CHAPTER 6

Development of Effective Water Management Institutions: The Upper Pampanga River Basin, Philippines

Honorato L. Angeles, Marcelino S. Santos, Jose L. Tabago, Ma. Excesis M. Orden, Aurora S. Paderes, Carlito M. Gapasin, Lorna A. Bitangcol, Alejandro L. Duran, Lorie M. Cabanayan, Elizabeth D. G. de Guzman and Rachelle E. Liberato

Introduction

The Upper Pampanga river basin (UPRB) is one of the biggest river basins in the Philippines. This basin provides abundant water resources for a big population, growing industries, and agricultural production in a vast fertile riceland in the Central Luzon region. While current water resources are still abundant, there is an urgent need to protect and manage it for future generations. Moreover, the absence of a coordinating body to effect overall water management necessitates studying the UPRB.

This report presents the highlights of the diagnostic study conducted in the river basin to assess the physical facilities, water accounting, socioeconomic conditions and system performance within the UPRB. Based on the diagnostic study, issues were identified and the suggested reforms for effective water management are presented. Finally, an action plan is presented aimed at developing an effective water management institution to ensure sustainable water resources in the river basin.

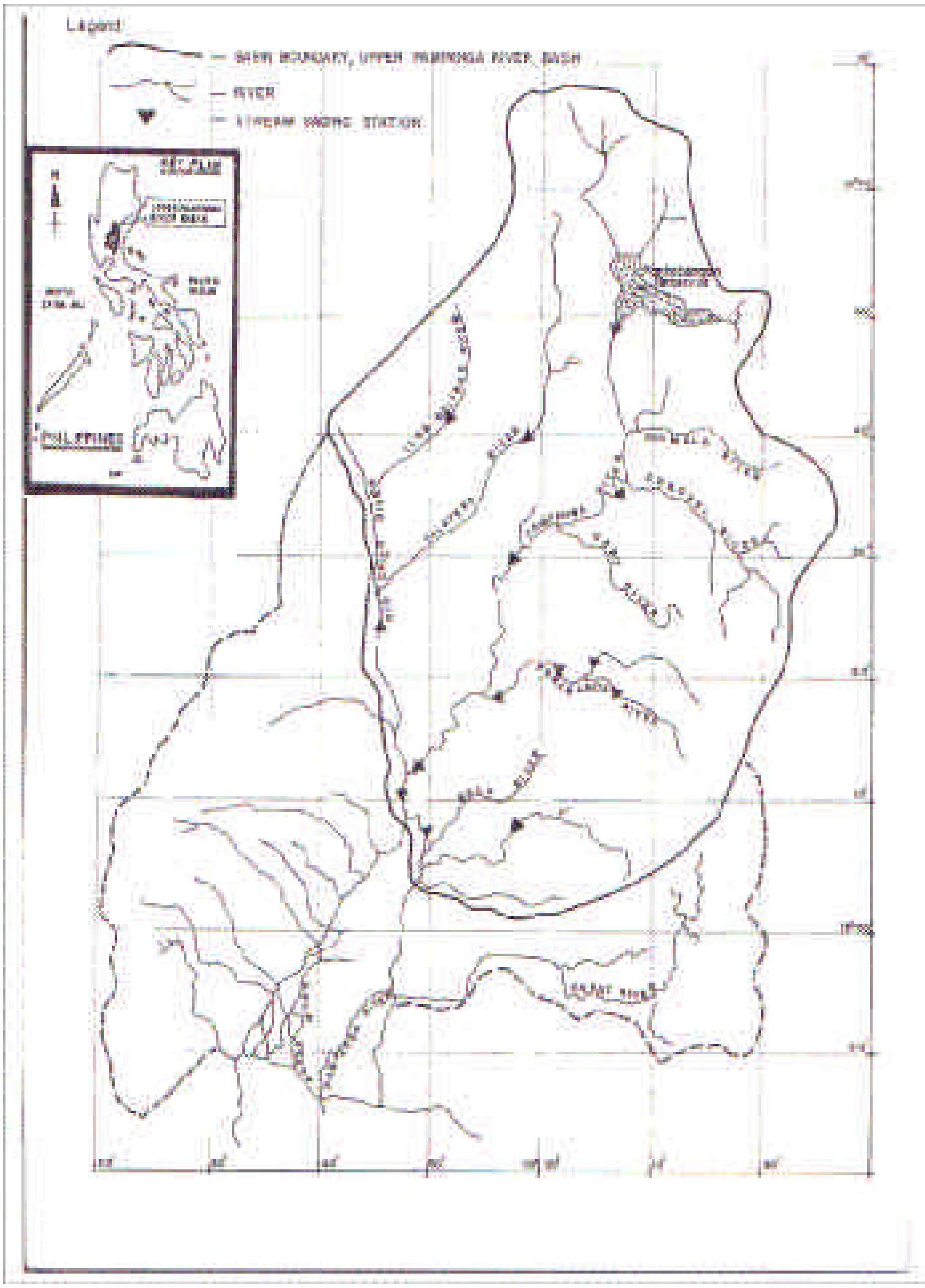
Project Site

The UPRB is in the upper reaches of the Pampanga river basin, in Central Luzon, the Philippines, between longitudes 120^{o} 40' E and 121^{o} 28' E and between latitudes 15^{o} 00' N and 16^{o} 08' N (figure 1). The estimated total area of the basin is 420,000 hectares covering 2 cities, 1 Science city and 25 municipalities in the provinces of Nueva Ecija, Pampanga and Bulacan.

The average landholdings in the Basin are small, ranging from 1.4 to 3.0 hectares (BAS 1999) owned by 152,292 farming households that primarily cultivate rice. Onion, garlic, tomato and other vegetables are produced, especially during the dry season.

Agriculture is the major source of employment and income in the basin, particularly in Nueva Ecija, which is considered the Philippine's major rice producing province. Added to agriculture are agro-industries, such as livestock, including poultry and pig farms, and light industries, such as feed mills, rice mills, ice plants and cold storage of onion, that all contribute to the basin's economy. Commercial establishments abound in population centers within the basin, especially in first class municipalities like Santa Rosa, Gapan, and San Miguel and in cities, such as Cabanatuan and San Jose. However, commercialization of agricultural and nonagricultural activities in the basin has given rise to the problem of environmental pollution.

Figure 1. Map of the Upper Pampanga river basin.



The UPRB has two distinct seasons. The wet season runs from May to November and the dry season from December to April. The average rainfall is 1,900 mm for a normal year and 1,100 mm for dry year. Rainfall during the rainy season is brought about by the southwest monsoon, accompanied by an average of 22 tropical depressions during this part of the year. Table 1 shows the basic profile of the basin.

Table 1. Basic profile of the Upper Pampanga river basin, Philippines.

Basin Characteristics				
General information				
Geographical area		4,200 km^2		
Location		N 14° 45' to N16° 10'; E 120° 20' to E 121°15'		
Physiographic features		Plains 90% Mountainous 10%		
Average rainfall				
Normal year		1,900 mm		
Dry year		1,100 mm		
Agro-climatic information (average from 1989 to 1999)				
Location	Total Rainfall (mm)	Total Evaporation (mm)	Average Temperature (°C)	Average Humidity (%)
CLSU	1,994	1,904	28	75
Cabana-tuan city	1,754	1,847	28	81
Facilities/Assets				
No. of irrigation schemes (surface irrigation)		4 major systems		
No. of hydropower plants		1		
No. of rainfall stations		2		
No. of pan evaporation stations		2		
Large reservoir	1 (2,996 million m^3)		Irrigation, hydropower, industry	
Shallow wells	1,571	Deep wells	11	
Urban Centers				
No. of urban centers	4	Area of urban centers	807 km^2	
Socioeconomic Data		*Land Use and Agriculture*		
Total population	1.374 million (1990)	Cultivated area	254490 ha	
	1.583 million (1995)	Urban land area	67,365 ha	
No. of households	308,347 (1995)	Irrigated area	123,357 ha	
Average household size	5			
Population density	341 persons/km^2 (1995)	Average landholdings	1.4 ha to 3.0 ha	
Maximum population in Urban sector	490,425 persons/km (1990)	Major farm crops rice, onion, garlic, vegetables		
Maximum population in Rural sector	884,470 (1990)	Cropping intensity	120% (1998)	
Ratio of urban: rural population 1:1.8			154% (1999)	
Per capita land area	0.006 km^2 (1995)			
Households with piped water 28% of total				
Number of IAs (under NIS)	365			
Number of IA members (IAs under NIS)	62,104			

Sources: NCSO 1990 & 1995, PAG-ASA 1990–1999, and BAS 1999.

The surface water supply in the UPRB is provided by the Pantabangan reservoir, and the major river tributaries in the upper reaches of the Pampanga river, such as the Awilan, Digmala and Coronel rivers. Other sources of irrigation water in the basin are the Talavera and Peñaranda rivers. Within the basin is the Upper Pampanga River Integrated Irrigation System (UPRIIS), one of the biggest national irrigation systems in the Philippines. In 1975, the UPRIIS became fully operational and it is used mainly for irrigation. Small irrigation systems and rainfall provide the irrigation requirements of other rice producing areas outside the UPRIIS. Water in the basin is also utilized for hydropower. One plant produces 150 megawatts of electricity and water is reused for irrigation.

The Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) operates a hydro-meteorological station and a synoptic station within the UPRB. The first is the CLSU Agromet Station located at the Central Luzon State University, Muñoz, Nueva Ecija, and the other is the Cabanatuan Synoptic Station located 30 km south-southwest of the CLSU Agromet Station.

Several government agencies are tasked with the administration of water in the basin. Their interests and functions are administrative and regulatory in nature. These agencies are the following:

- National Irrigation Administration (NIA)
- National Power Corporation (NPC)
- Department of Environment and Natural Resources (DENR)
- Bureau of Soil and Water Management (BSWM)
- Philippine Atmospheric, Geophysical Astronomical Service Administration (PAGASA)
- Local Water Utilities Administration (LWUA)
- National Electrification Administration (NEA)
- Bureau of Fisheries and Aquatic Resources (BFAR)
- Department of Public Works and Highways (DPWH)

Despite the presence of these agencies within the basin, it is still beset with problems and issues such as siltation of waterways, land conversion, water pollution and the lack of a coordinating body to promote effective water resources management in the basin.

Results of the Diagnostic Study

Physical System

The physical system of the UPRB consists of the Pantabangan reservoir, the river system, the diversion dams and the irrigation channel network, which are used to supply water for irrigation, fisheries, municipal, industrial, and other requirements. Within the UPRB is the UPRIIS, which services 102,500 hectares, which area is about 24 percent of the whole basin.

Rice is the major crop in the UPRIIS, with an average annual production of 63 million metric tons. Communal irrigation systems (CIS) provide irrigation to about 2,500 hectares of ricelands and diversified croplands. Individually operated 4-inch shallow well pumps also contribute to the overall irrigated areas in the UPRB. As many as 1,571 units of shallow well pumps and engine sets with an average discharge of 9 liters per second (lps) were installed from 1997 to 1998.

The survey and evaluation of irrigation facilities indicated a deteriorating trend in their functionality over the years since the UPRIIS became operational in 1975. The most common problems observed were a) silted irrigation channels, b) absence of farm ditches and farm-level water control structures, c) inadequate drainage systems, particularly in low-lying areas, and d) poor maintenance of farm-to-market roads. The irrigation performance efficiency, estimated at 50–64 percent during the wet season and 53–65 percent during dry season, and the cropping intensity are contingent partly on the functional status of irrigation infrastructure in the UPRIIS.

Potential irrigable areas outside the UPRIIS can be converted into productive agricultural lands by the construction of more communal schemes. For this reason, small water impoundments, capable of supplying irrigation water to 10–20 hectares of riceland in the UPRB, are being programmed by the Department of Agriculture. Also, small farm reservoirs capable of irrigating 1–2 hectares of riceland are continually constructed. To this end, the NIA is mandated by the Republic Act No. 6978 to undertake a 10-year program for the construction of irrigation projects in the remaining 1.5 million hectares of irrigable lands throughout the country. Specifically, 50 percent of the funds allotted for the purpose is to be used for communal irrigation projects.

Additional physical infrastructures are being constructed by the Casecnan Multipurpose Irrigation and Power Project (CMIPP). This project is expected to irrigate 35,000 hectares of agricultural land in June 2004 and provide hydroelectric power of 150 megawatts in March 2001. The irrigation component of the project consists of 64 km of the main diversion canal and 611 km of laterals and sublaterals, together with water control structures and irrigation facilities.

The need to rehabilitate and maintain the nonfunctional irrigation facilities in the UPRIIS has become imperative. Their deteriorating conditions have rendered most of them ineffective in controlling water for irrigation and drainage. A concerted effort involving the national government, concerned line agencies and local governments should therefore be geared towards the development of infrastructural facilities not only for irrigation and drainage but also for transport facilities such as farm-to-market roads.

Water Quality

Water in the Upper Pampanga river was categorized as Class A, while that in the Lower Pampanga River was categorized as Class C. Class A is good for municipal water supply requiring complete treatment (coagulation, sedimentation, filtration and disinfection) while Class C is meant for irrigation. Unfortunately, no data are available on the quality of water in the Pampanga river where its chemical, physical and biological characteristics are concerned.

However, visual inspection of the flowing water indicated a relatively high turbidity level due to sediment load, which may have affected the river biota population, particularly fish and crustaceans. This turbidity level has shown that the quality of water has indeed deteriorated steadily from Class A in 1975 to a much lower class at present. This deteriorating quality of water in the Pampanga river and its tributaries is attributed to increased agricultural activities, human settlements and deforestation.

On the other hand, groundwater in the UPRB has remained unaffected in terms of volume and quality. Groundwater drawn from deeper aquifers has remained the sole source of municipal water supplies in population centers such as the Cabanatuan city, San Jose city and the Science city of Muñoz, all located within UPRB.

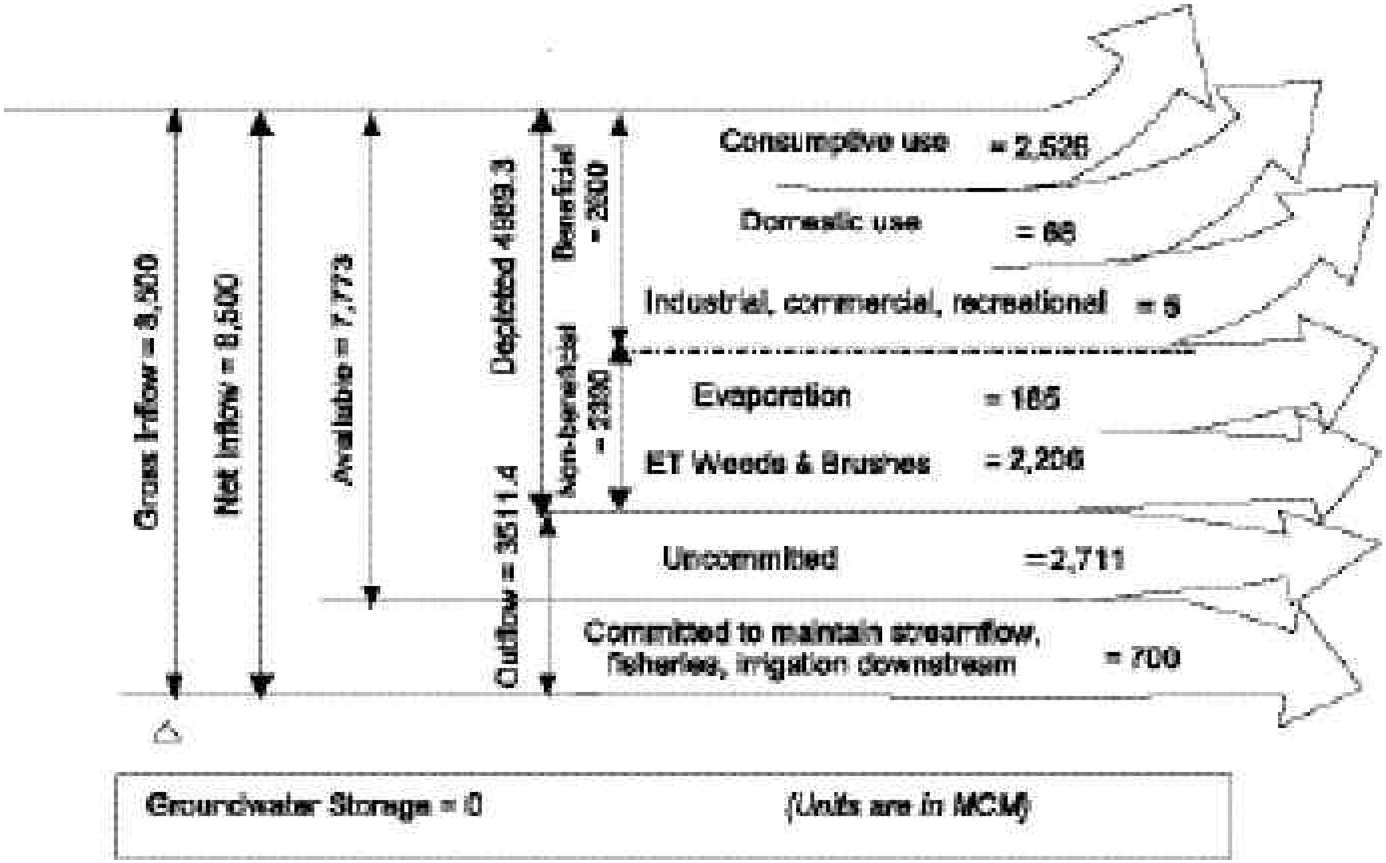
Availability of Water

Aside from natural rainfall from May to November, the basin’s water supply is regulated by the Pantabangan reservoir, which is capable of irrigating 102,500 hectares of riceland. Flows from the Coronel, Digmala, Talavera and Peñaranda rivers also contribute to the overall irrigation requirement of the basin. The supply of surface water is more or less fixed by the average annual rainfall of 1,900–2,000 mm. However, surface water flows into the Pantabangan reservoir while the base flows of the Upper Pampanga river and its tributaries tend to decrease during the dry season when demand for irrigation is highest. This low base flow may be attributed to loss of land cover in the watershed. Coupled with the deteriorating water quality downstream, the available surface water supply for beneficial use may become critical in the next 10 to 20 years. Thus, the supply of groundwater might be relied upon to support the increasing water demand of all water use sectors in the basin.

Water Budget

The roughly estimated water budget of the UPRB gives an overall picture of the gross water inflow and its present level of depletion (figure 2). Over the long term no change was observed in the storage of the Pantabangan reservoir; groundwater withdrawals are replenished during the rainy season. The committed outflow for downstream users in the Pampanga delta for irrigation, fishery and maintenance of streamflow of the Pampanga river is 700 million m^3 (MCM) leaving 7,800 MCM available water out of the annual inflow of 8,500 MCM. About 2,600 MCM are beneficially utilized for industrial and recreational use (5 MCM), domestic water supply (68 MCM) and consumptive use (2,526 MCM). For non-beneficial use, it is estimated that about 2,206 MCM of water are lost through evapotranspiration of weeds, brush and other vegetation.

Figure 2. Water accounting for the Upper Pampanga river basin, Philippines (1998–1999)



The uncommitted portion of the available water amounts to 2,711 MCM. Presently, most, if not all, of this amount of water drains out to the Pampanga delta, the Candaba swamp and finally to the Manila bay. This occurs because of the absence of storage facilities that can trap the water for later use.

In dealing with the water balance equation, some difficulties were encountered due to the unavailability or incompleteness of data regarding outflows and water depletion. The water accounting figures on uncommitted and committed outflows were arbitrary in nature and are subject to further refinement. Nevertheless, the resulting finger diagram provides a bird's eye view of water availability and its disposition in the context of future developments in the basin. More water storage facilities and water conservation measures are needed to optimize the use of the uncommitted portion of the available water in the basin.

Socioeconomic Conditions

The socioeconomic condition of the river basin provides a basis for a future agenda to improve water management. The UPRB is relatively large in terms of population, land area and coverage. In 1995, within the basin's administrative boundary there was a population of 1.58 million. The increased population pressure on land and other resources including water is likely to affect the river basin. The population growth rate is 2.86 percent per year, which is very high by international standards and higher than the country's (2.3%/yr.) and the region's (2.12%/yr.) growth rates. Unless efforts are made to minimize the growth rate, the population in the basin will be 2.1 million in 2005. The population density was 341/ha in 1995, an increase of 45 persons/ km^2 within 5 years. The proportion of the population, which is highly dependent on the household for survival (0 to 19, and over 65-years olds), is relatively large, at 50 percent. The urban population was 36 percent in 1990, 13 percent higher than the 1980 level, and it is expected to increase because of the growing importance of the nonagriculture sector and migration in the domestic economy.

Farming households constitute about 50 percent of the total households in the basin. In Nueva Ecija, the average farm size has continued to decrease from 3.47 hectares in 1971 to 1.78 hectares in 1991. A similar trend was reported in Pampanga and Bulacan due to fragmentation and land conversion. If this trend continues, food supply in the basin will be a problem unless efforts are made to increase productivity per unit area.

Annually, on average, 218,710 hectares are planted to rice, 92 percent of which is irrigated paddy. However, the 3-year data (1996 to 1998) did not show any significant increase in area irrigated. In 1997, the major sources of irrigation were the national irrigation system (NIS-79%), the communal irrigation system (CIS-12%) and the pump irrigation system (9%). The average rice yield in the basin is still below the yield potential of modern rice varieties. From 1996 to 1999, the yield per hectare ranged from 3.0 to 3.62 tons/ha during the wet season and from 3.73 to 4.33 tons/ha during the dry season.

Data from 1992 to 1997 showed a decrease in area irrigated by NIS in 1993 and CIS in 1994 due to both insufficient water released and deteriorating irrigation facilities. In contrast, a significant increase occurred in area irrigated by pumps, from 400 hectares in 1992 to 10,000 hectares in 1996. The increase in service area by pumps could be attributed to an increase in the ownership of pumps, as a result of individual purchases and the distribution program of the Department of Agriculture.

The river basin is primarily agricultural. In Nueva Ecija, the labor force in agriculture is 57 percent although the corresponding ratio in Bulacan and Pampanga is only 30 percent. For the whole basin, the employment rate is 45 percent, while the unemployment rate is 4.7 percent. Most of the household heads are gainfully employed. There is more employment in the nonfarm sector in Bulacan and Pampanga than in Nueva Ecija. This has contributed to the big difference in household incomes in the river basin. In Nueva Ecija, 63 percent of the households had an income of less than 100,000 Philippine pesos (P) per year (US$1.00=P54.4), as compared to less than 40 percent in Bulacan and Pampanga. In 1997, Nueva Ecija had the lowest per capita income of P20,959 while Bulacan had the highest at P31,343. The low household income and per capita income in Nueva Ecija could have been caused by the low productivity and low prices in agricultural produce. Efficient use of labor, fertilizer and water must be made to promote increases in agricultural productivity.

Considering that agriculture is the primary source of employment and income within the UPRB, the National Irrigation Administration Upper Pampanga River Integrated Irrigation System (NIA-UPRIIS) and its thousands of farmer beneficiaries, who are mostly members of the Irrigators' Associations (IAs), are considered as the major stakeholders of water from the UPRB. As of 31 December 1999, altogether 365 IAs in the whole of NIA-UPRIIS have been recorded, with a total membership of 61,880.

Most of these IAs are registered with the Securities and Exchange Commission (SEC) and currently have contracts with NIA.[1] They share in the management of operation and maintenance (O&M) of the irrigation system. The objective of the "shared management or participatory irrigation management" is to encourage the active involvement of the IAs in the O&M of the NIS. However, results of a recently concluded study, which reviewed the cost-recovery mechanism for the national irrigation systems, including the NIA-UPRIIS, revealed that "the NIA-IA partnership, in practice, is asymmetrical and that NIA controls the technical expertise and subsidizes maintenance and improvements in the canals that are being operated and maintained by the farmers (Shepley et al. 2000). In other words, the "paid" maintenance and contracts for collection of the irrigation service fee (ISF) do not provide enough accountability and incentives to the IA, and inhibit the farmers' capability for sustained O&M of the irrigation system.

The performance and capacity of the IA in the O&M of the irrigation systems are assessed annually using a NIA-devised functionality survey.[2] These assessments showed a

---

[1]O&M contracts entered into by IAs with the NIA are of three types. Type I involves a canal maintenance contract. For this, an IA receives an incentive of P400 for every km or a total of P1,400/ mo for a 3.5 km earth canal or a 7-km lined canal. In a Type II contract, the IA participates in system operation, ISF campaign and collection within its area of jurisdiction. An IA receives an incentive based on collection efficiency. Type III involves the transfer of the O&M of a system or part thereof to the IA, which amortizes the direct chargeable investment cost to NIA without interest for a period not to exceed 50 years.

[2]The functionality survey involves evaluating the IAs, based on a set of criteria considering the irrigation and organization-based management-related indicators and additional indicators.

downward trend in the number of functional IAs in the last 4 years. Inversely, the number of nonfunctional IAs has increased.

The diagnostic study involving the IAs and NIA-UPRIIS revealed certain realities, which can help explain the declining functionality status of the IA. One reality is that NIA field personnel and the IA officials were engrossed with ISF collection, probably because of NIA’s policy of assessing its field offices in terms of financial viability. Since ISF is the lifeblood of the NIA, the field personnel are expected to exert their best efforts to collect ISF from the farmer beneficiaries. Another reality is that the O&M budget of NIA limits its capability to improve and rehabilitate the deteriorating facilities. Moreover, because of its limited budget, NIA often fails to give the O&M contract incentives to IAs on time.

It was found that the training, designed to enhance the IA’s capability for O&M of the irrigation systems, was attended mostly by IA officials, and seldom by the members. This could be the reason why some farmers alleged that the IAs are “organizations of leaders,” which means training in O&M hardly trickled down to the mass-based membership of the IAs. Moreover, another reality observed was the lack of personnel to assist and guide IAs so that they can effectively participate in all aspects of irrigation management. The NIA-UPRIIS, like the other field offices, has streamlined their field personnel. Those who remain with the agency are preoccupied with the ISF collection or the water distribution in the field.

These realities pose a big challenge to the NIA. With the implementation of Republic Act No. 8435, otherwise known as the Agriculture and Fisheries Modernization Act of 1997, which mandates NIA to accelerate the turnover of the management of the O&M of the NIS to the IAs, improvement of the IAs overall performance has become very important. Improving the performance of IAs is imperative as they constitute the biggest group of water users in the basin and as they can adversely affect the effective water management of the UPRB.

System Performance of UPRIIS/NIS Districts

The O&M expenses increased from P296/ha in 1989 to P645/ha in 1998. However, the actual area irrigated in all the UPRIIS districts has continued to be lower than what was programmed for both dry and wet seasons. A declining trend in irrigated area was observed: the highest area irrigated was 79,292 hectares in 1992 and the lowest was 48,484 hectares in 1998 when the basin was affected by the El Niño phenomenon. This decline in irrigated area means that irrigation needs of the districts cannot be sustained by effective rainfall, local flows from the different diversion dams within the service area, and releases from the Pantabangan Dam during the planting seasons. The available water from the system was not sufficient to increase the basin’s cropping intensity as planned from 1989 to 1999. The yield was highly variable and did not show any significant improvement during the 11-year period studied.

The target collection efficiency of the system was set at 70 percent of the total collectibles. From 1993 to 1996, however, it was adjusted to less than 70 percent due to the wide exemption of areas affected by typhoons and other calamities. The collection efficiency ranging from 30 percent to 55 percent was much lower than the target collection efficiency. Water-gauging devices used to determine the inflow of water into laterals were not available. Hence, irrigation fees could not be charged in proportion to the quantity of water used. Due the low area irrigated and low paddy price during both dry and wet seasons it was hardly possible for the field personnel of NIA to collect the ISF. The collection efficiency was strongly correlated with paddy price, but had a low correlation with area irrigated. Moreover, the implementation of Administrative Order No.17 (AO 17) issued on September 7, 1998 affected the total ISF collection. AO 17 has reduced the target collectibles by 26 percent; from P179 million (without AO 17) to P137 million (with AO 17).

Two other performance indicators were used to assess the operation of UPRIIS from 1989 to 1999. The first was output per unit irrigated area, computed as the value of production divided by irrigated area, and second was financial self sufficiency which is total income divided by O&M expenses. The first indicator showed an increasing trend during the dry season from 1989 to 1996. The best year was in 1996 with more than P 45,000/ha as a result of high farm gate price of P 10.00 per kg, and an increase in yield over its 1995 level. Conversely, in 1997, output per unit area decreased by 7 percent over the 1996 level because the 13 percent increase in yield was offset by an 18 percent decrease in the price level.

Wet season yield fluctuated, although an increasing trend was observed from 1993 to 1995, and again in 1997, because of the increase in farm-gate prices. These results indicated the importance of better farm prices in improving the total value of rice production because of the inelastic nature of the demand for rice. A price increase subsequently increases the total revenue. However, improving revenue in rice production requires complementary production inputs and reasonable price levels.

From 1989 to 1999, financial self-sufficiency was highly variable. Within the 11-year period, the system was not self-sufficient for four years (1993, 1995, 1997 and 1998). During these periods the increase in O&M costs was more significant than the increase in the total income. The financial situation was worst in 1998, with a very low self-sufficiency value of 0.60 as a result of low yield and low income from production. The highest self-sufficiency ratio was recorded in 1994 at 1.30, when income increased with a decrease in O&M.

The above data showed that the overall performance of the system has been affected by lack of funds for O&M and low ISF collection. When O&M are not sustained, facilities and equipment would fail to deliver enough water supply to the farmers and, as a result, farmers are unable to produce high yields and pay their ISF.

Suggested Institutional Reforms

The identified problems and vital issues relating to the physical facilities, water accounting, socioeconomic conditions and system performance within the UPRB were the basis for an institutional analysis of the basin. This analysis (presented in appendix 1) sought to identify the needed reforms to ensure more effective water management within the basin. Results of the analysis and the corresponding suggested solutions to the problems identified are herein presented and discussed.

Institutional Collaboration for Effective Water Management

Water at the UPRB, particularly within the NIA-UPRIIS service areas, has been found to be closely tied to agriculture, high population growth rates and population density, and an increasing rate of urbanization. This close linkage has raised the need for cooperation among the various agencies and interest groups within the basin. The researchers are of the view that a multi-sectoral committee or core group should be formed composed of representatives from the NIA, DENR, LGU, National Power Corporation (NPC), local water districts, local communities and other interest groups. This group would be responsible for reviewing and integrating plans and projects or in developing an institutional framework that would define how the various stakeholders of the UPRB can collaborate and operate in an integrated manner. This integration is imperative because, at present, there is an apparent lack of effective mechanisms for coordination among agencies within the basin that are concerned with water management.

Adoption of O&M for Water Accounting and Valuation

Water accounting is crucial for planning and managing water resources. However, it is extremely difficult to do water accounting within the UPRB because of the lack of trained personnel responsible for getting the needed information. This is aggravated because of the inadequate or nonfunctional staff gauges and other measuring devices in strategic locations within the basin.

To remedy these situations, each LGU should install and maintain rain gauges and evaporimeters. Fund allocation for rehabilitation and installation of new gauging stations including maintenance could be provided by the Department of Public Works and Highways (DPWH), NPC, and NIA. The NPC and NIA can jointly undertake collection and maintenance of needed information within the basin.

In terms of valuation of water as a resource, several approaches are available depending on water use and sector. For irrigation, NIA charges an ISF for the service rendered in the delivery of water. The ISF collected is primarily used to fund the O&M of irrigation systems. With the issuance of AO 17 dated 7, September 1998, payment of ISF was socialized with the following rates: 75 kg/ha in paddy for wet season and 100 kg/ha for dry season for less than 2 hectares; 125kg/ha and 175 kg/ha for wet season and dry season, respectively, for 2 hectares to 5 hectares; and 200 kg/ha and 250 kg/ha for wet season and dry season, respectively, for 5 hectares and more. Payment in cash is computed based on the prevailing government support price for paddy. A 10-percent discount is provided to all farmers who pay the ISF before the due date.

However, the recently concluded study, which reviewed the cost-recovery mechanisms for national irrigation systems, pointed out that NIA's efforts to increase the level of ISF collection had been discouraging as a result of AO 17. Its ISF collection efficiency was at its lowest (34%) in 1998 when AO 17 was implemented, a huge decrease from 47 percent in 1997. While collection efficiency slightly improved to 36 percent in 1999, it was not enough to equal the level of collection prior to the implementation of AO 17 (Shepley et al. 2000). In the UPRIIS area alone, the reduction in total collectibles was estimated at 26 percent. The researchers are of the view that the abolition of AO 17 needs to be advocated and an appropriate ISF rate should be implemented such that 6.5 cavans/ha be charged in the diversion systems and 7.5 cavans/ha/yr. in the reservoir systems (Shepley et al. 2000).

For the water service sector, the rates may vary in the different water districts (WDs) because of differences in O&M expenses of the WDs, number of connections and presence and absence of subsidies. Recently, the National Water Resources Board initiated a series of fora to discuss the proposed increases in its fees and charges in compliance with Executive Order No. 197 (EO 197). EO 197 is a directive to all departments, bureaus and instrumentalities of the national government including government-owned or controlled corporations to increase their fees and charges by not less than 20 percent to cover the full cost of services rendered.

Enforcement of Policies and Regulations to Protect Water Quality

The protection of all water resources against pollution from point and nonpoint sources is a recognized concern of the state and the local government units. Uncontrolled application of pesticides and chemical fertilizers in the paddy field plus wanton disposal of solid wastes, untreated animal wastes, municipal sewage and industrial wastes all contribute to the degradation of the quality of water. To counteract these threats, the Department of Environment and Natural Resources has issued Administrative Orders Nos. 34 and 35 series of 1990, which define the criteria of the quality of surface water and freshwater, prohibitions in discharging industrial or domestic sewage effluents and other restrictions.

Likewise, Presidential Decree No. 1067 issued in 1976 embodies rules and regulations for the protection of areas of surface water or any groundwater that may be declared by the DENR as protected areas. Occupants within a protected area are prohibited from conducting activities that may lead to the deterioration of the quality of surface water and groundwater. Mine tailings as well as application of agricultural fertilizers and pesticides are regulated by the DENR and AO in these protected areas where their application may pollute a source of water supply.

Within the UPRB, the problem of deteriorating quality of water arises due to increases in population and urban activities. Household wastes as well as wastes from micro-industries, especially in more urbanized areas in the basin, have started to create problems. Solid wastes are being thrown into irrigation canals disregarding municipal ordinances that protect the quality of surface water. If these municipal ordinances and other rules and regulations for the protection of the quality of water are not strictly enforced, pollution of water within the UPRB will be critical in the future.

Advocating Proper Water Management Technologies

Micro-level analysis of the crop production in the UPRB shows that the predominant cropping pattern is rice-rice. This cropping pattern requires a large volume of irrigation water that is drawn heavily from the main canal of the NIA-UPRIIS. Rice fields are flooded with water starting from land preparation until 2 weeks before harvesting.

Efforts have been exerted to teach farmers on proper water management in rice culture for minimizing wastage. In the past, training on rice production and proper water management at the farm level has been conducted by NIA and other government and nongovernment agencies. However, farmers have continued their conventional practices, indicating that the training has not been successful in attaining the objective of increased water efficiency at the farm level. The concern to increase the efficiency in the use of irrigation water was made more explicit in the provisions of RA 8435, the Agriculture and Fisheries Modernization Act, issued on July 10, 1998.

Strengthening IAs' Capability for Irrigation O&M

Traditionally, the NIA has been tasked with irrigation development in the country. Over the years, however, amendments in NIA's original charter have been made, particularly by virtue of Presidential Directive (PD) No. 552 issued in 1974. The PD later paved the way for NIA to implement the shared management or participatory approach with irrigation management of O&M in the irrigation system. In the NIA-UPRIIS service areas, the first IA was organized in 1975. It was only in the mid-1980s that the proliferation of IAs began. Through the years, the IAs proved to be potent partners of the NIA-UPRIIS as they performed their roles and responsibilities pursuant to their O&M contracts with the NIA. Of late, however, the functionality of the IAs within the NIA-UPRIIS has indicated a downward trend according to results of the functionality survey conducted during the last 4 years.

NIA has indicated a willingness to consider transferring to the IAs the full or partial authority and responsibility for operating and managing the NIS in the service areas each of whose extent is less than 3,000 hectares. This impending transfer necessitates that IA's management capability be enhanced to prepare them for the responsibility of operating and maintaining the irrigation systems.

Action Plan

The results of the diagnostic studies and the institutional analysis were bases for a workable action plan that is proposed to improve the water management in the UPRB. Details of this plan are presented in the subsequent pages.

For the formation of the UPRB Coordinating Council, initially, a core group that will orchestrate the planning, implementation and evaluation of water resources management programs for the UPRB must be organized. However, this can only be realized when a position paper detailing the justifications for the need to form the UPRB Coordinating Council is prepared and presented to the various stakeholders of the basin.

Heads of the different agencies/organizations including the LGU and representatives of interested groups within the basin will be invited to join as members of the Council. The research team can serve as an ad hoc secretariat for the Council and be responsible in the monitoring, documentation and evaluation of all activities during the first year of its operation. Once organized, the UPRB Coordinating Council can line up activities and programs that will:

- improve the irrigation system performance;
- improve the temporal and spatial availability of water;
- strengthen and rationalize measurement, gathering and recording of the hydrological and socioeconomic data for water resources planning and management;
- monitor and evaluate the quality of surface water and groundwater; and
- improve the utilization of water.

Table 2 presents the details of the proposed action plan, indicating the activities, target outputs, and agencies involved.

Table 2. Action plan.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]		
[illegible]					
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]				
	[illegible]	[illegible]		[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table 2. Continued.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]			
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Appendix 1. Institutional analysis of the UPRB.

[illegible]	[illegible]	[illegible]		[illegible]		[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	√		√		[illegible]	[illegible]
	[illegible]	√		√		[illegible]	[illegible]
	[illegible]	√		√			[illegible]
[illegible]	[illegible]	√		√			
	[illegible]	√		√			
	[illegible]					[illegible]	[illegible]
	[illegible]	√		√		[illegible]	[illegible]

Appendix 1. Continued.

[illegible]	[illegible]						
[illegible]	[illegible]					[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]		[illegible]	[illegible]
	[illegible]	[illegible]		[illegible]		[illegible]	[illegible]
	[illegible]	[illegible]		[illegible]		[illegible]	[illegible]

Appendix 1. Continued.

	[illegible]					[illegible]	[illegible]
[illegible]	[illegible]		√		√	[illegible]	[illegible]
[illegible]	[illegible]	√		√		[illegible]	[illegible]
	[illegible]	√		√		[illegible]	[illegible]
	[illegible]	√		√		[illegible]	[illegible]
[illegible]	[illegible]	√		√		[illegible]	[illegible]
	[illegible]	√		√		[illegible]	[illegible]
	[illegible]	√		√		[illegible]	[illegible]
[illegible]	[illegible]	√		√		[illegible]	[illegible]

Appendix 1. Continued.

	[illegible]					[illegible]	[illegible]
[illegible]	[illegible]		[illegible]		[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]		[illegible]	[illegible]
	[illegible]	[illegible]		[illegible]		[illegible]	[illegible]
	[illegible]	[illegible]		[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]		[illegible]	[illegible]
	[illegible]	[illegible]		[illegible]		[illegible]	[illegible]
	[illegible]	[illegible]		[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]		[illegible]	[illegible]

Literature Cited

BAS (Bureau of Agricultural Statistics). 1999. *Commodity profile for Nueva Ecija*. Cabanatuan City.

NCSO. 1990. *Census on population and housing.* Manila.

NCSO. 1995. *Census on population and housing.* Manila.

PAGASA (Philippine Atmospheric, Geophysical, and Astronomical Services Administration). 1990–1999. *Clsu Agromet Station and Cabanatuan Synoptic Station. Nueva Ecija.*

Shepley, Steven C.; E. M. Buenaventura; and D. C. Roco. 2000. *Draft final report. TA 3235 – PHI: Review cost recovery mechanics for national irrigation systems.* August 2000.