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Introduction

Irrigation has historically been a major factor for increasing rice productivity in the Philippines. Irrigation raises the productivity of land directly by providing sufficient water supply to raise yield per hectare per crop and by allowing a second crop to be grown during the dry season when yields are potentially higher. It also increases yields indirectly by raising the profitability of modern rice varieties and fertilizer use.

Because irrigation in the Philippines has been predominantly the gravity irrigation type which typically require collective investment, operation, and maintenance irrigation has been a key policy instrument for achieving government's goals with respect to the rice sector. Public expenditures for irrigation at its peak in the late 1970's accounted for nearly 20% of total public investments in infrastructure and 40% of public support to the agriculture sector. It has also been a major recipient of foreign loans and grants.

The importance of continuing the heavy public investments in irrigation expansion has began to be questioned in the early 1980's as self-sufficiency in rice was briefly achieved. With the sharp drop of world rice prices since the mid-1980's, foreign debt problems, and severe budgetary squeeze, public expenditures for irrigation fell sharply in real terms, as well as in proportion to total infrastructure budget and to public support to agriculture. The energy crisis,

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underdeveloped communication system, and poor market infrastructure have also lowered priority given to irrigation development.

The purpose of this paper is to analyze the critical policy issues in irrigation development confronting the Philippine government. Irrigation has been a relatively well-studied topic in the country by the universities, (both local and foreign), international research agencies (IRRI, IFPRI, IIMI) and the World Bank and Asian Development Bank. In recent years, these studies have focused on issues of the trade-off between new construction and rehabilitation, national vs communal irrigation system, efficiency and institutional issues of operation and maintenance, determinants of investments, financing and cost recovery. This paper will necessarily draw heavily on those previous studies particularly the recent papers by the World Bank (1991), Svendsen et al. (1990), Azarcon and Barker (1993), Ferguson (1987), and David (1992). While these studies have typically focused either narrowly on a specific policy issue or treated them separately, this paper adopts an integrated framework as suggested by Roumasset (1990), for analyzing policy decision with respect to project selection, design and construction, operation and maintenance, cost recovery and administration. Moreover, irrigation policy is viewed from the context of alternative public investments in general, and considers sector and macroeconomic policies affecting agriculture.

The first section of this paper provides an overview of irrigation development including the trends and patterns in expansion of irrigated area and capital and recurrent expenditures. The second section analyzes the determinants of irrigation expenditures. In the third section, the policy issues related to the performance of irrigation investments; operation and maintenance; level and nature of irrigation investments; and cost recovery are discussed.

Overview of Irrigation Development

Irrigation development in the country dates back to the pre-Spanish period as evidenced by the centuries-old. Banawe terraces covering 25 thousand has that were built by the local community. During the Spanish period, many small run-of-the river irrigation schemes along coastal plains totaling about 200 thousand has. were constructed largely in friarlands close to Manila and Ilocos region. These irrigation schemes were built either through cooperative societies ("Zanjaras") or by mobilizing labor for construction and operation in large haciendas and friarlands.

Public investments in irrigation development began under the American regime with the establishment of an Irrigation Division in the Bureau of Public Works in 1908. This division directly constructed and managed 12 irrigation systems in Central Luzon, Ilocos, and the Panay Island in Western Visayas by the late 1920's. Although some public support for communally built and managed small-scale irrigation were provided in the 1930's and 1940's, it was not until the postwar period that major public support for irrigation was resumed. This renewed expansion of irrigation in the 1950's included communal irrigation and the first irrigation projects in Mindanao and other new areas.

In the effort to further strengthen institutional support for irrigation development, the National Irrigation Administration (NIA) was established in 1964 as a public corporation in place of the former Irrigation Division and provided greater financial resources and financial flexibility. Although NIA continued to be attached to the Department of Public Works and Highways, the board included the Secretary of Agriculture to ensure the coordination of irrigation with other agricultural programs. There were other government agencies (Irrigation

Service Unit and the Farming Systems Development Corporation) involved in irrigation development mainly in promoting private pump irrigation. These have been abolished and the task of developing both pump and communal irrigation was eventually integrated into the functions of NIA. With the recent transfer of the NIA to the Department of Agriculture (DA), the irrigation-related (Small Water Impounding Projects) projects of the DA's Bureau of Soils and Water Management as well as other agricultural programs are expected to be better coordinated with irrigation concerns.

Trends and patterns in irrigated area

In Fig. 1, the trends in irrigated area since 1960 are depicted. About 1 million has. constituting over 30% of rice crop area was being irrigated by the early 1960's. From the late 1960's to the late 1980's, irrigated crop area doubled to just above 2 million has, and as a proportion of total rice crop area is now over 60%. In contrast, rainfed lowland and upland areas have been on a downward trend, and together now total only about 1.2 million has, about half of its peak in the early 1960's. Evidently, many rainfed areas particularly the uplands have been losing the competitive advantage in rice production.

Prior to the 1970's, irrigation was mainly to assure adequate water supply during the wet season crop as less than 30% of irrigated crop area is grown during the dry season. With the construction of major reservoir systems in Central Luzon and Cagayan Valley, the second crop irrigated area grew rapidly, increasing more than four-fold compared to the less than doubling of the irrigated first crop area. It should be noted that growth of irrigated area, both the first and second crop, ceased by the 1990's. This may be due not only to the deceleration of irrigation investments as shown in the next section but also to the conversion of irrigated areas to non-agricultural use in the urbanized areas.

Irrigation in the country is classified into national (NIS) and communal (CIS) irrigation systems and pump irrigation system (Table 1)[1] Crop area irrigated by pumps using groundwater is estimated to be only about 10% of the total service area, down from 12% in the 1970's. While there has been some government programs to promote pump irrigation, these are largely owned and managed privately.

About half of irrigated area are under communal run-of-the-river gravity irrigation systems which are typically less than 1000 has in size. Government support for CIS consists of loans for capital investment amortized over 50 years without interest; farmer irrigation associations are fully responsible for their operation and maintenance. National irrigation systems, which now account for about 40% of total service area are larger in size. Three of these systems are served by reservoirs to provide water for the dry season. The NIS are directly constructed, operated, and managed by the government though in recent years, certain tasks of O&M of NIS have been transferred to a few viable farmers' irrigation associations. In NIS, farmers are then charged irrigation fees that in principle cover the cost of operation and maintenance and part of capital cost.

Table 2 and Fig. 2 show the distribution of service area across regions by type of irrigation and measures of irrigation development. The three top rice growing regions -- Central Luzon, Cagayan Valley,and Western Visayas -- account for over 40% of irrigation service area.

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[1] Data on service area are estimates by NIA based on reports from regional offices. These are different from the data on irrigated crop area by the Bureau of Agricultural Statistics based on farm surveys, particularly during the earlier years.

It is also in these regions where the NIS systems are predominant. In all other regions, the small-scale communal irrigation systems are more important.

Overall, only about half of irrigation potential area seems to have been reached. But it should be emphasized that official estimates of irrigable potential area are based solely on soil quality and slope of contiguous areas (i.e., all contiguous areas over 100 ha with 3% or less slope). Although these do not represent the potential economically irrigable area as the cost of providing irrigation water has not been considered, they are useful reference points in comparing regional patterns in irrigation development.

Despite the historical concentration of irrigation development in Central Luzon, Cagayan Valley, Ilocos, and Southern Tagalog, from 40% to 50% of potentially irrigable area in these regions apparently remain to be exploited. It is also interesting to note that with the exception of Regions VIII, X, and XII which are primarily non-rice growing regions, the ratio of service area to irrigation potential do not seem to vary widely among the main rice growing regions. The generally higher ratios of actual irrigated area to rice crop area compared to ratio of service area to irrigable potential suggest that irrigation expansion can bring more cultivable area into rice production and not simply convert existing rainfed to irrigated rice areas. This may not be true for land close to urban areas where non-farm use may even more be profitable than irrigated rice crop production.

Trends in capital investments

Public expenditures for irrigation consists of capital investments and recurrent expenditures for operation and maintenance. Fig. 3 depicts the trends in public capital investments by type of irrigation and as a ratio of infrastructure investments and public expenditures for the agricultural sector.[2]

Fig. 3 clearly indicates the priority accorded to irrigation expansion in pursuit of the government's rice policy objectives in the 1970's and early 1980's. Though not shown, a major effort at irrigation expansion was also undertaken in the early 1950's, but the public budget allocated was not nearly close to the capital investments achieved in the 1970's (Hayami and Kucln, 1978). The spurt in the early 1970's represents the expenditures for the construction of the Upper Pampanga River Project (UPRP), the first large multi-purpose reservoir-backed irrigation system that was designed to provide year-round irrigation to more than 100 thousand has of rice lands. At its peak in 1979/1980, capital investments for irrigation reached nearly ₱3 billion in 1982 prices in contrast to only about ₱200 million in the late 1960's. Irrigation constituted over 40% of public expenditures for agriculture and nearly 20% of total spending for infrastructure.

As shown in Fig. 3b, the massive capital investments for irrigation in the 1970's up to the early 1980's were allocated mainly for national irrigation systems. Communal and pump irrigation systems accounted for less than 10% of total capital investments.

Capital investments dropped sharply in the early 1980's, down to about ₱1 billion (in 1982 prices) during the late 1990's, and fell further to only about ₱300 million by the early 1990's. The 1992 capital investment data do not include government allocation for construction

[2] It should be noted that capital releases refer to actual amounts released to NIA for capital investments, including foreign loans and grants. Irrigation as a ratio of agricultural public expenditures is based on government approved allocations which are not usually equal to actual expenditures. Irrigation as a ratio of infrastructure investments refers to actual expenditures.

of new communal systems which has been integrated with the local government budget. This is not expected to significantly change trends, however, because the size is relatively small and local governments need not spend this amount for irrigation.

Irrigation investments relative to public expenditures for agriculture also fell sharply to less than 10% by 1992 mainly because of the much greater spending for the agrarian reform and environment and natural resources programs. Interestingly, the decline in irrigation investment as a ratio of total infrastructure investments was less sharp.

Changing Nature of Investments

It should be noted that despite the sharp fall in capital investments in irrigation in the 1980's, irrigated crop area has been increasing up to 1990. Time lag between expenditures and completion of projects is one reason but the changing nature of investments is an even more important one. This can be observed in Fig. 4 which shows the trends in the generated new and rehabilitated irrigated area by type of irrigation.

The nature of capital investments in irrigation shifted markedly in the 1980's. Newly constructed irrigation for communal irrigation increased while national systems decreased. Moreover, a shift in investments from construction of new irrigation systems to the rehabilitation of existing systems for both NIS and CIS occurred. The hectarage of rehabilitated NIS was significant in the late 1970's because the large reservoir-backed irrigation systems constructed covered many areas that already had existing run of the river irrigation facilities. The much higher cost of NIS compared to the CIS and the cost of new construction over rehabilitation can be inferred from the comparison of Figs. 3 and 4. While investments for CIS in the late 1970's were minor compared to NIS, the hectarage of new area for CIS was in fact higher than the

NIS. And while capital investments dropped sharply in the 1980's, the total generated areas was higher in the late 1980's compared to the 1970's because of the higher proportion of rehabilitated vs new construction.

Sources of Capital Investments

Table 3 presents the distribution of capital investment by source of funds. Up until the end of the 1960's, irrigation investments were primarily funded from domestic sources. The first major irrigation construction loan was from the World Bank for the UPRP project approved in 1969 and since then, foreign loans and grants became a major source of funding. At the peak of irrigation investments in 1979/80, nearly 40% of total investments originated from foreign sources. Its share increased to as high as 84% in 1987 as budget constraints reduced domestic funding for irrigation. Whereas availability of foreign loans may have induced greater domestic spending for irrigation in the 1970's as local counterpart funds have to be provided, some of the foreign loans in the mid-1980's were in fact to substitute for counterpart funds which the government failed to provide for existing projects. By the early 1990's, however, the share of foreign loans declined to about 20%. The World Bank has been the most important source of foreign financing, contributing about two-thirds of the total in the 1970's and early 1980's (Table 4). ADB is the second in importance, but in recent years the OECF of Japan has become more prominent.

It is clear from Table 3 that up to 1980/81, direct government appropriations for irrigation projects were the dominant source of funding. As government budgets were squeezed, NIA has increasingly dipped from its equity and other corporate funds to support capital investments. Direct government appropriations began to gain importance in 1987 primarily to support CIS.

Trends in recurrent income and expenditures

With the establishment of NIA as a public corporation , the financial flexibility to charge direct beneficiaries for the cost of irrigation became possible. It was not until 1976, however, that use of irrigation was linked to financing. Before 1976, NIA expenditures for both capital investments and operation and maintenance were funded through budgetary allocations, while revenues from water charges were remitted to the national treasury. After 1976, the financing of O&M became the responsibility of NIA as all revenues from their operation were allowed to be retained.

In Table 4, the trends in NIA revenues from its internal operations, expenditures for operation and maintenance, and the rate of collection of irrigation service fee (ISF) are reported. The fact that revenues are much lower than expenditures before 1980 suggests that part of the capital budget allocation was used for operation and maintenance. The irrigation service fee which was set in paddy per ha in 1974, should theoretically cover the cost of operation and maintenance. In fact, ISF collections account for only 30% to 50% of expenditures because collection rates are below 50%. The major part of O&M expenditures comes from a variety of sources, including CIS and pump amortizations, equipment rentals, management fees, interest earnings and others. Indeed, expenditures on O&M per ha of service area have declined over time despite some improvement in ISF revenue collections per hectare, because revenues from other sources decreased such as interest earnings, management fees, and other sources..

This decline need not reflect an equivalent rate of deterioration of O&M quality because improvements in efficiency may have been achieved as NIA had to adopt institutional reforms in the face of dwindling resources. For example, management of secondary canals in some NIS systems has been transferred to viable irrigation associations; greater decentralization was effected; an incentive system adopted; and central office operations were substantially trimmed.

Determinants of Irrigation Expenditures

The trends in capital investments shown in the previous section are consistent with the changes in the social profitability of irrigation investments and the degree of budgetary constraint faced by the government. Hayami and Kikuchi (1978) have shown that the introduction of modern varieties in the mid-1960s which were more suited to irrigated conditions raised the social profitability of irrigation expansion compared to the opening up of new land for cultivation. Although changes in world price are short-term in nature, the sharp increase in the world price of rice (Fig. 5) in the early 1970s contributed to the perceived higher social profitability of irrigation during this period. It should also be stressed that the buoyant nature of the Philippine economy and the higher priority accorded by foreign lending agencies must have contributed to the acceleration of capital investments on the supply side.

Significant varietal improvements which raised profitability of irrigation occurred in the late 1960's up to the mid-1970's. By the 1980's, varietal research succeeded primarily in maintaining yield gains achieved earlier. More important, world rice price dropped sharply and was only about a third of average world prices in real terms from the 1950's to the 1970's. Given the burgeoning foreign debt problem and severe budgetary constraint, capital investments including those for irrigation suffered the greatest cuts during the period. Even with the modest economic recovery achieved in the late 1980's, irrigation investments did not recover as government priorities shifted to agrarian reform and natural resource and environment programs. Changes in government priorities have been also influenced by foreign lending agencies. As Svendsen et al. (1990) pointed out, the upswing in the 1970's, and the decline of irrigation investments and emphasis on natural resources and the environment in the 1980's conform to the changes in the pattern of international lending.

In Table 6, regression results to quantify the impact of changes in social rates of return on irrigation and budgetary constraints are reported. The social rate of return is hypothesized to depend on the changes in the real world price of rice, real construction cost per ha, and on technologies that raise the productivity of irrigation. The latter pertains to the introduction of modern varieties and was crudely represented by a dummy variable equal to 1 for the years 1966-1980 when the most significant varietal improvements occurred, and zero otherwise. Estimates of construction cost per ha are based on the recent study of Ferguson (1987) for NIA systems which provided benchmark average figures for the (pre 1965), (1965-1972), and (1992-1978) periods. With the NIA estimates for 1993, the figures for the intervening years were interpolated. The degree of budget constraint is proxied by the gross domestic product per capita in real terms. The dependent variables used were alternatively, actual capital investments from 1966 to 1992 and the government approved allocations (GAA) for irrigation from 1955 to 1992. Although GAA figures do not usually equal actual expenditures, these were used to have a longer time series and because these better reflect government intentions than the actual releases. There are undoubtedly other missing explanatory variables, particularly those reflecting political economy factors or availability of foreign loans but were not included because of lack of appropriate variables.

Preliminary estimations used a simple linear regression; but despite the simplistic specification, the statistical results are generally highly significant and conform to expectations. Because of the longer time series and the fact that GAA better reflect the intent and decisions of policymakers more than actual capital releases, the GAA equations show better goodness of fit and higher significance of the coefficients. World price of rice and construction cost per ha significantly affect GAA in the right direction in all of the equations.

The dummy variable for technology was not significant in the GAA equation but is significant in the capital investment equations. The ambiguity in the results indicate the weakness of the dummy variable as a proxy for the impact of modern varieties, because Hayami and Kikuchi's study using estimated rates of return variable before and after modern varieties did show the positive impact of the technology variable. In the capital investment equation which is based on a shorter time series, world price of rice was significant only in the first equation. It is clear, however, that budgetary constraints as denoted by GDP/capita consistently showed highly significant coefficients in all the equations. GDP/capita may also be interpreted as a political economy variable a la Anderson and Hayami (1986). The positive sign is consistent with the hypothesis that at higher income levels, consumers are more willing to subsidize farmers and farmers have greater political clout. Svendsen et al (1991), Azarcon (1990) and World Bank (1991) argued that self-sufficiency objective is a major factor in determining investments. But that hypothesis has not been borne out in recent years as public support to irrigation continued to decline in the 1980's despite the emergence of imports.

Policy Issues

Performance of irrigation systems

A great number of studies have been conducted to examine the various dimensions of performance of publicly supported irrigation systems. These studies generally show that performance have been less favorable than projected; operation and maintenance typically fails to distribute water efficiently and equitably; and irrigation systems are rapidly deteriorating. In this section, we summarize some of the recent findings that illustrate the major problems such as the failure to reach service area target, cost and time overrun; a lower than projected rates of return.

Ferguson's study of a sample of national irrigation systems indicates that the actual average maximum irrigated area reached is only about 75% of designed service are (Table 7). Large systems appear to have a lower ratio than smaller systems. But what is striking is the rapid decline in the ratio with newer irrigation projects. Projects after 1972 were only reaching 56% of designed service area in contrast to the high of 94% before 1965.

In Table 8, performance indicators for selected World Bank and ADB NIS projects are reported. Time overruns are averaging 60% while cost overruns 50% (particularly in ADB projects). Estimated economic rates of returns (EER) at completion dates (PPAR) are generally lower than at appraised (SAR). And for the two projects evaluated ex post (IES), the EER's are even lower, in part because of lower world rice price as the figures in parenthesis which used prices at completion dates show higher EER's.

Communal irrigation system's performance in terms of proportion of service area actually irrigated is not better than NIS. A 1989 study by Reyes and Jopelle reports that under a participatory system of management, the ratio is about 74% and only about 64% in the non-participatory system. The ex post estimated economic rates of return (Table 9) of selected CIS seem higher than NIS as 8 out of the 10 systems show EER's above 10%, while there were only 6 out of 11 for the selected NIS in Table 8.

Level and nature of investments

The level of investment depends on the social rate of return of irrigation in comparison to other public investment and the nature of investments, i.e., new construction or rehabilitation, and NIS vs CIS vs pump irrigation. Yet, in practice, those decisions are also strongly influenced by donor priorities, bureaucratic biases, budgetary constraints, and political-economy factors. For example, the preponderance of large-scale gravity irrigation projects in the 1970's may have been in part which had irrigation high in its agencies. And subsequently it was primarily a World Bank study in the early 1980's that questioned the need to invest further in new irrigation construction based mainly on the brief experience of rice self-sufficiency in the late 1970's and projected low world rice prices. While world rice price has been low, it is not clear that the much greater allocation to natural resource and environment projects since the late 1980's induced principally by donor support is based on an accurate assessment of relative costs and benefits. With NIA being historically an office for public works, irrigation development will tend to be biased in favor of public gravity irrigation against pump systems using groundwater resources; for large scale vs small scale systems; and emphasis on design and construction rather than operation and maintenance, as has been pointed out in other studies.

The fact that government policy requires public investments for CIS and pump irrigation to be amortized and the cost of operation and maintenance fully borne by farmers create a bias for NIS, at least on the demand side. The transfer of land ownership (rights) from a few more cohesive land owners to a larger number of farmers with land reform may have reduced, rather than enhanced political influence to lobby for greater public support for the sector.

It is difficult to generalize the general direction that irrigation should take in the future. Decisions on level and nature of irrigation investments will have to depend ultimately on comparative social rates of return on a project by project basis across the whole spectrum of public investments and other public expenditures including current expenditures that are investments in nature, such as reforestation projects, agricultural research, etc. The key is to develop the institutional and incentive structure that can lead to correct decisions. There are at least three issues which must be considered;

a) Estimates of economic rates of return (ERR) found in project studies and the literature in general have not taken into account the distortions in the foreign exchange rate. Based on the estimated degree of peso overvaluation due to trade protection policies and balance of payments disequilibrium, the ERR must be adjusted upwards by 20%. Since most other investment projects derive benefits from their impact on non-tradeable or protected goods, such a correction will likely raise the ranking of irrigation projects relative to other public investments.

b) Institutional reforms and other efforts to minimize the biases in the system that lead to misallocation or misdirected priorities must be adopted. The higher social rates of return of communal-small scale irrigation projects have only recently been recognized, but the economic potentials for exploring ground water resources and the appropriate public sector role in this effort has largely been neglected (David 1992). Essential to achieving these, efforts must be made to generate reliable estimates of potentially economically irrigable area for various types of irrigation technologies, including the characterization of shallow aquifers and small surface water resources for pump irrigation. Updated benchmark information must be generated for improved planning and forecasting, development of design criteria and systems operation and maintenance and monitoring and evaluation. This has become even more critical with the devolution of responsibilities for developing small-scale irrigation projects to the local governments.

Cost Recovery

To achieve efficiency, irrigation investments must be fully recoverable, i.e., the present value of public revenues generated must at least equal to the present value of cost. Who (and in what proportion) should pay for the cost depends on the distribution of benefits from irrigation. And farmers must then pay the cost in proportion to the benefits they receive (Roumasset 1987). The remainder should be paid by indirect beneficiaries through the existing tax system as modified to assure that total cost recovery is sufficient to finance the project, including the repayment of loans. Any additional land or other taxes paid by the farmers due to irrigation must be considered part of farmers' obligation.

Despite the prominence of cost recovery issues in irrigation policy discussions, there has been no systematic studies on the distribution of benefits from irrigation investments, an essential basis for designing the appropriate cost recovery policy.

The official policy for NIS is to "recover O&M and at least partial construction costs from farmers subject to ability to pay". This statement is vague with respect to farmers' obligation with respect to capital cost, and the policy does not link cost recovery to distribution of benefits. The irrigation service charge has been set largely to cover O & M. However, the policy differs by irrigation technology being biased against CIS and pump. Whereas the government fully subsidizes NIS construction cost and in practice also about half of O & M, CIS farmers are required to finance operation and maintenance as well as contribute 10% of construction costs in cash or kind and to repay the balance without interest over not more than 50 years. The policy for pump irrigation is largely similar to CIS. Such differential rate of subsidization is not only inequitable, it increases farmers' demand for NIS relative to the lower cost CIS and pump irrigation systems. In the case of pumps, its use has been further discouraged by the tariff and sales taxes.

Benefits to irrigation may accrue not only to farmers but to consumers or the general public, if increases in production due to productivity growth reduces farm price. The trends in domestic rice price in real terms presented in Figure 6 show a decline of about 30 to 40% since the mid 1970s. Although rice is a tradeable good, the decline in the late 1970s as the country shifted from being a net importer to a net exporter of rice is due to productivity growth from irrigation and new seed-fertilizer technology. The decline after 1980 was due to the drop in world rice prices.

The proportion of cost of irrigation shouldered by the government must therefore be related to the proportion of benefits from irrigation accruing to consumers. That proportion may also be higher for a number of reasons. As second best measure, at least part of farmers' losses from the lower world rice price may be shared with the general public through irrigation subsidies. Also, irrigation subsidy may also be considered as a second-best instrument for compensating farmers for the implicit tax imposed by the overvaluation of the exchange rate. The rate of irrigation subsidy to compensate for the 20% estimated degree of overvaluation is expected to be significant. Of course, one may argue that irrigation subsidy as a means of compensation for such implicit taxes on rice or the decline in world rice price is inequitable because rainfed farmers do not benefit. Raising rice price through trade protection, however, may not be politically acceptable and not feasible in times when rice is exportable or non-traded.

The actual cost of irrigation is usually increased by corruption, inefficiencies in management, and negative externalities such as siltation due to mining and deforestation. These externality costs must obviously be paid by mining companies and loggers and not the general public nor the farmers. On the other hand, farmers must not be expected to pay the full cost of corruption and inefficiencies in public irrigation systems.

In summary, the cost recovery principle will not mean that farmers should pay the full cost. Whether or not the proper irrigation charge is equal to the O&M or more remains an empirical question. Charging the appropriate irrigation fees is an important element in "getting the incentives right" to promote efficiency, but the manner in which this is collected and the institutional framework for organizing the production and distribution of irrigation services are critical elements as well.

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Table 1. Trends in irrigation service area by type of irrigation.

	Service area of irrigation systems (000 ha)				Distribution (%)		
	Total	NIS	CIS	Pumps	NIS	CIS	Pumps
1964	662	218	393	52	33	59	8
1973	883	350	429	104	40	49	12
1974	915	355	449	111	39	49	12
1975	985	396	470	119	40	48	12
1976	1,055	436	493	126	41	47	12
1977	1,105	456	516	133	41	47	12
1978	1,143	464	538	141	41	47	12
1979	1,173	475	549	149	41	47	13
1980	1,201	472	577	152	39	48	13
1981	1,241	492	597	152	40	48	12
1982	1,328	514	662	152	39	50	11
1983	1,342	505	685	152	38	51	11
1984	1,397	548	697	152	39	50	11
1985	1,424	568	704	152	40	49	11
1986	1,458	596	710	152	41	49	10
1987	1,441	616	673	152	43	47	11
1988	1,453	616	685	152	42	47	10
1989	1,469	621	696	152	42	47	10
1990	1,504	637	715	152	42	48	10
1991	1,522	646	725	152	42	48	10
1992	1,533	647	734	152	42	48	10

Source: NIA Year End Reports

Table 2. Status of irrigation development by region, 1992.

Region	Potential[a] irrigable area (000 ha)	Service area (000 ha)				Irrigation development	
		Total	National	Communal	Private	Irrigation[b] potential (%)	Crop[c] area (%)
I. Ilocos	309.8	186.0	45.4	135.1	5.5	60	54
II. Cagayan Valley	539.7	262.0	138.2	87.2	36.6	49	90
III. Central Luzon	482.2	283.2	172.1	88.2	22.9	59	75
IV. Southern Tagalog	263.6	159.1	56.7	74.4	27.9	60	59
V. Bicol	239.6	89.8	20.2	52.6	16.9	37	59
VI. W. Visayas	197.2	109.8	53.5	34.6	21.7	56	41
VII. C. Visayas	50.7	22.7	0	20.2	2.5	45	54
VIII. E. Visayas	84.4	57.2	15.6	39.4	2.2	68	37
IX. W. Mindanao	76.5	39.2	14.6	21.8	2.8	51	50
X. N. Mindanao	230.2	79.7	29.9	47.7	2.0	35	80
XI. S. Mindano	290.2	136.0	61.2	67.9	6.9	47	77
XII. C. Minadano	362.1	108.3	39.1	65.0	4.1	30	65
Total	3,126.3	1,532.8	646.5	734.1	152.1	49	62

a Based solely on an inventory of soils and topography done in 1980 without consideration of water resource contraints or economic feasibility.

b Service area as a pecentage of potential irrigable area.

c Irrigated area as a percentage of crop area in rice.

Source: NIA, Corporate Plan: 1993-2002
Bureau of Agricultural Statistics

Table 3. Distribution of capital releases to NIA by source (%).

	Foreign	Local			
		Equity	Corporate funds	Appropriations	
				CIS	Others
1976	17	31	-	3	49
1977	23	6	-	7	64
1978	23	4	-	2	71
1979	36	4	-	1	59
1980	36	16	-	6	42
1981	44	12	-	5	39
1982	38	54	-	8	-
1983	53	41	-	6	-
1984	84	11	-	5	-
1985	63	9	23	4	-
1986	53	15	23	9	-
1987	49	25	1	23	2
1988	36	38	1	20	4
1989	40	28	5	21	6
1990	41	23	2	15	19
1991	21	32	-	9	38
1992	25	48	-	-	27

Source: From 1976 to 1986, original data are from NEDA; from 1987 to 1992, data are from NIA.

Table 4: Distribution of foreign loans for irrigation by source (%).

	1969-1977	1978-1982	1983-1987	1988-1992
World Bank	67	68	4	29
ADB	23	23	83	33
OECF	9	3	13	38
IFAD	-	3	-	-
OPEC	-	2	-	-
USAID	1	1	-	-

Source: National Economic Development Authority

Table 5. Trends in recurrent income (by source) and expenditures and rate of collection of irrigation fees.

	Revenues (₱ mn at 1982)								Expenses[a] (₱ mn at 1982 prices)	P/ha[b]			ISF rate of collection (%)
	Total	ISF	CIS amrtn.	Pump amrtn.	Eqmt. rental	Interest earnings	Mgt. fees	Others		Expn.	Revenue	ISF	
1976	72.5	46.4			26.1				175.9	403	166	106	
1977	81.6	54.5			27.1				210.0	460	179	119	
1978	150.8	62.5			21.0	4.2		63.0	183.8	396	325	135	
1979	387.5	95.6			24.7	5.6		261.5	330.4	696	816	201	36
1980	164.4	72.4		9.4	19.1	42.1		21.4	133.5	283	348	153	43
1981	260.3	56.7		8.0	17.6	58.8		119.3	263.1	535	529	115	39
1982	325.2	57.5	6.9	5.4	25.5	65.5	140.5	60.0	211.1	411	633	112	48
1983	298.2	66.1	5.6	4.8	22.3	110.7	73.9	14.8	173.0	315	543	120	46
1984	263.5	60.3	4.3	4.1	17.1	120.2	41.3	16.2	159.1	290	481	110	48
1985	248.2	73.7	3.8	3.1	19.9	113.8	18.2	15.7	156.5	276	437	130	44
1986	203.5	97.0	4.4	3.0	19.8	34.7	31.5	13.1	191.7	322	341	163	44
1987	248.9	94.2	17.1	2.4	41.0	40.5	42.1	11.7	225.2	375	415	157	43
1988	203.0	79.3	18.9	1.6	34.8	29.4	31.9	7.2	201.6	327	330	129	42
1989	175.1	79.9	17.6	1.2	28.4	14.6	24.1	9.3	174.3	283	284	130	46
1990	201.3	88.2	32.9	0.8	21.7	15.7	32.5	9.6	209.9	338	324	142	46
1991	182.9	90.1	14.1	0.6	23.6	7.5	26.1	20.9	179.0	281	287	141	53
1992	164.2	83.4	11.2	0.5	18.3	3.5	16.5	30.7	192.4	298	254	129	47

[a] Excludes depreciation

[b] Per hectare of service area

Source: National Irrigation Administration

Table 6. Regression estimates of determinants of irrigation expenditures.

	Government budget allocation (1955-1992)				Capital investments (1966-1992)			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Intercept	-6000	-5495	-5461	-3454	6230	-2241	-5209	-5149
World price	2.51**	1.97**	1.94**	-	1.62**	0.41	0.04	-
	(5.36)	(3.66)	(3.20)		(3.10)	(0.66)	(0.08)	
Cost/ha	-	-0.060*	-0.061*	0.13	-	-0.39	-0.16	-0.16
		(-1.84)	(-1.78)	(-4.04)		(-2.97)	(1.04)	(-1.16)
GDP/capita	1.20**	1.26**	1.25**	1.11**	1.26**	1.41**	1.45**	1.46**
	(12.37)	(12.73)	(12.27)	(10.60)	(7.64)	(9.28)	(10.39)	(10.63)
Technology	-	-	16.47	178.8	-	-	664.6**	670.1**
			(0.14)	(1.45)			(2.42)	(2.58)
R^2	0.85	0.86	0.86	0.82	0.71	0.79	0.83	0.83

Table 7. Maximum irrigated area as a percentage of design area of a sample of 43 national irrigation systems (%).

	%
Size	
Small	79
Medium	76
Large	73
Vintage	
Pre NIA	94
Early NIA	70
Recent NIA	56

Source: Ferguson (1987).

Table 8. Performance indicators of selected World Bank and ADB supported national irrigation systems projects.

	% time overrun	% cost overrun	ERR (%)		
			Apprai-sal	Comple-tion	Evaluation
World Bank					
UPRIIS	43	105	13.0	14.0	8.9 (11.7)[b]
Aurora Penoranda	88	44	17.0	8.6	2.6 (4.5)
Tarlac ISIP	69	33	15.0	13.0	n.a
MARIIS	56[a]	-4[a]	13.0	9.5	n.a
Upper Chico	90	-3	15.0	7.7	n.a
Jalaur	37	-2	20.0	20.0	n.a
ADB					
Cotabato	15	68	14.0	n.a	n.a
Davao del Norte	30	177	17.2	18.4	n.a
Pulangui	87	25	18.0	11.0	n.a
Agusan del Sur	114	54	19.0	7.0	n.a
Angat-Magat	45	102	24.2	16.6	n.a
Laguna de Bay	63	42	14.2	2.0	n.a

[a] Weighted average of three projects.

[b] Figures in parenthesis estimated based on rice price at completion date.

Source: World Bank (1991)

Table 9. Ex post estimated economic rates of return and service area of selected new and rehabilitation communal irrigation projects.

	Service area (ha)	ERR (%)
New		
Santol R.A.	85	14.7
Kabilukulan	489	17.6
Bugaan	100	12.2
Camagsang.	85	10.0
Sodog	137	4.2
Rehabilitation		
Santol R.S.	85	10.8
Taytay-Badian.	295	2.1
Mantayupan	170	9.9
Kilacubong	50	14.3
Kamada-Tagbac	150	12.7

Source: Dy (1989)

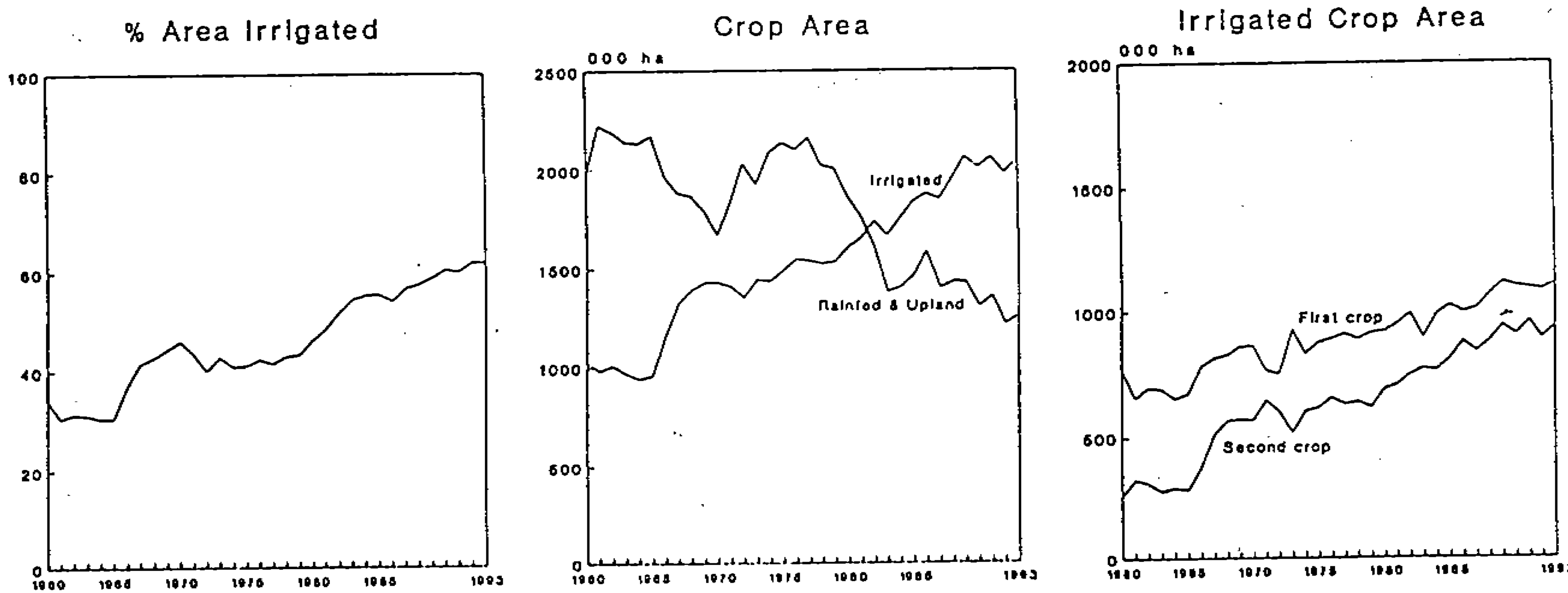

Fig. 1. Trends in ratio of irrigated crop area, irrigated area (first and second crop), Philippines, 1960-1993.

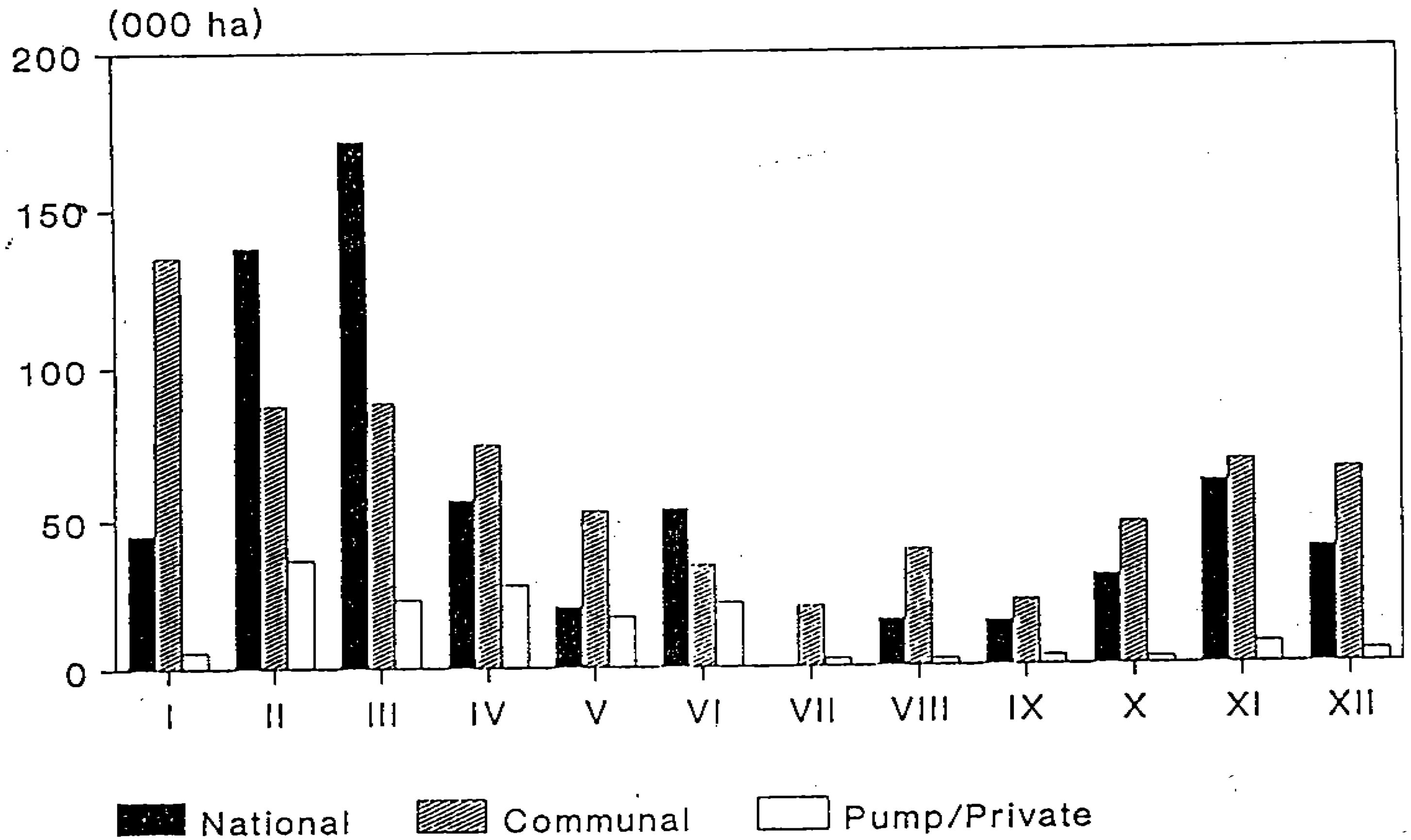

Fig. 2. Regional status of irrigation development, 1992.

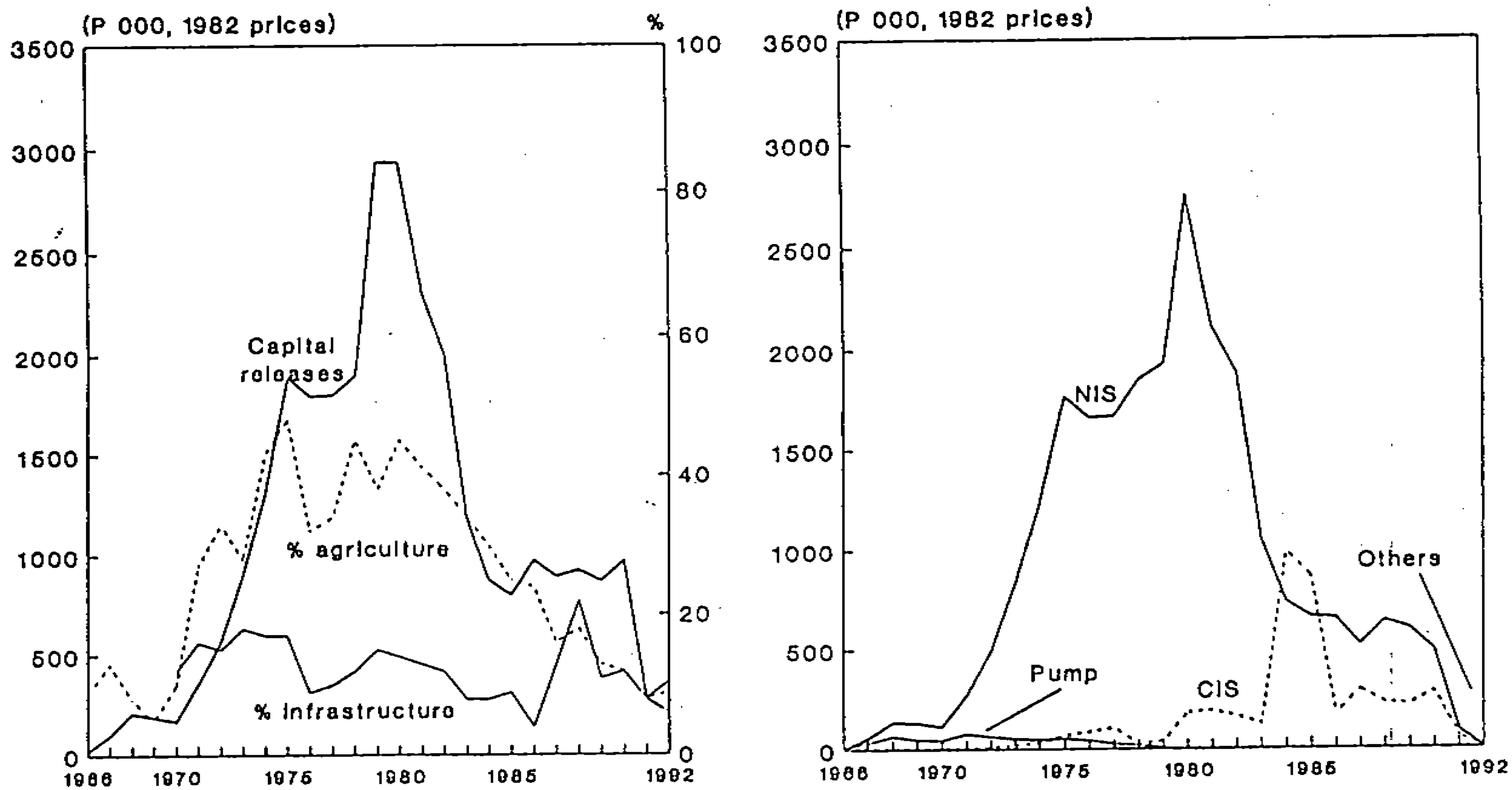

Fig. 3. Trends in capital releases to NIA by type of irrigation and as a ratio of infrastructure investments and public expenditures for agriculture.

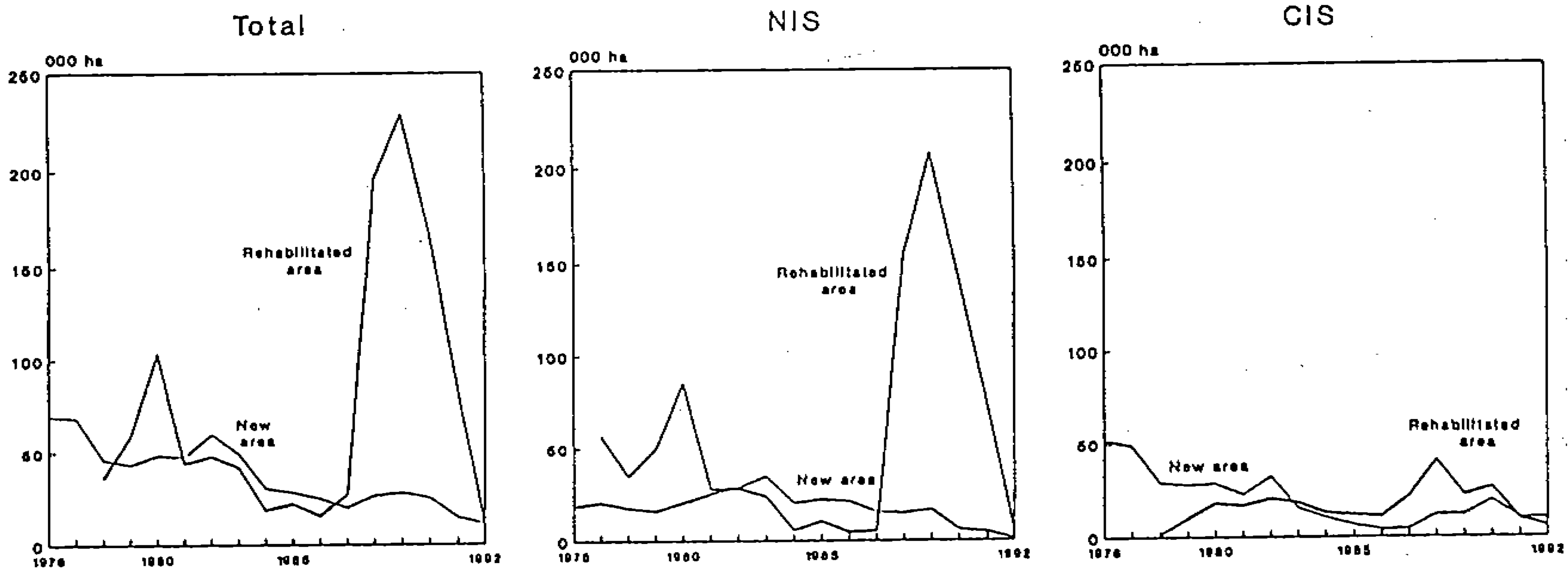

Fig. 4. Trends in generated new and rehabilitated irrigated area, by type of irrigation.

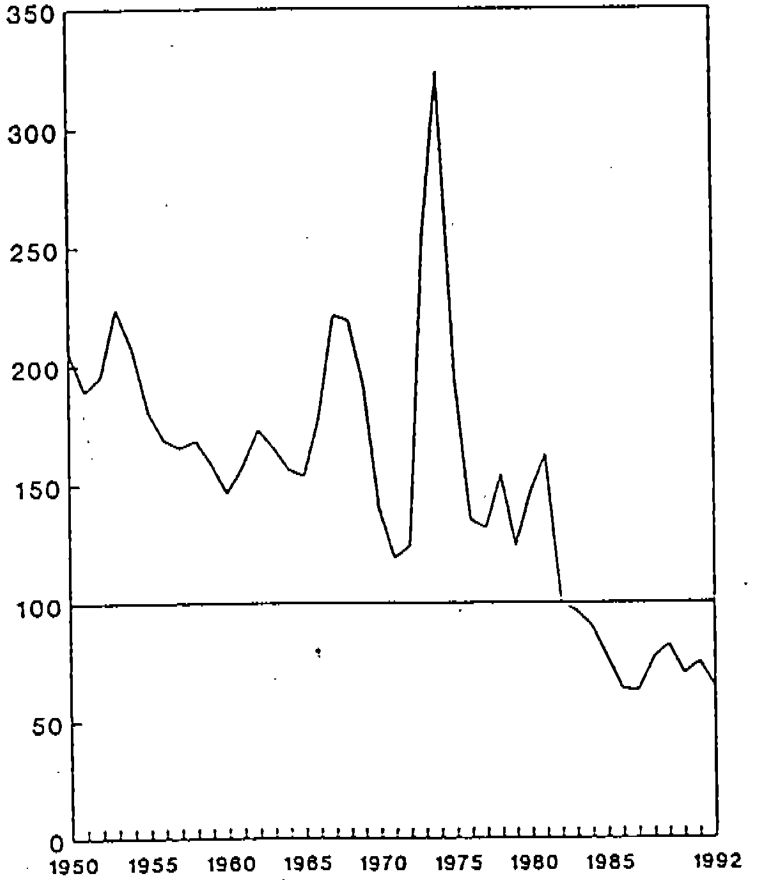

Fig. 5. Trends in world rice price in real terms (1982=100).

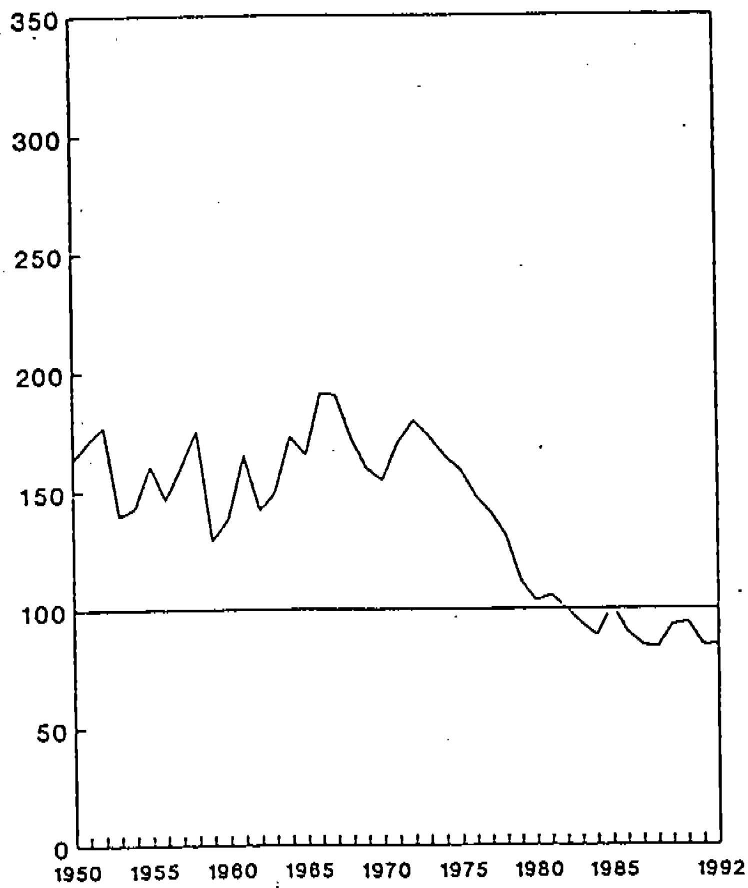

Fig. 6. Trends in domestic wholesale rice price in real terms (1982=100).