Paper 2

Will the Future Be Like the Past?

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INTRODUCTION

IRRIGATION HAS BEEN undeniably important in the development paths taken by most Asian nations since 1950. Irrigated area in Asia currently comprises about 143 million ha, more than 60 percent of the world's total, and more than one-third of Asia's cropland is now irrigated (Rosegrant and Svendsen 1992). The importance of irrigation was enhanced by the Green Revolution of the late 1960s and the 1970s, and irrigated agriculture today remains a central economic and food security pillar in the region.

And though industrialization proceeds at varying paces across the developing world,

> *...the agricultural sector will continue to play an essential role in efforts to accelerate economic growth and alleviate poverty and food insecurity in most of the developing countries, particularly the low-income ones. Although world market prices for food are low and although global food surpluses currently exist, low-income developing countries cannot afford to rely heavily on food imports to meet the needs of their people (Pinstrup-Andersen 1992).*

The purpose of this paper is to provide a generalized framework of socioeconomic issues relating to the future of irrigation in Southeast Asia as a backdrop against which individual country situations can be examined. In this paper we will (1) examine the pattern of recent growth in irrigation in Asia, (2) identify the larger forces for change which are at work in the region, and (3) speculate on their implications for irrigation in the region over the next one or two decades.

TRENDS[7]

Production

The introduction and rapid spread of high yielding rice varieties combined with heavy investment in irrigation and rapid growth in fertilizer use in the late 1960s and the 1970s resulted in strong output growth for these crops in Asia. Yield growth was the primary contributor to rice output

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7 This section of the paper draws heavily on Rosegrant and Svendsen (1992).

growth throughout these periods (Table 1). After growing at a rate of 2.3 percent per annum during 1966-74 and 2.9 percent during 1974-1982, growth in rice yields has slowed to 1.9 percent annually since the early 1980s. Area expansion contributed about one-third of Asian rice output growth in 1966-74, but virtually halted after that. The rate of growth in output in Asia therefore also declined in the 1980s, from an annual growth rate of 3.1 percent in 1974-82, to 2.2 percent during the period beginning in 1982. The pattern of growth, however, varied significantly by subregion, with China and Southeast Asia experiencing substantial declines in the rate of yield growth during the latter period (Table 1).

Table 1. Rice: Annual growth rates of area, production, and yield, Asia, 1957/59-1988/90 (units: %/ year).

Countries/ Regions	1957/59-1988/90	1957/59-1965/67	1965/67-1973/75	1973/75-1981/83	1981/83-1988/90
Asia Total					
Area	0.73	0.85	1.09	0.24	0.25
Production	3.08	2.60	3.37	3.09	2.16
Yield	2.36	1.74	2.27	2.86	1.91
Southeast Asia					
Area	0.93	1.73	0.35	1.51	0.72
Production	3.24	3.17	3.29	4.28	2.29
Yield	2.32	1.46	2.94	3.22	1.57
South Asia					
Area	0.89	1.26	0.61	0.88	0.25
Production	2.33	3.13	1.63	2.57	2.31
Yield	1.45	1.89	1.02	1.71	2.03
China					
Area	0.52	-0.58	2.25	-1.07	-0.38
Production	3.55	2.62	3.92	2.98	1.25
Yield	3.03	3.21	1.68	4.06	1.63
India					
Area	0.67	1.21	0.74	0.46	0.34
Production	2.49	1.95	2.90	2.22	3.62
Yield	1.81	0.74	2.15	1.57	3.23

Notes: South Asia includes Bangladesh, Nepal, Pakistan and Sri Lanka excluding India. Southeast Asia includes Burma, Cambodia, Indonesia, Laos, Malaysia, Philippines, Thailand, and Vietnam.

Source: World Rice Statistics, 1990, IRRI.

The slowdown in productivity growth for rice in Asia since the early 1980s has been caused by declining world commodity prices; factors related to the process of intensification of rice and wheat production; and broad policy reforms and structural changes in economies, which have altered relative factor prices and incentive structures.

Investment and Area

At the same time, irrigation investment has fallen precipitously. Aggregate lending and assistance for irrigation in Asia by the major international donors in the 1980s was only half as high as in the 1970s (Table 2). Total irrigation investment expenditures for the major rice-producing countries in Asia show similar declines in rate of investment in irrigation during this period (Table 3).

Table 2. Average annual lending and assistance for irrigation in Southeast Asia by World Bank, Asian Development Bank, U.S. Agency for International Development, and Japanese Overseas Economic Cooperation Fund (in constant 1980 prices).

Year	Lending and assistance to irrigation					
	World Bank (1)	ADB (2)	JOECF (3)	USAID (4)	Total of (1)+(2)+(3)	Total of (1)+(2)+(3)+(4)
	..... US$ Million					
1969-70	–	35	6	–	–	–
1971-73	–	61	7	–	–	–
1974-76	319	52	16	–	387	–
1977-79	467	134	29	18	630	648
1980-82	237	153	31	17	421	438
1983-85	147	87	59	5	293	298
1986-87	88	96	18	9	202	211

Sources: World Bank, ADB, JOECF, and USAID.

Table 3. Index of average annual public expenditures for irrigation development, 1976-80=100.

Time Period	Bangladesh	China[a]	India	Indonesia[a]	Philippines[a]	Sri Lanka	Thailand
1971-75	97[b]	70	60	20	25	37	88
1976-80	100	100	100	100	100	100	100
1981-85	143	74	94	192	125	92	151
1986-90	103	54	80	170	45	55	109

Notes: [a] For China, Indonesia, and the Philippines, the successive time periods are 1969-73, 1974-78, 1979-83, 1984-88, 1974-78=100.

[b] 1973-1975.

Sources: For India, Indonesia, Philippines, Sri Lanka, and Thailand: Rosegrant 1991, computed from Gulati 1991; Rosegrant and Pasandaran 1990; Azarcon 1990; Aluwihare and Kikuchi 1990; Rosegrant and Mongkolsmai 1990. For Bangladesh, Annual Development Programme of Bangladesh, various issues. For China, Ministry of Water Resources and State Statistical Yearbook.

The result of this investment decline has been a sharp drop in the growth of irrigated area in Asia (Table 4). Annual average growth rates over the full period, 1960-88, average 1.7 percent, led by Southeast Asia's 2.7 percent rate. In Asia as a whole, and in each subregion, there has been a sharp decline in the rate of growth in irrigated area in recent years. In Southeast Asia, the growth rate remained strong through the mid-1980s, but declined sharply from 4.1 percent from 1980-85, to 1.5 percent in 1985-88.

Table 4. Average annual growth rate of irrigated agricultural area in Asia, 1960-88 (in %).

	Total	South Asia	Southeast Asia	East Asia
1960-88	1.7	1.9	2.7	1.1
1960-65	2.0	1.8	1.6	2.2
1965-70	2.5	2.9	1.2	2.4
1970-75	2.0	1.8	2.8	2.1
1975-80	2.0	2.8	3.6	1.2
1980-85	1.2	1.8	4.1	-0.3
1985-88	0.4	0.1	1.5	0.3

Note: East Asia includes China, Hongkong, Japan, DPR Korea, Korea Republic, Macau and Mongolia. Southeast Asia includes Brunei, Burma, Cambodia, Indonesia, Laos, Malaysia, Philippines, Singapore, Thailand and Vietnam. South Asia includes Bangladesh, Bhutan, India, Sri Lanka, Maldives, Nepal and Pakistan.

Source: FAO.

What has caused this decline in the rate of irrigation investment? Contributing factors include the large public and foreign debt loads carried by most of the agriculturally based economies in the region; the declining share of unexploited irrigation development potential in many countries in the region; and political resistance from environmental interests and those displaced or otherwise negatively affected by irrigation development. However, recent studies show that the main reasons for declining investment are the decline in world rice prices and the increasing real costs per hectare of new irrigation development (Aluwihare and Kikuchi 1990; Rosegrant and Pasandaran 1990; Rosegrant and Mongkolsmai 1990; Ramirez and Svendsen 1990).

The decline in real commodity prices is shown in Figure 1. Table 5 summarizes trends in real capital costs for new irrigation systems in the five countries where the case studies were done. All countries show large increases in the costs per hectare of investment over the past two decades. In India and Indonesia, the real costs of new irrigation have more than doubled since the late 1960s and early 1970s; in the Philippines, costs have increased by more than 50 percent; in Sri Lanka, they have tripled; and in Thailand they have increased by 40 percent. The result of these increases in costs and declining prices is low rates of return for new irrigation construction. Aluwihare and Kikuchi (1990), for example, show benefit-cost ratios for new construction in Sri Lanka declining from 2.1 in 1970-74 to 0.7 in 1985-89.

Table 5. Real capital costs for construction of new irrigation systems, 1966-88 (in US$/ha).

Year	India (1988 prices)	Indonesia (1985 prices)	Philippines (1985 prices)	Sri Lanka (1986 prices)	Thailand (1985 prices)
1966-69	2698	1521	1613	1470	1419
1970-74	2368	1681	1882	2056	2584
1975-80	1656	3187	2263	2909	2366
1981-85	4033	3283	2688	5288	2276
1986-88	4856	4096	na	5776	2812

Sources: Computed from Gulati 1991; Rosegrant and Pasandaran 1990; Azarcon 1990; Aluwihare and Kikuchi 1990; and Rosegrant and Mongkolsmai 1990.

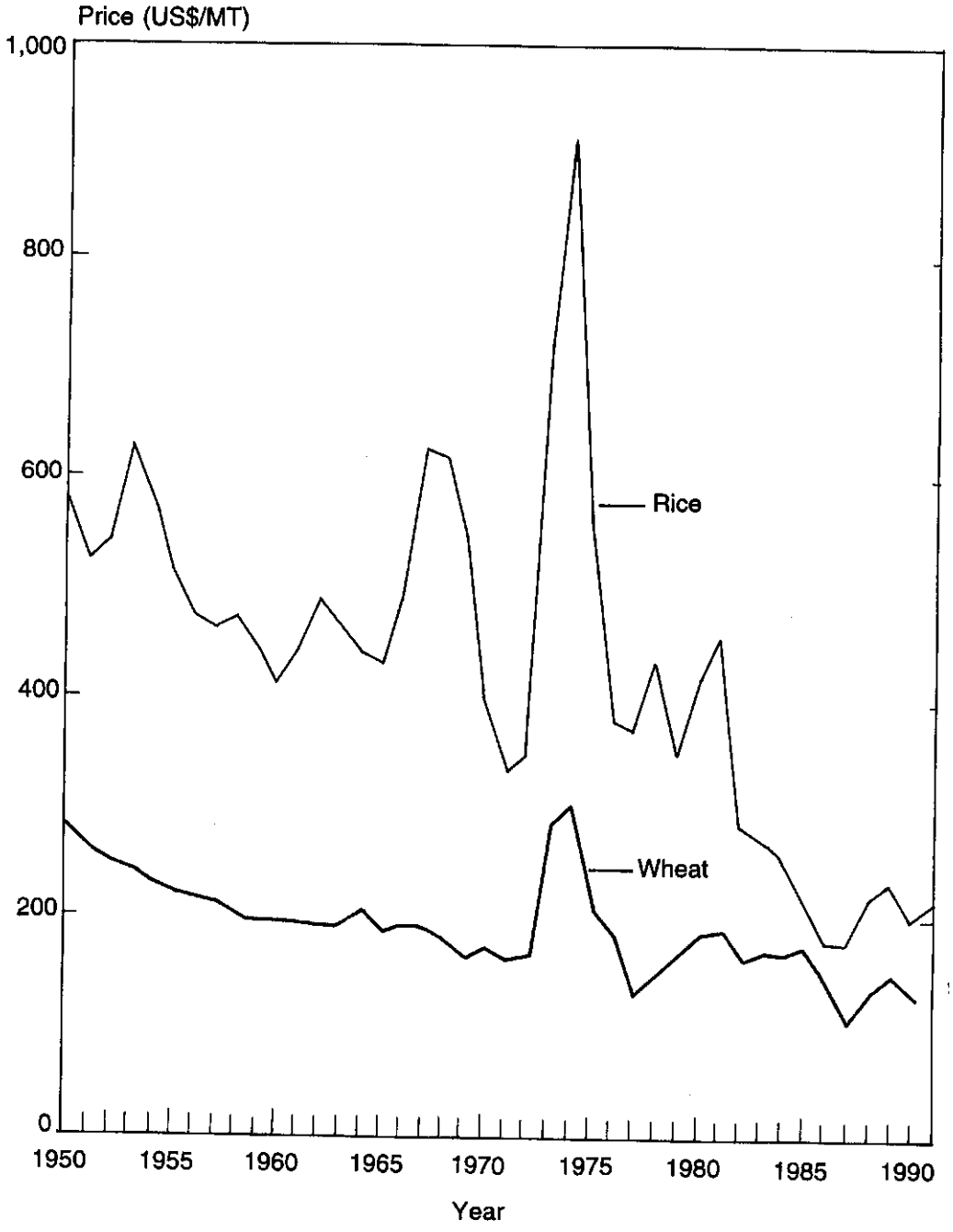
There are sharp differences of opinion on the desirability of the slowdown in irrigation investment in the past decade, and on whether significant increases in investment in new irrigation would be appropriate. Some observers argue that recent slowdowns in production growth are appropriate responses to changes in relative prices and government reforms. With continuing low prices of rice and increasingly high per hectare capital costs for new irrigation development, reductions in the rate of irrigation investment have been appropriate, and investment in new irrigation remains unattractive relative to alternative investments in agricultural research and technology. Other analysts argue that the impact on rice production of declining investments in the 1980s will be felt most strongly during the 1990s, further exacerbating the slowdown in new area irrigated and crop yield growth, so that it is essential to expand investments in new irrigated area in addition to improving existing systems, in order to maintain desired growth rates in grain production.

According to the latter argument, increased irrigation investment would be justified by extending cost-benefit analysis to incorporate endogenous world prices through feedback from the effect of total irrigation investment to prices, to better incorporate risk considerations, to incorporate the adjustment costs of irrigation agencies, and to take account of secondary benefits of irrigation.

Rosegrant and Svendsen (1992) conclude that the substantial cutback in public investment during the 1980s was, in general, an appropriate response to declining world rice prices and the rapidly increasing capital costs of irrigation. However, due to the endogeneity of world prices and asymmetric risk concerns, a modestly higher shadow price for rice and wheat could be utilized in evaluation of irrigation (and other) investments. These modified shadow prices would reflect the probable long-terms effects of the reductions in irrigation investment over the past few years. If shadow prices were revised slightly upward, the portfolio of cost-effective new irrigation projects would increase compared to current levels, moderately boosting expenditures on new irrigation. However, these adjustments would not be expected to result in a major outburst of irrigation construction activity.

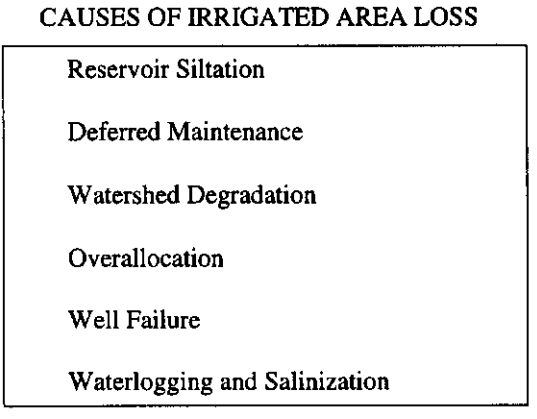
One positive result of the decline in expansion of irrigated area may be increased viability of the decay of the existing irrigation base. Irrigation schemes are not permanent, and the irrigated area of any country or region is always in dynamic balance—with new area being added and existing area going out of production. When more area is being added than is being lost, we record aggregate growth, and when the opposite is true, we record contraction. When the growth rate is high, it tends to mask area losses because of the resulting high net growth rates. As construction activity declines these losses become more visible.

Figure 1. Real world rice (5% broken, FOB Thailand) and wheat (No. 1 WRS, FOB Canada) prices, 1950–90 (1985 prices).



Area can be lost from the base from a variety of causes (Figure 2). Reservoir siltation reduces storage capacity and ultimately results in reduced area irrigated, particularly during the dry season. Deferred maintenance and resulting system deterioration have the same effect. In addition to its indirect effect on rates of reservoir siltation, watershed degradation also affects irrigated area directly, in river diversion systems, by changing the shape of the river's hydrograph, making it "flashier" and less stable. Over-allocation results in shifting irrigation benefits from one location in a river basin to another without increasing productivity, all the while decreasing aggregate economic efficiency due to overinvestment. Wells decline in productivity and go out of service as strainers corrode, pumps wear, and watertables drop. Finally, waterlogging and salinization resulting from irrigation in arid environments, salinization of aquifers and coastal cropland due to salt water intrusion, tidal bores in rivers and drainageways have a major effect. It may now be possible to focus on the reversal of these effects and the resulting impact on irrigated area and productivity as an alternative investment opportunity to new construction.

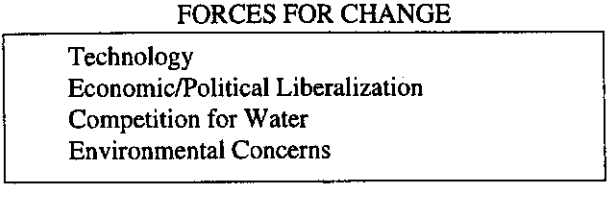
Figure 2. Mechanisms causing loss of irrigated area.



FORCES FOR CHANGE

In considering the near-term future, trends can be extrapolated to provide a sense of anticipated conditions. Extrapolations are far less reliable when dealing with the mid-range and longer-term future, however. In this case, it is useful to identify and examine fundamental forces and to speculate on their implications for change. We have identified four such forces—technology, economic and political liberalization, competition for water, and environmental concerns (Figure 3).

Figure 3. Forces for irrigation-related change in Southeast Asia.



Technology

The employment of new technology in developing-country irrigation is a perplexing issue. Theory tells us that new technology is the way to improve the productivity of an economic enterprise and reduce its costs. Yet while there have been sweeping changes in irrigation technology in the West in the past 30 years, little of this development has affected Asian irrigation. Technology employed in many recently constructed canal irrigation systems in the region would be perfectly recognizable to a turn-of-the-century irrigation engineer. A principal reason for this lack of technology transfer is that the most important developments in irrigation technology have occurred in the area of water application and not in the area of conveyance and distribution.

In Asia where farms are far smaller than U.S. farms, and where irrigation schemes are often much larger than their U.S. counterparts, there has been little adoption of the sprinkler and drip technologies which are the principal targets of research attention there. In Asia, the greatest need is for improved technologies for water conveyance, delivery, and allocation, and not for water application to crops. This requires a type of research which is vastly different than the agronomy-related research models which have been introduced to the region from abroad. Such new models must be developed in Asia and must involve close linkages between technology assessment and adaptation and system management innovation. In addition, widespread adoption of new technologies at the main system level will depend on more sweeping sectoral policy and institutional changes before strong effective demand for them will emerge.

Economic Liberalization

Of the forces for change currently at large in the developing world, none is more significant than "economic liberalization." Recent changes in economic and political philosophy and policy in Eastern Europe, the former Soviet Union, South Asia and in most of Africa are profound and will shape the course of economic and political development in these countries for decades to come. Although applied in different forms in different countries, economic liberalization is characterized by market-oriented economic policies, realistic exchange rates, liberalization of international trade, a central role for private enterprise in producing goods and services, reduction of subsidies, and transparency in economic policy instruments, i.e., overt rather than hidden subsidization and taxation.

Restrictive economic policies, such as overvalued exchange rates or trade protectionism to maintain domestic prices above world prices, entail significant costs to national economies. Policies which protect some commodities or sectors at the expense of others can cause resources to shift from more efficient production activities to less efficient ones. Protective trade policies also penalize consumers through increased domestic prices. Proponents argue that rationalization of prices and removal of trade and other barriers will result in more efficient allocation of resources in production, and will provide net welfare gains.

The overall impact of continued economic liberalization on Southeast Asian countries is weaker than for the former Soviet Union and Eastern Europe, because many of the policies that liberalization suggests are already in place in one form or another. Still, some scope remains to reduce trade protectionism and overvalued exchange rates which have favored industry over agriculture. Continued economic liberalization will improve the relative competitive position of agriculture in the economy. However, liberalization also implies reduction of indirect subsidies to agriculture, applying further pressure for increasing the efficiency of irrigation and raising agricultural productivity.

Competition for Water

Water is a finite but renewable resource. What we are concerned with is the allocation of the average quantity of fresh water which will be replaced annually in the channels and aquifers of a country or region. As we close on the limit imposed by this level of annual replacement, we expect costs of exploitation to rise, as we saw earlier to be the case for canal irrigation systems, and for competition among various users to increase. This we are now also seeing across much of Asia, especially in the more arid central and western portions of the continent. Even in more humid Southeast Asia, however, competition is being felt, and can only increase as populations grow, per capita demand for municipal water increases, and industrialization—with its own often heavy water requirements—proceeds. Because irrigation is typically the largest consumptive user of water, because the priority of its claim on water is always lower than domestic use claims, and because its economic productivity is usually lower than in industrial uses, irrigation will be subject to increasing pressure to reduce its consumption to release supplies for competing uses and to pay the economic scarcity cost for water, rather than the current highly subsidized prices.

Environmental Concerns

Several kinds of environmental issues are of direct concern to irrigated agriculture in Asia. On the one hand, there are issues which directly affect irrigation, such as watershed deforestation and on the other, are externalities which result from irrigation or are exacerbated by it, such as rising water tables, salinization of irrigated land, or chemical contamination of groundwater.

In addition, though, there are several other categories of environmental issues associated with irrigation which merit consideration. One relates to the environmental damage associated with constructing new irrigation schemes, especially reservoir-based schemes, stemming from reduction in forested area and associated wildlife habitat, damage caused by construction activities in fragile mountain environments, secondary damage caused by opening up previously inaccessible areas, and submergence of prime valley bottom land. When manifested politically, these concerns can delay or halt new irrigation construction, especially of large projects, even where results of conventional economic appraisal are favorable.

The largely negative influence of this simple approach to environmental damage assessment is buffered, however, when the far more complicated set of human, economic, and environmental interactions stemming from a more comprehensive perspective are brought into view. For example, when the issue is expanded to address the problem of supporting a particular population level in a given region, tradeoffs between irrigation-based agricultural intensification in high potential areas versus more intensive use of fragile upland environments are encountered. This creates a situation which contains options, is far less clear-cut and less subject to ideologically based decision making, and is considerably more complex than the one outlined earlier.

Implications

We now turn to a review of some of the implications of the impact of these forces on Southeast Asian irrigation sectors. Because the forces mentioned above are interrelated, we will not, in general, attempt to associate impacts with particular forces. Nor will we pretend that this list of issues is a comprehensive one. We do contend, however, that these are significant issues which will have important influence on irrigated agriculture in the region over the next ten to twenty years.

Public Investment

Irrigation is losing its status as a privileged investment option. Henceforth, it will be subject to increasing scrutiny and more careful comparison with competing investment alternatives such as rural roads, power generation and agricultural research. At the same time, the range of investment options within the irrigation sector will widen to include investments aimed at restoring or preventing losses in irrigated area and productive capacity, more carefully targeted low-cost rehabilitation investments, and management and policy-based interventions. However, before being accepted, these alternative investments will need to show strong objective evidence of their effectiveness in increasing system output, something many have not done to date.

To the extent that new area is brought under canal irrigation, environmental concerns may bias project selection toward smaller-scale projects, which are generally regarded as having fewer and less-severe negative environmental consequences than larger projects. Such concerns will also strengthen the case for investments in existing projects which make them more efficient or which alleviate past environmental harm.

Private Investment

The expansion of private-sector tubewell irrigation in India, Pakistan, and Bangladesh is the most successful example of private-sector irrigation in the developing world, and the potential for further expansion in both South Asia and Southeast Asia appears substantial. Private tubewells have grown most rapidly in areas with reasonably good roads, research and extension systems, available credit, and accessible electric or diesel energy. In many locations, private tubewells have developed most intensively in and around the commands of large surface irrigation systems because of the availability of supplemental irrigation from the canal system and the aquifer recharge the canal system provides.

Rapid development of the private-tubewell sector, successful development of markets for water, and the underexploited positive externalities between canal and tubewell irrigation all indicate the potential for considerable expansion of this sector in Asia. The highly successful deregulation and privatization of the tubewell sector in Bangladesh in the mid-1980s suggests that the major role of the government in this process is as a facilitator, through provision of public goods, and a regulator, through enforcement of legal rights rather than as the direct implementor.

Performance of Existing Schemes

With the rapid escalation in the cost of developing new irrigated land, a logical alternative to further expansion is investment in improving the performance of existing irrigation schemes. Indeed, there has been high optimism in many quarters that this improvement process would provide very large production benefits and a concomitant increase in rural incomes. However, both the physical processes of surface irrigation and the empirical evidence related to rehabilitation and management reform for improved irrigation performance suggest more modest and highly variable benefits. Nevertheless, the prospect, at least, of relatively low-cost gains is real, and considerable effort will be focused on assessing performance of existing irrigation schemes and designing management and policy-based interventions for improving them.

To understand the range of options available for improving existing irrigation, it is useful to look at the three mechanisms through which improvement efforts based on a given water supply affect agricultural output. The first relates to the timeliness of irrigation deliveries to farmers—making the deliveries more predictable and more coincident with the timing of the water requirements of crops being grown. Such improvements reduce or eliminate periods of water

stress on crops, increase their yields, induce use of higher levels of complementary inputs such as fertilizer and labor, and induce shifts to higher-valued crops.

The second, the impact mechanism, is the saving of water which is not used productively, and its application to unirrigated or underirrigated cropland. This mechanism acts on total production levels by expanding irrigated area rather than by increasing output per hectare. Along with the water saving itself, however, must go effective steps to apply the water where it will have the greatest impact in boosting yields. Otherwise, the potential impact on production will be lost. This effect can also be exploited by redistributing a fixed total volume of water within a command away from more generously supplied areas to areas where its marginal value will be higher. This has often been an objective of improvement programs emphasizing rotational irrigation and other forms of rationing. It is a difficult program to implement in practice, as it implies redistributing a fixed resource among individual users.

The third, the output-improving mechanism, works through the reduction of waterlogging and salinity problems. Waterlogging and resultant problems of soil salinization lead directly to reduced crop yields and to productive land going out of cultivation. These problems are exacerbated by overapplication of surface water to crops, and therefore steps taken to reduce overapplication of water can result directly in production increases due to reduced salinity levels and improved aeration in crop root zones.

In economic terms, performance improvements can also be realized by reducing system operating costs while, at least, holding output constant. However, interventions which do none of these things, though they may have aesthetic or political impacts, will not produce economic benefits and will be increasingly difficult to justify in the more critical evaluative climate expected to prevail in the future.

Water Prices

A central feature of the new economic policy regime establishing itself across Asia is adjustment of prices of agricultural inputs and outputs to levels consistent with a free market regime. This has resulted in higher prices for fertilizer and other production inputs and has provided a precedent and a rationale for increases in water tariffs as well. Increasing competition for water from other users may also tend to force water prices up. On the other side of the coin, continuing budget deficits make the public subsidy outlay for irrigation operation and maintenance an attractive cost-reduction target for government financial managers. The combination of these pressures can be expected to provide a strong push for substantial hikes in irrigation fee levels, which historically have failed even to keep pace with inflation in most countries.

Attention to irrigation cost-recovery systems can be expected to go beyond fee levels, however. The obsessive traditional concern on the part of resource economists with correct pricing levels for irrigation water is beginning to give way to a more relevant and realistic interest among a wider group of professionals in the broader topic of charging systems for irrigation water and their relationship with resource use efficiency. This trend is expected to continue and to extend into the realm of the institutional structure of irrigation managing agencies, with which it is strongly interrelated. A recent study (Small and Carruthers 1991) has shown that financial autonomy of a managing agency is a necessary condition for a strong linkage between irrigation fees and efficient irrigation service provision, and financial autonomy can be expected to be an increasingly important feature of irrigation management organizations.

Water Markets

Accompanying the rapid expansion of tubewells in South Asia are emerging markets trading in tubewell water. These markets increase access to well water on the part of smaller farmers and

increase the utilization rates of pumping equipment. Little market development has occurred in areas served by public canal distribution systems, because of legal reasons related to water rights and because irrigation service supplied by public distribution systems is usually insufficiently defined, quantified, and controlled to permit transactions to take place.

As the scarcity value of water rises and as publicly distributed production inputs shift toward the private sector, some of these deficiencies will be remedied and the conditions for trading and selling of short- and long-term water rights will become more favorable. Still, the emergence of water markets in surface water is likely to be a slow and lengthy process. Meanwhile, markets in groundwater can be expected to continue to expand, since water-right and water-control issues are not significant problems here.

Water Costs

Marginal costs of providing irrigation service to entirely new areas will continue to increase, following the trend already established. To the extent that externalized costs of drainage remediation are brought into the cost structure for irrigation water supply, the cost of irrigation water could rise still further. There are few examples of this being successfully done elsewhere in the world, though, and such internalization is unlikely to occur in Southeast Asia over the period of interest. As alternative investment packages of system improvements are further developed and tested, marginal costs of water made available by them may well begin to decrease. Overall, costs of supplying irrigation water thus may not increase dramatically over the coming decade.

Power of Farmers

Economic liberalization also has strong democratic political overtones, and democratic political structures appear to be gaining strength and resiliency in Southeast Asia. As a result, farmers' organizations of various kinds, including irrigators' associations, may find an encouraging climate for growth. Although often a slow process, evidence from several countries in the region indicates that development of irrigators' associations can be accelerated by carefully designed interventions.

To the extent that farmer irrigation organizations multiply and grow stronger, several results can be expected. First, organized farmers can demand and receive greater accountability from irrigation agencies, presumably improving the quality of irrigation service. Second, they can be expected to assume responsibility for managing smaller systems and portions of larger systems themselves, replacing public control over these systems. This trend is already evident in several countries in the region. Third, they may gain added political clout, allowing them to request and receive additional public benefits in the form of rural infrastructure and services (including irrigation), and possibly subsidies on these services (including irrigation). This last feature may run counter to some of the other tendencies asserted here, which emphasizes the dynamic and political nature of many of the issues being considered.

Irrigated Crops

Although prices of basic food grains are expected to remain low over the coming decade, the same is not necessarily true of other crops. As a result, and as marketing infrastructure continues to improve in rural areas, shifts from staple grains to higher-value crops in irrigated areas can be expected. This will also make farmers better able to pay the higher water rates anticipated and reinforce their demand for higher quality (adequate, timely, reliable) irrigation service. Rising farm incomes which result will strengthen farmers' political clout, enhancing the prospects of the empowerment mentioned above.

New Government Roles

Changes outlined above imply reduced roles for government irrigation agencies in the provision of irrigation water to farmers. On the one hand, some government irrigation departments will be spun off into private or quasi-private entities delivering irrigation services for fees. Additionally, organized groups of farmers will assume greater responsibility and control over some schemes. The growing groundwater sector will remain firmly in private hands.

In the wake of these changes, governments will need to play new roles. Some of these roles are technical and might naturally fall into the realm of former irrigation management agencies. Others are new and will require skills and perspectives not usually found in irrigation departments. Some important examples are given below.

a. As pressure on the water resources increases, resources allocation and dispute adjudication will become increasingly important. Governments will need to strengthen their capacity to document and monitor water rights and settle disputes among rival claimants. Improvements in this area will also facilitate the development of macro-level markets in water rights.

b. As externality problems, such as waterlogging and salinization, expand, governments' role in this field will expand also. Because of the nature of externalities, public-sector involvement is usually necessary to address them. This function will include allocating costs of remediation among beneficiaries, those responsible for the externality, and society at large. With respect to positive externalities, a corollary function will be to recover some share of canal irrigation costs from those users of groundwater benefiting from aquifer recharge resulting from canal operations.[8]

c. A third new function falling to governments is to ensure the financial probity of the corporate and cooperative entities set up to deliver irrigation water instead of the government departments and agencies. Revenues previously moving through government channels will now course through public utilities and farmer cooperative organizations, and auditing systems and standards will need to be established and enforced. This is an extremely important function, essential to the success of privatization policies. It is not necessary for governments to be the implementing agencies for all audits and monitoring efforts, but they must establish auditing systems and ensure their effectiveness.

d. As water is reallocated in response to market forces, some traditional users will find themselves with less water or no water to work with. Governments have a strong responsibility to monitor and regulate market mechanisms to protect the interests and rights of less-powerful farmers vis-à-vis those more powerful. Additionally, governments must remain aware of the impacts of shifts in water allocation patterns, even those legitimately accomplished, on those who give up or lose allocations. While transfers may move the economy as a whole in the direction of greater efficiency, the welfare of vulnerable segments of the society must also be protected.

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8 This can be a positive externality in fresh groundwater areas since it reduces groundwater extraction costs, or a negative one in saline groundwater areas since it can lead to land salinization.

WILL THE FUTURE BE LIKE THE PAST?

The answer to this question, unsurprisingly, is yes and no. Irrigation, and irrigated agriculture, will continue to be important as a principal source of agricultural growth and as an essential contributor to national food security in most Asian countries, including those of Southeast Asia. Public agencies will continue to play important, though changing, roles in irrigation development and management, while farmers remain the central actors at the productive end of the system, while becoming more important at higher levels as well.

Importantly, where irrigation policy once involved deciding how much money to invest in irrigation construction each year, and how to allocate it among districts, the number of policy questions and options have now expanded considerably. New sets of issues relating to the various modes of enhancing productivity in existing systems, appropriate organizational forms for managing entities, the role of farmers in higher-level management processes, selling and trading of irrigation water rights, intersectoral allocation and sale of water rights, and intensive cultivation/fragile lands trade-offs now demand consideration.

Many of these new issues can be captured as changes occurring in our concept of water itself.

First, irrigation water has traditionally been viewed in many societies as a "social" good, something the government was obliged to supply where possible, much like a road or drinking water. Water, including irrigation water, is increasingly being seen as an economic good, useful in a variety of productive enterprises, whose costs should be reflected in charging and allocation decisions.[9]

Second, there is a change in the perception of what an irrigation system is obliged to supply to recipients (or purchasers) in the system. The oldest view is that it provides facilities which can extract water from a river and deliver it to an area of agricultural land. This view places primary emphasis on construction of new facilities. A second stage view is that the obligation is to supply water to command areas. This view places greater emphasis on operating main system sluices and gates but is little concerned with the nature of the demand for water or actual patterns of deliveries.

The third stage view is that the system should supply irrigation service to farmers. In this stage, the temporal and spatial pattern of demand for water across the system is the critical factor driving the water supply process. Success is measured not in constructing, or in opening main gates, but in making particular patterns of water flows available across the system. Many agencies and systems in Southeast Asia appear now to be in transition between the second and third of these stages.

Third, there is a change in the concept of "rights" to water. Patterns here are as yet less clear, but changes will likely involve more precise specification of and accounting for rights to water, devolution of the rights from central government agencies to smaller lower-level producer-based units, increased transferability of rights from one use or group to another, and the valuation of these rights and the emergence of markets for both short-term and long-term water rights.

This is an interesting time in the history of Asian water resources development. It is one marked by more rapid, more sweeping, and more basic flux than the past three decades which saw tremendous growth, but little change in basic principles, assumptions, and concepts. How long this period of change will last is an open question, but the fact that change is on the way seems clear.

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9 Agenda 21, the document growing out of the recent Earth Summit in Rio, recognizes it as such.

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