

Irrigation System Management Turnover Program: The Philippine Experience

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INTRODUCTION

THIS PAPER IS about the Philippine experience on farmer participation in the operation and maintenance (O&M) of irrigation systems, with emphasis on its more-than-a-decade management turnover program (MTP) for the irrigators associations (IAs).

Initially, it presents the status of irrigated agriculture in the Philippines in terms of potential and presently irrigated areas, the categories of irrigation systems and extent of irrigation development; its climate, agriculture and initial farmer participation in the O&M of irrigation systems. It also describes the National Irrigation Administration, a government owned and controlled corporation tasked with the irrigation development program of the Government of the Philippines (GOP), and the initiating laws that brought about the present MTP of the agency.

THE PHILIPPINES AND ITS IRRIGATION DEVELOPMENT

The Philippines is a country whose economy is based on agriculture. By 1992, its population was about 60 million. The majority of people (about 70%) of these live in the rural areas, and their basic livelihood is farming.

Area: Irrigable and irrigated

The Philippines has about 3.13 million hectares of irrigable land of which about 1.53 million hectares are already irrigated (Table 1). Out of these presently irrigated areas, about 646,519 hectares are irrigated by national irrigation systems (NIS); 734,104 hectares by communal irrigation systems (CIS); and 152,128 hectares by private irrigation systems (PIS). The average irrigation development in the country is about 49.03 percent.

Table 1. Status of irrigation development by region.

Region	Potential irrigable area (ha)	Systems and area (ha)			Total	Irrigation development in percent (%)
		National	Communal	Private		
1	309,810	45,386	135,095	5,520	186,001	60.04
2	539,710	138,187	87,199	36,593	261,979	48.54
3	482,220	172,064	88,161	22,946	283,171	58.72
4	263,590	56,681	74,438	27,948	159,067	60.35
5	239,650	20,223	52,558	16,943	89,754	37.45
6	197,250	53,500	34,591	21,677	109,768	55.65
7	50,740	0	20,202	2,481	22,683	44.70
8	84,380	15,633	39,395	2,176	57,204	67.79
9	76,500	14,578	21,979	2,804	39,179	51.21
10	230,150	29,948	47,738	2,045	79,731	34.64
11	290,250	61,176	67,908	6,872	135,956	46.84
12	362,080	39,143	64,992	4,123	108,258	29.90
Total	3,126,330	646,519	734,104	152,128	1,532,751	49.03

Source: NIA Corporate Plan 1993-2002.

Climate

The Philippines belongs to the tropical monsoon climate, and can be divided into four major climatic areas. The first type has two pronounced seasons and is dry from November to April and wet during the rest of the year. The second type has no dry season with a very pronounced maximum rainfall from November to January. The third type experience

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no pronounced seasons and is relatively dry from November to April and wet during the rest of the year. The fourth type has a rainfall more or less evenly distributed throughout the year. The climatic range in the Philippines is shown in Figure 1.

Agriculture

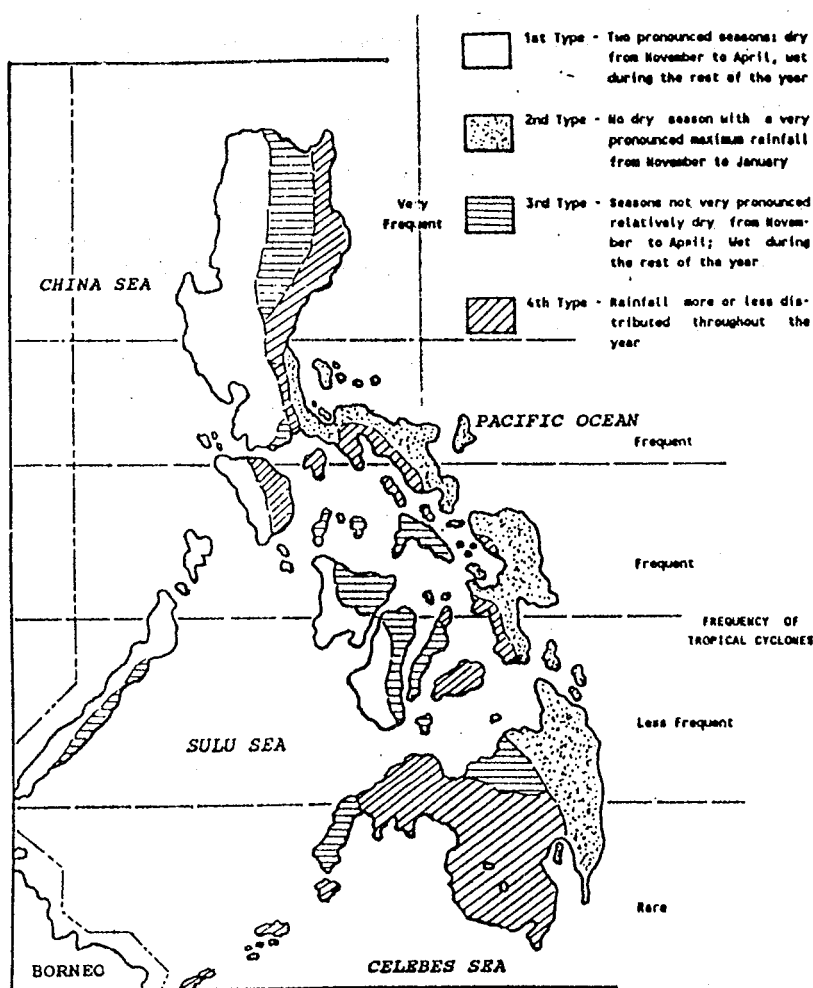
Irrigated agriculture in the country almost always relates to irrigation of [paddy rice]. Newly irrigated areas, although planted to other crops prior to the introduction of irrigation, always end up planted to paddy rice.

This is so because, similar to other Asian countries, the staple food of the Filipino people is rice. However, there are now government efforts to introduce crops other than rice in the irrigated area. Those efforts are focused on areas of the irrigation system where rice irrigation is not possible during the dry season when the water supply for rice irrigation is not enough.

Farmer Participation

As early as 1916, farmer participation in irrigation development was formally articulated in the Irrigation Act 2152. The farmers' capacity to construct and manage irrigation systems was evident from the terrace irrigation and Zanjera systems in the northern portion of the country.

Figure 1. Climate map of the Philippines.



THE NATIONAL IRRIGATION ADMINISTRATION (NIA)

The National Irrigation Administration (NIA) is a government-owned and controlled corporation (GOCC) tasked with the development and O&M of irrigation systems all over the country.

Mandate and Initiating Laws

NIA was created under Republic Act 3601 enacted by the Fifth Congress of the Republic of the Philippines and signed into law by President Diosdado Macapagal on 22 June 1963. It is the forerunner of the Irrigation Division of the Department of Public Works and Highways (DPWH).

Through Presidential Decree (PD) No. 1, dated 23 September 1972, all irrigation activities in the country were integrated under NIA. The agency powers were broadened and capitalization was increased from 300 million Pesos (P) to 2 billion Pesos by PD 552 on 11 September 1972. Through PD 1702, dated 17 July 1980, capitalization was increased further to 10 billion Pesos.

Powers and Functions

Embodied under the three laws are the following powers and functions of the Agency:

1. To investigate and study all available and possible water resources in the Philippines, primarily for irrigation purposes; to plan, design, construct and/or improve all types of irrigation projects and appurtenant structures; to operate, maintain, and administer all national systems; the authority to supervise the operation, maintenance and repair, or otherwise, administer temporarily, all communal and pump irrigation systems constructed, improved, and/or repaired wholly or partially with government funds; and to delegate the partial or full management of national irrigation systems to duly organized cooperatives or associations, under such terms and conditions which the NIA Board of Directors may impose.
2. To charge and collect from the beneficiaries of all irrigation systems constructed by or under its administration such fees or administration charges as may be necessary to cover the cost of operation, maintenance and insurance; and to recover the cost of construction within a reasonable period of time to the extent consistent with government policy; to recover funds or portions thereof expended for the construction and/or rehabilitation of communal irrigation systems (CIS) which shall accrue to a special fund for irrigation development.

It is a national policy that in order not to discourage participation of farmer-beneficiaries in the development and operation of irrigation facilities, the government shall bear the cost on interest on all indebtedness for the construction of projects. NIA has been authorized to impose charges to generate revenues sufficient to cover only operation and maintenance (O&M) costs of such facilities and to recover within a period of not longer than 50 years, the monies initially invested in such facilities; provided that such charges shall not impair the user's incentive to avail of the benefits from irrigation, and provided further that surcharges are within the beneficiaries' capacity to pay (NEDA Board Resolution No. 20, Series 1978).

Mission, Objectives and Vision

NIA's mission aims to develop water resources for irrigation and provide corollary services in line with the agricultural program of the national government. Its general objectives are:

- To develop irrigation systems in support of the national food production program.
- To provide an adequate level of service;
- To enhance economic and social growth in the rural areas.
- To maintain the operation of the Agency as a stable and autonomous corporate entity.

NIA as an agency envisions to establish by 1997 a dynamic and functional NIA and IA, working in partnership to accelerate irrigation development and provide efficient levels of irrigation service.

Organization: National, Regional and Local

NIA is a fairly large organization. Its policymaking body is the Board of Directors (BOD) chaired by the Secretary of the Department of Agriculture (DA) and co-chaired by the Administrator of NIA. Membership to the BOD includes the Secretary of the Department of Public Works and Highways (DPWH), Director-General of the National Economic Development Authority (NEDA), President of the National Power Corporation (NPC), and a representative from the private sector which is appointed by the President.

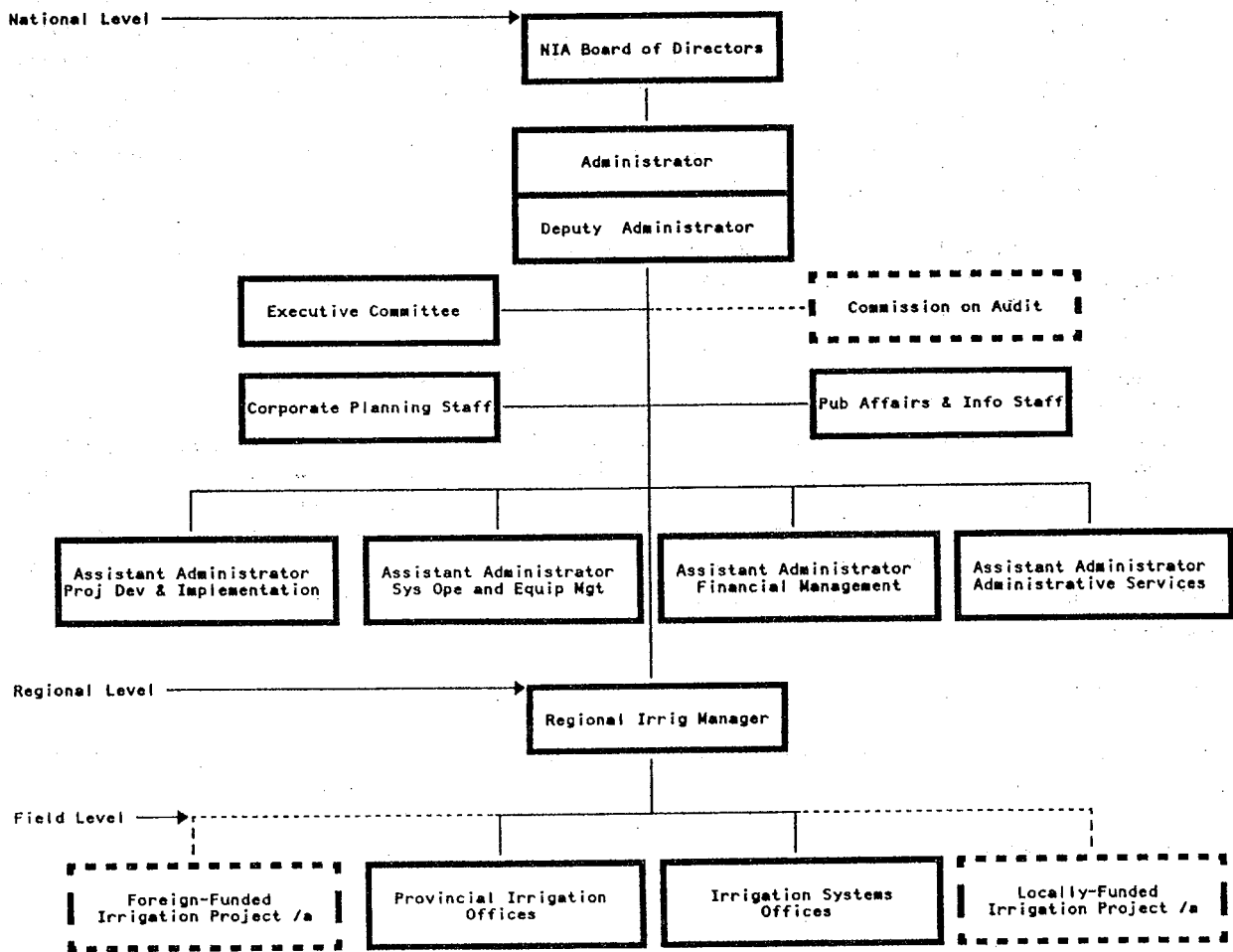
At the national level, the overall responsibility over the Agency's irrigation development program is lodged in the Office of the Administrator. He is assisted by a Deputy Administrator and four Assistant Administrators, namely, Project Development and Implementation (PDI); Systems Operation and Equipment Management (SOEM); Financial Management (FM); and Administrative Services (AS).

At the regional level, there are 12 regional irrigation offices, one autonomous regional office, and two (2) region-size integrated NIS which are responsible for the implementation of the regional irrigation development programs.

The Provincial Irrigation Offices (PIOs) and the Irrigation Systems Offices (ISOs) are the field implementors of the NIA's irrigation development program at the local level. The 67 PIOs are responsible for the CIS while the 113 ISOs are responsible for the NIS.

The Agency's organizational chart is shown in Figure 2.

Figure 2. NIA's organizational chart.



Notes: /a are ad-hoc offices (Co-terminus with project construction)

MANAGEMENT TURNOVER PROGRAM (MTP)

Background

In 1964, when NIA assumed the function of the Irrigation Division of the DPWH, it also assumed the operational and financial problems of the NISs. Available funds were not enough to rehabilitate the deteriorating irrigation structures and farmers are not motivated enough to participate in any O&M activity of the NISs.

In 1969, the NIA with the assistance of the Asian Development Bank (ADB) started the pilot projects on water management in response to the deteriorating performance of NISs. These pilot projects initiated the introduction of rotational irrigation by section of a main farm ditch. The concept required that farmers in a rotation area (about 50 hectares) served by a turnout be organized into a farmer-irrigators group (FIG).

With the construction of numerous national irrigation projects funded by the International Bank for Rural Reconstruction (IBRD) and ADB, the concept of organizing FIGs coupled with the training on water management was expanded nationwide.

However, improved performance of NIS was not realized. The area placed under irrigation expanded but the performance of a unit of irrigated area remains the same.

Throughout the period, particularly before 1980, persistent problems on low irrigation performance and collection of irrigation service fees (ISF) beset the NISs.

Agency Program

With those low irrigation performance and ISF collection problems aggravated by the eminent phasing out of government subsidy for O&M in 1980, NIA embarked on a more serious effort of organizing farmers for their eventual participation in the O&M of the NISs. Primarily, the goal of farmer participation in the NIS was to involve the farmers in the Agency's efforts to improve systems performance particularly in equitable water delivery and distribution, ISF collection, and reduce O&M costs for personnel and repair and maintenance of irrigation structures.

For more than a decade farmer participation has become an innovative feature in the NIS. This participation has evolved an agency program which is now known as the Management Turnover Program (MTP) in the NISs.

Organizing and Developing Irrigators Associations

In 1980, farmer participation, dubbed as the NIA's Participatory Approach Program, and the concept of turning over O&M responsibilities to farmer groups in the NIS, were initiated. The idea was to organize the FIGs into a bigger group called Farmer-Irrigators Associations (FIAs) or plainly IAs. The initiating program was the Irrigation Community Organizing Program (ICOP) for the NIS. The ICOP is basically participatory in approach and utilizes the services of degree-holder Irrigation Community Organizers (ICO) in the organizing works. The program rides on either or both the issues on the systems' physical and operational problems. The program is coupled with programs on minor repair, restoration or rehabilitation works in the NISs.

Milestones in Organizing Farmers into IAs

The organizing program in the NIS follows a chronological process of four major phases:

1. Organization of the farmers of the turnout service area (TSA) into TSA groups: This is where the farmers are formed into TSA groups formerly called FIG. The farmers start to discuss the physical and operational problems of the systems and possible collective actions to resolve these problems. They also start identifying their ad hoc leaders and discuss the draft of the constitution and by-laws that will govern their IA. They also list down their proposed solutions to the systems' physical and operational problems and formally elect their TSA officers.
2. Formation of the IA: This is when the organized TSAs in a hydraulically-bounded irrigated area, usually served by a lateral (secondary) canal are formed into IA.
During this period, the elected TSA officers, serving as representatives of the members of their TSA organizations, ratify the constitution and by-laws of the IA. After ratification, they elect the IA officers and formally organize the IA. This milestone is concluded with the newly elected IA officers undergoing training in basic leadership or in the Basic Leadership Development Course (BLDC). The different IA committees are also

formed during the period. Such committees are: a) membership and training; b) service; c) finance and audit; and d) grievance.

3. Registration of the IAs with the Securities and Exchange Commission (SEC): This starts the collective works of the IA members. An ad hoc committee for SEC registration is formed. The committee is tasked with the preparation of the required papers for the registration of the IA with the SEC which are submitted to NIA who assist them in the registration process. Also, at this stage, the IAs are encouraged to do collective work by directly involving themselves in minor repairs, restorations, or rehabilitation works.

The milestone is concluded with the training of the IA officers and TSA leaders in charge of finances and audit. They are provided with Financial Management Training (FMT) given to IA officers and TSA leaders.

4. NIA-IA contracting for O&M responsibilities: This is the milestone when the IAs start to study the advantages and disadvantages of taking over some of the O&M responsibilities in the irrigation facilities within their area.

After a series of meetings and negotiations, the NIA and IA sign a Memorandum of Agreement (MOA). Normally, the IAs are given incentives for their takeover of some O&M responsibilities. Usually, those incentives are for the IA's capital build-up funds. The officers of the IA in charge of O&M are provided with the System Management Training (SMT).

This milestone is actually a continuing and cyclical process of developing the relationships and rapport of the NIA staff and IA officers, TSA leaders and members for the improvement of the performance of the NIS.

Management Turnover Contracts

The contracts for turning over O&M responsibilities to the IAs evolved throughout the implementation of the MTP.

Early MTP Contracts. In 1980, to provide incentives to IAs in their involvement and takeover of some or part of the O&M responsibilities in the NIS, the NIA initiated the adoption of the following contracts:

- i. Stage I - Maintenance Contract - It is a contract where the IAs take over the responsibilities of maintaining the irrigation canals within the IA area.

For every 3.5 km of irrigation canals under the maintenance of the IA, the NIA pays them the sum of six hundred sixty Pesos (P660) per month (or about US\$26.40 per month, or a total of thirteen thousand two hundred Pesos (P7,920) per year (or about US\$316.80 per year, at P25 = US\$1.00).

- ii. Stage II - Joint System Management Contract - It is a contract where the IAs take over the O&M responsibilities within the IA area.

Prior to contracting the breakeven point in O&M cost of the NIS is determined in percent. The breakeven point is used in the determining the sharing in the ISF collection. If the breakeven point is 60 percent, at 60 percent or lower ISF collection, 60 percent goes to NIA while 40 percent goes to the IA. Beyond 60 percent, 60 percent goes to the IA and 40 percent goes to NIA.

- iii. Stage III - Full Turnover Contract - It is a contract where IAs take over the whole NIS. Normally, these contracts are for marginal NIS. These NIS are the ones whose current ISF collectibles are not even enough to cover their O&M expenses. In these contracts, the governing policies are those that apply to the CIS. Farmers amortize the chargeable costs in the construction of the NIS.

In these staged contracts, the IA can avail only one of the contracts or they can start with Stage I, terminate it in lieu of either Stage II or III.

Present MTP Contracts. In 1988 and after a few years of experience with the staged contracts, a new set of management turnover contracts were initiated. The changes were made because, at Stage II Contract, the IAs tend to focus more on ISF collection and provide less attention to the maintenance of irrigation facilities.

With these new MTP contracts, the IA can have either or both of the first two types of contracts and they received incentives for all the contracts they entered into with the NIA.

These present set of contracts are the following:

- i. Type I - Maintenance Contract - It is a contract where the IAs take over the responsibilities of the maintenance of irrigation canals within the IA area. This is the same as the earlier Stage I Contract except

that the remuneration was adjusted to conform with the increasing costs of services and the inclusion of NIA's acceptance of IA output prior to payment.

For every 3.5 km of irrigation canals under the maintenance of the IA, the NIA pays the IA the sum of one thousand one hundred Pesos (P1,100) per month (or about US\$44 per month, or a total of thirteen thousand two hundred Pesos (P13,200) per year (or about US\$528 per year, at P 25 = US\$1.00).

- ii. **Type II - ISF Collection Contract** - It is a contract where IAs assist (campaign for payment or collect) in the collection of ISF from farmers within the IA area. The IA is given incentives based on their collection of current ISF. The rate of incentives are indicated in Table 2.

For the collection of back accounts on ISF incurred prior to the signing of the contract, the IA is given a share of 25 percent of the collected ISF back accounts.

- iii. **Type III - Full Turnover Contract** - This contract is the same as the earlier Stage III contract where the IAs take over the whole or portion of an NIS. However, contract is extended to NIS that are not marginal or portion of the NISs which could be isolated.

The contract also follow the policies that are applied to the CIS and the IAs amortize the chargeable cost in the construction of the NIS.

Table 2. IA share under Type II (Collection Contracts).

Collection	Incentives
below 50 %	0 %
50 - 60 %	2 %
60 - 70 %	5 %
70 - 90 %	10 %
90 - 100 %	15 %

Evolving MTP Contracts. During the last three years (starting 1990), there were MTP contracts that evolved from the present contracts. They were applied on a case-to-case basis. IAs and/or their federations are encourage to take over management of the NIS, if they have shown capability.

Local Government Units (LGUs), in view of the implementation of the Local Government Code which devolved some functions of National Government Units to LGUs, also have manifested their desire to take over management of irrigation systems, both CIS and NIS.

In those evolving contracts, the organization (IAs, IA Federations or LGUs) takes over the management of the portion or the whole of the irrigation system and the incentives may take any of the following forms:

1. ISF is shared equally between NIA and their organization after deducting O&M costs.
2. The organization pays NIA lease or rental costs for the use of the irrigation system.
3. The organization amortizes the costs of construction of the system.

Status of MTP Coverage

The status of the MTP Program of the NIA is shown in Table 3. A majority of the regional offices have almost completed the IA organizing works in their respective NISs. The focus now is on developing these organized IAs by way of training and O&M contracting.

Table 3. Status of NIAs Management Turnover Program.

Region	Number of systems	Service area (ha)	Number of farmers	Number	IAs organized:		IAs registered:		IAs with contracts			
					Area (ha)	Members	Area (ha)	Members	Area (ha)	Members		
1	21	45,386	139,453	115	46,646	139,453	100	43,165	120,554	78	26,082	29,489
2	20	138,187	67,931	459	124,501	66,781	445	118,018	66,781	417	100,860	56,309
3	16	172,064	120,975	460	126,594	88,402	460	126,594	88,402	460	126,594	88,402
4	28	56,681	22,339	88	32,275	14,393	37	10,913	11,285	37	10,913	11,285
5	14	20,223	22,516	73	21,074	22,516	73	21,074	22,516	38	20,728	22,173
6	13	53,500	37,438	85	53,500	25,078	79	52,014	23,308	65	34,582	17,520
7	NO NTS	0	0	0	0	0	0	0	0	0	0	0
8	16	15,633	15,770	73	14,821	14,951	48	9,240	9,931	48	9,240	9,931
9	4	14,578	9,959	26	9,640	8,193	26	9,640	8,193	18	6,843	3,940
10	8	29,948	13,668	69	25,715	13,668	67	24,970	13,272	67	24,970	13,272
11	14	61,176	35,994	212	43,549	35,994	129	43,025	21,902	129	43,025	21,902
12	8	39,143	27,675	74	39,879	27,675	71	38,262	26,553	71	38,262	26,553
Total	162	646,519	513,718	1,734	538,194	457,104	1,535	496,915	421,281	1,448	442,099	307,907

The service area of the existing 162 NIS is about 646,519 hectares with 513,718 farmers. At present, about 1,734 IAs covering 538,194 hectares (83.24 %) with about 457,104 members (88.98) are organized. Of this number, about 1,535 IAs covering 496,915 hectares (76.86 %) with 421,281 members (82.00 %) are registered with the SEC.

About 1,448 IAs covering 442,099 hectares (68.38 %) with 307,907 farmers (59.94 %) have existing MTP contracts with the NIA. These vary from the earlier, present and evolving MTP contracts.

MTP Constraints

The limiting factors in the implementation of MTP within the IAs are the following:

1. Lack of strong, sincere and visionary leaders with long-term programs that will truly develop and manage a strong, viable and functional IAs.
2. Proliferation of IA leaders that are politically-motivated with tendencies to be autocratic.
3. Lack of cooperation among members because of their bad experiences with farmer organizations in the past.
4. Selfish interests of some IA members and IA officers.

Although the NIA desired to accelerate its MTP, it is faced with the following problems:

1. Because of their perceptions that MTP is a threat to their existing jobs, many O&M personnel are reluctant to cooperate with the program.
2. Turning over O&M responsibilities to IAs is transferring such to the IA from the existing O&M personnel. Since NIA provides IA incentives it cannot just do it while O&M personnel are still employed, because such will increase the O&M costs in some NISs.
3. Lack of the necessary funding support to finance the voluntary retirement of existing O&M personnel who want to give way to IAs.

Performance MTP and Non-MTP Areas of NISs

In 1993, NIA did a comprehensive assessment of the impact of farmer participation in the performance of the 77 NISs. It compared the MTP and non-MTP areas of the NISs. These IAs studied started their MTPs during the 1982-1991 period. It focused on the impact of system performance on: ISF collection efficiency (CE); repair and maintenance (RM) cost; personnel costs (PC); [dry season benefited area] (DSBA); and dry season rice yield (DSRY).

Impact of MTP on System Performance

Studied were 28 MTP systems and 43 non-MTP systems in 1982. MTP coverage was 26 percent of the MTP systems. In 1985, there were 52 MTP systems and 25 non-MTP systems and 51 percent of the service area was under MTP. These MTP and non-MTP systems were compared and the findings are summarized below:

Collection Efficiency (CE). From 1982 to 1991, MTP areas had higher CEs over non-MTP areas. In 1982, MTP areas had an average CE of about 60 percent compared to the 43 percent of the non-MTP areas, although their differences were not significant. It was in 1985 that the MTP areas (about 58%) had significantly higher CEs than their non-MTP counterparts (about 24%). The CEs of the non-MTP areas deteriorated. In 1991, they regained their CE levels to 38 percent. The MTP areas have 61 percent CE and MTP coverage was 83 percent of their service area. The findings implied that the systems which adopted MTP after 1985 were performing better than those which earlier adopted MTP. Also, the deteriorating trend of CEs points, to the emerging issue in the partially turned-over IAs which is generally dissatisfied with the partial or delayed collection share they received from the NIA.

Repair and Maintenance (RM). In 1981, the MTP areas incurred lower RM cost (P50/ha, P27 = US\$1.00) than the non-MTP areas (P85/ha) but the difference was narrow. In 1985, the MTP areas' RM cost was P210/ha to non-MTP areas' RM cost of P 300/ha. In 1991, the RM cost difference between the MTP (P380/ha) and non-MTP areas (P 540/ha) was wider. The narrower difference indicates similar ageing of the physical facilities requiring similar RM costs at the early stages of MTP. The wider difference implied the non-participation of farmers in the

maintenance functions meaning costlier RM costs due to the rapid deterioration of the facilities. This was caused by farmers' unabated destruction of facilities and lack of O&M personnel to do continuous maintenance works.

In summary, the finding that MTP areas have lower RM costs than non-MTP areas implies that: firstly, the partial and full turnover IAs absorbed most of the RM costs; and secondly, the MTP areas contributed to the prevention of the rapid deterioration of the systems' physical facilities.

Personnel Costs (PC). In all time periods under study, the MTP areas incurred lower personnel costs than the non-MTP areas. The PC of MTP areas were P200/ha, and non-MTP areas were P280/ha in 1982. In 1991, the MTP areas had a PC of P340/ha while the non-MTP areas were P450/ha. This is due to the displacement of several ditch tenders, the O&M field staff who do the maintenance works prior to turnover to the IAs, in the maintenance and joint management contracts.

[*Dry Season Benefited Area (DSBA).*] The MTP areas consistently had higher DSBA than non-MTP areas. Benefited area refers to the irrigated area with yields higher than 40 *cavans* (1 *cavan* is 50 kilograms) of paddy rice yield per hectare. The MTP areas had a DSBA growth rate of 40 percent while it was 20 percent for the non-MTP areas.

The positive impact of MTP areas on the systems' DSBA is seen in the higher DSBA of MTP areas and the general increase of DSBA of the 77 NISs in 1991 where MTP coverage is about 79 to 83 percent of the service area.

Dry Season Rice Yield (DSRY). The MTP areas had higher DSRY than the non-MTP areas. The findings also indicated that the length of the MTP experience did not make much difference. It was the adoption of the MTP that made the greater difference.

Other Intangible Benefits of Farmer Participation

Besides the quantitative results shown in the impact of MTP, there are undoubtedly positive social change with long-term implications that the MTP brought. These were as follows:

1. Development of the local leadership and organizations.
2. Development of farmer skills and capacities for self-management and resource mobilization.
3. The setting up of mechanisms to articulate local needs and interests to the government sector and other external institutions.

Lessons and Recommendations

The more than a decade's experiences as well as the results of the comprehensive study on the NIA's Management Turnover Program provided very significant lessons to the NIA. Among these are the following:

1. In a joint management set-up like in the NISs, the parties involved must have the organizational readiness and capacity to comply with their stipulated obligations. In the case of IAs' inability to comply with their expected obligations, NIA must have the legal right to impose sanctions against the erring party. On the part of NIA's non-compliance, such as support services, collection share and incentives and remuneration for the IA, the latter must also have the legal right to hold the Agency liable for the default. Such should be clear-cut provisions along with the incentives for both parties in the NIA-IA MTP contracts.
2. Farmer participation in O&M promises better water services and more effective agricultural technology application through effective coordination with NIA and the external agencies, among farmers in the different canal reaches; and a prolonged functional life of the physical system. Realization of this promise is anchored on the IAs' and the NIA's organizational capacity and available resources to implement their programs.
3. Farmer participation in the NISs is a human as well as an institutional engineering feat. It involves continuous development of farmer consciousness that water is a valuable resource that must be equitably distributed to all.
4. Farmer participation in the management of some irrigation functions contributes to the efficiency and effectiveness of irrigation systems. This means expansion of irrigated area, thereby, providing an important mechanism to increase the production and income of some of the poorer farmers.

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