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Economic Perspectives on Water Conflicts in Thailand

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Water is no longer a "free" good in Thailand. During the dry season many important uses and regions have to compete. In addition, the quality of water is being increasingly degraded by pollution. TDRI's project on "Water Conflicts" commissioned social scientists to document conflicts over water use. This paper provides an economic perspective on the conflicts discussed in these studies.

The allocation of scarce resources—or the resolution of conflict—is the starting point of economics. As the case of water illustrates, economic analysis must weigh the efficiency and equity implications, not only of patterns of resource use, but also of institutional mechanisms for resolving conflicts.

Inadequate use of economic instruments to regulate water use in Thailand has caused inequities and inefficiencies, and has resulted in significant economic and social losses. Furthermore, the economic rents that arise from non-market allocation mechanisms will lead to escalating conflicts as water becomes increasingly scarce. Competition for these rents will aggravate social conflicts and increase economic waste.

"THE WATER PROBLEM" IN THAILAND: CASES AND EXAMPLES

The economic issues arising from water allocation are illustrated by a few basic types of conflict outlined in the case studies below.

Conflicts Over Quantities of Water: Intra- and Inter-basin

The central region study (Pongsudhirak, 1994) examines conflicts within and between river basins. They are of two types: a) interregional conflicts over the use of the resources from a single, or at least interconnected, supply source (north versus central region), and b) inter-basin conflicts within a region when supply sources can be connected only at some cost (Tha Chin and Mae Klong versus Chao Phraya).

The Chao Phraya basin serves many users, including farmers, urban industries, and the Electricity Generating Authority of Thailand (EGAT). Growing demands throughout the basin have lead to water shortages during the dry season. This requires allocation choices between the north and central regions, and among uses in the central region. Diversions of water from the Tha Chin and Mae Klong basins have also been used as part of the solution. This can be accomplished by piping water from the latter basins to the Chao Phraya.

We illustrate the economic issues involved in these conflicts by making some gross simplifications which ignore many of the details of the real-world, but which permit us to focus on the questions at their most basic level. The greatest simplification is to assume that there is only one water user in each competing group. We also assume that the total amount of water available during the time period under consideration is fixed and known.

Each user has a demand for water which depends on personal characteristics, on the uses (s)he has for the water, and on the price (s)he has to pay for its use. This is summarized graphically by a demand curve which relates the amount of water (s)he would want to use and that water's price. If the water is used as an input into some other activity, agriculture or manufacturing say, then the height of the demand curve represents the value of the extra agricultural or manufacturing output made possible by a little extra water in one of those uses. If it is used for final consumption purposes, washing or drinking, then the height of the demand curve represents the marginal benefit the user derives in terms of willingness to forgo other forms of consumption. The negative slopes of the demand curves reflect the fact that the marginal value of water increases for any user as its availability decreases.

Consider first the north/central allocation issue. Here we have two water users, *N* and *C,* competing for water from a common source—the Chao Phraya river and its tributaries. The total demand at a zero price exceeds the total water supply during the dry season. In Figure 1, the total amount of water available during the dry season is given by the length of the horizontal axis*, OW.* The demand curves of *C* and *N*, measured from the left and right respectively, are given by D_C and D_N. At a zero price, the total demand, OC_0 plus WN_0, exceeds the total amount available by N_0C_0. Since these demands cannot be met, conflict is inevitable. Some mechanism must be found for allocating this scarce water.

Many mechanisms and allocations are possible. For instance, suppose that *N,* by virtue of being upstream of *C,* simply takes whatever water (s)he wants, and leaves the remainder to *C.* In this case, the final allocation will be at N_0, with *N* consuming WN_0, and *C* consuming the remainder*,* ON_0. Is this allocation efficient? Clearly it is not, since the marginal value of water to *C,* MV_0, exceeds the marginal value of water to *N,* which is *0.* A small reallocation of water from *N* to *C* would yield a net economic gain of MV_0.

An efficient solution is one in which the marginal value of water to the two users is equalized. At that point, *W*,* there is no economic gain to be realized by reallocating water between the two users. If there were a well functioning market for water, this allocation would be achieved "automatically," with the market-clearing price being determined as *p*.* At that price, total quantity demanded would equal total quantity supplied, and the marginal value of water would be equalized among users.

For a market solution to work, however, there must be well-defined property rights to water, and some mechanism in place for water owners to sell to others. In the case at hand, the geographic location of the upstream users might be expected to convey a right to sell water that flows through the north on its way to the central region. Unfortunately, while the upstream location provides a "first claim" to water in the Chao Phraya system, there is still no mechanism for the users in the north to sell unused water to those in the central region. Therefore, there is no monetary incentive for them to reduce water use when there are higher valued uses for the same water elsewhere. However, if either *C* or *N* were given clear property rights to the water, and they were able to market these rights, they would be able to, and indeed would tend to, allocate the water between themselves efficiently. As long as the marginal value of water was higher to one than the other, they would be willing to trade until the marginal values were equalized.

Without a market mechanism, or some other system for achieving efficient allocations of water, there can be considerable economic waste. In Figure 1, where *N* had first claim on the water in the basin, the total economic waste arising from the inefficient allocation is indicated by the area N_0AB. This shows the loss in economic output resulting from the allocation of water to uses where its marginal value is less than in others.

A market, of course, is only one type of allocation mechanism. The "first grab" system, whereby N has a first claim on the water, is another. In general, the available water will be allocated by one means or another, and there will not be more water used than is available. The economic problem is not simply to resolve the conflict among competing uses, but to resolve it in a way that is both fair and efficient. For a non-market mechanism to work, it is necessary for the decision maker(s) to know the marginal value of water in its various competitive uses. Armed with this information, it would be possible for a water rationing authority to allocate water in an efficient manner.

Non-market allocation mechanisms depend on authorities having information on the marginal value of water in alternative uses. This might not be so easily obtained. In our case studies there is scarcely any reference at all to the use of this sort of information in making allocation decisions.

Non-market mechanisms are also subject to manipulation. Consider again the case illustrated in Figure 1 where, as a result of *N's* "first grab" rights, the allocation is at N_0. To achieve efficiency, the water authority would have to change the allocation to *W** by reducing *N*s consumption and increasing C's. This results in an economic gain to *C* and a loss to *N. N*s loss of economic rents is depicted by the area BW^*N_0 in Figure 1; *C*s gain is $ABWN_0$.[1] These economic rents can be considerable. It is not difficult to imagine, therefore, that the interested parties would be willing to invest a great deal to manipulate the decisions of the water authority. The dissipation of rents through such processes could be very large, and could dwarf any efficiency gains that might arise from improved allocations. And the rent-seeking process might lead to highly inefficient water allocations as well.

In summary, non-market allocation mechanisms can lead to inefficiency and waste in water allocation due to the information demands placed upon the regulatory agency(ies), and the possibilities of manipulation and rent-seeking behavior. The case studies show that administrative allocation mechanisms are often ineffective, overburdened and inefficient.

The discussion so far has centered on economic *efficiency*. We now turn briefly to *fairness* as a criterion for water allocation. Fairness can be thought of in terms of either the *process* or the *outcome* of decisions. Political scientists often tend to concentrate on the former, and economists on the latter. Factors relevant to the fairness of allocation processes would include openness, so that all relevant parties have an input into decisions, and respect for pre-existing property rights. With two very large caveats—unacceptable inequalities in the initial distribution of wealth and incomes, and conditions leading to the existence of monopolies—markets are relatively fair allocation mechanisms. Fairness in these senses is much more difficult to achieve in bureaucratic and political allocation processes.

Looking solely at the outcomes of allocation decisions, how might an equitable solution differ from an efficient one? A fair solution would differ from an efficient one if, according to a criterion of social equity, different users have different social weights (i.e., some are seen as more or less important and/or more or less deserving of any benefits that society can provide). If, for example, *N* were a poor farmer and *C* were a rich urban industrialist or golfer, a fair allocation of water might be one in which *N* paid a lower amount at the margin than did *C.* The extent of this divergence depends on the differences in the social welfare weights attached to *N* and *C.* In the "fair" solution, however, *N* would consume more water, and *C* less, relative to the efficient solution. In terms of Figure 1, the fair solution could be determined by shifting N's market demand curve upward by an amount reflecting the excess of *N*s relative to *C*s social welfare weights.[2] This would move the optimal solution, *W**,* to the left of *W*,* the efficient solution. The fair solution, for example, could be achieved in a market setting if one group's water use were subsidized or taxed relative to the other.

To achieve a fair outcome by a non-market mechanism, the decision maker(s) would need all the information required for an efficient solution (i.e., information about the value of the output made possible by additional water in its different uses), and also the relative social welfare weights attached to the use of water by the different users.

What we have been considering so far has been an example of intra-basin conflict. The two consumers, *N* and *C,* are in two geographically separate parts of the same basin, with one lying upstream of the other. Consider now the case of the conflict between, on the one hand, the Chao Phraya *(CP* for short) and, on the other, the Tha Chin and Mae Klong basins (*MK* for short). As long as these basins remain separate, the only real manifestation of conflict can be either in the form of envy of the (relatively) water abundant basin(s) by the other(s), or migration of people and/or economic activity from the water-scarce to the water-abundant basins. However, the conflict that has arisen recently as a result of the rapid growth of water demand in the Chao Phraya is over a proposal to divert water from the other two basins to the Chao Phraya. This would turn several basins into one, with the total amount of water pooled into a single source for allocation.

The situation is illustrated in Figure 2. The total water supply available from the pooled basins is given by the horizontal axis. The demand curve by users in the Chao Phraya basin is D_{CP}, while the demand curve from the other two basins is D_{MK}. The allocation before pooling is at a point like W_0 where, because of the greater relative scarcity in the Chao Phraya, the marginal value of water is higher than in the Tha Chin/Mae Klong.

When these water sources are connected through the construction of a piping system, water can be diverted from *MK* to *CP.* The opportunity cost of such a transfer is the sum of the marginal value of the water to *MK* and the cost of piping the water. The efficient solution is not where the marginal value product of water is equalized across the basins, but where the marginal value in *CP* is equal to its marginal value in *MK,* plus the cost of piping. This is shown in Figure 2 as the point *W**, where piping costs are given by the distance *pc.*[3] This efficient solution could be achieved by a market mechanism as long as piping costs were included in the price paid by *CP.* If the property rights to the *MK* waters were vested in their initial users, then both *MK* and *CP* would gain from the introduction of a market for allocating water across the basins.

As in the previous case, the efficient allocation also could be achieved through some sort of a centralized (non-market) allocation process. If the process did not include a mechanism to compensate *MK* for the loss of water usage, however, implementation of the efficient allocation would mean net gains to *CP* and net losses to *MK.* The unequal distribution of the gains would be a source of conflict, and could lead to large economic losses through socially unproductive rent-seeking and/or rent-protecting behavior.

If *CP* water demand were to grow faster than in *MS* (which could be illustrated in Figure 2 by imagining D_{CP} to shift to the right over time) the efficient allocation, *W**, would move further and further to the right. *MK* would face steadily rising rent losses as a result of uncompensated inter-basin water transfers (i.e., the area ABW^*W_0, representing *MK* rent loss, would grow over time). It would be in the interest of *MK* to devote considerable resources to prevent the construction of the piping system. Under another scenario, *MK* might perceive the political allocation system to be biased in favor of *CP.* In that case, *MK* might fear that a) after construction of the piping system the centrally chosen allocation might be to the right of *W**, and b) there would be no compensation given to *MK.* Once again, this would give a strong incentive to invest in preventing connection of the water basins. In either of these scenarios, the costs of the rent-seeking and/or rent-protecting behavior might far outweigh the efficiency implications of achieving (or not achieving) an efficient allocation of water.

Use of Water in Irrigation Systems

A number of the case studies dealt with conflicts over water use in irrigation systems. The sorts of problems that arose were of the upstream/downstream type already discussed above (see Pongsudhirak, 1994, and Charoenmuang, 1994) or were caused by the entry of new users (see especially the cases discussed by Charoenmuang, 1994). The new users were often not of the traditional type—rather than small, long time resident farmers, they were often either new industrial or commercial firms, or absentee landowners. The entry of these new users often meant that traditional methods of settling disputes and of cooperative resource management broke down. The new users also increased the total demand for water in the system, thus putting an additional burden on allocation decisions regardless of whether traditional systems continued to "work."

The economic issue in all of these cases is to find an efficient solution to the water allocation problem. There is little indication in any of the cases described that data required to determine efficient solutions are systematically used in either traditional or "modern" systems. What is clear from many of the cases, however, is that there are considerable rent distribution implications of different allocation decisions. The entry of new users, with the resulting increase in demand for water, makes the potential rents even greater. As would be expected, bureaucratic or administrative decision-making in these circumstances is subject to many types of rent-creating and/or rent-protecting behavior. This can have serious implications for the efficiency and fairness of water allocation.

Agricultural and Industrial Pollution

Conflicts over water use often arise not just over *access* to water, but also over the uses that are made of it. This happens when one party's use affects the quality of the water available to others. A significant part of the water that is "used" by factories, farmers and households is not actually used up; rather it is returned for further use by others. The problem that often arises is that the water's characteristics are changed in a manner which reduces its value to other users.

A classic case is that of the conflict between, on the one hand, salt miners and, on the other, farmers, fishermen and household water users in the Nam Siaw basin in Northeastern Thailand (Wongbandit, 1994). Salt mining involves the evaporation of brine. Surrounding water supplies can be affected through deliberate discharge of heavily salinized water during this process, seepage of salt from sludge or from evaporation pits, or washing away of salt as a result of flooding during the rainy season. This increases the salinity of neighboring water sources and sharply reduces yields from fishing and/or agriculture.

This is a classic externality problem. Salt mining imposes external costs on both fishermen and farmers. These are real economic costs but, since they are not incurred by the salt miners themselves, they are not taken into account. The situation is illustrated in Figure 3, where *D* is the market demand curve for salt, and *PMC* represents the private marginal cost of salt production—i.e., the costs facing salt producers, exclusive of external costs imposed on farmers and fishermen. In the absence of any external intervention, total salt production will be at the point S_o, and the market price of salt will be P_o. At that point price equals (private) marginal cost.

This is inefficient because at S_o the *social* cost of salt production exceeds the market price. The difference between the social and private cost is the external cost imposed on farmers and fishermen by the salt mining. If the external costs are given by *E*, then the social marginal cost is shown by *SMC (= PMC + E)* in Figure 3, and the efficient level of salt production would be given by *S**. Forcing salt producers to take account of the external cost imposed on fishermen and farmers would raise their costs to *SMC* and would induce them to produce at the efficient level. However, it would also impose an aggregate loss on salt consumers and producers indicated by the area *ABCFE* in Figure 3. The offsetting gains to farmers and fishermen (and/or to consumers of their products), however, would exceed that amount by *BCG.*

One way to force the salt producers to "internalize the externalities" imposed on others would be to charge them for these costs. In other words, salt miners would be charged according to estimates of the amount of salt discharged from their production areas. If such charges were imposed, salt miners would be induced to reduce production and/or find ways to reduce salt discharges from their operations. The latter could be achieved, at least to some extent, through relatively low cost measures, such as eliminating intentional discharges of water, building dikes and ditches to contain runoff and seepage, and building impermeable evaporation tanks. A great attraction of this sort of pricing scheme is that it would provide an incentive to minimize the cost of reducing the externality. This would be to everyone's benefit.

As described in the case study of the Nam Siaw basin (Wongbandit, 1994), the government response to this externality problem was, for some time, to do nothing, and then to impose a total ban on salt mining. This solution (the ban) would very likely be even more costly than ignoring the externality. It is certainly a very crude instrument relative to most conceivable alternatives. After a period of time, when the cost of the ban became apparent and as a result it became increasingly difficult to enforce, the policy was changed to one of selective bans in certain regions, and regulation of salt mine production in the remaining regions to attempt to reduce the size of the externality. To accurately evaluate this policy, it would be necessary to have information about external costs, costs of abatement as required by the regulations, and salt production costs and revenues in each of the regions affected by the policy.

Another externality illustrated in the case studies, also in the Northeast (Wongbandit, 1994), concerned the effects of industrial pollution on the Nam Pong River. The cases related to ongoing water discharges by a pulp mill, and "catastrophic" accidents at a sugar mill and a particle board factory. Each involves the effects of external costs imposed by industrial users, and the basic economic issues are similar to those in the salt mining case. These cases highlight a few other interesting issues. One is the uncertainty about the sources and effects of emissions. In the case of the sugar mill accident, the government for some time had no information about the source of the emissions. And in the case of the pulp mill, there is ongoing uncertainty about the types of emissions and their effects.

Water Pumping Races

Water can be obtained from sources on or beneath the surface. Sub-surface water, or groundwater, is accessed by digging wells and pumping from underground sources. These natural aquifers provide a "free" form of natural storage, and are thus less expensive than man-made dams and reservoirs. In addition, these aquifers may flow laterally, acting as would an underground river to move water from one area to another at lower cost than would a comparable pipeline constructed on the surface. Due to unreliability and unavailability of piped water from local water authorities and partly due to its cost, industrial and commercial users in Bangkok have always relied heavily on groundwater. With increasing scarcity of water from other sources, other users have turned increasingly to groundwater as well.

The central region study (Pongsudhirak, 1994) shows how rice farmers have increased their reliance on groundwater to deal with dry season shortages. They have been encouraged to do this by conflicting government policies. On the one hand, the government has encouraged rice farmers to switch to less water-intensive crops during the dry season in light of the inability of the Royal Irrigation Department (RID) to guarantee sufficient water for rice-growing. On the other, farmers have also been subsidized to sink shallow wells as an alternate water source.

In both urban and rural uses there is a significant divergence between the private and social costs of water pumping. This is due in part to the incentive effects of government pricing and subsidy policies. Groundwater pumped in the Bangkok area is theoretically subject to a minimal fee, which is less than that charged for piped water. In practice, the fee for groundwater pumping is seldom levied. The subsidy for well construction in the central plain has a similar effect on farmers who receive it. The other reasons for the divergence between social and private cost are that groundwater is scarce, so that pumping by any one user reduces the amount available to others, and excessive removal of groundwater imposes broader social costs on all others.

The lack of proper pricing of groundwater encourages excessive pumping. Farmers complain that wells which were initially deep enough no longer suffice, and they are being forced to sink ever deeper and increasingly expensive wells. The combined effects of the pumping of all farmers depletes the aquifer and lowers the level of the water table. In the Bangkok urban area, excessive groundwater pumping has had a similar effect and is causing the ground to sink. This damages buildings and other structures, and increases the risks of flooding. Furthermore, substantial volumes of "free" underground water storage facilities, provided by nature, are being destroyed.

To maintain natural storage facilities and guarantee sustainable water supplies, groundwater pumping cannot exceed the rate at which the natural aquifers can replenish themselves. This requires restricting water use, through market or non-market means.

POLICY IMPLICATIONS: THE RANGE OF POSSIBLE SOLUTIONS

Water allocation is a policy issue because a) water is treated as a "free" commodity when it is not—i.e., it is has been made a more or less "open access resource"—and b) some water uses impose costs on other users of the same water. There are two types of solutions to these problems. The first are administrative solutions, whereby some agencies impose allocation rules upon users. This is referred to as the "command and control" solution. Second, the government can rely on "economic instruments," generally in the form of pricing mechanisms or allocations of tradable rights to water uses.

Under certain hypothetical conditions—availability of detailed information about the marginal value of water in different uses, ability to monitor behavior of water users, and authority and ability to enforce regulations—the government would be able to achieve equity and efficiency goals through "command and control" methods. Similarly, under conditions of well-defined property rights and zero transactions costs, private markets could be relied upon to achieve the same goals.

The experiences of Thailand and other countries show that the conditions describing the "first best" world cannot be met with open access resources such as water. This is especially true when regulation is achieved through command and control. The wide variety of sources, uses and users, and their geographical dispersion makes centralized monitoring and information-gathering costly and difficult. Furthermore, the magnitudes of the rents involved makes it difficult for regulatory agencies to elicit unbiased information from users and suppliers of water.

In the "second-best" environment of incomplete information and weak institutional structures, the equivalences between different types of policy instruments disappear, and the achievement of "first-best" solutions is no longer possible. Choices among policy instruments become more interesting, more difficult, and more important. The strengths and weaknesses of institutions—markets, bureaucracies, governments and community organizations-must be taken into account. Otherwise, apparently sensible and efficient policies can turn out to be wasteful and misguided.

The command and control approach focuses on technical instructions whose economic bases are often not readily apparent, and which are often very difficult to monitor and enforce. Moreover, the general thrust is more often to seek new sources of supply rather than to attempt to encourage conservation of demand.

A general lesson from Thailand and elsewhere is that market-based policy instruments are often superior to command and control when monitoring and enforcement are costly. Market-based approaches work better because they impose much smaller information burdens on implementing agencies, and they provide firms and individuals with private incentives to act efficiently.

Under a pricing regime the government does not have to instruct individual users on how much water to use. In times of water scarcity, prices can be raised and consumption will fall. The government only has to raise the price sufficiently to achieve the required reduction in aggregate use. There is no need to decide how much to ration individual users. Furthermore, under a pricing regime, the reductions in use will be allocated among users in a manner which is much more efficient than could be achieved through rationing of individuals. The same general observations apply to the control of harmful discharges into water. Faced with prices which impose costs on these actions, firms and individuals will have an incentive to reduce discharges in a cost-efficient manner.

The same conclusion holds when markets are created through the issuing of tradable permits for the use of water. Unlike a command and control situation in which users will have an incentive to increase use, regardless of the value of water to them relative to other users, they will have an incentive to sell their rights to others whenever others are willing to pay more for the rights' use than it is worth to the permit holder. Once again, the main burden on the government will be to set overall use (or emission) levels, and to leave it to the market to determine their allocation among different agents.

Where they are feasible, market instruments have the additional virtue that they are more likely to be viewed as being "impersonal" and beyond influence. When important allocation and distribution decisions are made by agencies and bureaucrats, especially when they are made on the basis of incomplete or uncertain information, and/or according to vague or uncertain criteria, affected groups and individuals will lobby for changes that improve their allocations. This is especially true when there are no user charges. The resources devoted to such lobbying can very easily exceed the economic costs that arise from misallocations of water between high and low valued uses. In addition, the lobbying process often diminishes the quality and reliability of information available to decision-makers.

The principal market-based schemes involve using tradable entitlements, permits, or licenses to assign the rights to use water. Without the ability to trade these rights, the system would be no different from command and control; the greater are the restrictions on transferability, the closer does the system come to one of command and control. Some schemes feature pricing of the flows of resource services, i.e., a license is granted to use a certain amount of water, at a certain price. Licenses and pricing can be complementary or substitute policies for efficient water management.

The prospect of a policy that increases users' water costs may raise concern about the poor water users' welfare. Although water pricing might have adverse equity implications, it should be emphasized that the current system also imposes high costs on water users. When water is "free," it is often allocated on the basis of power and influence rather than economic efficiency or need. This usually means that the poor and powerless bear the major burdens of water shortages. This is illustrated by the water pumping races in the central region (Pongsudhirak, 1994).

Experience with the operation of irrigation systems indicates that pricing alone is not always sufficient to secure increased efficiency. Pricing of irrigation water rations water use. More importantly, it also raises revenues and induces operating agencies to provide good service and to operate and maintain the systems. Recent evidence, however, shows that there is no simple correlation between pricing and operations and maintenance (O&M) service. The additional crucial element is the design and capabilities of the irrigation organizations themselves. There is now a large and growing body of evidence on the determinants of institutional success or failure in the provision of irrigation services.[4] These conclusions focus on the importance of devolution of authority and fiscal responsibility to local management organizations, and the structuring of these organizations so that market-based incentive systems can operate effectively. The northern region study (Charoenmuang, 1994) illustrates the fragility of the *muang fai* (community irrigation) system in times of rapid economic change.

Several general messages emerge on water and resource conflicts in a "second-best" world. The first is that, while the application of economic criteria is more difficult than in a hypothetical "first-best" world, their use is no less important in achieving efficiency and fairness in the water allocation. Second, the "technical issues" of allocating scarce water among competing users must be solved through mechanisms that provide incentives for agents to be self-regulating. This requires greater reliance on economic instruments rather than on mechanisms of command and control. Third, the choice of policy instruments is also an economic decision which depends on organizational capabilities, information, monitoring and enforcement capabilities.

SUMMARY AND CONCLUSIONS

The conflicts discussed in the case studies illustrate the following "generic" types of economic problems:

- The *free access* or *common property* problem exists internationally (e.g., Mekong), at a national level (e.g., the proposed Mae Klong diversion) and within regions (e.g., the breakdown of the *muang fai* system as described in Charoenmuang, 1994, and the conflicts in irrigation systems in the central plain documented by Pongsudhirak, 1994). When water is no longer a free good, unrestricted free access leads to *inefficient* use.
- The *externality* problem arises when an agent takes actions that have direct effects on others, some or all of which (s)he is under no obligation to consider. In the case of water use, these externalities generally take two forms: i) water discharges into common water sources are contaminated in a way that harms other (potential) users of the water pool—for example, industrial pollution (Wongbandit, 1994), cabbage pesticide pollution (Charoenmuang, 1994), and salt mining discharges (Wongbandit, 1994), and ii) where, because of inappropriate pricing, the true cost of drawing water from alternative sources is not reflected in the incentives facing individual users—for example, industrial/urban use of ground water versus surface or piped water (Pongsudhirak, 1994). Such externalities create a discrepancy between private costs, which guide the actions of individual agents, and social costs, which are the proper guide to economically efficient allocations.
- The *equity* or *fairness* question arises when allocation decisions impinge differentially on groups with different economic or social characteristics, such as when water is reallocated from poor farmers to electricity generation, to industrial uses, or to golf courses, or when it is suggested that farmers should be taxed or pay user charges for irrigation water in the dry season. Fairness is more important when governments, rather than "impersonal" markets, play the primary role in allocation decisions.
- The *institutional/regulatory design* issue concerns the selection of policy instruments for dealing with water allocation. The main question relates to the appropriate mix of administrative and market-based instruments. The choice depends on the information needs and monitoring and enforcement capabilities of different agents and institutions. There is no question that Thailand has relied far too heavily on methods of "command and control" and has made insufficient and inadequate use of

economic instruments.

Among the general conclusions that emerge from the case studies are the following:

- Water is now scarce in Thailand, especially in the dry season.
- There is a considerable and increasing incidence of pollution of water sources from agricultural, mineral extraction and industrial production.
- The allocation of water is an issue of growing importance and increasing conflict in Thailand.
- Current means of dealing with water conflicts are inadequate. Existing mechanisms are ineffective in dealing with allocation questions, and are also viewed as increasingly unfair. Policy discussions focus on the issue of fairness with insufficient understanding of the (un)fairness of the existing patchwork of allocation mechanisms, or of the net social gains to be realized from increases in the efficiency of water use. Greater use of economic instruments would lessen conflict and improve the efficiency and equity of water use.

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