

CONCLUSIONS

IRRIGATION INVESTMENT IN ASIA: WHERE SHOULD THE MONEY GO?

Throughout Asia irrigation has been the mainstay of agricultural development for over four decades. In many countries, India for example, irrigation investment accounts for almost 10 percent of total public outlays since independence. As late as 1980 in Sri Lanka, similar investments have climbed above 20 percent of total government capital expenditures. The majority of this spending has gone to bring new land under irrigation and most efforts have paid off. Most of Asia is now self-sufficient in rice production, but having reached that stage, a new question arises — In what direction should future irrigation investments be channelled? Should the money be spent to build more systems or to deepen existing irrigated land base or to a host of other possibilities?

In the recent past, a quiet revolution has taken place among international donors and policymakers with the pendulum of thought swinging from irrigation construction to system rehabilitation to improvements in irrigation system management. That trend, in and of itself, is not surprising. What is surprising is that despite the continuing importance of irrigation in economic development, few attempts have been made to determine the integrated manner of past investments, or more importantly to examine the profitability among investment alternatives in the future.

To fill the gap, and using Sri Lanka as the test case, International Irrigation



Construction investment has dovetailed with world rice prices.

Management Institute (IIMI) researchers instituted a study that compiled time series data on different types of irrigation investments — new construction, rehabilitation, and management improvement projects — during the last four decades and analyzed changes in the process of economic development. In doing so, researchers have been able to provide hard evidence supporting the argument that IIMI and others have put forth for the past five years. “Generally speaking, the era of major irrigation construction in Sri Lanka is over,” says Masao Kikuchi, IIMI’s principal author of the study. And he adds, “to the extent that land is scarce in relation to

Table 1. Annual compound growth rates of rice production, area planted, and yield per hectare in Sri Lanka.

	Annual compound growth rates (%)		
	Rice production	Area planted	Yield per ha
1952 - 1960	7.2 (100)	3.2 (44)	4.0 (56)
1960 - 1970	5.0 (100)	2.2 (44)	2.8 (56)
1970 - 1980	3.9 (100)	1.6 (41)	2.3 (59)
1980 - 1985	4.0 (100)	0.4 (10)	3.6 (90)
1951 - 1985	5.0 (100)	2.0 (40)	3.0 (60)

labor, the forces should be the same in all Asian countries."

Development of Rice Production in Sri Lanka

In carrying out the study, the author first sought to document the process of rice production in Sri Lanka. At the time of independence, Sri Lanka produced 40 percent of its rice requirement; by 1985, the figure had risen to 90 percent. By using new cropping technologies in combination with expanded irrigated area, domestic rice production increased six times. Answering how the increase was accomplished, says Kikuchi, "is almost synonymous to explain the process of irrigation development in the country."

The increase in rice production was due to increases in area planted to rice and to rice yield per hectare (ha). Specifically, the author says, the 5 percent annual growth rate in production between 1952 and 1985 was brought about by 2 percent annual increases in area planted and 3 percent annual increases in rice yield. The first came primarily in the development of new irrigation systems in Sri Lanka's dry zone — the irrigated rice area increased from about 250,000 ha in

Table 2. Irrigation investments in Sri Lanka, by type of investment, in 1986 constant prices, and their share in the government budget and the total public investments, 1950 to 1988.^{a)}

	Irrigation investments			Share of the total irrigation investments ^{c)} in	
	New construction ^{b)}	Rehabilitation ^{c)}	Operation and maintenance ^{d)}	Government budget	Total public investments
	Rs million in 1986 prices			%	
1950	907 (96)	-	34 (4)	8	37
1955	859 (96)	-	38 (4)	6	29
1960	601 (83)	-	121 (17)	3	19
1965	619 (91)	-	62 (9)	3	15
1970	994 (93)	-	78 (7)	3	16
1975	1116 (89)	5 (1)	127 (10)	2	13
1980	3023 (89)	225 (7)	137 (4)	6	21
1985	2770 (82)	451 (13)	141 (4)	6	18
1988	1676 (81)	299 (15)	89 (4)	3	na

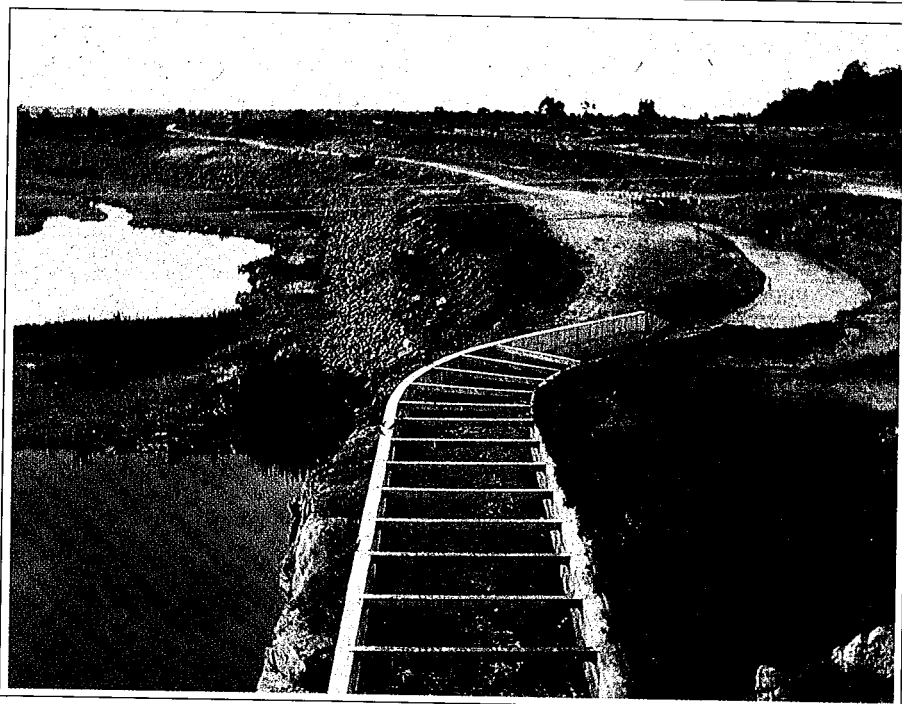
Note: a) Five-year averages centering the years shown.

b) Investments made for constructing new systems or restoring old abandoned systems. Only irrigation infrastructure related investments, such as tank and canal construction, are included.

c) Investment for major rehabilitation and modernizing existing systems.

d) Not including overhead costs such as personnel emoluments and administrative expenditures.

e) Ratios are obtained between the series in current prices.



System rehabilitation is gaining popularity over new construction.

1952 to twice that by 1985, almost all of which came from new major irrigation systems in the dry zone, located in the northern and eastern areas of the island. As Table 1 shows the contribution to production increases of new irrigated area and yield per hectare shifted towards the latter over time. By 1985, virtually all farmers were using new crop varieties, developed by the national agricultural experiment stations and others, and were also using large amounts of fertilizer.

According to Kikuchi, irrigation development in Sri Lanka played a pivotal role in increasing total rice production by increasing the area planted and land productivity. But, its importance declined over time so that the contribution of higher yields exceeded 90 percent in the 1980s. That

suggests, say the authors, that the development of peasant agriculture in Sri Lanka has come to a turning point.

Trends in Irrigation Investment

In the next stage of the study, the authors, using government records, developed an irrigation investment series to devise hypothetical situations that could be used to determine irrigation investment variants. Public investments in the post independence period are summarized in Table 2, grouped into the three categories of new construction, rehabilitation, and operation and maintenance (O&M).

Several important points emerged from the analysis, says Kikuchi. First, irrigation in general, and construction in particular, have been far and away the most important investment opportunities in Sri Lanka. Second, irrigation construction has dominated the three, indicating that the irrigation sector has been directed to attain a national policy goal of rice self-sufficiency by using more irrigated land. Third, investments in new construction have experienced three peaks, in the early 1950s, the late 1960s, and the late 1970s reaching into the early 1980s. The peaks and valleys in investment raise the question of why investment has not been on a sustained level and has fluctuated so dramatically.

Kikuchi says he first saw such fluctuations in a similar study he completed in the Philippines 15 years ago, with Y. Hayami. "The peaks were induced by rises in world rice prices," he says. "The first peak came with the food shortage right after World War II and during the Korean War, the second coincided with the 1965-66 famine in the Indian subcontinent, and the last with the worldwide poor harvest in the mid 1970s."



Research on irrigation technology and management employ similar methodologies and approaches.

Another important point in the irrigation investment trend is the emergence of rehabilitation projects in the mid-1970s, which have increased in their share of investments ever since. "The trend represents a change in momentum in irrigation development," says Kikuchi.

The first major rehabilitation project in Sri Lanka, the Tank Irrigation Modernization Project (TIMP) was

started in 1976, and was quickly followed by others. In addition, this trend was accompanied by a stream of projects aimed at improving water management of existing irrigation systems, the first being the Minipe Water Management Project implemented in 1978.

Last, the table shows that expenditures for irrigation system O&M as a share of irrigation

Table 3. Rates of return of irrigation investments in the 1980s: Comparison among new construction, major rehabilitation, and water management improvement projects, based on 1986 constant price estimation.

	B/C ratio	Internal rate of return (%)
I. New construction:		
The average for the 1980s ^a)	0.8	9
II. Major rehabilitation projects:		
TIMP ^b)	1.1	11
Gal Oya	2.3	24
III. Water management projects:		
Kimbulwana	13.4	83
Pimburettawa	7.4	77
Nagadeepa ^c)	-	-

Notes: a) For the technology level "new improved varieties; N=120kg" and the estimated construction costs.

b) The rates of return for this project are based on "would-be" benefits assumed in the project appraisal report. For all other rehabilitation and water management projects, the project benefits are based on the data that show changes before and after the projects.

c) For this project, no systematic benefit from the project can be identified.

investment has remained as low as 4 percent as late as 1980, despite the huge investments in new systems.

Determinants of Irrigation Investments

The study next tried to test certain theories. On the surface it would appear that the long-term investment trend, from 1950-1985, in new irrigation construction was induced by high economic returns. At the same time it was proposed that the cost of construction was increasing throughout the period as development moved from "easy" sites to more difficult ones. Thus, scientists theorized that irrigation infrastructure and emerging seed-fertilizer technology reinforced one another and became a mechanism for sustaining the profitability of construction, despite rising construction costs. To test the hypothesis, the authors estimated the rates of return to investments in new construction over the last four decades along with estimated benefit/costs.

"What we found," says Kikuchi, "was that returns on investment in new irrigation were high initially, and sustained thereafter by successive development of seed/fertilizer technology. Without that, the economic potential would have been exhausted 15 years after independence."

Further analysis of the data also suggested that ultimately, the social payoff of investments in new systems, was largely determined by the rice import price and its short-term fluctuations. "A high import price gives a direct impact to the government decision on investments in irrigation construction" by increasing the prospect of returns. But there was one more factor — the availability of foreign funds. The study was able to show a direct relationship between the availability of foreign funds and construction. "The last two peaks of construction investment," says Kikuchi, "and particularly the third, were created by donor countries; they too were

influenced by the high profitability of investments."

Taking the analysis to its final conclusion, the authors found that decline in world rice prices, which hit rock bottom in 1986, and rising construction costs combined to make any new attempts at major irrigation construction economically unwise. Even in the event of a tremendous increase in rice prices, construction costs would still outweigh any possible gains. "There may be some spots where new systems can be built at low capital costs, though they will be projects of a much smaller scale," says Kikuchi.

The Bottom Line

In their final hypothesis, the authors theorize that irrigation development in Sri Lanka has come to a stage, given the massive investments in irrigation construction in the past, where greater profitability exists in investments aimed at improving and enhancing existing systems. To test the hypothesis, the study, using similar assumptions and techniques, sought to estimate the rates of return and benefit/costs of two completed rehabilitation projects and three water management projects. The results were then compared to rates of return of new construction investments in the 1980s as shown in Table 3.

"As we expected, the two major rehabilitation projects showed rates of return higher than for new construction," says Kikuchi. In particular, the Gal Oya project showed profitability rates equal to investments in new construction at the time of independence. On the other hand, rehabilitation projects are not ironclad investments. In the case of TIMP, the first such project in the island, a bias toward engineering and capital intensive changes and a failure to consult and include farmers in implementation, led to its poor performance. "It has given many valuable lessons to the rehabilitation projects that followed. Rehabilitation can be very profitable, providing there

is a heavy emphasis placed on the management component."

More surprising was the economic performance of the water management improvement projects. Even with conservative assumptions used to evaluate project benefits, the Kimbulwana and Pimburettawa Projects yielded internal rates of return almost 10 times that for new construction projects. "It suggests that such projects have been terribly underinvested." There is one caveat. In the third case of Nagadeepa, there was almost no improvement or discernable return on investment. The difference, according to the author, was that in two success cases, minor rehabilitation investments accompanied the water management components.

The bottom line is that the big profits lie in water management projects, accompanied by small physical improvements. Unfortunately, that is easier said than done, because, says the author, "We know next to nothing, or at best very little, about what makes a water management project succeed or fail. There are no comprehensive principles."

Still, says the author, the Sri Lankan experience revealed in the study illustrates that economic potentials in Asia's irrigation sector lay in pursuing a management orientation.

(Continued from Prelude)

systems or new ways of farming in general. Do you agree?

Swaminathan: I believe that scientists must learn to translate pure research into technologies that farmers can readily adapt to site-specific challenges. Science is good, but you do need to involve the farmers from the beginning. He's tradition-bound and has been farming in the same way that his father has done and his father before that. But as I said, if you can show them that something will work, that it fits in with the culture, then we have shown, from the Green Revolution on, that farmers will change and adapt to new technologies.