.5	68.0	17
- Voltage	kV	230	230	230	230	230	230	230	230	230	230	115
8. Project Cost (1994)	million Baht	19,591.38		11,408.88		23,173.03	18,173.69		7,987.12		11,684.94	7,018.34
9. Economic Evaluation (Discount rate 10%)												
- Net Benefit	million Baht		3,231.15	-2,647.16		5,127.99	654.80		5,028.74		315.95	-2,940.13
- Benefit-Cost Ratio			1.08	0.85		1.11	1.02		1.34		1.02	0.65
- Internal Rate of Return	percent		11.39	7.89		11.94	10.33		15.44		10.24	6.20

Source: Panya Consultants Co.,Ltd., Snowy Mountains Engineering Corporation Limited and Chiang Mai University. Department of Energy Development and Promotion. The Pre-feasibility Study of the Moei-Salaween-Chao Phraya Diversion Project. Bangkok: Ministry of Science Technology and Environment, 1995.

level would be at +189.0 m.MSL, the crest elevation at + 192.0 m. MSL and an active storage of 1.33 million m³.

d) Huai Khanaeng Pumping Station

Two 81-MW pumps operated by an annual average of 491 GWh would be installed at the upstream end of Huai Khanaeng reservoir to pump water via a 420-meter iron-cast tunnel to a storage tank at a water level of +335.0 m. MSL. The water would then be fed by gravity through a 18.5-km water tunnel to Nam Mae Tun River, near Bue Mee Tha village. Nam Mae Tun River drains into the Bhumibhol reservoir (Panya Consultants 1995).

The Cost of the Transfer

In theory, the Huai Khanaeng-Khi Thoe diversion would provide more water supply for domestic use, navigation, salinity control and industrial use in the Chao Phraya basin. The diverted water should help irrigate about 0.6 million more *rai* of agricultural lands in the Chao Phraya basin during the dry season and increase 284.3 GWh of energy produced by Bhumibhol power plant. Although local agricultural communities are placed in the list of the project's beneficiaries, Dr. Prates made it clear that the chance of water or energy derived from the project being used in the locale is slight, if any. The diversion is aimed at replenishing the Bhumibhol reservoir (Prates 1995; Kinghor 1995, 3).

Although the dam would be situated on Thai soil, it is by no means a scheme to take advantage of the Thai water resources. The Huai Khanaeng's flow, even in the rainy season, meanders sluggishly with the widest part narrower than 2 meters (Figure 6 to 9). The site's potential lays not in the in-stream flow, but in a gorge-like ridge that could possibly house a dam. Being remote and sparsely populated might well be another plus. To fill in the reservoir, the water will be drawn from the much larger Moei River. An international river by any standards, the Moei forms over a thousand-km of the Thai-Burmese borderline, even longer than the Salween (Figure 10-13).

The cost of the project, estimated for 1994, is 8,000 million baht. Though DEDP gave a picture of Huai Khanaeng diversion as a very small project that entails almost no impact on the environment, certain aspects of the project trigger serious concerns. The Huai Khanaeng dam site, Moei Pumping Station No. 2 and Huai Khanaeng Pumping Station would be situated in the Mae Ramad National Reserved Forest and a watershed classified as Class 1A and 1B (Appendix A: Watershed Classification in Thailand.) The reservoir would inundate part of Mae Ramad National Reserved Forest (Figures 12, 13 and 14). The pre-feasibility report stated clearly that the diversion canal will affect the forest and the watershed because it is located in the conserved forest area and watershed class 1A (Panya Consultants 1995, 6-7). Also, some forests would be cleared to access the tunnel. Four households in Khi Thoe village would be evicted, according to the report. EGAT officials were quoted as claiming that Huai Khanaeng dam will have less effect on communities than any of the dams that have been built so far (Walakkamon

1994, C8). Visiting the proposed dam site, Walakkamon argued that as many as 51 families from Karen communities may be adversely affected by the project. These people were not considered for compensation because they are said to be refugees or nomads who are not recognized by either Thai or Burmese law (Walakkamon 1994, C8). Mr. Chatchawan Sawasdirerk, EGAT's deputy chief of the project was quoted as saying that:

These Karens illegally occupy the land. There may be no need for use to pay them compensation. But we will find the best solution for them (Chatchawan quoted in Walakkamon 1994, C8).

Mitigation measures would be needed for a disposal of excavated materials. For this issue, the pre-feasibility report did not specify any possible sites nor methods. Mr. Choolit proposed that the project implementors dump the soil in a small non-1A catchment area. Trees should be planted to prevent an erosion which is likely to happen given the poor aggregate stability and ease of erodibility of the top soil in Mae Hong Son province (AIT 1994, 2-5). Mr. Choolit did not give an example of the qualified sites.

There is no report on what will happen to the water importing and exporting areas. Empirical evidences are rare as the technology is relatively new for the country. Reports from such similarly small-scale transfer of water as the Tennessee-Tombigbee Waterway in the United States confirmed that water logging of soil and aquifer drawdown is associated with an interbasin water transfer (Cummings 1974). In this case, ecological change of the Mae Tun River, which will serve a receiving end of the diversion, will become a major concern. Will Mae Tun have a capacity to carry more water than its normal condition? What will the effects be of the unnatural increase and expansion of its

flow? Will fish and wildlife be impacted? It must be reiterated that what would be diverted through the tunnel from the river Moei to Mae Tun is not only pure, ready-to-mix water but also all the unique characteristics and biota acquired by the Moei River from the diverse geography and environment it passes by. Will the mixing of water from two different sources with a different level of velocity, turbidity and sediment load, change the river's ecology? At this stage, in the point of view of Mr. Choolit, who supervised the pre-feasibility study, these are unanswerable questions.

So far, we have only secondary data on Mae Tun. We don't have a record on the river's mean flow or flood level. So I cannot tell if we would have to expand the water channel in Mae Tun to cope with the increased water. All we know now is that the river is virgin. Its water quality is probably more original than Huai Khanaeng or Moei, which are used by many human settlements. (Choolit 1996)

Dr. Nithi Eoaseewong, a professor of history from Chiang Mai University who has studied issues concerning water resources in the northern region, expressed concern over the rivers' natural ebb and flow. He was certain that decreasing the volume of Nam Moei and increasing the volume of water into Mae Tun river without respect for seasonal flow would affect the river's ecology. With hi-tech measurement and statistics, planners treated the river as if it were a pipeline, without any living organisms or biota (Nithi 1996).

The severest impact on the forest and watershed is expected to result from the transmission line. The two pumping stations require an energy through double-circuit, 230 KV line for their operation. According to the pre-feasibility report, about 42 km of

the 90-km transmission line will pass through the national reserved forest. The line of 24-km length would be in the watershed class 1A while 0.5 km in watershed class 1B.

Mr. Choolit said that building a direct line would save the cost but at the expense of more losses in the watershed class 1A. An feasible option is to lay down a longer, more winding line along the existing road systems. The engineer is quite certain that the increasing cost would not ruin the project's B/C ratio. He also added that it would be a good idea for the government to give something to the local communities in return for the lost water. Educational development was cited as an example.

Fighting between the Burmese junta and armed minority groups poses security problems in the area. The Huai Khanaeng dam site is only 40 km from Tha Song Yang district, which was recently attacked by Burmese and Karen soldiers. Mae Hong Son Governor Somjet Viriyadamrong is concerned that the diversion, carried on unilaterally, might hamper Thai-Burmese relations. The argument boils down to the question of water rights: whether Thailand is entitled to drawing the Moei water unilaterally. After all, both the Salween and Moei are international rivers. Dr. Prates's rationale is Thailand can claim the 5 percent of its natural right to the Salween catchment area. Along this line of thought, Bangkok assumes that it is entitled to using about 6,000 million m³ of water from the watershed without asking for permission from its Burmese counterpart. By pumping the water up only during the rainy season, the director hopes that downstream impacts will be minimal.

Personally, DEDP's Director General did not think Rangoon would be interested in this project as their natural resource priorities are gas, then water, fisheries and timber respectively. Even so, he said he would rather complete the feasibility study for Huai Khanaeng Project before seriously approaching the Burmese government. The DEDP would build its case on whether a notification is enough for projects concerning international property inside the Thai territory (Prates 1995). Asked whether Thailand should continue the apparent natural resource politics with the Burmese junta, which is notorious for human right abuse, Dr. Prates's answer is a question — why not?

They have both water, fish and timber. Politics is their business not ours. I think Myanmar is and will be more interested in economic growth than environmental integrity. They can't afford it. They don't even have basic infrastructure at present. (Prates, 1995)

For Dr. Prates, the beauty of an interbasin transfer is DEDP would not have to invest in a new infrastructure. The Huai Khanaeng project would simply maximize the use of the existing reservoir, power plant and irrigation channels of Bhumibhol Dam.

I consider the water transfer a must. Within ten years, we will definitely have to build one, as long as the Bhumibhol dam is still empty. It is an all-out profit. The construction and maintenance cost of taking the water from the Salween is only a little more than one baht per cubic meter. People in 22 provinces in the central plain that get the water will be happy (Prates 1995).



Figure 6. The Area Where the Dam Structure Will be Located.
(Picture Courtesy of Mr. Choolit Vatcharasinthu and
Panya Consultants Co., Ltd.)



Figure 7. The Huai Khanaeng Dam's Reservoir Area.
(Picture Courtesy of Mr. Choolit Vatcharasinthu and
Panya Consultants Co., Ltd.)



Figure 8. Huai Khanaeng Stream At the Beginning of the Rainy Season, 1996.
(Photograph by Mr. Smith Sutibut.)



Figure 9. *Sob Huai Khanaeng*, The Place Where Huai Khanaeng Stream Flows Down to the Moei River, Tak Province, Thailand. (Photograph by Mr. Smith Sutibut.)



Figure 10. The Moei River, Which also Serves as the Border Between Thailand and Myanmar, at Tak Province, Thailand. (Photograph by Mr. Smith Sutibut.)

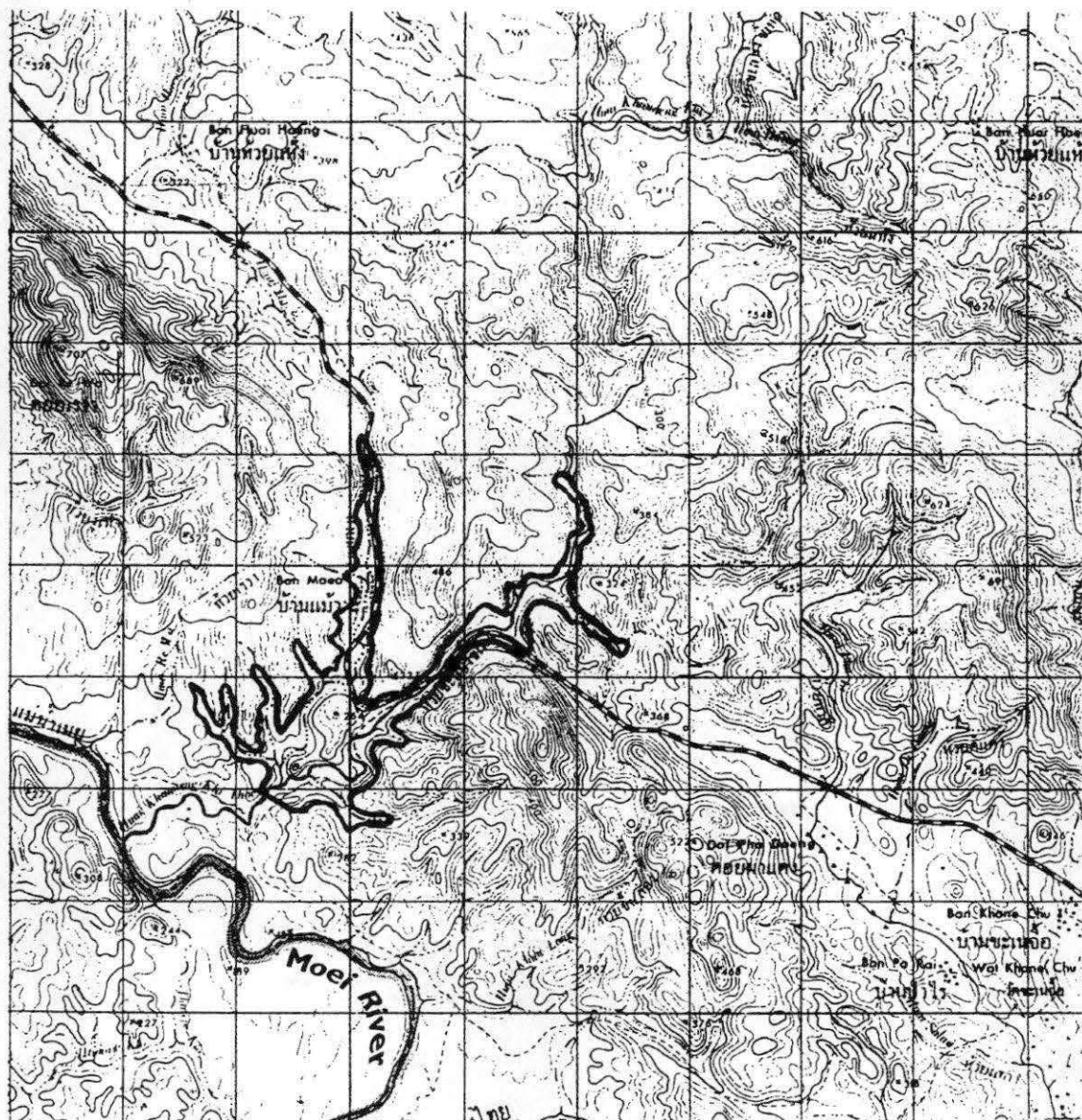


Figure 11. The Author's Estimate of the Flood Area (1:50,000, Approved by Mr. Choolit Vatcharasinthu Who Supervised the Study).



Figure 12 . Elevation Marks Found at the Proposed Dam Site. The Normal High Water Level of Huai Khanaeng Reservoir, According to the Pre-Feasibility, is 198.0 m. MSL . (Photograph by Mr. Smith Sutibut.)

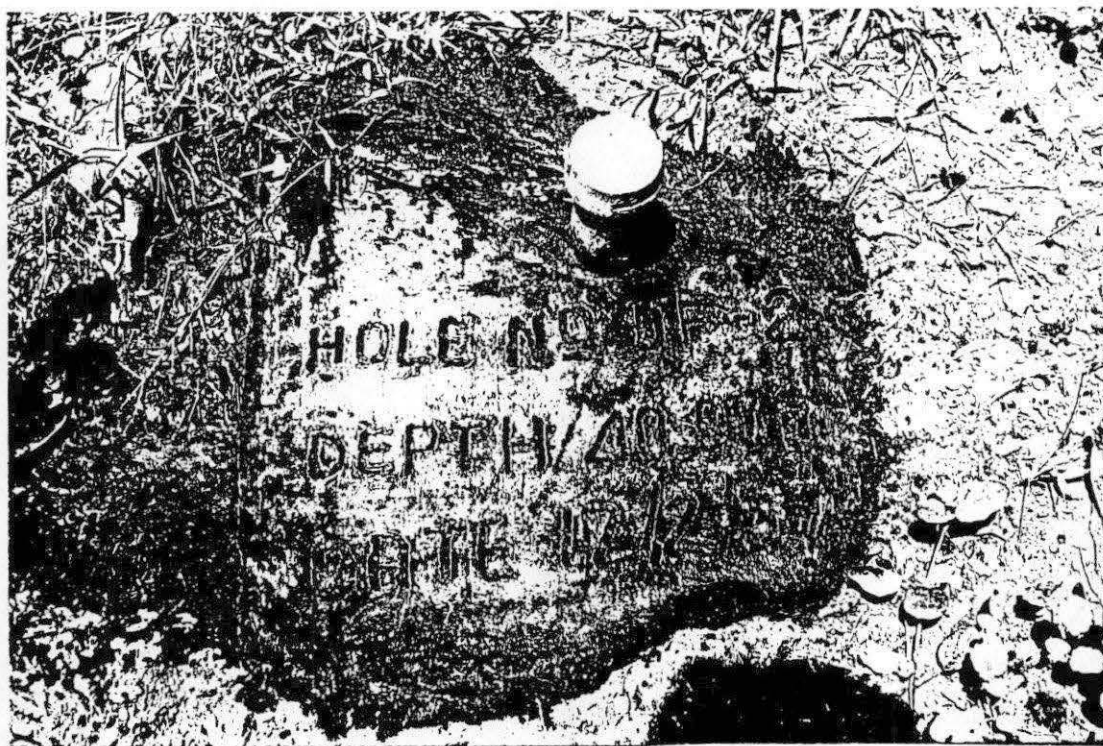


Figure 13. Soil Study Marks Found at the Proposed Dam Site.
The Normal High Water Level of Huai Khanaeng Reservoir,
According to the Pre-Feasibility, is 198.0 m. MSL .
(Photograph by Mr. Smith Sutibut.)

CHAPTER IV

DEPENDENT AND UNEQUAL

Of all the cities of Southeast Asia, the primate city *par excellence* — indeed, perhaps the world's best example of a primate city — is Bangkok, the capital of Thailand. (Rigg 1991, 133)

Records of past climate and hydrological conditions may no longer be a reliable guide for the future. Likewise, Jonathan Rigg made a solid point in indicating that the water shortage of 1992-1994 might turn out to be “an isolated event, not indicative of a general trend in the future” (Rigg 1995, 24). The significance of the incident, however, is it does bring to light many explanations of the cause of the water shortage and the solutions that have been offered. Seen in this light, projecting future water shortages is not worth examination. This thesis will, therefore, concern itself with the content and manner in which this debate progressed, which epitomized a macroscopic clash between economic growth and degradation of natural resources. It will also address the tenacious power of perception and the widening disparity between the urban and rural sectors, which promises to intensify in the next century.

Dispositional and Allocative Bias: Space

Entwined in a backdrop of the water crisis and ostentatious relief efforts are spatial inequalities and the super-primacy of Bangkok. Although the 1992-1994 water

shortage was ravaging nation-wide, with the worst effects in the Northeast, the shortage in the lower Chao Phraya basin was addressed first. The central region has been the main beneficiary of water supply projects. In a situation when demands from different uses are growing unabated and supplies are reaching the limit, the state wants the rural sector and outlying provinces to sacrifice for the well-being of Bangkok (Thitinan 1994, 244) .

“Urban bias”¹⁹ in the distribution of water resources is clearly reflected in the Royal Irrigation Department’s preliminary plan for water management and distribution, issued in after the 1992 shortage (RID 1992, 8). The six-month plan, to be implemented from January 1 to June 30 (which is an official no-rain period according to the RID’s standard), designated which activities and users would receive a higher priority and, as a result, a larger supply of water. At the end of December 1992, a total of 3,900 million m³ was anticipated to be kept in the Bhumibhol and Sirikit reservoirs. A portion of 2,400 million m³ would be allocated for domestic use in twenty-two provinces in the Central Plain. From this portion, Bangkok took as much as 500 million m³. The remaining 21 provinces, with numerous rice fields and orchards, had to make do with about 90 million m³ of water per province (Table 6). Dr. Jermsak Pinthong, a well-known rice researcher from Thammasat University, was quoted as commenting that whatever the net volume of water in the reservoir is, the BMA is always the first priority (Jermsak quoted in Vanchai

19 Rigg defined “urban bias” as policies that “favor urban development and urban populations at the expense of farmers and the countryside. . . . These policies can include industrial incentives, the taxation of agriculture and the subsidization of staple foods, overvalued exchange rates, tax breaks for industry and investment in — and subsidization of — urban services and infrastructure” (Summarized from Rigg 1991, 138 and Jones 1988, 145-7).

1993, 127). Combating sea-water intrusion and diluting polluted water comes second.

The left-over, then, is channeled off to farmers for their production.

Table 6. Preliminary Plan for Water Management and Distribution

Activities	Quantity of Water (Million Cubic Meter)
Domestic use of people in 22 provinces	2,400
Driving out salt-water intrusion	600
Inflow from January to June, 1993	500
Evaporation and loss ²⁰	500
Water reserved for the 1993 rainy season	900

Source: RID 1992, 4.

When asked why the BMA is privileged over the other provinces in the region, Mr. Den Tohmeena, the then Deputy Minister of Interior, who is in charge of the Metropolitan Waterworks Authority (MWA), told the daily Thai-language newspaper *Phujadkarn Raiwan* that the communities under the MWA's supply had to depend solely on piped water²¹. They could not take care of themselves. The outer provinces were closer to water sources, thus, not as helpless (*Phujadkarn Raiwan* 1993, 5). The statement mirrors an a priori superiority of the capital which is a result of an "urban bias"

20 It is noteworthy that according to the table, the amount of inflow into the dam and water losses from evaporation is roughly the same. The dam, then, is not capable of holding any water during the dry period when demands are at their peak.

21 The MWA provides water for Bangkok and three adjacent provinces: Thonburi, Nonthaburi and Samut Prakarn. Its service covers an area of 3,082 sq. km and 7.5 million users. Demands for MWA water are growing so fast that the agency is predicted to run out of the provision unless a new source of supply is secured.

model of economic development Thailand has pursued since 1960s (Pawadee 1987, 185). Similar to other Southeast Asian primate cities, Bangkok thoroughly dominates the rest of Thailand. The 1,500-sq km city is the functional core of the nation, commanding political and economic activities while dictating social and cultural life. Its near prototypical primacy has given rise to such notion as “Bangkok is Thailand” and “the Thai state is a Bangkok-based state,” — conditions which are hard to dispute since Bangkok is about 30 times larger than the second city (Rigg 1991, 156). From about 10.2 million persons residing in municipal areas in 1990²², almost six million (58.8 percent) were in Bangkok (NSO 1992). Bangkok’s population size was ranked the 24th largest in the world in 1990 and is projected to reach the 21st rank by the year 2000 (United Nations 1991). Bangkok Metropolitan Area generates over 50 percent of gross domestic product (GDP), processes 95 percent of imports and exports and has a per capita monthly income over two times higher than the national average (Paichitr 1993, 220).

From the publication of the First National Economic Development Plan²³ (1961-1966) onwards, the country has preferentially allocated resources to industries and the urban areas (Pawadee 1997, 185). Taxes and tariffs are imposed to favor the modern sectors of the economy at the expense of agriculture and rural communities. If

22 The official definition of urban areas in Thailand is equated with municipal areas. This classification excludes all the urban areas at the lower end of the urban hierarchy — the so-called sanitary districts which might be larger. If these sanitary districts are included in the definition of urban, then Thailand’s urban population and level of urbanization will be increased by a sizable margin. (Summarized from Thienchay and Suwanee, 1985: 49).

23 The National Economic Development Plan is a formal five-year plan for national development prepared by National Economic Development Board (NEDB), presently renamed the National Economic and Social Development Board (NESDB). Acting on recommendation from an economic team from International Bank for Reconstruction and Development (IBRD), the government of Thailand set up NEDB in 1959. The underlying philosophy of economic planning is a commitment to a market economy. So far, 8 Plans have been drawn up (Ramangura, 1990: 200).

colonialism is grounded upon an ideology that certain territories and people require and beseech domination (Said 1994), the exploitation by the city and the underlying supposition that Bangkok deserves amenities at the cost of rural provinces is nothing but an internal colonization.

Efficiency and Equity

According to Michael Lipton, the two central features of any 'best' policy are efficiency and equity²⁴, though it also happens that the most efficient policy is seldom the fairest (Lipton 1982, 45). Allocations between the two norms can be ambivalent, being urban biased with respect to equity but rural-biased with respect to efficiency. Lipton observed that many developing polities deliberately mapped out policies to shift resources away from rural areas until too little is left for efficiency *or* equity. By trading off the immediate fairness for a longer-run industrial growth, planners believed that the urban prosperity would eventually trickle down to the rural poor. However, Lipton thought that the vision was far from realistic. For him and many others, urban biased policies are self-defeating, causing the persistence of poverty in developing countries (Lipton 1982, 70).

[M]any of the resources allocated by the state to city dwellers would have earned a higher return in rural areas; that private

24 According to Lipton, the allocation of resources is efficient if and only if it is impossible to increase total national output by shifting one or more resources among product lines, and/or by improving the technique in one or more product lines. Equity, he noted, is controversial and perhaps impossible to define. Yet, any 'equity norm' must imply among other things distributing long-run income so as to maximize welfare (Lipton, 1982: 50-53).

individuals, furthermore, were indirectly induced by administrative decisions and price distortions to transfer from countryside to town their own resources, thereby, reducing the social (but increasing the private) rate of return upon those as well; and that, ultimately, inadequate inputs of rural resources substantially reduced even the efficient use of urban resources.

To summarize Lipton's idea, allocations that are biased townwards with respect to the efficiency norm are almost certainly biased with respect to the equity norm as well. True to the mode, the 'backwash' process which channeled most of the limited water to Bangkokians is a deviation from both efficiency and equity (to count only water for domestic use). Editor of *Feature Magazine*, Mr. Vanchai Tantiwithayaphithak,²⁵ wrote that, "like it or not, it is time to admit that city dwellers are overusing, misusing and wasting water" (Vanchai 1993, 127). Whereas irrigation which is essential for food production and security has, by and large, been blamed for the water deficit, the special status of the capital city obscures the reality that a large portion of urban water is used for convenience and comfort. Mrs. Chuanpit Dhamasiri, Governor of the Metropolitan Waterworks Authority (MWA), estimated that people in the rural sector use about 100 liters per person per day while city dwellers consume about 450 to 480 liters per person per day²⁶. With the economy expanding, which will bring along a higher standard of living, the urban rate of water consumption is expected to increase up to 640 liters per person per day — over six times higher than an average amount for basic needs which is

²⁵ Feature Magazine is a leading Thai-language magazine in environmental conservation, sociology and culture.

²⁶ Other estimates including that of Project for Ecological Recovery gave a much lower rate of about 50 liter per person per day ("Water Management Problems" 24).

estimated at 50 to 100 liters per person per day (Yos 1993, 22). The governor also admitted that within the BMA areas, such habits as leaving the tap running unnecessarily, contributed to up to 20 percent of water losses (*Phujadkarn Raiwan* 1996, 5). Ironically, the city's inefficiency coincided with parched paddyfields and poor farmers leaving the rural livelihood for an unknown destiny in urban slums. Executive Director of the United Nations Centre for Human Settlements, Archo Ramachandran raised the paradoxical question during the International Conference on Water and the Environment, held in Dublin, Republic of Ireland in 1992:

How can one justify a situation in which one section of society cannot obtain enough water for a basic healthy life while on the other side of town others have copious, cheap and often highly subsidized supplies with which to water their gardens and wash their cars? (Ramachandran quoted in Sanitsuda 1992, 25).

According to *Phujadkarn Raiwan*'s special series on the 1992-1994 water crisis, perception is a forceful sculptor of habits (*Phujadkarn Raiwan* 1993, 5). Because of the closeness to the Chao Phraya river or the regular flooding, people in the BMA held on to the endogenous myth of abundant water. The problem is their perception of the availability of water has never been allowed to adapt naturally along with a general decrease in the supply because the government intentionally insulated the space and user group from the real circumstance of scarcity. The MWA sustains the false view by assuring that the city taps would never run dry. This spatial distortion of the so-called water crisis might explain why the government-initiated campaign urging the urban users to conserve the water was a complete failure. Based singly on advertisement-related

activities, the campaign wound up with only 7 percent change of behavior (*Phujadkarn Raiwan* 1996, 5).

Intersectoral Bias and Government Failure

Since the effects of the 1992-4 water deficit had to do with intersectoral, concomitant and competing uses/users, the government's intervention was unavoidable. The Thai government's actions and policy leave considerable room for questions about its reductionistic approach and uncoordinated response to the problem. The crisis confirmed an official dethronement of the role of the agricultural sector in economic modernization. As soon as the supply was short in 1992, RID mandated that *na prang* or second crop farming was the culprit and, subsequently, became the first sector to go dry. The drastic decrease of irrigated areas in the following dry season meant a collapse of livelihood for hundreds of farming families. Prasong reported that out of an estimated 5.5 million *rai* of farm lands under the irrigation networks, water had been enough for a combined rice field of about one million *rai* only during the past few years. For profits or sheer survival, many farmers took the risk still and cultivated up to three or four million *rai*. Certainly, water was not spared for them. The green rice seedlings soon turned yellow and withered away in the un-flooded fields. The result was a total or partial damage to the paddy and a deeper plunge into a cycle of indebtedness for the growers (Prasong 1996, 17).

Despite the ubiquitous ‘farmers as a backbone of the country’ eloquence, when it comes to who will get what, the urban and industrial sectors prevail over the agricultural communities. Inconsistency in the government’s policies was glaring in the hasty denouncement of *na prang* farmers. When a comparative advantage of Thai rice was revealed in the worldwide food shortage after World War II, the Thai government sunk massive investment into the development of irrigation and canal systems for rice culture in the Central Plain and began urging farmers to plant two rice crops a year to occupy the potential export niche.²⁷ The subsequent expansion of both *na pi* and *na prang* — made possible by the Green Revolution, including hybridization of seeds and agricultural mechanization — earned substantial income and foreign exchange for the government. (Rigg 1992, 1; Montgomery 1994, 232; Small 1973). Rice producers were heavily taxed through the rice premium, a form of tax imposed on shippers which was then passed back to farmers (Rigg 1992, 1). Obviously against the interest of those who farm, one of the objectives of rice premium is to depress the price of rice in urban areas. Between 1955 and 1966, the rice premium represented a tax to the farmer of over 80 percent and accounted for 11 to 14 percent of the total government revenue (Rigg 1987, 23). Although the rice premium is the most researched and the most disputed policy element in the Thai economic history, no one questioned that it has seriously disadvantaged agricultural producers and benefited urban consumers. The rice premium, along with

27 The Siam Canals, Land and Irrigation Company was established in 1988 to open lands of the lower Chao Phraya delta to rice culture to meet the demand created by trade treaties signed with Western countries. Seeing the niche of rice as a top income earner, the government later revived the costly Greater Chao Phraya Project, featuring a dam across the Chao Phraya river at Chai Nat province and a vast network of irrigation channels.

other implicit policies, has helped encourage rural-urban migration, by making the opportunity cost of working in the city more attractive (Pawadee 1987, 189-190). Controversial for bringing more hardship to the poor, the rice premium was finally abolished in 1990 (Rigg 1995, 23-4).

Ignoring that the growth of dry-season farming to become one of the biggest consumers of water in the Chao Phraya basin was a product of its own promise and promotion, the Thai government punished the dry-season farmers as soon as the crisis descended. Citing what he called "one of the most glaring inconsistencies to date in the area of Thai water management," Christensen wrote that in 1994, the Thai government launched the largest paddy price guarantee program in the country's history. The period during which the program was implemented, however, coincided with the tightest ever dry-season water supplies in the Central Plain. The government was at one and the same time restricting surface water allocation in the Central Plain's irrigation system at record extremes, while conducting a paddy-pledging rice price support scheme which was subsidizing farmers to grow rice, the most water intensive of all crops grown in Thailand (Christensen 1994, 67).

The Cabinet was providing strong incentives for farmers to grow rice while at the same time, instructing the Royal Irrigation Department to restrict water supplies in the major rice-growing area in order to maximize water delivery to Bangkok residents. This was the same government which was trying to build up support among both urban and rural voters. Political priorities came into conflict with common sense, making public policy inconsistent and ultimately unenforceable.

The government faltered in another policy encouraging farmers to grow soya beans, mung beans or sugar-cane which are short-lived and less water-intensive in the dry season. There are many explanations for the shortcoming. First, the irrigation and canal systems in the Central Plain are designed specifically to suit rice production. Slow drainage and long period of flooding made it difficult for other crops, especially dry-root ones, to survive. In this light, then, the farmers are given no choice at all. Like it or not, they are stuck with rice. Second, a number of farmers are reluctant to make the change because they get a higher yield and better price for dry-season rice than they do from the rainy season harvest and the other crops. Some farmers, in the final analysis, decided not to plant anything at all because they feared, rationally, that the little water in almost exhausted irrigation canals would not be enough for any plants to grow till they bear fruits. To make it through the harsh dry season, this group might have to either go to Bangkok to sell labor or send their children to work.

Because irrigation water is heavily subsidized — in fact most farmers get it free of charge — Jonathan Rigg deduced that farmers have no incentive to use water efficiently and are wasteful. He acknowledged that farmers as a group are the poorest segment in the Thai population, many too poor to afford even the subsidized price of water. To pin the 'blame' on the farmers is, therefore, not only "practically difficult but also emotionally hard" (Rigg 1995, 28).

I would argue that Rigg drew a valid conclusion from a fallacious causality. In an absence of social structure, historical and class analysis, the inference makes it not only

‘emotionally hard’ but dangerous because it risks punishing the circumstantial victims for the crimes they do not commit. That the charge to farmers does not reflect a full cost or investment in irrigation facilities might indicate that the farmers have no incentive to save, however, this fact does not necessarily mean that the farmers are inefficient users *by their behavior*. After all, a high percentage of water losses in irrigation is due to leakages in the unlined or poorly designed irrigation channels. A historical context as to how the second-crop farming came into being and the state’s urban bias policies especially those that depress prices of staple food is indispensable if one is to appreciate the dilemma in which Thai farmers are trapped.

In a pure economic sense, water used for agricultural activities is relatively low-value and low efficiency. Beyond the commodification, however, water is an intrinsic part of cultural integrity — not only as a resource that sustains life but part of the livelihood itself. In agrarian societies, plants and planting have extensive and more profound meaning than food production. Their relation to human — people’s domestication plants, the man-plant adaptation, tools and technology chosen, responsibility and ties to the land — has shaped the elusive yet crucial thing called culture. Rice is to Thai people as maize is to Mexican villagers. It is not only a staple food or the country’s most important crop but also a center of their culture (Anderson 1954, 181).

In many regions in Thailand, water, objects or processes related to wet rice culture are deified. In fact, Rigg himself noted that “rituals and songs which dwell upon the

vagaries of the monsoon, or which are designed to ensure the prompt arrival of the rains — such as the *boon bang fai* (skyrocket) festival of Northeastern Thailand and Laos — all indicate the central role that water plays in the life of farming families in the region” (Rigg 1992, 1). Given these illustrations and more, I would argue that the intricate relationships and interdependence between human and availability of water make a strong motivation to avoid the “tragedy of the commons” scenario where farmers appropriate the water and waste assimilative capacity of the water course for their own benefits. The importance of the water-agriculture-culture link to the continuance of village communities is immeasurable, yet, grossly overlooked (Iam 1994; Iam 1995; Sujit 1989).

Rural-Urban Migration

Even when the share of agriculture in GDP has declined to 12 percent, it remains the largest employer. Over sixty percent of Thai population work on the farm, mainly growing rice. For several years, many rural Thais have been fairly mobile and they have been traveling to and working in Bangkok. The development of road systems, coupled with the decreased availability of farmland and widened disparities between Bangkok and the rest of the country made migration to the capital a more attractive proposition. For some rural poor, it is even more a necessity than an option (Rigg 1991, 135). To gain an access to better education, health care and other services, individuals have to go to

Bangkok. Even so, there is a report that the 1994 drought had turned a normal dry-season flow of workers to the capital into a torrent of mass migration. That year, the government estimated that about one million rural people went to Bangkok in search for jobs (Fairclough and Tasker 1994, 22). The migrants may find a rightful place as a backbone of the labor force amid Bangkok's industrial and construction boom but definitely not in the city's overburdened systems of infrastructure and services. In what E. F. Schumacher called a 'process of mutual poisoning' — "whereby successful industrial development in the cities destroys the economic structure of the hinterland, and the hinterland takes its revenge by mass migration into the cities, poisoning them and making them utterly unmanageable" (Schumacher 1975, 166), gradually, the "city of angels" is transformed into the capital of negative maximalism: plagued by severe traffic jams and pollution problems. Overurbanization and agglomeration diseconomies of scale reveal their dreadful faces through overcrowdedness, lack of amenities, unemployment, slums and soaring crime rates (Paichitr 1993, 219). Indeed, there is research on a relationship between large-scale rural-urban migration and the higher crime rates in Bangkok as compared to the rest of the country (Suntaree 1989). A concentration of young, rural migrants in the urban setting may lead to alienation and breakdown of rural values, which used to serve as social rules and norms of behavior. Probability of deviance and a downturn into crimes is, therefore, higher.

A study shows that migrants are younger than the population in general, rural-urban migrants are younger than other migrants and migrants to Bangkok are younger

than migrants in other streams (Guest n.d., 302). The age structure of migration affects both the sending and receiving areas. The departure of young, economically active persons from the rural labor force increases economic dependency in rural communities (Hugo 1987). Among the young who migrate are usually found the most dynamic of the rural population who will comprise potential leaders of the sending communities. Thus, the loss to urban areas tends to deprive rural communities of agents of change, perpetuating the peripheral status and inequality (Lipton 1980).

Analyzing the Solutions

Among developed nations, efforts to establish mechanisms to reallocate the finite supply for a maximum gain in the most sustainable fashion dominate debates on water resource management. The methodologies include promoting more efficient use and equitable access. Water resource management expert Daniel P. Beard, commissioner of the United States Bureau of Reclamation (USBR), recently conceded that large-scale dams and reservoirs are no longer cost-effective (Beard 1995). The USBR came to realize that the assumed beneficiaries of dams could not repay the operating and maintenance cost of large-scale water development projects, even at zero percent interest rate. Overtime, the human, social and environmental costs, which were once hidden, began to surface and wreak havoc. Soil salinization, decline or elimination of fisheries, destruction of wetland habitats and uprooting native culture are some of the by-products

Beard identified. He said that the agency is “still learning how severe they are and how to correct them” (Beard 1995). Announcing that dam-building time in the United States is over, Beard said that the USBR will embrace water conservation, demand management and efficiency improvement and reuse as its strategy for the future (*Watershed* 1995b, 6). The USBR helped design the Bhumibhol Dam, based on the Hoover Dam. It also helped with the designing of the controversial 17,500-MW Three Gorges Dam in China and Pa Mong Project on the mainstream Mekong River (Nantiya 1994a, A7).

In a similar move, the United Nation’s Food and Agriculture Organization (FAO) orchestrated the finale of supply-side approaches in water resource management (United Nations 1993). “The era of meeting growing demand by developing new supplies is ending,” the agency declared in its special chapter on water policies and agriculture. In the present-day economy, a strong case is emerging for emphasizing human behavior as an additional component of water problems. Management practices are increasingly emphasizing a non-structural, user-focused approach which encompasses demand management, education and persuasion to coordinate and influence how humans use water through organizations and institutions (United Nations 1993, 20-26).

These demand-side policies attempt to address the human causes of water problems such as water quality degradation, overexploitation of aquifers and the decreasing availability of water flows to meet non-consumptive water uses (hydroelectric power, pollution assimilation and fish and wildlife habitat).

In Thailand, the idea of curbing the demand has been well received and supported by non-governmental organizations. Mr. Witoon Permpongsachareon, Director of

Towards Ecological Recovery and Regional Alliance (TERRA), for example, reiterated that a demand analysis is imperative for every demand/supply imbalance (Witoon 1995). TERRA is a non-governmental organization working on issues concerning the natural environment and local communities. It supports the network of NGOs and people's organizations in Cambodia, Lao PDR, Thailand and Vietnam. Speaking along the line of a "watershed approach" to managing natural resources — "a way of looking at things as a whole, of seeing people and not just the trees but the forest, not just the river but all that creates and diminishes its flow" (*Watershed* 1995c, 2) — Witoon emphasized the need to recognize the rights of people who live in a river basin to have a say in policy that will affect their resources. It would be unjust for the Chao Phraya basin to be kept full of water that belongs to people in other basins (Fahn 1993, C1). To a certain extent, the notion is a development-study tautology. Individual freedom, equity, popular participation and local control are unequivocal objectives any development efforts should strive for. Still, inseparable are the right and control over water resources from political decentralization. No centralized government, said Dr. Prakob Wirojanakoot, Dean of Engineering, Khon Kaen University, can effectively handle the details of water resource management at a local level. As long as the Thai government does not start decentralizing the administrative power and allowing an election of provincial governor or members of district councils (*sapha tambon*), it will be useless to discuss local independence and participation in natural resource management (Prakob 1992, 10; *Siam Post* 1992, 4).

Unfortunately, demand management has not been a policy agenda in Thailand despite the skyrocketing growth in demand and the apparent wasteful use of water. The country's discourse on water resource management has been so heavily centered around the pros and cons of dams that other aspects are neglected. There are a few explanations for the tendency. First, the Thai environmental movement found its breakthrough in a controversy over the Upper Khwae Yai Hydro-electric Project, better known as the Nam Choan Dam. The proposed 187-meter high dam was to be built on the upper part of the Khwae Yai River, creating a 75-kilometer long reservoir. A large portion of the flooded area would have been inside the Thung Yai Naresuan Wildlife Sanctuary, one of largest and most biologically-diversified forests remaining in Thailand. (Nart 1984, 88-91; Hirsch 1986, 45-46; Hirsch 1987, 220-222; Cox 1987, 212-219; Korten 1992, 4-43.) The project provoked a series of debates and campaigns which incorporated people from every background and social strata, even removing antagonism and polarization caused by Communism in the 1970s (Hirsch 1993). Being bombarded both at home and from environmentalists around the world, the Nam Choan dam project was shelved partially because Thai politicians "have discovered there are votes in soil erosion and conservation, not to mention the green peafowl, the red-headed vulture, the masked finfoot and the fishing cat" (*The Economist* 1988, 32). The success raised tremendously public concern over the environment and diminishing resources and, to a remarkable extent, became a stereotypical contour to which new flesh of any disputes on water resource development can be overlaid (Hirsch 1993). Second, the government itself

helped framed the issue in a take-it-or-leave-it fashion with its rigid offer of either living with the scarcity or building new dams (and transferring water from other basins).

Numerous writings on both sides of the dam issues in Thailand (cf. Hirsch 1993; Murrey 1993; Goldsmith and Hildyard 1986; Vanchai, 1993; WFT 1987; Prinya 1987 and Dhira 1989) cover most of the debates and will not be repeated here. With few sites remain that will require minimum engineering manipulation and environmental mitigation, new dams face a rising curve of construction, maintenance and environmental costs. Criticisms about new dam construction generally revolve around issues of resettlement, which can cause massive economic and social disruption; exaggerated benefits and underestimation of some hidden costs that are either too long-term for the cost/benefit analysis to recognize or that can not be valued in monetary terms at all. By changing the flow of water, sediment, nutrients, energy and biota, dam structures interrupt and alters a river's ecological processes (Ligon 1995, 183). After all the concerns, the central argument from demand-side supporters is best critically summarized by an analyst who said that building another dam is equal to giving people another excuse not to focus on managing the demand. If anything, the debate about dam-building only distracts attention from the real problem (Fairclough 1994, 25).

Witoon considers the dam-building configuration an acquisition of power (Witoon 1995). In his words, dams are unfair tools that benefit those who control political power and technology. Dams benefit one region at the expense of another. They nourish one basin with no compensation for losses at another. He said that Bhumibhol and Sirikit

dams stood as perfect examples for they are built to squeeze the water from the north to feed the central region (Atiya 1992a, 28).

On the contrary, many technocrats and researchers are of the view that there is no intrinsic fault with dams. Properly executed and planned, the structures deliver the promise of water and hydropower, thereby contribute to industrial and economic growth. Many consultants and engineers believe that despite the antagonism and aid donors' reluctance to finance new dam projects, dam-building will not stop (*Watershed* 1995a, 7). The shifting in economic expansion from western Europe and the USA to newly industrialized countries and subsequently to Southeast Asia will result in an overall higher standard of living. The trend, coupled with an ever-increasing population and the concomitant necessity for a larger food supply, are likely to raise the region's demand for dams. Besides, some of the functions of dams, like flood control and storing water for a constant supply, cannot be achieved in other ways (*The Economist* 1992, 93).

Brushing aside the USBR Director's no-more-dam declaration as unjustified and politicized, Mr. Nattawuth Udayasen, one of Thailand's leading dam engineers, who designed the controversial Pak Mool Dam, reaffirmed the promises of dams. Environmental costs, said the engineer who was also trained at the USBR, can be repaid by social benefits.

The construction of Bhumibhol and Sirikit dams, for example, has fed the whole country. The dam allows farmers to grow two crops of rice a year. As a result, we have become the world's largest rice exporting country. They save Bangkok and the Chao Phraya basin from salt water intrusion. People just forget these things." (Nattawuth quoted in Malee 1995, A10)

Thailand's water policy to date has focused almost exclusively on finding a greater supply of water — mainly by building more reservoirs (Fahn 1993, C1). Thai irrigation officials are mostly trained to believe in the “jar” theory — that dams and reservoirs work like jars that store water for times of shortage. The then RID's Deputy Director-General Chamroon Chindasanguan who was the Thai representative to the Dublin conference viewed that for national economic growth, Thailand has no other choice but to build more big dams. He supported public participation in the sense of having the right to know but never the right to make a decision, especially one he perceives as negative:

What right do they have not to want it? It does not matter if they want it or not, as long as the government wants it. The project is well-thought out in all aspects. What do the villagers know? . . . If we listened to the people, chaos will reign. The country would never be developed. We should choose what is good for the country, not for the few. (Chamroon quoted in Sanitsuda 1992, 25)

TERRA's director Witoon voiced considerable concern over the RID's big leap to tap such international rivers as the Salween and Moei. Choosing to feed itself with other people's resources is, figuratively, breathing with a borrowed nose. Essentially, Thailand is giving up water security and autonomy over its own national resource management to the whim of international politics and good will of the upstream Myanmar. In an absence of written agreement or treaties, it will readily be reduced to being a dependent country whose future domestic resource bases will be not only limited but weak.

Witoon's concern is, in fact, an international fear. Robin Clarke, the author of *Water: The International Crisis*, writes how countries that control the water resources of their neighbors can exert formidable power. In time of scarcity, countries would do anything to ensure a security of their own supply, even at the expense of downstream nations (Clarke 1991, 94). All things considered, the water-based potential for conflicts is enormous. Globally, 47 percent of all land falls within international river basins. The United Nations classified more than 200 main stem rivers as multinational and pointed out that most non-island countries share part of their freshwater resources with one or more countries (United Nations 1972). Almost 40 percent of the world's population lives in international river basins; they are dependent on the smooth cooperation of all the countries sharing the basins for their survival (Clarke 1991, 91). At least thirteen rivers are shared by five or more countries. Unlike Europe, whose four international river basins are regulated by over 179 treaties, most of Asia's shared water resources are informally exploited.

Today, the sharing of water resources contributes to many international disputes, particularly in countries where water is scarce and its use unregulated by treaty (Clarke 1991, 90). Competition and conflicts are only likely to intensify. In South Asia, the diversion of Ravi and Beas-Sutlej from Pakistan to India's Rajasthan and Haryana wedged a bitter rift between the two countries which was settled only through the World Bank's intervention (Clarke 1991, 90). Also, the collaboration between Brazil and Paraguay on the construction of the gigantic Itaipu dam across the river Parana strained

the relationship between upstream Brazil and downstream Argentina (Clarke 1991, 90-91). The dam's 200-km long lake flooded almost all of the north-eastern part of Argentina. Although most affected by the project, Argentina was left out of the joint venture. Chile's decision to dam and divert the River Lauca has soured its relations with Bolivia since 1962 (Clarke 1991, 98). Bolivia claimed that the diversion increased the salinity level in its Lake Coipasa, that humidity in the basin area has dropped due to the reduced river level and that the reduced volume of water caused water shortages for Bolivian people. Bolivia severed diplomatic relations with Chile two days after the diversion (Clarke 1991, 98).

Although Thailand is relatively inexperienced with the interbasin transfer of water (no international diversion has ever been initiated in the country), the Chulabhorn-Huay Khoom network of dams and small-scale interbasin transfer qualifies as a miniature replica of what might happen after a river's course was changed. Chulabhorn or Nam Phrom Dam was built across Nam Phrom River in the middle of Phu Khieo Wildlife Sanctuary, Chaiyaphum Province, in 1958. To raise the head level for electricity generation, the EGAT, the project operator, diverted the water from Nam Phrom reservoir via a 4-km tunnel to a power plant at Nam Churn River. The completion of the dam and diversion caused a severe shortage in areas downstream of Nam Phrom. The EGAT, then, built another dam below the Nam Phrom dam. Though Huay Khoom dam was supposedly built for irrigational benefits, it was installed with a 1-MW generator.

Chainarong reported that, once overflowing, some parts of the Nam Phrom river are totally exhausted during the dry season. Along the river's course, conflicts between upstream and downstream residents over an access to the limited water simmer (Chainarong 1996). Mr. Pijit Narmdaeng, 50, a farmer from Nong Bua Phrom village near the outflow of Nam Phrom River, said that as soon as the dam was completed, farmers along Nam Phrom river have never had enough water for farming.

All the water was brought to Nam Churn. We aren't able to grow rice unless there is very heavy rainfall. There are almost a hundred weirs along the river. We had to request the authorities at the dam to release the water for us (Atiya 1993, 27).

Protests and a quest for water soon set in as routine for people in six villages downstream. The intensity of the situation was literally proportional to a reduction in the river's flow. Many villagers laid wooden and concrete weirs across the river in a hope to trap as much water as possible while it still lasted. Without any inter-village agreement or mechanism to monitor uses of the common-pool river, there were times in the dry season when some weir owners up-river did not open a water channel to let the water flow down. Conflicts erupted, turned violent sometimes and led to one death. To catch up with the farming cycle, downstream farmers had as their only resort a politics of protest. They had to march to the dam and started pressuring dam authorities months before a ploughing season began. Pijit told that in 1992, the down-stream marchers wasted one and a half month in search of water (Atiya 1993, 27). It was a distressing experience. They had to stay at the dam all day and night to monitor the water release and pay for their time from savings, as exhausted as water in the Nam Phrom river.

If the war over water continued, Pijit said, he might have to abandon the rice fields and join his predecessors to find jobs in town. In despair, the farmer predicted that within three years, the natural course of Nam Phrom would diminish to the point of vanishing. "It is not flowing now," he said. "Silt is piling up. The river will finally become ponds of water disconnected from one another by weirs. That will be the end of the river and our lives" (Pijit quoted in Atiya 1993, 27).

CHAPTER V

TABLING THE OPTIONS

In no small sense, South East Asia is a region where water — not land — is the defining element and where human-water relationships, not human-land relationships, are determining (Rigg 1992, 1).

As vast and complex as an old, well-networked river can be, a study on water scarcity and management in Thailand encompasses numerous branches and localized systems. By focusing on certain projects and solutions, this thesis makes no pretense to be an exhaustive study of water resource management in Thailand. Some of the courses and undercurrents of the problem are partially touched while such subjects as institutional and legal frameworks of water resource management, which deserve a separate treatment, are totally left out. Similarly, this discussion on alternatives is not an attempt to form a separate set of policies or programs to solve the shortage, nor is it aimed at cataloging all the ideas on water management available. What this section seeks to accomplish is that the water shortage is not a dam-or-die dilemma. There is more than one safety valve to the stressed system; many of them are near at hand and can be realized by individuals. Its purpose here is to reflect critically about available options and to encourage re-learning.

Retrieving What is Lost

Each year, about 100,000 leakages or breaches are found in Bangkok's water supply distribution system, which has not been changed for decades. Over 30 percent of the MWA's water supply leaks away before it reaches the users, which is a loss of roughly 960 million m³ everyday. At an average consumption of 200 liters per person, the lost water could have been used by no fewer than five million persons.

A report by Thailand Development Research Institute (TDRI) gave an irrigation efficiency at below 30 percent and unofficially at somewhere around 15 percent (TDRI 1994). A huge portion of the valuable resource is simply lost along the irrigation canals. Since most of them are dirt-lined, water can simply seep out in every direction. Dirt canals also vary considerably in depth, making the water level uneven and an access to it unequally distributed along their courses (Thitinan 1994, 232). A lack of proper maintenance, whether siltation of distribution canals, incursion of aquatic weeds or damage to control structures and devices, is prevalent among the RID's medium-and small-scale irrigation projects (Anat 1987, 66).

From these figures, it seems Thailand does not need dams more than an efficient system of water supply and distribution. Mr. Kevin Kinvig, an economist studying water resources at TDRI, ascertained that if efficiency is increased, the existing supply could be managed to last at least until the year 2010 (Kinvig quoted in Fahn 1993, C1). A

reduction of leakages and more effective maintenance will require massive capital outlay but, beyond a certain point, will have minimal or no impact on the environment (Sacha et al. 1990, 17). With most of the suitable sites used up, building and maintaining more dams presupposes a steep rise in economic, social and environmental cost. In principle, economists and environmentalists agree that learning to live with the existing supply by rehabilitating and making better use of the existing infrastructure and improving the management is the most/cost effective way to deal with a scarcity (Sacha et al. 1990, 17).

Around the world, a new trend emerges which focuses on employing free market mechanisms, mainly pricing, to determine an optimal allocation — to whom the water should be granted for the highest rate of return. For the idea to work, the more traditional concept of water as a free goods — a basic necessity and human right every human should be entitled to — must be replaced with an idea of water as an economic good. Unlike minerals or timber, water has rarely been traded in the world economy and, for that reason, given no intrinsic value. Being more scarce, the “classic free goods” may no longer be undervalued still remains widely underpriced. To assist farmers, urban lower middle-class consumers and particularly to attract investment, governments more or less subsidized water supply service. From Baja California to the Chao Phraya delta, water charges comprise a tiny fraction of the real cost of obtaining raw water supply, treating, plumbing and distributing the production. An investment in building such storage infrastructures as dams, has never been entered as a part of the equation. Governed by the “free goods” attitude, the Thai government has been supplying irrigation water for

free while imposing a very low, declining block rate on domestic, commercial and industrial users. Notably, the price of piped water is lower today than in 1986 even though the cost of supply has increased (Table 3). Currently, piped water in Thailand costs 7 baht per cubic meter or 0.007 baht per liter. Agriculturists, the biggest consumer, with over 90 percent of water flowing their way, are more vulnerable to blame and most likely to lose out when supplies tighten. Claiming that the free supply to farmers has naturally led to an uncontrolled expansion of cultivation or the use of high-yield rice varieties, Kinvig suggested that the Thai government remove the free-water subsidy to correct the distorted agricultural economy.

After prolonged debates, the International Council on Water and the Environment (ICWE) eventually declared in its Principle 4 that water has an economic value in all its competing uses and should be regarded as such (United Nations 1993, 14). The Council hoped that recognizing and managing the resource as an economic good — mainly by internalizing all the cost that occurs in the supply process in the charge to users — will not only bring about a more efficient and equitable allocation but encourage conservation rehabilitation and protection of the scarce resource and watersheds. Assuming that self-interest is the pre-dominant factor at work, Sacha believed that restructured water pricing would effectively determine the optimal sectoral allocation of water (among competing agricultural, industrial and domestic uses); encourage reduction of waste and promote efficient use, thereby limiting demand, recovering the cost of supply and making funds available for other activities (United Nations 1993, 17).

There are substantial concerns, however, that the strategy would price-off farmers who are normally too poor to pay even the subsidized charge. However crucial, agriculture remains the lowest earning and least value-added sector. It naturally cannot compete with cities or industries in economic returns. Other things being equal, a full-cost accounting of irrigation water might be an effective solution to management of scarce resources. In a real world where social hierarchy, level of wealth and financial opportunities are a chasm apart, internalizing the full cost can sidestep ethics and equity ingrained in the ability to pay, which is related to the buyer's level of wealth. In other words, "it assumes that a dollar is worth exactly the same to a billionaire as to a beggar" (Peet 1992, 138). Farming is literally a back-breaking job, with very relatively low economic returns and very low regard in Thai social status (Rigg 1995, 25). To help farmers survive to fulfill the crucial function, it seems politically, economically and socially justifiable for the government to intervene and correct the inequalities. One possible measure would be subsidization. I, therefore, agreed with Kinvig who, knowing that it would not only be "emotionally hard" but also politically unacceptable to take away the subsidy from poor farmers, proposed that the government substitute subsidies. Instead of free irrigation water, the government can provide other incentives like loans or investment credits (Kinvig quoted in Fahn 1993, C1). In a similar response, Sacha recommended that the lowest block of water tariff be controlled, leaving the rest to the invisible hand of supply and demand (Sacha et al. 1990, 17).

A foreseeable flip-side of imposing the water charge to farmers is it would make the decision to leave the farms for new jobs in the city much easier to make. The charge would increase the opportunity cost of farming, which is already higher than migrating to the urban industrial sector. A townward movement and “mutual poisoning” will occur (Rigg 1995, 30; Schumacher 1975, 166). Also, some planners believe that a change in the price structure would not work in the Thai cultural and habitual context and that the demand for water is not responsive to price even if the price is allowed to increase (Sacha et al. 1990, 17). The MWA’s governor herself believed that an increase in water charges would not overcome users’ cost-related inertia (*Phujadkarn Raiwan* 1993, 5). The increase would be effective for a short while during an initial stage. Once the users are accustomed to the new price structure, the old routine would just return. She said that instilling an awareness and need to conserve the scarce resource would be more effective in this case (*Phujadkarn Raiwan* 1996, 5).

Ideologically, this market-oriented solution relies heavily — and some would argue precariously — on the laws of the capitalist market which is arguably far from being flawless. The free market is incapable of taking into account certain things or values that cannot be priced. Efficiency (in economics) might be defined by an attainment of the so-called “optimum allocation” through market forces. Yet, the optimum allocation itself depends on an initial distribution of resources among members of the society.

The prices that are determined in the free market, and that determine the final allocation, are themselves pre-empted by the initial allocation. In a market in which there are a few rich people

and a lot of poor people when trading starts, the final allocation of wealth will be very different from that in a market in which everyone had the same resources at the start (Peet 1992,141).

Peet acknowledged that how imperfect it is, the market has been a useful tool in resource allocation. Yet, its achievement is one of improving the allocation, not of attaining the optimum allocation. He also cautioned against the trap of sub-optimization — if links among parts of the system are ignored or oversimplified, it is easy to optimize only one or more subunits, to the detriment of a whole (Peet 1992, 141).

The Power of Perception

Thailand's water crisis is, in a large part, a crisis of perception. Living close to, as well as depending on, rivers and water for such agricultural practices as rice culture, has forged a link among water, happiness and prosperity (Iam 1994; Rigg 1992, 1-2). Thais believe that their country would never run out of water. The perception has been reinforced by annual flooding. The myth of plenty expresses itself in inefficiency in the part of users, while it induces planners to adhere to the supposition that one will always find and tap new sources of supply for utilization.

In his article on "Water Allocation Conflicts in Central Thailand", Thitinan Pongsudhirak predicted that true solutions to the water problems would require a profound shift in Thai cultural attitudes towards water scarcity and the collective acceptance of the cost of water — a time consuming process (Thitinan 1994, 248).

Clarke, however, stated that contrary to popular belief, human attitudes can change swiftly in the face of a crisis. He cited as an example the sharp reductions in energy use the energy-dependent West made during the oil crisis of the 1970s (Clarke 1991, 71).

In Thailand, when the first sign of water scarcity was revealed a decade ago, the then Prime Minister Prem Tinsulanonda ordered a nation-wide one-hour shut-down of television airtime during the peak period to save on the water that would have been used to generate the electricity. Instead of pointing to second-crop farmers, crying “culprit” and displacing the problem, the tough action by Prime Minister Prem clearly sent the message across, summoning a collective realization of the water scarcity. The shortage notwithstanding, it is precisely a “crisis scenario” that was missing from the Thai so-called severe water shortage of 1992-4. The MWA’s water conservation campaign concentrated almost single-handedly on media exposure of the water crisis. The information on the problem was useful but it does not necessarily influence a change in users’ attitude or behavior. Although well-informed about the severe shortage, users in the MWA felt no threat against their water security. This is because, unlike the inconveniences made by the rising price and unavailability of oil, the MWA guaranteed there would be no change in the quantity or quality of the supply. There is, therefore, no need for the users to change their habit, swiftly or slowly, not until there were to be a ration of water or emptiness in the tap (*Phujadkarn Raiwan* 1993, 5).

This is not to deny the importance of information dissemination and awareness building. I do recognize that educational campaigns are essential in inducing a paradigm

shift in every sector. The MWA is planning to invest 3,800 million baht in its 20-year DSM program, focusing on preventing unnecessary losses and development of environmentally-sound technology (*Phujadkarn Raiwan* 1996, 5). Redesigning domestic appliances such as showers and toilets to be more water efficient can produce at least a 50 percent saving in domestic use (Clarke 1991, 72). If the government is serious in encouraging the use of 6-liter flush toilets instead of the existing 20-liter ones and sequential re-use and recycling, it will retrieve as much as 1.4 million m³ from the BMA (*Siam Post* 1992, 4).

Commendable as the MWA's effort is, Thailand's water resource management leaves a lot to be desired, particularly in terms of coordination and integration. At present, 17 committees from 31 agencies under eight ministries share the responsibility for various aspects of water resource development (Table 7). The majority of the projects are carried out independently for each agency's specific purpose. The lack of coordination results both in inefficient use of the resources and conflicts between upstream and downstream users. The need for full coordination and by extension a national agency to plan and coordinate water resource development is expressed by Anat:

It is apparent . . . that water resource development in Thailand lacks comprehensive planning. The emphasis is often on the construction of dams and reservoirs which is just one aspect of overall development. Also, little effort is put into stimulating the government agencies involved into concurrently carrying out other relevant aspects of development. (Anat 1987, 66)

Table 7. Government Agencies Involved in Water Resources Development

<u>Ministry of Agriculture and Cooperatives</u>	<u>Office of the Prime Minister</u>
Office of the Permanent Secretary	Electricity Generating Authority of Thailand
Royal Irrigation Department	Rural Employment Generating Committee
Department of Agricultural Extension	
Department of Agriculture	
Royal Forestry Department	
Land Development Department	<u>Ministry of Industry</u>
Cooperatives Promotion Department	Department of Mineral Resources
Department of Fisheries	Department of Industrial Works
Department of Livestock Development	
Agricultural Land Reform Office	<u>Ministry of Communications</u>
Royal Rain Making Research and Development Institute	Department of Harbor
	Meteorological Department
<u>Ministry of Interior</u>	
Local Administration Department	<u>Ministry of Defense</u>
Department of Public Works	Naval Hydrographic Department
Department of Public Welfare	National Security Command
Office of Accelerated Rural Development	Headquarters
Department of Community Development	
Department of Lands	<u>Ministry of Science, Technology and Environment</u>
Metropolitan Water Works Authority	National Energy Administration
Provincial Water Works Authority	National Environmental Board
	National Research Council of Thailand
<u>Ministry of Public Health</u>	
Department of Health	

Source: Anat 1987, 66.

With limited personnel and budget, the RID has been overwhelmed by irrigation maintenance work. One way to alleviate the work load is to review the RID's norms for maintenance work and put more emphasis on preventive maintenance — a systematic program of inspection of facilities and routine maintenance to prevent unnecessary breakdowns. Another method is to urge farmers to form user groups or associations to look after the maintenance of tertiary structures at the farm level. Given information and guides on preventive and breakdown-related maintenance, these groups would emancipate the RID from the impossible task of maintaining the system at all levels. Farmers would also benefit from a un-disrupted flow to their crops (Anat 1987, 66).

Redefining irrigation may create new channels to reclaim some irrigation losses. According to Prof. Nithi Eoaseewong from Chiang Mai University, irrigating does not necessarily mean that there must be a physical flow of water into a plot of land (Nithi 1996). A means that will restore humidity in the soil throughout the dry season can qualify as irrigation. Such means as small-scale weirs (northern *muang faii* technology), agroforestry or permaculture deserve to be explored, promoted and re-enacted (Chatchawan 1991, 101-6). While modern technology in obtaining and using water has been developed almost exclusively in association with means to exploit river systems or ground water sources, an intermediate technology school of thought suggested securing water supply by collecting rainfall immediately after it fell before evaporation occurred (Pacey and Cullis 1986, 1). With the use of house roofs, rainwater tanks, artificial surface at ground level and land surface with slopes, rainwater harvesting has been a

complementary and more extensive means of capturing water both in monsoon countries and areas where rivers are few. To circumvent the idea of intensive technology in big dams for irrigation, it is recommended that the technique for domestic or run-off farming be extensive and small in scale. A scatter of small rainwater catchments, each serving an individual farm, homestead or hamlet, is the characteristic pattern (Pacey and Cullis 1986, 3). A point to ponder, however, is that collecting rainfall from house roofs was a common practice all across Thailand a few decade ago. Since air-pollution has contaminated the rain water, the practice has been largely abandoned. Should the country continue with its present rate of industrialization and urbanization, it is less likely this method will be adopted as a strategy for change.

“In the waters are fish, in the fields are rice.” Deconstructing the well-known Thai saying reveals an intriguing paradox. After all, the adage Thai people use as a definition of their country might be merely an ancient tool to manipulate the public perception. Dr. Thida Saraya, a well-known authority on Sukhothai history from Chulalongkorn University, convincingly argued that the symbolic expression of agricultural prosperity is a piece of propaganda by the Sukhothai state to develop economic security and political unity — a typical expression of subsistence ethic²⁸ (Thida 1989, 99). Dated back to about 700 years ago, Sukhothai, which some scholars believe to be a former kingdom of Thai people, was located in the lower part of the northern region

28 According to Dr. Thida, insecurity in food supply gives birth to a worldview that promotes hope and faith in the future abundance (Scott, 1979, 1-12). The system of belief, called subsistence ethic, is borne among subsistence communities.

of Thailand, to the north of what is now Nakhon Sawan province (Thida 1989, 99). Dr. Thida argued that the saying is antithetical to historical and economic development of the Sukhothai kingdom (1989, 99-101). Archaeological evidence revealed that there had been no traces of human settlement in the Sukhothai areas until the 13th century. One interpretation is that the area was not attractive enough for permanent agriculture. Since Sukhothai was located at the intersection of various trading routes, it is more likely that mercantile activities contributed to the kingdom's rise to power. Apart from providing food for the kingdom, farming, specifically, rice culture, creates communities which, in turn, will attract and provide shelter for more new labor. In this context where the land was semi-arid and rice culture played a secondary role to trading, "in the waters are fish" fits better as a belief system constructed by the State to promote confidence in agriculture, in the process expanding and augmenting the political power of Sukhothai state (Thida 1980-1981, 86-95; Thida 1982a, 16-17, 21-22; Thida 1982b).

Conclusion

Sustaining water use in Bangkok at the cost of water users in the rest of the Central Plain reaffirmed the problem of primate city parasitism, which draws on the wider theory of dependency. Lipton observed that a transfer of resources away from the countryside or channeling water away from ricefields to urban sewage, reconfirmed the stereotypical model of development for most developing countries — economic

modernization by replacing the agriculture with industrial sector (Lipton 1982, 65). The development paradigm turned Bangkok into a worldclass metropolis, yet, failed to make it self-reliant. Any attempt to solve the water shortage that centers on the capital will speed up a collapse of rural communities and widen the urban-rural divide. At a larger scale, the dam building and diversion of water from the Salween basin to the Chao Phraya basin with no respect to local rights and spatial and social equity, is an unscrupulous reaction to a symptom of the deep-seated, complex problem of internal colonialism resulting from unequal development. Trying to treat the shortage without analyzing the underlying socio-economic and political circumstances in which it is embedded will, at best, displace the problem, causing many more to be solved. With many more mouths to feed in the coming decades, water remains finite. Instead of asking how much water we need and how to get it, as Clarke has asserted, now is the time to ask how much water there is and how we can best benefit from it (Clarke 1991, xi).

APPENDIX A

WATERSHED CLASSIFICATION IN THAILAND

The watershed classification regulation was introduced in the late 1970s to classify areas for watershed protection, production forestry and agriculture. Based on the agreement among the relevant state agencies, five watershed classes were identified and characterized as follows. The classification is based on land elevation, slope, land form, geology and soils of the area.

- WSC 1 — Protection or Conservation Forest and Headwater Source:

Areas under this class are usually at high elevations and have steep slopes, so that they should be with permanent forest cover. This class has two subclasses, namely, WSC 1A if the area is wholly undisturbed or WSC 1B if the area has already been cleared for cultivation.

- WSC 2 — Commercial Forest:

Areas under this class may be at high elevations and may have steep slopes but their land form results in relatively less erosion than WSC 1. These areas may be used for logging, mining or grazing and crop production if accompanied by appropriate soil protection measures.

- WSC 3 — Fruit Tree Plantation:

These areas cover uplands with steep slopes but less erosive landform and may be used for commercial forests, grazing fruit trees or some agricultural crops if accompanied by soil conservation measures.

- WSC 4 — Upland Farming:

These areas are gently sloping and are suitable for row crops, fruit trees and grazing with moderate use of soil conservation measures.

- WSC 5 — Lowland Farming:

These areas have very gentle slopes or are flat and are suitable for paddy fields and other agricultural crops with few restrictions.

(Summarized from Asian Institute of Technology (AIT). 1994. *Study of Potential Development of Water Resources in the Salween River Basin*. Bangkok: NESDB)

APPENDIX B

FROM ELECTRICITY TO WATER: A HISTORY OF DEVELOPMENT

PLANS IN THE SALWEEN BASIN

To understand the potential and the making of the Salween diversion, it is useful to recapitulate a history of the watershed development — from electricity to water — since most of the water transfer projects are parts of the same old plans. Bound for electricity, the main-stream Salween is slated for a colossal project: the Upper Salween Dam. According to a desk study by S. Boonpiraks, EGAT's Assistant General Manager, the Upper Salween dam would have an installed hydropower capacity of 4,540 megawatts and an estimated annual energy production of 30,000 GigaWatt hours. The energy output is more than double the total 2,250 megawatts of electricity produced by all of the 21 existing hydro-electric dams in Thailand (Boonpiraks quoted in Green November 1993, 7-8). EGAT also expected to channel a by-product of 30,000 million m³ of water, from over 100,000 million m³ flowing into the dam, off to Bhumibhol reservoir. This feature, however, is still under debate as to how far and how much the Thai planners will go for the water. Citing a report from the Bangkok-based English-language newspaper *The Nation*, Green November 32, a non-governmental organization supporting the autonomy of the Karen people, claimed that Thai politicians would like the dam to be built high enough that they could divert up to 30 percent of water in the

Salween (potentially about 40 billion m³ per year) to the Ping River which is a major tributary of the Chao Phraya. The aspiration, however, is likely to be unfulfilled when the scheme is placed in the real geography of the watershed. The diversion would require a massive network of tunnels and canals over 100 km long through and around high and rugged mountain ranges. The difficulty would be translated into an incredibly high cost and, considering present circumstances in the relationships between the two countries, very low feasibility. The Upper Salween Dam, if materialized, would arguably become the largest dam in Southeast Asia (Green November 1993, 8-10).

According to Green November 32, Thailand and the State Law and Order Restoration Council (SLORC) have studied and discussed several other hydroelectric dams. In the plan for the Salween basin are the 792-MW Lower Salween dam, blocking the Salween 30 kms above its confluence with the Moei river; Moei 1, 2 and 3 on the Moei River sized 110, 231 and 254 MW respectively (Green November 1993, 11). Three non-Salween basin dams under the Thai-Burmese cooperation scheme are a 130-MW project on the Kra River in the southernmost tip of Myanmar that flows into the Andaman Sea at Ranong Province in Thailand; a 294-MW project on the Nam Kok River in the north of Thailand and a small 12.5 MW dam on the Mae Sai river which runs into the Mekong River (Chainarong 1993, 20).

In 1993, Thailand submitted a Memorandum of Understanding to Myanmar on the joint development plan and feasibility study of the Salween river. According to the MoU, Thailand proposed the construction of the Upper and Lower Salween dam and a

purchase of any hydroelectricity the dams would produce. The offer from Bangkok was left unanswered for more than a year. When the Burmese Energy Minister finally picked up a site for a feasibility study in its controlled area of Hutgyi town near Pa-an, the Karen state capital, however, the Thai government agencies involved in the project could not reach a decision²⁹. The Foreign Ministry was reported to be concerned with a question of ownership. If built at the selected site, the dam would belong to Myanmar. As such, the Rangoon government should pay for the study which should cost approximately US \$ four to five million plus US \$ ten million for an engineering design. An Irrigation Department official was reported to express doubt as the site would require a construction of over-100-kilometer-long tunnels to divert irrigation channels into Thailand. (*Bangkok Post* 1994e ; *Bangkok Post* 1995a).

A variety of agencies are involved in the planning of these projects. The State Law and Order Restoration Council (SLORC) generals and Myanmar Electric Power Enterprise (MOGE) played a major role on the Burmese side. The Thai counterpart in the discussion include the EGAT, the National Energy Administration (now upgraded to be the Department of Energy Development and Promotion) and the Prime Minister's Office. A "Joint Working Group for the Development of Hydropower Projects on Bordering Rivers" was established in mid 1989 after an approach made to the SLORC by the then Supreme Commander of Thailand General Chaovalit Yongchaiyudh. Preliminary studies

²⁹ Representatives from the Foreign Ministry, Department of Energy Development and Promotion, Royal Irrigation Department and Electricity Generating Authority of Thailand took part in the meeting to consider the Burmese government's proposal.

for all of the dams — including pre-feasibility and feasibility study for some — have been done. Most of them were carried out by the Electric Power Development Corporation (EPDC) which is funded by the Japanese government and closely connected to the Japanese Overseas Development Aid (ODA). Although Burmese representatives consistently declare that no decision has been made on the Salween dams, a few companies have already tendered their bids for the projects including Bangkok-based MDX, Wes Group and World Impec.

APPENDIX C

COMPONENTS OF THE UPPER PAI AND NAM MOEI-MAE SONG

DIVERSION PROJECTS

The study team from Aggie Consult Co.,Ltd. and Macro Consultant Co.,Ltd. recommended two projects for feasibility study (Aggie Consultant 1995).

1. Upper Pai Diversion Project: The project is designed to divert an average of 400 million m^3 of water annually to Ping river via Mae Tang river. The cost per diversion unit is 1.42 baht per cubic meter. The major components of the project are Pai-Sa dam and a 43.17-kilometer-long water tunnel to be laid out from Nam Pai to Mae Tang. The tunnel will be 4.60 meters in diameter, sending the water by gravity at a highest rate of 35 m^3 per second.
2. Nam Moei-Mae Song-Bhumibhol Diversion Project: Of all the diversion plans in Salween and Moei river basin, this project has a highest potential as a long-term solution to the water shortage in Chao Phraya basin. The project has a capacity of diverting an average of 2,000 million m^3 of water annually at a cost of 1.34 baht per m^3 . The major components are:
 - A 1-kilometer-long canal from Nam Moei to Mae Song weir.
 - Mae Song weir and a station to pump the water up to the reservoir and push the water to Mae Song Dam.

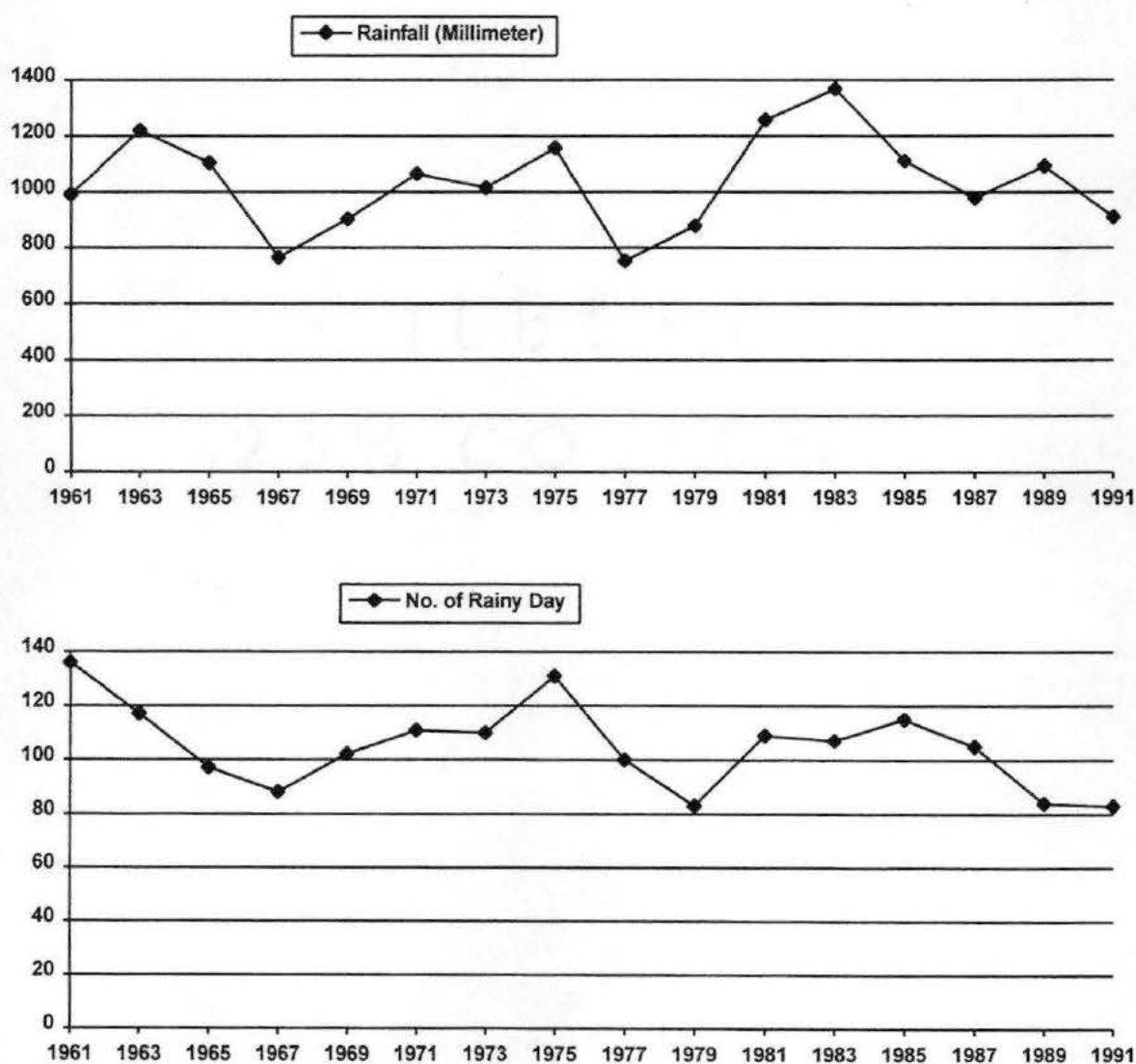
- Mae Song Dam No.1 and Mae Song Dam pumping station No.1 to pump the water up to Mae Song reservoir No.1 and push it to Mae Song Dam No.2.
- Mae Song Dam No.2 and Mae Song Dam pumping station No.2 to pump the water from Mae Song reservoir No.1 to Mae Song reservoir No.2 and push it to a Mae Song Bhumibhol water tunnel.
- A 48.83-kilometer-long water tunnel from Mae Song reservoir No.2 to Bhumibhol reservoir. The tunnel is designed to transport the water by gravity at the highest rate of 100 m^3 per second.

Further Studies on the following topics are recommended:

1. Geological study and survey to assist a design of water tunnels. (The tunnels cost 70-80 percent of the total project cost.)
2. Geological survey and mapping for dam and facility design.
3. Finding source of electricity for diversion operation.
4. Preparation for international negotiation and cooperation.
5. Defining a policy and goal of water diversion.

The cost of the project was estimated at 12,140 million baht for 1994.

APPENDIX D

ANNUAL RAINFALL DATA AT TAK METEOROLOGICAL
STATION (1961-1991)

Source: National Statistical Office (NSO). 1964-1992. *Statistical Yearbook: Thailand*
Bangkok: NSO.

APPENDIX E

LIST OF ACRONYMS, ABBREVIATIONS

AND THAI LANGUAGE TERMS

AIT	Asian Institute of Technology
<i>Baht</i>	Thai unit of currency, approximately 25 baht = US \$ 1.
BMR	Bangkok Metropolitan Region
DEDP	Department of Energy Development and Promotion
EGAT	Electricity Generating Authority of Thailand
<i>huai</i>	Thai word for stream
ICWE	International Council on Water and the Environment
<i>mae nam</i> or <i>nam mae</i>	Thai words for "river"
MWA	Metropolitan Waterworks Authority
NESDB	National Economic and Social Development Board
<i>na pi</i>	First-crop farming
<i>na prang</i>	Second-crop farming
PER	Project for Ecological Recovery
<i>rai</i>	Thai measure of land area. 1 rai = 1,600 square meters
<i>Sob</i>	Convergence of rivers.
RID	Royal Irrigation Department
TDRI	Thailand Development Research Institute
TERRA	Towards Ecological Recovery and Regional Alliance
USBR	United State Bureau of Reclamation

REFERENCES

- Aggie Consultant Co.,Ltd. and Macro Consultant Co.,Ltd. 1995. *The Feasibility Study of the Pai and Tributaries of Moei Rivers Project*. Bangkok: Department of Energy Development and Promotion (DEDP).
- Ammar Sayamwala. 1979. *Khao Nai Setthakit Khong Thai* (Rice in the Thai Economy). Bangkok: Munnithi Khronkarn Tamra Sangkhomsart Lae Manutsayasart.
- . 1987. Productivity and Competitiveness in Thai Agriculture. Paper presented at Thailand Development Research Institute 1987 Year-end Conference, 28-29 November, at Regent Cha-am Beach Hotel, Thailand.
- . 1991. *Changing Comparative Advantage in Thai Agriculture*. Paris: OECD Development Center.
- Anat Arbhabhirama, ed. 1987. *Thailand Natural Resource Profile: Is Resource Base for Thailand's Development Sustainable?* Bangkok: Thailand Development Research Institute.
- Anderson, Edgar. 1954. *Plants, Man and Life*. London: Andrew Melrose Limited.
- Anita Pleumarom. 1992. "Course and Effect: Golf Tourism in Thailand" *The Ecologist* May-June, 104-110.
- Anuchit Sodarathit. 1989. Bangkok flood and control. Paper presented at seminar on Bangkok Land Subsidence — What's Next?, 22 - 23 June at Imperial Hotel, Bangkok, Thailand.
- Arshad, Mohd Fatimah., Rahman, Abd. Aziz Abdul., Fee, Leong Wah and Yoong, Chee Wong. 1989. *Malaysian Agricultural Policy: Issues and Directions*. Kuala Lumpur: Center for Agricultural Policy Studies (CAPS), Universiti Pertanian Malaysia.
- Asiaweek*. 1996. "A tale of two," 12 January. Available from <http://www.newsweek-int.com/>.

- Asian Institute of Technology (AIT). 1994. *Study of Potential Development of Water Resources in the Salween River Basin: Volume II: Main Report*. Bangkok: Office of the National Economic and Social Development Board (NESDB).
- Atiya Achakulwisut. 1992a. "The Official Answer" *Bangkok Post*, 3 November, 28.
- Atiya Achakulwisut. 1992b. "Why Farmers Bear the Brunt" *Bangkok Post*, 2 November, 28.
- Atiya Achakulwisut. 1993. "Life After Dams" *Bangkok Post*, 2 July, 27.
- Bangkok Post*. 1994a. "Burma Undecided on Salween Dams Plan" 30 March.
- Bangkok Post*. 1994b. "Salween Scheme won't Breach Treaty with Burma — Savit" 3 May.
- Bangkok Post*. 1994c. "Student Group: Dam Project Violates Human Rights" 30 March.
- Bangkok Post*. 1994d. "Thai Envoy: Salween to be River of Mutual Benefits." 1 April, 5.
- Bangkok Post*. 1994e. "Thais Table Plan for Dam on Salween in Burma" 29 November.
- Bangkok Post*. 1995a. "Burma Suggests Salween Project" 19 March, 5.
- Bangkok Post*. 1995b. "Salween Water Gets Green Light" 15 July. Available from Reuter Textline via Nexus Lexus.
- Bangkok Post*. 1995c. "Thailand: Plan to Divert Water May Harm Relations." 10 September. Available from Reuter Textline via Nexus Lexus.
- Beard, Daniel P. 1995. Speech presented to Forum of the Japan Federation of Bar Association, 15 February, at Tokyo, Japan.
- Chainarong Sethachau. 1993. *Super Projects on the Salween River Basin*. Bangkok: Wildlife Fund Thailand.
- Chainarong Sethachau. 1996. Interview by author. Bangkok, Thailand, 30 April.
- Chatchawan Thongdeelert and Lohmann, Larry. 1991. "The Muang Faai Irrigation System of Northern Thailand" *The Ecologist*, March-April, 101-6.
- Choolit Vatcharasinthu. 1996. Interview by author. Bangkok, Thailand, 1 June.

- Christensen, Scott and Areeya Boonlong. 1993. "Institutional Problems in Water Allocation: Challenges for New Legislation" *TDRI Quarterly Review* 8, no. 3: 3-8.
- Christensen, Scott R. 1994. "Water Allocation Conflicts in Thailand: An Analysis of Government Failure" *Water Conflicts*. Bangkok: Thailand Development Research Institute, 53-85.
- Chuanpit Dhamasiri. 1989. "MWA's Present and Future Water Supply Situation" Paper presented at seminar on Bangkok Land Subsidence — What's Next?, 22-23 June, at Imperial Hotel, Bangkok.
- Clarke, Robin. 1991. *Water: The International Crisis*. London: Earthscan Publications Ltd.
- Coedes, George. 1971. *The Indianized States of Southeast Asia*. Edited by Walter F. Vella. Translated by Susan Brown Cowing. Honolulu: University Press of Hawaii.
- Cox, Belinda Stewart. 1987. "Thailand's Nam Choan Dam: A Disaster in the Making" *The Ecologist* 17, no. 6: 212-9.
- Cummings, Ronald G. 1974. *Interbasin Water Transfer: A Case Study in Mexico*. Baltimore: John Hopkins University Press.
- Dhira Phantumvanit and Widhanya Nandhabiwat. 1989. "The Nam Choan Controversy: An EIA in Practice" *Environmental Impact Assessment Review*, no. 9: 135-47.
- The Economist*. 1988. "The Dam over the River Kwai" 2 April, 32.
- The Economist*. 1992. "The Beautiful and the Dammed" 28 March, 93-97.
- The Economist*. 1993. "Wet and Dry" 10 April, 36-37.
- The Economist*. 1994. "Drying Out" 12 February, 35.
- Fahn, James. 1993. "Thirsting for Dam Efficiency" *The Nation*, 8 February, C1.
- Fairclough, Gordon and Tasker, Rodney. 1994. "Separate and Unequal." *Far Eastern Economic Review*, 14 April, 22-23.
- Fairclough, Gordon. 1994. "The Big Dry: Water Shortage Threatens Thai Rice Production" *Far Eastern Economic Review*, 27 January, 25.

- Forest Research Center. 1991. *Master Plan for Management of Salaween Wildlife Sanctuary: Mae Hong Son Province*. Bangkok: Kasetsart University.
- Giddens, Anthony. 1979. *Central Problems in Social Theory*. London: Mcmillan.
- Goldsmith, Edward and Hildyard, Nicholas. 1986. *The Social and Environmental Effects of Large Dams*. San Francisco: Sierra Club Books.
- Green November 32. 1993. *Deadly Energy*. Thailand: N.p.,n.d.
- Guest, Philip. n.d. "People as the Basic Resource: Urban-Rural Redistribution through Migration" Bangkok: Mahidol University.
- Gup, T. 1994. "Dammed from Here to Eternity; Dams and Biological Integrity" *Trout*, no. 35:14-20.
- Hardin, Gareth. 1968. "The Tragedy of the Commons" *Science*, no. 162:1234.
- Hirsch, Philip. 1986. "Dam on the River Kwai" *Inside Asia*, no.10: 45-6.
- . 1987. "Nam Choan: Benefits for Whom?" *The Ecologist*, 17 no. 6: 220-2.
- . 1993. *Political Economy of Environment in Thailand*. Manila: Journal of Contemporary Asia Publishers.
- Holtsberg, C. 1982. "Rice Pricing Policy" *Basic Needs and Government Policies in Thailand*. Singapore: Maruzen Asia.
- Hugo, Graeme. 1987. "Demographic and Welfare Implications of Urbanization: Direct and Indirect Effects on Sending and Receiving Areas" *Urbanization and Urban Policies in Pacific Asia* Edited by Ronald Fuchs, Gavin Jones and Ernesto Pernia. Boulder: Westview Press.
- Hurst, Philip. 1990. *Rainforest Politics: Ecological Destruction in South-east Asia* London: Zed Books.
- Iam Thongdi. 1994. *Wattanatham Khao: Phithikam Kiewkap Khao and Karn Tham Na* (Rice Culture: Rituals Concerning Rice and Rice Farming). Nakhon Pathom: Mahidol University.
- . 1995. *Khao: Wattanatham Lae Karnplianplaeng* (Rice: Culture and Change). Bangkok: Samnakphim Matichon.

- Japan International Cooperation Agency (JICA). 1989. *Effective Use of Industrial Water in the Kingdom of Thailand: Final Report*. March.
- Jones G.W. 1988. "Urbanization Trends in Southeast Asia: Some Issues for Policy" *Journal of Southeast Asian Studies*, no. 19:137-54.
- Jumsai, Sumet. 1988. *Naga: Cultural Origins in Siam and the West Pacific*. Singapore: Oxford University Press.
- "Kaeng Sua Ten: The Power of Footprints on the Rock." 1995. *Green World*, 17, no. 3:10-27.
- Khao Phiset. 1993. "Water Management Problems in Thailand." 16, no. 109, 24-25.
- Kinghor Laohong. 1995. "Prates Sutabutr: The Moei-Salween Diversion will Do Us Good for Ten Lifetimes" *Krungthep Thurakit*, 14 August, 3.
- Klomjit Chandrapanya and Nantiya Tangwisutijit. 1994. "Three Thai Companies Submit Bids for Building Dams on Salween River" *The Nation*, 30 March.
- Korten, David. 1992. "NGO Strategic Networks: From Community Projects to Global Transformation" *Forests, Trees and People Newsletter*, 18 September, 42-3.
- Ligon, Frank K., Dietrich William E. and Trush William J. 1995. "Downstream Ecological Effects of Dams: A Geomorphic Perspective" *Bioscience*, 5, no. 3:183-192.
- Lipton, Michael. 1980. "Migration from Rural Areas of Poor Countries: the Impact on Rural Productivity and Income Distribution" *World Development*, 8, no. 1:1-24.
- . 1982. *Why Poor People Stay Poor: A Study of Urban Bias in World Development*. New Delhi: Heritage Publishers.
- London, Bruce. 1980. *Metropolis and Nation in Thailand: the Political Economy of Uneven Development*. Boulder: Westview Press.
- Malee Traisawasdichai. 1995. "Thailand's Leading Dam Engineer is a Hero to Some and Villain to Others." *The Nation* 7 July, A10.
- Manida Unkulvasapual and Seidel, Harris F. 1991. *Thailand: Urban Sewage and Wastewater Management in Sectoral Development*. Washington D.C.: World Bank.

- Ministry of Agriculture and Co-operative (MOAC). 1981. *Agricultural Statistics of Thailand, Crop Year 1980/81*. Bangkok: MOAC.
- Ministry of Agriculture and Co-operative (MOAC). 1991. *Agricultural Statistics of Thailand, Crop Year 1990/91*. Bangkok: MOAC.
- Ministry of Agriculture and Co-operative (MOAC). 1992. *Agricultural Statistics of Thailand, Crop Year 1991/92*. Bangkok: MOAC.
- Montgomery, John. and Warren, William. 1994. *Menam Chao Phraya: River of Life and Legend*. Bangkok: Post Publishing Public Co.,Ltd.
- Murray, David. 1993. *The Dam(ned) Conflicts in Thailand*. Translated by Kannikar Phromsao. Bangkok: Development Promotion and Support Committee.
- Nantiya Tangwisutijit. 1994a. "Dam-Buster US Bureau Chief Heralds a New Environmental Era" *The Nation* 23 November, A7.
- . 1994b. "The River of Many Names." *World Rivers Review*, 9, no. 2/3: 10-11.
- . 1994c. "Two New Dams to Quench City's Thirst" *The Nation*, 7 March, A3.
- Nart Tantawiroon. 1984. "Public Perception of Tropical Rain Forest and Its Future in Thailand." *Environment, Development and Natural Resource Crisis in Asia and the Pacific* Penang: Sahabat Alam Malaysia, 88-91.
- National Statistical Office (NSO). 1964-1992. *Statistical Yearbook: Thailand*. Bangkok: NSO.
- National Statistical Office (NSO). 1992. *Advanced Report 1990 Population and Housing Census* Bangkok: NSO.
- Nithi Eoaseewong. 1996. Interview by author. Chiang Mai, Thailand, 30 May.
- Nusara Sawatsawang. 1995. "Thailand: Options to Ease Water Crisis" *Bangkok Post*, 30 May. Available from Reuter Textline via Nexus Lexus.
- Pacey, Arnold, and Cullis, Adrian. 1986. *Rainwater Harvesting: The Collection of Rainfall and Runoff in Rural Areas* London: Intermediate Technology Publications.

- Paichitr Uathaveekul. 1993. "City and Environment," in *Environment '93: the Fourth Seminar on Natural Resource Conservation and Environment of Thailand*. Bangkok: N.p., 219-232.
- Panya Consultants Co.,Ltd., Snowy Mountains Engineering Corporation Limited and Chiang Mai University. 1995. *The Pre-feasibility Study of the Moei-Salaween-Chao Phraya Diversion Project*. Bangkok: Department of Energy Development and Promotion.
- Park, Christ C. 1992. *Tropical Rainforest*. London: Routledge.
- Pawadee Thonguthai. 1987. "Implicit Policies Affecting Urbanization in Thailand." *Urbanization and Urban Policies in Pacific Asia*. Boulder: Westview Press, 183-194.
- Peet, John. 1992. *Energy and the Ecological Economics of Sustainability*. Washington D.C: Island Press.
- Phujadkarn Raiwan* (Manager Daily, Thailand), 1993, "Piped Water and Behavioral Change" 23 December, page 5.
- Phujadkarn Raiwan* (Manager Daily, Thailand), 1995, "Advancing on Diversion from Salaween to Bhumibhol" 22 August, page 12.
- Phujadkarn Raiwan* (Manager Daily, Thailand). 1996. "Revealing DSM for Piped Water: City is Wasteful" 12 April, page 5.
- Prakob Wirojanakoot, Thidarat Tiayajamorn and Sunet Boonma. 1992. *Water and the National and Community Security*. Khon Kaen: Faculty of Engineering, Khon Kaen University.
- Prasong Charasdamrong. 1996. "Good Rains for Second Rice Crop" *Bangkok Post*, 28 April, 17.
- Prates Sutabutr. 1995. Interview by author. Bangkok, Thailand, 5 September.
- Prinya Nutalai. 1987. "Earthquakes and the Nam Choan Dam." *The Ecologist*, 17 no. 6, 223-5.
- Project for Ecological Recovery. 1993. "Fundamental information concerning the water crisis in Thailand." Project for Ecological Recovery, Bangkok. Photocopy.
- Rigg, Jonathan. 1991. *Southeast Asia: A Region in Transition*. London: Unwin Hyman.

- Rigg, Jonathan., ed. 1992. *The Gift of Water: Water Management, Cosmology and the State in Southeast Asia*. London: School of Oriental and African Studies, University of London.
- Rigg, Jonathan. 1995. "In the Field There is Dust." *Geography*, 80, no. 346: 23-32.
- Royal Irrigation Department. 1992. *Water Shortage in the Chao Phraya Basin and Ways to Solve it*. RID, Bangkok. Photocopy.
- Sacha Sethaputra, Theodore Panayotou., and Vute Wangwacharakul. 1990. "Water Resources: Shortage Amidst Abundance." *TDRI Quarterly Review*, 5, no. 3:12-19.
- Said, Edward W. 1994. *Culture and Imperialism*. New York: Alfred A. Knopf.
- Said, Edward W. 1978. *Orientalism*. New York: Vintage Books.
- Sanitsuda Ekachai. 1992. "Water's Shorter, Everywhere..." *Bangkok Post*, 17 February, 25.
- Sathit Manas-surakul. 1994. "Diverting the Salween to Fill in the Bhumibhol Reservoir: Questions that Must be Answered" *Siam Post*, 18 June, 5.
- Schumacher, E. F. 1975. *Small is Beautiful: Economics as if People Mattered*. New York: Harper & Row Publishers.
- Scott, James C. 1979. *The Moral Economy of the Peasant*. New Haven: Yale University Press.
- Seni Pramroj. 1990. "Father King Ram Khamhaeng's Stone Inscriptions: First Constitution of Thailand." *Development, Modernization and Tradition in Southeast Asia: Lessons from Thailand*. Edited by Pinit Ratanakul and U. Kyaw Than. Bangkok: Mahidol University.
- Siam Post*. 1992. "Water is Short: Is Dam an Answer?" 24 December, 4.
- Small, Leslie E. 1973. "Historical Development of the Greater Chao Phya Water Control Project: An Economic Perspective" *Journal of the Siam Society*, 61, no. 1.
- . n.d. *Returns to Public Investment in Water Control in Southeast Asia: A Case Study of the Greater Chao Phya Project of Thailand*. Rutgers University, Department of Agricultural Economics and Marketing. Bulletin 842.

- Sujit Wongthes., ed. 1989. *Khao Phrai-Khao Jao Khong Thai* (Thai Rice). Bangkok: Matichon Press.
- Suntaree Komin. 1989. *Social Dimensions of Industrialization in Thailand*. Bangkok: NIDA.
- Thailand Development Research Institute (TDRI). 1994. *Water Conflicts*. Bangkok: Natural Resources and Environment Program, Thailand Development Research Institute and Queen's University, Canada.
- Thara Buakhamsri. 1993. Ecology and Development Projects on the Salaween Basin. Master's thesis. Chiang Mai University.
- Theeraphap Lohitkul. 1992. *Mae Nam Chao Phraya* (The Chao Phraya River). Bangkok: Na Banwanakam.
- Thida Saraya. 1980-1981 "Kalapana and Community Expansion" *Muang Boran* (Ancient City), 12, no. 1: 86-95.
- . 1982a. "Dhevaravati Civilization and the Development of State in the Chao Phraya river basin" *Art and Culture*, 3, no. 11: 16-17; 21-22.
- . 1982b. The Development of the Northern Tai States from the 12th to the 15th Centuries. Ph.D. diss., Sydney University.
- . 1989 "Rice, Rice Cultivation and Politics in Sukhothai History" *Khao Jao Khao Phrai Khong Thai* (Thai Rice). Bangkok: Matichon Press, 98-107.
- Thitinan Pongsudhirak. 1994. "Water Allocation Conflicts in Central, Thailand." *Water Conflicts*. Bangkok: Thailand Development Research Institute, 239-259.
- United Nations. 1972. *Development in the Field of Natural Resources — Water, Energy and Minerals; Technical and Economic Aspects of International River Basin Development: Report of the Secretary General*. New York: United Nations.
- United Nations. 1991. *World Urbanization Prospects, 1990*. New York: United Nations.
- United Nations. 1993. *The State of Food and Agriculture (SOFA) 1993: Special Chapter*. Available from gopher.fao.org/.
- Van Beek, Steve. 1995. *The Chao Phya: River in Transition*. Kuala Lumpur: Oxford University Press.

- Vanchai Tantiwithayaphithak. 1993. "War over Water: A Soluble Problem" *Feature Magazine*, April, 116-135.
- Virabongsa Ramangura and Bandid Nijathaworn. 1990. "An Overview of Economic Development in Thailand." *Development, Modernization and Tradition in Southeast Asia: Lessons from Thailand*. Edited by Pinit Ratanakul and U. Kyaw Than. Bangkok: Mahidol University.
- Walakkamon Eamwiwatkit, 1994. "Wet Water Fighting." *The Nation* 17 June, C8.
- . 1995. "A Dam-building Frenzy." *The Nation*, 27 July, C8.
- Watershed*. 1995a. "Dam Will Always be Needed" 1, no.1: 7-9.
- Watershed*. 1995b. "We are Going to Have to Get out of the Dam Building Business." 1, no. 1: 6-8.
- Watershed*. 1995c. "Why Watershed." Editorial. 1 no.1: 2.
- Wildlife Fund Thailand. 1987. *Consider the Costs: A Position Paper on the Nam Choan Dam*. Bangkok: WFT.
- Witoon Permpongsachareon. 1995. Interview by author. Bangkok, Thailand, 22 July.
- Yindee Lertcharoenchok. 1995. "Burmese Military Backs Hydropower Feasibility Study" *The Nation*, 21 January, B1.
- Yos Santasombat. 1993. *Water 1360*. Bangkok: Local Development Institute.
- Yoshikazu, Takaya. 1987. *Agricultural Development of a Tropical Delta: A Study of the Chao Phraya Delta*. Translated by Peter Hawks. Honolulu: University of Hawaii press.