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Natural Resources and Environment Program

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EXECUTIVE SUMMARY

Water scarcity in Thailand has led to the thought of improving the social benefit of water utilisation by diverting water from lower to higher value activities. If water is to be diverted from the Mae Klong basin to Bangkok there needs to be a management tool to accomplish the job. Two options are available for the Thai Government: the command and control method together with full-cost water pricing and the market mechanism known as *tradable water rights*.

Under the command and control method, the Government decides when and how much water will be diverted from the Mae Klong basin. This method needs not suggest economic inefficiency nor biased against the people of Mae Klong who may consequently have to forego their second crop. The command and control method can be made efficient and help increase social welfare if water is transferred from lower value to higher value activities. To achieve this economic efficiency, the Government must have information on the marginal value of water for agriculture in the Mae Klong basin and the marginal value of water in the Chao Praya basin. Equally important, a payment equal to the value of water must be compensated when water is transferred out of the Mae Klong basin. This will ensure that water transfer is unbiased. This report suggests that full-cost water pricing be used to finance this water transfer.

Tradable water rights on the other hand attempts to grant water rights to water users in the Mae Klong basin and to allow these rights to be traded in the market. It is believed that water will be traded away from low value activities to higher value activities and hence result in a social welfare improvement. Those who sell or lease their water rights will be directly compensated by the amount equal to the market value of water or the market price of water. Thus, tradable water rights is a method which ensures economic efficiency as well as fairness in water transfer. Tradable water rights has been practiced in many countries such as Chile, Mexico or the State of California, USA. In addition to water trade, water pollution, too, can be managed through market mechanism commonly known as "Tradable Pollution Permits"

With tradable water rights the role of the water agencies, such as, the Royal Irrigation Department will shift gears from farm level monitoring to regional or national level water resource issues. Its responsibility will include forecasting annual water availability, large scale investment in water storage and distribution, exploring relationship of inter-basin water transfer, monitoring water transactions, supervision of possible negative effects of water trade (environmental impact or negative effect to other economic activities), law enforcement or waterway navigation. In order to implement tradable water rights some preparations are required. Water laws must be revised to permit secure water ownership to water users. Water distribution, channeling and appropriate, yet simple, metering system are required.

This report concludes that diverting water from Mae Klong to Chao Praya river can be made efficient if the command and control method is implemented together with full-cost water pricing. Tradable water rights is another option and will also ensure efficiency in water allocation.

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1. INTRODUCTION

Water is no longer abundant in Thailand. The increase in the demand for water to serve the expanding urban population and industrialisation while at the same the demand for water in agriculture has not subsided has turned the status of water resource in Thailand from what used to be abundant to now a scarce resource. Water pollution resulted from untreated industrial waste, agricultural residuals as well as household outlets makes water shortage problem even more complicated. Resulted from this scarcity are various forms of conflicts in water usage which are becoming more apparent in Thailand. The common example is the case where water previously used for dry season agriculture, such as second crop rice, has been diverted to serve urban economic activities.

To meet this growing demand for water the Thai Government has attempted to increase water supply through construction of new dams to store water during the raining season. This supply side attitude of solving water scarcity is approaching its limit as new constructions have become a burden to Thailand both financially and environmentally. As the demand for water continues to expand and the increase in the supply of water becomes more unlikely, it then leaves the Thai Government with only one other alternative, that is, to address the issue of water resource scarcity and water allocation by employing a more efficient management skill, such as, full-cost water pricing or tradable water rights -- techniques that the Thai Government has neglected for too long.

The thought of diverting water from the Mae Klong Basin (which is used mainly for agriculture) to serve the population and industrialisation in Bangkok is another case which illustrates a conflict cum scarcity in water resource allocation in Thailand. Although this notion of "*urban is preferred to agriculture*" is not entirely new to the Thai society, it nevertheless leaves some of us with guilt when the farmers along the Mae Klong river have to make sacrifices so that golfers around the Bangkok areas can continue to make birdies and relax themselves in tub water afterwards. This seemingly unfair water allocation has its roots in fact that the current water allocation system in Thailand (managed by the command and

control method) permits urban water users to obtain raw water for free without having to make any compensation to the Mae Klong water users.

As surprising as it may be, diverting water from the Mae Klong Basin to Bangkok can be made more economically efficient and socially acceptable to both the Mae Klong and the Bangkok water users if the method of water reallocation is carefully selected and well designed. The command and control can lead to economic efficiency and can also be socially acceptable if it is augmented with full-cost water pricing. The command and control method will divert water according to the benefits of water utilisation (which have to be calculated). Full-cost water pricing will calculate the price of water according to its opportunity cost and those who lose the priviledge to use water will be compensated accordingly.

On another hand, the tradable water rights method argues that if water resource has well defined property rights and is tradable then economic efficiency will be attained where water will be allocated to high value activities. When these water rights are distributed among the water users in an acceptable fashion, those who had the rights but choose not to use water will be compensated according to the market value of water at that time.

Tradable water rights is not exactly a new concept. Chile has a successful experience with tradable water rights for over twenty years. Since the beginning of 1990's Mexico has began implementing tradable water rights along with many other free market innovations to liberalise its economy. The state of California has also used tradable water rights to solve its upstream downstream water conflicts. Malaysia has adopted this same method but used it to reduce water pollution problem from palm oil industry. And tradable water rights too, can be used to solve conflicts in water resource allocation in Thailand if it is carefully designed and implemented.

At present water resource allocation in Thailand is rarely managed through economic instruments, such as, tradable water rights or full-cost water pricing but instead by the command and control method or arbitrary pricing handled by responsible government

agencies. The Royal Irrigation Department develops irrigation systems and ensures water for agriculture, the Water Works Authority supplies water to urban users at a subsidised price, EGAT uses water for electricity and more. The Thai Government has, thus, assumed the responsibility of finding or producing water through construction of dams, irrigation system and the operation of urban water supply. In addition, the Thai Government also makes decisions as to how and how much this water will be allocated to various users: agriculture, urban areas, industries, electricity generation as well as recreation.

Despite the fact that this water allocation method has existed in Thailand for many decades, today, no one is certain as to what this allocation system exactly entails. Questions often raised include: Who has the rights to use water and how much? Is water allocation based on the first come first serve basis? What does the Thai law say about the ownership of water resources? Which activities are more important and more water deserving? or Why does the Government only issue ownership titles to land and not water when both are important factors of production?

These queries suggest a possibility that the existing water allocation method in Thailand has not been transparent. And if this is the case, diverting water from the Mae Klong Basis to Bangkok based on the existing water allocation method in Thailand will most likely result in a chaos. The outcome will be economically inefficient as the marginal value of water in different uses can differ, socially unacceptable as the poor farmers never receive compensation when water is transferred from their farm to the city and can even be politically unwise.

This report will illustrate how the command and control method can be made efficient and socially acceptable through full-cost water pricing. Special emphasis will be given to the possibility of adopting tradable water rights to serve as a tool to divert water from the Mae Klong Basin to Bangkok users. Following this introduction is an overview of the status of water resource in Thailand followed by a description of the socio-economic status of the Mae Klong Basin. Section 4 explores the options available for the management of water resource: the command and control method together with full-cost water pricing,

tradable water rights and tradable pollution permit. The report will focus on tradable water rights by discussing its benefits in section 5. Section 6 reviews the experience of using water markets in other countries and 7 outlines the mechanism involved in establishing the water markets as a means to transfer water from the Mae Klong Basin. Some conclusions will be provided in section 8.

2. STATUS OF WATER RESOURCE

The Central region can be used to illustrate the ongoing water scarcity in Thailand. The two major water reservoirs that store water to serve the Central region are Sirikit and Bhumipol dams. The carrying capacity of these two reservoirs total 229,000 million cu.m. Over the last 40 years the flow of water into these two reservoirs averages about 15,600 million cu.m. per year. But it was reported that at present the flow of water has decreased to only about 5,600 million cu.m. per year. The increase in the demand for water in the Northern region which is above these reservoirs, the decline in rainfall and the possible decrease in water yield due to highland plantation are the majors factors contributing this decline in the amount of water flowing into Sirikit and Bhumipol dams.

In the Northern region it was estimated that the demand for water has increase three folds during 1980-1989 from about 81 cu.m./person/year to 257 cu.m./person/year. While the increase in the demand for water in the Northern region, both for agriculture and urbanisation, and the decline in rainfall are more familiar factors explaining the decline in the amount of water flowing in two Sirikit and Bhumipol dams, the choice of plant species used in the highlands is a more recent finding.

A study by Vincent J.R. (1995) examines the Mae Tang water basin in the Northern region and finds that the demand for water in the urban area such as Chiang Mai city and agriculture has continued to increase. This together with a possible decline in water yield has led to a conflict in water utilisation between agriculture and urbanisation thus leaving less water available to the Central Plain.

Below Sirikit and Bhumipol dams the Royal Irrigation Department uses about 6,600 million cu.m. of water for dry season agriculture. Usually about 4,000 million cu.m. is available for agriculture and consumption. The amount of water available to serve the basic needs has sometime decreased from 2,500 million cu.m. to 1,100 million cu.m. per year. During water shortage period the Royal Irrigation Department sets a priority to various types of water use and allocates water accordingly. The priority used by the Royal Irrigation Department at present is that water for consumption of 2500 million cu.m. has the highest priority following by saltwater intrusion 600 million cu.m., navigation 300 million cu.m. If water is available it will then be allocated to second rice plantation of about 2000 cu.m. per rai and then crops plantation of about 1000 cu.m. per rai.

At present water has also been diverted from the Mae Klong river to Chao Praya river via Tha Chin river. The two channels serve to divert water are Chorakae Sam Pan and Kaow Sarn Bang Pla channels. Each of these channel transfers water at the rate of 5 million cu.m. per day totalling 10 million cu.m. per day. This divertion from the Mae Klong to Chao Praya via Tha Chin river is carried out without any compensation being made. The reason that this divertion has not been a problem thus far is because the Mae Klong river has a surplus of water which is drained into the ocean if not used. For that reason diverting water from Mae Klong to Chao Praya river has not reduce water consumption for the Mae Klong water users.

In the future should the water demanded along the Mae Klong increases or more water is needed in the Chao Praya area diverting water will surely create a conflict between the water users. At this time economic instruments such as full-cost water pricing or tradable water rights will help make water transfer more efficient and socially unbiased.

On the demand side, the United Nations (1991) survey reports the change in the pattern of water consumption in the Central region. The findings show that between 1987-2000 water consumption for agriculture, industrialisation and household increases from 21,000 million cu.m. per year to 30,000 cu.m. per year. On a per capita basis, water consumption in the Central region increases from 1,624 in 1987 to about 1,782 in 2000.

This increase in the demand for water and the decrease of the volume of water available for consumption indicates that water resource in Thailand is becoming a scarce resource. Water which was once free when it was abundant should now be priced as its status has changed to a scarce resource. However, the Thai Government has chosen to fight this scarcity by increasing the supply of water through constructions of new dams. This approach to ease scarcity has reached its limit as new constructions have become a burden to the Thai Government financially and environmentally when large areas have to be endued. Areas suitable for dam constructions are also becoming scarce. The Government has also failed to properly maintain the existing irrigation system where leakage and loss of water account for as much as 70% for agriculture and 30% for pipe water in the urban areas.

Another approach used to overcome water scarcity is to persuade the farmers to refrain from dry season rice plantation or to switch to other crops which are less water demanding so that water can be used or diverted for urban consumption. This method has not been very successful as much of the irrigation system in the Central region is designed for rice plantation where water will remain in the rice field for 24 hours. An improved irrigation system which can reduce water loss and can be adapted for non-rice agriculture will need to be developed before any efficiency can be realised.

Conflicts in water usage at various level have also been common during water scarcity. Conflicts among the farmers are found between the upstream farmers and those located at the end of the irrigation channels who receive little or no water. Sometimes the farmers also have to confronts with irrigation officers when trying to convince them to release more water for plantation. At the governmental level the Royal Irrigation Department is responsible for providing water to the various users such as farmers and other government agencies such as Water Works Authority. When these government agencies are pressured to served an increasing number of households they in turn demand more water from the Royal Irrigation Department. At present there are no rules to determine which agency has the rights to use the water or which activities are more water deserving than others. These institutional conflicts between water demanding agencies thus becomes another source of inefficiency in water resource allocation in Thailand.

Thai Water Laws – And Still No Rights [1]

Thailand has many laws governing the use of water. Unfortunately, these laws tend to leave too much room for interpretation and do not explicitly specify who exactly has the rights to use water. According to the Civil and Commercial Code, Section 1304 states that:

"The public domain of the State includes every kind of State property which is in use for the public interest or reserved for the common benefit, such as

1) ....

2) property for the common use of the people e.g., foreshores, waterways, highways, lakes;

This language suggests that water in rivers, canals, lagoons is public domain which can be used by anyone but is still under the supervision and protection of State. This law does not clearly entitle the State to the full ownership of water but it may be interpreted that way.

This vagueness does not at all suggest that in the Thai water laws are meaningless and worthless. When these laws were passed many years ago when water resource in Thailand was still abundant. There were also fewer water users. Under those circumstances there were not reasons to have the water laws exactly specify the user rights. But as the status of water resource in Thailand has changed from abundant to scarce there is then a need to revise the existing water laws. The Thai law under Section 1304 also leaves out other kinds of water bodies, they are, runoffs, underground water, sea water, atmospheric water and natural springs.

The Civil and Commercial Code, Section 1335 and 1336 concern the ownership of property and may have an implication over the use of runoff as it passes by or

[1] This section of Thai Water Laws is summarised from " The compilation and revision of water resources law" by the Faculty of Law, Thammasat University, Bangkok, 1993.

passes through each property but it again depends on the interpretation as to how much water belongs to the land owner and how much is considered as passing runoff. Section 1339 is more relevant to runoff as it states that: "The owner of a piece of land is entitled to take water that passes through naturally from higher land". So it can be concluded here that property owners only have the rights to use runoff but runoff still belongs to the State. Furthermore, it may be surmised that these laws were written when water resource was abundant which is no longer the case for today.

The use of natural springs should fall under Section 1339 of Civil and Commercial Code if such natural spring is located within the property. The owner of the property where natural springs originates only have the rights to use and the State still have the ownership of natural springs.

The legal status of underground water has to be divided into two cases: underground water inside and outside the Underground Water Area (UWA). As for underground water inside the UWA the Section 16 of the Underground Water Act, B.E. 2520 states that "Without license from the Director General or his/her designee no one shall render services relating to drilling, abstracting and recharging underground water within the Underground Water Area". This law suggests that underground water inside UWA belongs to the State. It is worth to note here that Section 16 of the Underground Water Act, B.E. 2520 only applies to underground water more than 15-30 metres below the surface depending on the province. Groundwater less than the specified depth is not currently subject to this law but may be interpreted as being under Section 1339 of the Civil and Commercial Code.

As for underground water outside UWA Section 1335 of the Civil and Commercial Code said that the owner of land owns everything beneath his/her land. However, Section 1335 may be interpreted not to apply to underground water as it passes through many other property as well and can be subject to Section 1339 discussed previously. Excessive use of underground water in one area can reduce the stock of water and reduce the total amount of water available to other areas as well. Thus the use of underground water

outside UWA should be treated under Section 1339 which would imply that such water belongs to the State and not the property owner.

As for sea water Section 1304 of the Civil and Commercial Code treats this resource as a "public domain" available for common use. The atmospheric water is currently not regulated under any water laws as the technology used to abstract water from the air is still limited. Another issue currently not under any Thai water laws is the ownership of water bed. The Faculty of Law, Thammasat University (1993) suggests that water bed should be designated as public property in order to prevent it from being occupied or damaged.

So it can be concluded at this point that the existing water laws in Thailand do not explicitly state who owns the water or has the rights to water resource. Most of the water laws can, however, be ***interpreted*** that water resource belongs to the State and only individuals who are legally assigned the rights to use although not the full ownership.

Besides the above laws which are describe the ownership of water there exist another sets of laws which govern the use of water for various purposes, such as, agriculture, industrialisation, hydropower generation and navigational use. Following will briefly outline this body of laws as they can have an affect on water allocation and utilisation in Thailand.

In agriculture, the Public Irrigation Act, B.E. 2485 empowers the Government to control the use of water for agriculture only in the "*Irrigated Areas*". Farmers are required to obtain permission from government and pay a fee when water is drawn from irrigation cannel. The Private Irrigation Act, B.E. 2482 allows the Government to control all kinds of private irrigation except those which are temporary or serve an area less than 200 rai. The Land Consolidation Act, B.E. 2517 is used only for land under the "*Land Consolidation Area* ". These three acts therefore only extended government control over water use only in the designated areas. There exist many other land and water use which are not in the designated areas and hence are not regulated under these laws.

Water for industrial use is also subject to the Public Irrigation Act, B.E. 2485 mentioned previously. As for mining, the Mining Act, B.E. 2510 prevents miners from using

water from public waterways and allows the government to control mining activities and to prevent it from creating external effects to public roads or waterways. Section 1355 of the Civil and Commercial Code on water use by riparian landowners is also relevant to industrial use of water. Use of underground water for mining is still subject to the Underground Water Act, B.E. 2520.

As for hydropower activities, the Public Irrigation Act, B.E. 2485 also allows the Royal Irrigation Department to construct dams and maintain water for agriculture and energy production. The Electricity Generating Authority of Thailand Act, B.E. 2511 permits EGAT to construct, operate and maintain dams within its jurisdiction. EGAT is also supposed to cooperate with the Royal Irrigation Department in determining the water storage level and the amount release.

The laws governing navigation are the Navigation in Thai Waters Act, B.E. 2456, the Canal Protection act, R.S. 121 and the Ship Collision Prevention Act 2552. The Public Irrigation Act, B.E. 2485 also extends to cover navigation activities in the irrigated areas. The Port Authority Act of Thailand Act, B.E. 2494 gives the Port Authority of Thailand responsibility to maintain navigation channels, navigation safety within its jurisdiction. Despite all these laws regarding navigation, none of them empowers the Government to control the level of water necessary for navigation.

Lastly, the national park or forest reserve acts also have some relevance to the protection of watershed even though these laws seem to have limited applications. These laws include: the National Reserved Forest Act, B.E. 2507, the National Park Act, B.E. 2504 and the Protection and Conservation of National Environmental Quality Act, B.E. 2535.

Given that there exist many laws governing water resource in Thailand following are some common characteristics which are shared by many of them. First, many these laws were written more than 30 years ago when water was abundant in Thailand. At present when scarcity is what best describes water resource the appropriateness of these laws are in question. Second, none of these laws seems to clearly specify who owns the water. Many of them tend to empower the State to only regulate the use of water and not the sole

ownership. None of these laws permit private ownership of water -- something which is very essential before tradable water rights can be successfully established in Thailand. Third, these laws tend to cover only water use in the designated areas. There are many areas which are under no water laws at all.

Proposed Drafts to Revitalise Water Laws

Given that the existing water laws in Thailand have become inappropriate as they do not enable an efficient use and allocation of water there are now attempts to revise these laws. The effort of the Faculty of Law, Thammasat and the National Research Council (NRC) are the two drafts which attempt to revise Thailand water laws by making them more appropriate and effective. Following are some comparisons between these two drafts which are of some relevance to this report.

First, the NRC draft does not empower the State the ownership of water resource but only state specific locations which are to be considered as state water properties. NRC does not include natural springs but it includes atmospheric water. The Thammasat draft entitles the State the full ownership of water regardless whether such water is located on private or public property. This will allow the State a full control on the use of water and will establish a full ownership to water.

Second, NRC draft will replace the Civil and Commercial Code, Act 1355 which does not allow downstream users the rights to use water. The NRC draft suggests that "Water users have the rights to use only an appropriate amount water from public domain and such use will not be harmful to the third party". The Thammasat draft went further and said that "In order to obtain water from the public domain water users must obtain water rights certificates from the State, except for household consumption". Water pricing may be used together with water rights certificates in order to help finance public investment in water resource development. It will become clearer in the Section 4 that the concept of water rights proposed by Thammasat University is along the line with tradable water rights proposed by this report.

As for assigning priority to water use both NRC and the Thammasat University suggest that the concerned government agencies should decide who will receive water particularly in time of water shortage. The Thammasat University further stresses that during water shortage household water consumption should receive first priority as water will be used to satisfy the basic needs.

It can then be summarised that the current status of water resource in Thailand is characterised by its scarcity and lack of efficient allocation method. The demand for water has been increasing and will continue to increase in the future. At present water is no longer just a factor of production for agriculture but it also supports other economic activities such as manufacturing industries, urban consumption, hydropower, transportation as well as recreation. Attempts to increase the supply of water through constructions of new dams have become a burden to the Government both financially and environmentally. This scarcity and water shortage make the existing water laws obsolete and new revisions are long due. The major concern in the new drafts of water law is that the lack of ownership or free access has led to inefficiency and conflicts in water allocation. The new drafts proposed by NRC and the Thammasat University aim to establish a more secure ownership or secure property rights to water resource as it is seen as an essential requirement for any improvement in water resource allocation and consumption.

3. SOCIO-ECONOMIC STATUS OF THE MAE KLONG BASIN

The Mae Klong basin is located in the Western part of Thailand covering an area of about 30,800 sq.km. or about 18.5 million rai The two major tributaries of the Mae Klong river are Khwae Yai river and Khwae Noi river which flow into the Mae Klong river at Kanchanaburi province and passes through Ratchaburi province and empties into the sea at Samut Songkhram province. The Mae Klong basin also covers parts of other provinces, they are, Tak, Uthai Thani, Samut Sakhon, Nakhon Pathom and Suphanburi.

In 1992 the Mae Klong basin as the total population of about 1.5 million with the total residential area of about 125 sq.km. The average annual per capita income

(measured in 1990) of the Mae Klong population are 30,355 baht in Kanchanaburi province, 22,529 in Ratchaburi province and 15,987 baht in Samut Songkhram province.

Table 3.1 Socio-Economic Characteristics of three provinces in Mae Klong basin, 1990.

	Kanchanaburi	Ratchaburi	Samut Songkhram
Area (sq.km.)	19,483	5,196	416
(million rai)	10.816	2.455	0.26
Population	641,000	735,000	92,000
Per Capita Income	30,355	22,529	15,987
GDP (million baht)	20,003	15,816	3,277
Agriculture	27.25%	19.89%	15.56%
Industry	14.71%	19.41%	15.49%
Services	13.35%	12.69%	19.92%
Land Use (rai)			
Community	217,758	1,891	14,109
Agriculture	1,766,738	1,094,106	238,002
Rice	211,797	369,879	9,036
Sugar Cane	1,217,075	153,892	0
Field Crop	257,035	285,692	0
Grazing	4,528	40,390	0
Animal Barn	0	0	121
Orchards/Tree	68,984	209,215	138,024
Vegetable	7,319	35,038	2,729
Fishery/Shrimp	0	0	82,169
Salt Farm	0	0	5,923
Forest Land	7,580,320	1,353,107	3,224
Water Surface	573,254	6,809	2,992
Shrub&Others	678,572	0	2,114

Sources: 1. National Statistical Office
2. NESDB, Study of Potential Development of Water Resources in the Mae Klong river basin, Vol. II, 1994.

Table 3.1 shows the summary of the socio-economic characteristics of the three major provinces in the Mae Klong basin. The three major income sources of the people in the Mae Klong basin are agriculture, industries and services such as tourism. In agriculture rice, sugar cane, tapioca, orchards, corn and fishery are the major agricultural activities.

The industrial activities commonly found in are sugar mill refinery, agricultural product processing/canning, textile, animal food, fish source factories. Mining is also another income source. The minerals found are tin, vulphram, selite, led, silver, zinc, flourite, dolomite, phosphate, lime stone, granite and precious stone. The mining activities concentrate more in the Kanchanaburi province where the royalty paid to the Government in 1992 amounted to 15.74 million baht.

Tourism is also important to the people of Mae Klong basin. The major tourist attractions are River Khwai Bridge, Deadly Route Railway, Khao Laem and Srinagarind reservoirs, Sai Yok and Sai Noi waterfalls, Erawan National Park and floating markets.

Water use in the Mae Klong is classified into off-stream use and in-stream use. Off-stream use includes activities such as i) irrigation which can be under the Greater Mae Klong Irrigation Project (GMKIP) or irrigation projects run by the Department of Energy Development and Promotion (DEDP), ii) domestic used through water supply plant operated by the Provincial Water Authority, iii) non-domestic use such as industrial, commercial, government, educational, hospital and other demand, iv) aquaculture which supplies water to fishing ponds, and v) trans-basin diversion where water from the Mae Klong is diverted to the nearby Tha Chin river to help meet salinity control requirement. In-stream use of water in the Mae Klong basin include i) hydropower where water runoff is stored in the Khao Laem, Srinagarind and Tha Thung Na reservoirs, ii) salinity control at the Mae Klong delta, iii) water transportation and iv) tourism such as rafting, water skiing, restaurant rafts.

4. THE MANAGEMENT OF WATER RESOURCE

Water resource is treated here as an economic good which has to be efficiently allocated according to its availability and pattern of consumption. Open access, absence of

ownership, zero charge or under-priced water are the characteristics of water resource in Thailand. Lack of ownership and open access allow many water users such as the farmers and government agencies (EGAT or Water Works Authority) to obtain water at zero price. Urban water users, industrialists as well as recreation industries are also paying a price for water which does not reflect the opportunity cost of producing it. When water is free of charge inefficiency in water consumption is inevitable. Over-consumption, lack of incentives to repair leakage and installing water saving devices indicate that water has been under-priced. As these characteristics of water resource has made its allocation sub-optimal its thence provides a justification for state intervention through the use of appropriate economic instruments.

Furthermore, the present mechanism used in allocating water to various users may not maximise the full benefit of water resource and may also be socially biased. When water allocation is discretionary and depends on government decisions as to who or which activity "*deserves*" water one cannot be certain that water will be directed to highest value activities and hence will not maximise the potential benefit. When water is diverted away from one group of water users without full compensation and is given to another group of water users without charging the full opportunity cost of water such allocation can be considered socially biased. Persuading the farmers to forego dry season cropping so that urban water users can maintain their lawn during the summer is an example illustrating how the present water allocation system in Thailand can be considered socially undesirable.

As the present water allocation method in Thailand cannot guarantee efficiency in water resource allocation. This report proposes economic instruments such as full-cost water pricing or tradable water rights can be used to help increase efficiency in water consumption, eliminate conflicts in water uses and can be made more socially acceptable among the water users.

Economic management of water allocation can be classified into two categories; command and control with full-cost water pricing and tradable water rights. Between these methods tradable water rights is more most powerful as it promises to effectively yield economic efficiency in water allocation and need not impair the existing

distribution of wealth in the society. This report will first describe the shortcoming of the command and control method and how it can be made more efficient if the command and control is augmented with full-cost water pricing. The disadvantages of full-cost water pricing will also be mentioned. The concept of the tradable water rights will be then be introduced.

On the management of water pollution this report suggests that pollution rights, too, can be issued and traded. This system known as tradable pollution permits proposed in this report will guarantee that water pollution be controlled up to the desired level at the least cost.

4.1 Command and Control with Full-Cost Water Pricing

The command and control method of water allocation refers to the system where water allocation to various uses is determined by the Government, such as, the Royal Irrigation Department. Under this management system the Government as the full power to decide who will receive water and by how much. The rules used by the government officials to decide how water should be allocated can be based on the previous historical use, political reasons or the economic returns or the value of water from various uses.

The command and control method has been accused as being inefficient because the rules used to allocated water is not based on the benefit that each unit of water can generate. For example, if the value of one cu.m. of water used for rice cultivation in Mae Klong is 100 baht which is higher than that of the Chao Praya area, say 80 baht, then this allocation is considered inefficient. As can be illustrated, for every cu.m. of water reallocated from the Chao Praya to the Mae Klong it will generate a net gain of 20 baht to the society. Therefore, economic efficiency states that in order to maximise the society welfare from water utilisation water should be allocated to various uses until the marginal benefits of water are every where equal and additional gain cannot be made from further water reallocation.

The above statement opens doors to the command and control method as it is possible that the Government can calculate the marginal value of water from various uses and allocate water accordingly, that is, between agriculture and urban areas or between various

crops. However, this approach to efficient water allocation faces some difficulties. First, calculating the marginal value of water for water utilisation is difficult and can never accurately be determined. Second, price information is important in calculating the value of water. In the case of Thailand where agriculture water is allocated at free of charge it will be nearly impossible to employ the traditional demand estimation models in valuing water when price information is missing. Third, as the demand for crops and other activities changes the marginal value for water will also change. Keeping up with these changes will be a tedious task. Lastly, the command and control method per se will make some water users worse off and some better off. Those who lose the priviledge to use water, such as the farmers along the Mae Klong, will be made worse off. This decrease in welfare can be approximated by valuing the reduction in crops or economic activities foregone as less water is available to them.

For these reasons it is believed that the command and control method per se may not guarantee efficient water allocation. However the command and control method can be made more socially desirable if it is followed by full-cost water pricing. Full-cost water pricing attempts to achieve two objectives: to efficiently manage the demand for water and to raise revenue which can be given to those who lose the priviledge of not having water and hence makes the command and control method more socially desirable.

Full-Cost Water Pricing

Full-cost water pricing attempts to price water so that its price reflects the full resource cost of producing it. Putting it more directly, the price of water will reflect its opportunity cost or its foregone benefit. When the price of water reflects its foregone benefit people who use or purchase water will then decide if the benefit of using this water is worth the foregone benefit. This way water will be consumed only by activities whose benefit is greater than or at least equal to the foregone benefit of producing water (opportunity cost). When water is allocated only to high benefit uses it is said that allocation efficiency is attained.

The full-cost water pricing is calculated as the sum of three components production costs, user costs and environmental costs. Production costs refer to all costs involved in producing water such as the cost of obtaining raw water, storage, distribution, irrigation, purification and distribution. User costs are involved when water is a non-renewable resource, for example, the use of groundwater at a rate higher than its natural filtration rate which will eventually lead to a total depletion of the resource. User costs are thus the costs of using water today instead of saving it for the future. User costs are calculated as the present value of the difference between the price of replacement technology or backstop technology and the cost of extracting water today. The environmental costs include all the negative side effect of having water. The common environmental costs of water are the lost of forests when dams are constructed, the possible relocation of settlements during dam construction. In the case when environmental effect is positive such as dam construction is used as flood control then the environmental cost becomes a negative number.

Like tradable water rights, full-cost water pricing will also encourage water users to invest in water saving devices such as bubbled-shower head, water-saving bowls, fix leakage and so on. Full-cost water pricing will make water users such as golf courses and massage parlours realise the true value of water and hence adjust their water consumption pattern accordingly. So it can be said that full-cost water pricing is not just an attempt to reduce water consumption but its advantage is more in terms of allocation efficiency.

Financially the producers of water such as the Water Works Authority will receive more income from sale of water and hence be able to reinvest in better water distribution system and fix leakage or, ideally, pay the farmers if water is diverted from agricultural irrigation. Part of the income generated from sale of water can be used to pay for raw water.

Just like tradable water rights, full-cost water pricing need not harm low income families. The system can be set up such that each family is entitled to a minimum amount of water necessary for home consumption. This minimum amount will then be allocated at free of charge. Any consumption beyond this amount will then be subject to full-

cost water pricing. Water pricing can also be made progressive where high level of water consumption is subject to a higher per unit price. This is known as multi-part pricing or discriminatory pricing which aim to extract welfare from the wealthy consumers. Rent earn from multi-part pricing strategy can be used to subsidise water allocated to poor families which is provided at free of charge.

It is, however, important to bear in mind that programme which provide water subsidy to poor families or the adoption of multi-part water pricing are attempts to redistribute wealth (implicit income) among people in the society. The objective of this programme is different from the rational of water pricing discussed earlier which is aimed to achieve allocation efficiency. Efforts to subsidise water to poor families and multi-part water pricing ***WILL NOT*** impair the economic allocation efficiency found in full-cost water pricing.

The concept of full-cost water pricing is not new to Thailand at all. Attempts to price agricultural water has been suggested on many occasion but, somehow, this suggestion never finds its way to implementation. It is possible that Thai politics may be a factor hindering the implementation of full-cost water pricing. When some politicians and some policy makers are short-sighted they will fail to see the full benefit of full-cost water pricing and fear that poor farmers will suffer as a result. As previously shown, full-cost water pricing can be designed so that it will not discriminate poor families while at the same time increases the efficiency in water resource allocation and helps towards financing of new public water facilities or maintenance of existing system -- all of which will ensure an improvement in water supply in Thailand. If water has to be diverted from another basin full-cost water pricing will also help generating revenue which can be used to pay those farmers who lose the priviledge of using the water.

A recent study by Direk Patmasiriwat et. al. (forthcoming) on full-cost water pricing in Phuket Province shows that the current price of pipe water in Phuket is below its full-cost of production or foregone benefit. The current price of water in Phuket is about 4-5 baht per cu.m. which is below the actual cost of producing it. When public water supply is making a loss this studies speculates that it could lead to what is known as "low-level

equilibrium trap". Low-level equilibrium trap means that low revenue from water sales will be insufficient to finance or maintain the existing public facilities and hence will result in a decline in water supply or water quality. When water supply/quality decreases consumers will switch away from public water to other sources such as private vendors or well water. This will further reduce the demand for public water and hence a further decline in revenue.

This study reports that the full-cost of producing water in Phuket is currently about 12.5 baht per cu.m. Because people in Phuket are now buying water from private vendors it is believed that they will be willing to pay a higher price for public water if it were more reliable and clear.

What is the Impact on Farmers if Water Pricing is Implemented Without Water Rights?

Water pricing will ensure that water allocation will be efficient, that is, the market will choose who should receive water. Water will be allocated to high value economic activities and hence water will be put to best use and will yield highest benefit to the society. Tradable water rights does just the same in terms of allocation efficiency.

If, however, water pricing is implemented in the agricultural areas while ownership rights or tradable water rights has not yet been established then one would expect that water allocation will still be achieved but distribution of wealth will be different for the following reason.

Water pricing is a cost to water users/farmers but tradable water rights is consider as wealth. When tradable water rights are allocated to the people, for example, the farmers in the location, it will create a wealth effect (or wind fall) where those who receive the rights will be better off just like those who receive free land title from the Government. The farmers can lease all or part of his/her rights or sell all or part of his/her rights to other farmers or even government agencies such as public water works. This will yield some additional income to the farmers. Or the farmers can keep those rights and use this free water to grow crops on his/her own land which will again generate income to the farmers. But in the case of

water pricing all the farmers will have to pay in order to have water (except for that minimum amount which they will receive for free). So water pricing will make farmers worse off as obtaining water will always be a cost to them while tradable water rights will ensure that all the farmers will at least get a given amount of water for free. This amount of water will depend on how these water rights are initially allocated.

Initial allocation of water rights is very important to the success of tradable water rights programme. The initial allocation of water rights can be carried out in many ways but what is important is that it has to be socially acceptable as these rights are in fact a transfer of wealth to the people. Initial rights can be allocated equally to all the farmers in the location. It can also be allocated according to the previous amount of water used by each farmer. Or it can even be auctioned out to the farmers. Lastly, the initial allocation of water rights has to be politically clean.

4.2 Tradable Water Rights

Rational behind the concept of tradable water rights or water markets is to correct water resource problems mentioned previously, they are, lack of well defined ownership or property rights and lack of market price. On distribution aspect, tradable water rights also provides the "*original*" water users a compensation when water is re-allocation to other users. Tradable water rights recognises that water resource should have the same legal status just like any other factor of production such as land or capital where ownership is well defined.

When water market is created water users will be allocated with a given amount of water rights which will give full ownership of water to that person. The amount of water on these rights can be quantified as volume of water per time period, share of water from the total availability of water, flow of water per time period or according to the size of cultivated area and the type of crop cultivated on that land. At this point it should be clear that tradable water rights aims at granting full ownership of water to water users and thus will prevent it from being an open access resource or a free resource.

Once these water rights are allocated they can also be freely bought and sold with other water users. The owners of water rights can then choose either to) use all the water he/she is entitled, 2) purchase or rent more rights from the other water users or 3) sell or lease part or all of his/her rights to other water users. When water rights becomes freely tradable it will ensure that water resource will be allocated to highest value activities while at the same time compensate those who have the rights to use water but choose to forego this privilege.

Suppose farmer A calculates that his/her crop will yield high value at harvest if more water is available, he/she will be willing to pay a price equal to or less than the expected net gain from having more water. If another farmer B finds that the value or returns on his/her crop is lower than the ongoing price of water in the market farmer B will be better off selling or leasing water to farmer A at the market price. If trade takes place between farmers A and B, both of them will be better off which indicate that there is a gain in total benefit of water usage. Farmer A pays a price for additional water but will enjoy a larger return from high value crops. Farmer B will receive an income from selling or leasing water which will be higher than the return from cultivation if he/she were to use that water himself/herself. So both parties are better off.

The above example also shows that water will be diverted away from low value crop and to higher value activities. This re-allocation of water resource will help increase income to both parties. More importantly, those who choose to forego cultivation will not be worse off as the foregone crop income will be replaced by the revenue from selling or leasing water rights.

Further, as tradable water rights will lead to a creation of water market where water can be bought and sold at a price, more water consumption will become efficient as waste, leakage or unnecessary use of water will become a cost to water users. In cases where additional water has to be bought, water users will minimise the use of water as it will help reduce the cost of production. As for those who have surplus of water they too will minimize the use of water as any additional water saved can be sold or lease at a market price. So

tradable water rights will yield what promises to be a more efficient use of water resource. Water users will now have an incentive to fix leakage, install water saving devices, select crops which are less water demanding or makes decisions whether his/her land should be lawn or shrub. For these reasons, tradable water rights will ensure both economic efficiency and will also be socially acceptable as both the sellers/leasees and buyers/leasors of water rights will benefit from water trade.

Tradable water rights will not only brings nearby activities in par with one another in terms of their contribution to the total value of the economy, technically known as equal marginal benefits condition. If water rights can be traded between urban water users and rural farmers, the value of crops grown will be also compared to the value of greener Bermuda grass in the city. In the case of water being diverted from the Mae Klong Basin to Bangkok, tradable water rights will implicitly be asking the question; Which activities are more water deserving or which activities have high value to the society? If water is in fact traded from Mae Klong Basin to Bangkok it would then imply that economic activities in Bangkok deserve water more than those around the Mae Klong areas.

Who Determines the Value of Water?

So it can be said that with tradable water rights the decision as to how water resource should be allocated will be in the hands of water users and not so much the government agencies. This is in some ways make sense because usually it is the water users who themselves know the value or the importance water to his/her activities. If a water user decides to keep the water rights it would imply that the value of water to him/her is greater than the prevailing market price of water rights. In other words, the value of water to this user is greater or at least equal to that of other water users. Thus the value or the price of water will depend on the value of crops or the value of products which use water as an input relative to the availability (total supply) of water at that time. If the value of some crops or products increases, it will drive up the value or the market price of water. More water will then be re-allocated to the production of these high value crops or products.

The value of water will also be determined by production technology. If a production process finds a new method or technology where the same quantity of water can be used for greater productivity (produce more output) then the owner of this plant will value water higher than previously. This improvement in water productivity will again drive up the value of water and hence the market price of water. This indicates that the price mechanism will allocate water to activities where water productivity is relatively higher. It can thus be summarised here that the value of water is determined by two factors: the value of crops or products which use water as an input and the productivity of water. Technically, it is said that the value of water is determined by its "*value of marginal product*".

It can be seen here that tradable water rights has much to offer to the business of efficient water resource allocation. Tradable water rights will ensure that water will be allocated only to high value activities. As water rights is traded in the market at a price water users will have incentive to minimize the use of water. Water users will also search for a more efficient water saving device in order to minimize expenditure when buying/renting water or increase revenue from selling/leasing water. Last but not least, those who choose not to use water will at least be indifferent or better off as they will be compensated usually with a payment of value equal to or greater than the worth of water if he/she were to keep it for himself/herself.

4.3 What About Water Pollution?

The issue of water pollution cannot be divorced from water allocation. Runoffs or water released back to the public domain after being used can create a negative externality to other downstream users if the water released is polluted. Controlling water pollution is thus an important issue in water allocation. Similarly to water allocation this report suggests that water pollution, too, can be managed via the command and control method or through the market. The market approach towards water pollution management is known as "tradable pollution permits".

The Command and Control Method

The command and control method allows the government authority to force water users such as the factories to observe the water standard set by the law. For instance, water release back after being used must be of acceptable quality and the level of pollution must not exceed the standard. This approach can effectively help reduce water pollution released from water users and hence helps improve the quality of water in the pubic domain such as the Mae Klong river. However, the criticism of this method is that the desired water quality may not be achieved at least cost. Putting it differently, to achieve the desired water quality the society may have to sacrifice too much resources than need be.

Consider two factories who have different technology (know how) in treating pollution before being released back to the public water. Suppose factory A treats water at lower cost than factory B. If the law force both of these factories to clean the water up to the standard then it will suggest that the cost of treating the last unit of water (or marginal cost) by factory A will be lower than that of factory B. This difference in marginal cost between factories A and B indicate that the desired water quality in the public domain has not been achieved at the lowest cost. Increasing more treatment effort by factory A and reducing treatment effort by factory B will leave the overall water quality in the public domain unchanged but will be cost saving to the society as factory A has a lower cost in controlling pollution compared to factory B.

What is ideal is to have factories who have lower treatment cost treat more pollution and other factories who may have high cost treat less. This allocation of pollution control effort can be made efficiently through the tradable pollution permits.

Tradable Pollution Permits

On the other hand, the quality of water in the public domain can be managed via market mechanism. This system is known as tradable pollution permits. The operation and benefit of tradable pollution permits is very similar to tradable water rights described previously. The government will issue a fixed amount of pollution permits which will be

distributed or sold to water users or polluters. These permits will allow each polluter to release pollution up to the amount of permit he/she has. These permits can also be traded between factories in the market at the ongoing market price.

Suppose factory A has a lower cost in treating pollution, factory A may find it more cost saving to sell the remaining permit to other factories use some of that revenue to treat the pollution itself. The remaining revenue of sale of permits represents the saving incurred to factory A. Factory B on the other hand may have a higher cost of treating its own pollution and may find it more cost saving to purchase these pollution permits and release polluted water. The total effect to the society is unchanged as the total amount of water pollution release to the public water domain will never exceed the amount of permit issued. What differs is that factories who can treat pollution at a lower cost will tend to treat more pollution than other factories who have a higher treatment cost. This outcome will ensure that water quality in the public domain will be achieved at the lowest cost to the society.

Tradable water permits will also provide incentives to factories to search for an efficient water treatment technology as it can help them save cost. Unused permits can then be sold at the market price and hence generate revenue to them. In the case of the Mae Klong basin, tradable water permits may be appropriate when dealing with water pollution release from point sources such as factories which release untreated water into the rivers. As for non-point sources such as agricultural pollution where the amount of pollution released is difficult to monitor other pollution control method may be more appropriate.

5. BENEFITS OF TRADABLE WATER RIGHTS

Following are the summary of the benefits of tradable water rights or water market.

I) Tradable water rights will ensure economic efficiency in water allocation. Water resource will be allocated to best use and hence maximise the full benefit of water consumption. Water users will also have an incentive to save water as water saved can be

sold or lease at a price. As water is bought and sold at a market price, water users will also have an incentive to install water saving devices as well as fix leakage.

II) Water users will themselves determine how water will be allocated hence will not cause conflicts among water users. For instance, when water is diverted from, say, agriculture to urban consumption it will be a voluntary act by the water sellers or leasors and the those who lose the privilege of using the water will be compensated according to the value of water in the market. Hence tradable water rights will not create conflicts among water users as water trade will be voluntary.

III) Tradable water rights will can be made poplar and more accepted among the poor as the system creates a wealth effect. Water pricing has not been as popular as tradable water rights. Full-cost water pricing means that some expenditure will be required in order to have any water for their cultivation. Further, tradable water rights can be also be augmented by allowing each family to always entitle to a minimum amount of water necessary for household consumption. Only water used for production or cultivation will be traded in the market.

VI) Water market is also more flexible compared to water pricing and much more flexible compared to the command and control method where water allocation is determined by the Government. When the pattern of demand for water changes, such as, the changes in the value of crops or changes in water related production technology the market price of water will change accordingly. Water users will then begin to re-calculate the value of water to his/her use and will decide whether to sell/lease water or buy/rent more water. Thus water resource will be re-allocation as soon as changes take place. Water pricing is not as flexible as tradable water rights as the price of water needs to be adjusted or estimated by the responsible government agency.

V) The price (value) of water determined in the water market (by water users themselves) will accurate reflect the benefit of water and need not be estimated like water pricing. This will ensure that there is less chance for price distortion which is more likely to occur with water pricing scheme.

VI) Water market will help the Government keep the expansion of water demanding activities in check, for example, golf courses. At present, the Government is having difficulty controlling the expansion of many water demanding recreation, such as, golf courses. Businessmen always find a way which makes expansion of these water demanding recreation feasible and the Government has had difficulty saying "no" to them. A reason that permits water demanding recreation to expand endlessly is that water is free or under-priced. If water has to be purchased at an ongoing market price it will drive up the cost of operating, reduce profit and will automatically reduce the number of many water demanding recreation activities without any explicit control from the Government.

VII) Tradable water rights will also be more politically feasible compared to water pricing. Politicians tend to benefit from tradable water rights as water rights is a transfer of wealth to the poor. If politicians in the area/district can bring to their people water rights which can be traded in the market it would simply mean wealth has been transferred to the people. Hence issuing tradable water rights can help politicians gain their popularity.

6. EXPERIENCE OF IMPLEMENTING WATER MARKET IN OTHER COUNTRIES

Tradable water rights or water markets have been adopted by some countries. Chile has a successful experience with its water market. Mexico is beginning its tradable water rights along with many other free market innovations in the hope to liberalise its economy. Water market is also used in the state of California as a rule to allocate water between the upstream and downstream water users. Following are some description of the experience one may learn from these countries.

Chile

Chile began its water market at the same time that new political change took place in 1973 from socialist to free market economy. Since 1973 the Chilean Government aimed at interfering in the market only when market imperfections exist and when income distribution needs attention. The major changes occurred in the agricultural sector were 1)

the private sector began to play a role in land and water allocation 2) land rights and waters rights were well established and 3) price mechanism and markets were means of resource allocation.

In terms of water resource management, the Chilean Government found that the old system where State controlled all forms of water allocation was inefficient. It was a financial burden to the Government, the water administration was clumsy and water services was always inadequate. After 1973 State water control was replaced by tradable water rights or water market. The only responsibility of the Government was only to ensure that the poor families at least receive a minimum amount of water necessary for own consumption.

Water laws were implemented in 1981 where holders of water rights could freely trade these rights in the market. Each right allows a water user a fix amount of water either in terms cu.m. per minute or cu.m. per year. During droughts, water allocated will be determined by the share of water to the total availability in that year. In addition, the laws also specifies that water trade will not endanger the environment or negatively affect other farmers. Water users association was also encouraged as to ease any conflict in water use which may occur.

Water rights can be obtained by the following: 1) by stating the amount previously used before the water market was established, 2) by auctioning the new water rights after each new water source is constructed and 3) by purchasing water rights from other water users. Water rights are of two types: 1) consumptive rights where water users can use the water for any purpose and 2) non-consumptive rights where used water has to be returned to the water source at a given proportion to the original amount of water consumed and the returned water has to be of specified quality.

In addition, water rights are also classified into: 1) permanent rights where water can be used without conditions, 2) contingent rights where water can be used only there is an excess water from permanent rights use, 3) continuous rights where water can be used for 24 hours, 4) discontinuous rights where water can only be used during specified hours and

5) alternate rights where water is used between two or more people but only one person can use the water at a time.

In terms of dam construction or designing irrigation system Chile encourages the participation of water users through water association. The participation involves sharing in the cost of construction and the design of the irrigation system. Irrigation projects storing water more than 50,000 cu.m. must receive approval from the irrigation department in order to prevent any undesirable environmental affects. The Chilean Government also provides subsidies to irrigation projects which generate benefit to the general public.

As for the metering system Chile relies on the divide flow system which as established since 1700's. Water is diverted from the public domain (main river) via channels of the amount equal to the total amount of rights of several rights owners. Water is then further diverted through what is known as "bocatoma" which has a flow measurement meter where the volume of water is measured according to the height of water. Further downstream this water is again diverted through what is known as "macros partidores" and at the farm level water is divided by "shifts". The amount of water at the farm level is controlled by fixing the amount of time until water has reached the desired volume.

In terms of water association it is specified that 1) 33% of those who will benefit from new irrigation projects must agree to the project in writing, 2) for improvement of existing system 33% of additional water must benefit the original water users and 3) for any new projects 50% of the water users must share the cost of construction. After completion, such irrigation projects will be owned by water association. Irrigation projects which previously belonged to the Government will be transferred to water associations at the market price.

In the urban areas, Government enterprises were privatised since 1980 and hope to be completed in 1995. Government stock in these enterprises will be sold to the public and local governments which can also be traded regularly. Once these enterprises have been privatised they will have to purchase raw water from water markets at the market price. The Ministry of Finance will only determine the maximum price of pipe water but it expected

that the price of pipe water will soon reflect the full cost of production, they are, cost of raw water, construction cost, maintenance, delivery and administration costs. The only involvement of Government in pipe water is to ensure that poor families are entitle to their minimum consumption allowance which is set at 20 cu.m. per family per month at free of charge. The Government will pay directly to the water company for the total amount of this water.

Over the past, water trade took place between two groups of water users: 1) among the farmers and 2) between farmers and private water company. Water trade between farmers are mainly found when the farmers are using water from the same irrigation system and their farms are located nearby. Trade was in the form of short term rent and out right purchase. There has also been a report of a change in crop selection where low value water demanding crops were replaced by higher value and less water demanding crops. As for water sold to private company it was found that such water transfer did not result in a substantial decline in agricultural production. This is because the traded water was usually unproductive and when sold to private company it would bring additional income to the farmers.

Given that water markets in Chile have been in operation for sometime, following are some of the factors contributing to their success:

I) The original allocation of water rights was accepted by the water users where 40% of the rights was given to the original water users and 60% to other users who did not have any water before.

II) Water rights were totally separate from land rights or land title. When water rights and land rights are separated it will ensure that these two resources will be efficiently allocated according to their scarcity.

III) The Government also ensured that this tradable water rights will be a permanent system and was not just a trial. This assurance has given an incentive to water users to trade water and also invest in water saving devices.

VI) During the period of droughts the amount of water each user is entitle to will be determined as a share rather than fixed quantity. This will ensure all water users that they will always have some water but the quantity will depend on the total availability in that year.

V) The Chilean Government also liberalise other aspects of its economy so as to allow market economy to function together as a whole. Market prices of crops or goods and services were allowed to freely adjust according to their scarcity. This would further increase efficiency in water allocation where water will be allocated to best use only.

Mexico

Before 1990 Mexican economy was centrialised where the Government had the full control of resources such as land or water. Land use in Mexico was under the Ejido system characterised by communal use. Each farmer did not have the ownership or land rights and thus Ejido land could not be traded in the market. In terms of water resource allocation each farmer was entitled to receive water for cultivation not more than 20 hectare. Water availability was also unreliable as it was controlled and managed by the Government.

After 1990 Mexico began to liberalise its economy and to become more market oriented. Land title were issued and can now be traded freely in the market. Water concessions were allocated to water users which can also be traded. Water concessions or water rights were allocated according to the previous amount of water used and trade was carried out under the supervision of the Ministry of Water. The new Mexican water laws empower the Ministry of Water the following responsibilities; 1) increase the efficiency in providing water, 2) search for new water sources, 3) reduce environmental impact from water use, 4) reduce water pollution and 5) induce water users to be financially responsible for new investments and system management.

Under the new water laws passed in 1992 and 1994 water rights were issued in the form of water concessions to the people and government agencies (local, city and regional). Each water concession entitles water rights for a period of 5 to 50 years but most

concessions are of 30 year period. There are still some conditions specified in these concessions which may have become a hindrance to water trade. For instance, water concessions can be revoked if water needs to be transferred for public use or if it is found that water has not been put to efficient use.

Most of water concessions in Mexico were allocated to water associations rather than directly to individual water users. However, within each water association water can be allocated to each member according to an acceptable rule. In the case of droughts where the total water availability is reduced from its normal level by, say, 20%, each owner of water concession will have his/her rights reduced by the same percentage too. In addition, when water is used outside agriculture water quality of the return flow is also monitored according to the standard. Agriculture return flow is not subject to quality control as agriculture return flow is often of acceptable quality.

In sum, the Mexican new water laws now recognise the importance of water rights and water trade. However, Government supervision of water trade is still practiced and has sometime hindered the efficiency of water allocation in Mexico. Actual water trade has taken place between farmers. The price of water trade during the dry season was reported to be about $US 400-450 per hectare or about 0.5 baht per cu.m. As for water trade between economic sectors it was found that although individual trade was not reported but there were transfer of water from one area to another and compensation was made accordingly. For example, Hermosillo city purchased water from the nearby areas and paid the price of electricity pump and the electricity bill, Monterrey purchased water from the farmers in Bajo Brava and Bajo Sa Juan at a price equal to the foregone reduction in the value of crops and in Guanajuato city a factory also purchased water from the nearby area.

California, USA.

Water trade was introduced in California in 1982 as an attempt to settle upstream and downstream water uses. California has a similar problem as Thailand in that the cost of new dam construction is high and new dam constructions tend to impact the

environment. However, water trade in California faces many problems, such as, environmental impact as water is being drawn away from the northern part of the State to the South, the change in the flow of water which could affect the fish population and pollution problems around the Sacramento San Joaquin delta.

Water rights in used in California are of two types: 1) appropriate rights where land owners have the rights to draw water from the nearby sources for use on his/her land and 2) riparian rights where land owners can make use of water passes by his/her land. Most of water trade in California has been in the form of appropriate rights. Appropriate rights has a special characteristics known as "*first in time, first in rights*". This means that water users who received their rights first (senior rights) get the rights to use water before newer water users (junior rights).

It is further stipulated in the law that appropriate rights issued before 1914 can be traded without an approval from the State but those issued after 1914 must seek approved if the new purpose of water use differs from its previous use. Permanent transfer of water rights has to be accompanied by an environmental assessment but temporary transfer or leasing does not. In addition, if water transfer were to affect the fishery industry or wildlife, a separate fishery permit or wildlife certificates is required (must be bought separately).

Although tradable water rights has been adopted in California since 1982, the state government has still been involved in water transactions. The State of California wants to ensure that water transaction will not result in environmental damage and will not create any third party effects.

7. MECHANISM INVOLVED IN ESTABLISHING WATER MARKET AS A MEANS TO DIVERT WATER FROM THE MAE KLONG BASIN

There are some common procedures essential for a well functioning water markets. In each country these procedures will differ depending on the circumstances of that particular location, types of water users, social setting and more. The following will describe

some of these procedures with special reference to the case of diverting water from the Mae Klong Basin to Bangkok.

I) Water law will have to change to permit full private ownership of water just like land title. Currently the Thai law is still ambiguous as to who owns water rights. Even the Government themselves cannot claim the full ownership to water. As previously mentioned, the Government can often assume ownership only after some interpretation of the law. The new laws have to permit water users, individual, communal or government agencies to be able to have a well secure ownership of water.

Water rights can also be given to the community in the form of communal water rights. The community will then decide how this water will be distributed among the members using its own rules and tradition. Currently, the NRC and Thammasat water drafts are moving along this direction. The Thammasat draft proposes that all water shall be property of the Government which is probably a step towards an adoption of an economic instrument in water allocation.

II) Water rights will need to be separate from land rights. This means that the owner of water can trade water rights separately from land title. However, the farmers has to be able to sell either all or just part of his/her water rights. Farmers has to also be able to lease all or just part of his/her water rights. This separation between land rights and water rights would have an impact in lowering the value or the price of land. The extent of this price effect is an empirical question. This effect can also make tradable water rights less favourable as if can be opposed by some land owners.

III) Depending on the reliability of water these rights have to specify whether water rights owners are entitle to a given quantity of water or a share of water to the total availability during that season or that year. In the case if the amount of water available each year is unreliable then the share method may be more appropriate. Short term forecasting of water availability will then be useful in determining how much water each farmer can expect to receive this season. This forecasting will also help determine the price of water in the coming year and hence its allocation.

IV) Once water rights are well secured its initial allocation to the people is very important as it will determine whether this system will be socially acceptable. The initial allocation of rights need not be fair nor unbiased. All that is required is that the initial allocation of these rights must be satisfactory among the water users or otherwise the water users may retaliate against the tradable water rights system altogether. It is imperative that the Government shows to the people that once tradable water rights is operating the system will only transfer water from one group of water users to another leaving wealth distribution least affected.

In the case of Mae Klong water rights should be distributed to the previous water users in Mae Klong location and they will decide whether they want to keep the rights or sell to Bangkok water users (Bangkok Water Works Authority). The question is how much water should be given to each person. Four common methods are 1) allocate water rights equally to each farmer 2) allocate water rights according to the amount of water used previously and 3) auction out these rights to the local people.

However, it is important to note here that the initial allocation of water rights will not impact the water allocation efficiency. It does not matter which rights distribution method the Government decides to use water will still eventually be allocated (bought and sold) to its best use. Lastly, as income distribution in Thailand could use some attention tradable water rights can also be employed to achieve both efficiency in water allocation as well as to help bridge income gap when water rights are allocated more favourably to the poor.

V) The Government must continue observing, but not controlling, the use of water to prevent any undesirable third party effects, such as, environmental damage, pollution or negative effects on other economic activities. It is often argued that if too much water is sold to water users outside the location, in this case Bangkok, then the decline in agriculture around the Mae Klong area can negatively affect other related businesses near Mae Klong as well and hence create an undesirable third party effect. Another example of possible third party effect is the local communication. If too much water is drawn out of Mae Klong then

the water level can be too low which will not allow any water transportation/navigation. The responsibility of water related agencies will shift gears to higher level activities, such as, relationship between inter basin transfer if need be, the forecast of water yield in order to help predict the market price of water in the coming season, the monitoring of trading records and water transactions, supervision of possible negative effects of water trade (environmental impact, negative effect to other economic activities) or law enforcement.

VI) A suitable metering system has to be installed in order to monitor the amount used by each farmer. Laws have to be enforced when violations are found or reported. In Chile it was found that this metering system need not be sophisticated and it was found that many existing irrigation can be altered at small cost to permit water trade. At present the notion of tradable water rights in still new for Thailand and further examination is recommended in order to fully understand how water is actually distributed, traded, monitored.

VII) Transaction cost in water trade has to be kept as low as possible in order for any water trading to take place. The Government can be involved here to keep records of water trade or announce the ongoing water price. Many countries found that if water transaction is complicated or costly it will discourage water trade and hence will prevent water from being allocated to best use.

VIII) In the case of water being diverted from the Mae Klong Basin to Bangkok for urban consumption it is very imperative that Bangkok water users are paying the full price of water. The price of water sold to water users in Bangkok must reflect the cost of purchasing water from Mae Klong, the cost of water purification, transportation cost, distribution cost and administrative cost. Should water price in Bangkok be subsidised, too much water will be consumed in Bangkok and too much will be transferred from Mae Klong Basin. This does not mean that the farmers in Mae Klong will be worse off as they will be compensated by sales of water (and usually at higher price of more is water is diverted). The problem associated with subsidised water price in Bangkok will be in the form of misallocation of water resource. If Bangkok water price is subsidised, too much water will be

used in low value activities in Bangkok and not enough water will be used for higher value activities in the Mae Klong area.

IX) Where appropriate water user association should be created so that they can help in many important decision making. Examples of some of the decisions important to water users are, How the cost of maintaining the distribution should be financed? How should new investment in water irrigation or dam construction be designed? or How the cost of new investment be shared among the water users?

Fortunately, the concept of water user association has a long history in some parts of Thailand. In the Northern region water user associations have been operated for many years in the form of communal water users locally known as "*Muang Fai*". It was reported that Muang Fai operation has been efficient in terms of water distribution and maintenance of the irrigation system. As these Muang Fai are not recognised by the Thai law their operation and efficiency are beginning to vanish.

There are many reasons contributing to the decline of Muang Fai in the Northern region of Thailand. For example, expansion of economic activities (housing projects) near a Muang Fai irrigation area can affect the water flow to Muang Fai. These new economic activities do not recognise the rules of that Muang Fai as this type of communal water association is not recognised by the Thai laws. So where possible communal water association should be revived or strengthened. Most importantly their existence and operation have to be recognised by law.

8. CONCLUSION

Water resource problem in Thailand is not merely just shortage or scarcity but rather the way in which water is being allocated among competing uses. Thailand has been accustomed to the way water resource is managed and controlled by responsible government agencies. Statistics indicate that the demand for water will continue to expand and the increase in the supply is approaching its limit. Under these circumstances it seems to suggest

that the old way of allocating water in Thailand will no longer be sufficient nor appropriate. A more efficient method of water resource allocation seems the only solution.

This report offers two options to the government 1) to continue the command and control but allocate water according to the calculated marginal value of water and full-cost pricing be adopted and 2) to create a market for water trade or tradable water rights. In the case where water might be diverted from the Mae Klong Basin to serve the Bangkok water users it was illustrated that tradable water rights can help make this transfer more efficient and socially acceptable. Water will be put to best use. People will have incentive to invest in water saving devices. Conflicts in water transfer will be minimised as those who lose the privilege of using the water will be compensated. The poor families will not be affected. And most unusual, politicians will probably go along with tradable water rights as it can help them gain (or re-gain) their popularity.

As experience from other countries have shown, in order to implement tradable water rights one needs to start from the top, that is, the water law must prevent water from being freely accessible and must recognise full private ownership of water resource. Water rights must be made tradable and water trade should be carried out with lowest transaction costs. Water associations should be strengthen and recognised by law.

This report concludes that demand management is perhaps a more effective approach towards solving long term water scarcity. The two options suggested in this report should receive further examination as they will help make our effort in solving Thailand water resource problem more rewarding.

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