CHAPTER 3

Socioeconomic Conditions in the Five River Basins

Madar Samad[1]

Introduction

This document provides a synthesis of the salient socioeconomic features of the five basins selected for the study: east Rapti (Nepal), Inderagiri-Ombilin (Indonesia), Upper Pampanga (the Philippines), Deduru Oya (Sri Lanka), and Fuyang (North China). The analysis is based on the reports of the socioeconomic investigations carried out by the respective national research teams. The aim of the socioeconomic studies is to develop a deeper understanding of the socioeconomic conditions in a river basin in order to devise institutional options that would cater to the specific needs of the community and the society at large. Detailed information is given in the respective country reports.[2]

Historically, river basins have been the scene of the development and progress of human societies. There is clear evidence that the momentous change of human life style from a mostly nomadic way of life to sedentary farming that occurred several thousand years ago took place in narrow river valleys. The second major turning point in human history also occurred along riverbanks, this time along rivers of northern England, which powered the early factories that set off the industrial revolution. Over the years, rivers and their hinterlands have been the centers of intense human actions that have had profound impacts on the river basin as an ecosystem and human society.

The paper begins with an overview of the macroeconomic context, focusing specifically on the key objectives of the national water sector policy. The next section summarizes the key physical characteristics of the basins. The sections that follow deal with some key aspects of the socioeconomic situation prevailing in the respective basins.

Macroeconomic Context

There are marked variations in the water resource endowments and their utilization in the five countries selected for the study. In aggregate terms, Indonesia is well endowed with water, with an annual per capita water supply of 14,000 m^3. But there are marked regional variations,

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[1]Senior Regional Researcher, IWMI, Colombo, Sri Lanka.

[2]Perera et al. 2000; Ghimire et al. 2000; Center for Chinese Agricultural Policy 2000; Ifdal and Helmi, 2000; Orden et al. 2000.

with less than 2,000 m^3/capita/year in parts of Java to some 28,200 m^3/capita/year in Irian Jaya. The Philippines, with 12,000 m^3 and Nepal with 10,000 m^3 also have abundant water supplies. Annual per capita water resources of Sri Lanka and China are 2,400 and 2,200 m^3, respectively, with the latter, especially its northern region, fast becoming one of the most water-scarce regions in the world.

Agriculture remains a vital sector of the economy in the five countries selected for the study. It is the largest user of water, accounting for about 70 percent of withdrawals in China and over 90 percent in each of the other countries. However, in four countries, China, Indonesia, Philippines, and Sri Lanka, the contribution of agriculture to the Gross Domestic Product (GDP) has declined vis-à-vis industry and the services sector. In Nepal, it remains the dominant sector and accounts for about 40 percent of the GDP.

Providing sufficient good quality drinking water for the increasing populations is a high priority policy item in all five countries. Other policy objectives vary from one country to another. In China, flood control, water pollution and water conservation are major components of government policy on water resources development (WRD). Irrigation is considered vital for China's food security but public funding for irrigation development is much less than investments in other areas of WRD. In all other countries, provision of irrigation facilities, especially for rice production, has been a dominant component of WRD along with other objectives such as hydropower generation, urban water supply, sanitation, protection of the environment, and controlling water pollution. In the irrigated sector, transferring operation and maintenance (O&M) responsibilities to irrigators is an established policy in all five countries. In more recent times, river basin management within the framework of integrated management of water resources is a dominant theme in national policy discussions.

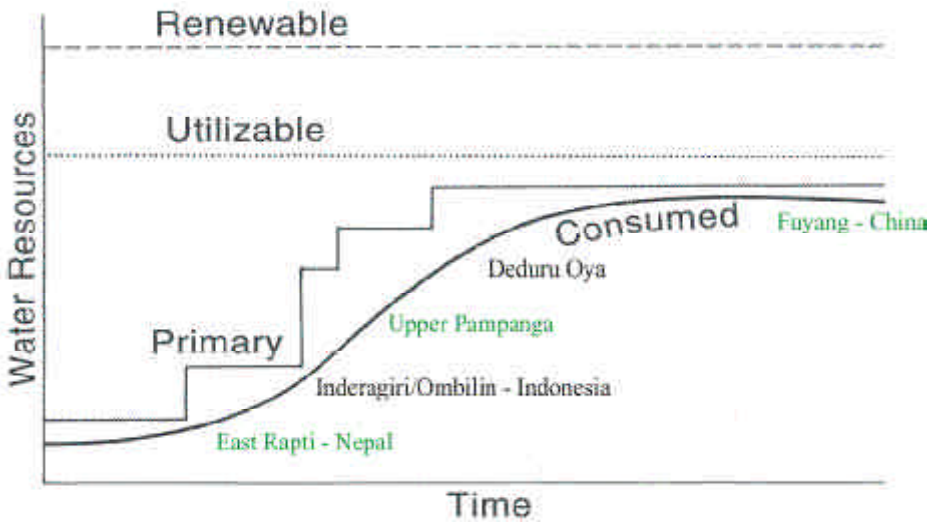
The indications are that WRD in the five countries, which for most of the twentieth century focused on irrigation development, is being refocused to achieve a broader set of objectives. There is greater emphasis on efficiency in allocation and management of the resource, equity considerations and environmental sustainability. There is a greater recognition of the need for institutional reforms in the water sector, user participation in water management, clearer definition of property rights and a greater appreciation of the growing scarcity of water.

Physical Characteristics of the Basins

Each of the five river basins selected for the study typifies a specific stage in the development of river basins (figure 1). At one end of the scale is the east Rapti river basin in Nepal, an open basin, relatively underdeveloped but well endowed with water resources. Per capita water availability is estimated at about 9,000 m^3. At the other extreme is the Fuyang river basin in China, which is a closed basin. With an annual per capita water availability of 868 m^3, it is one of the most water-short regions in North China.[3] The other three basins fit in between these two extremes as indicated in figure 1, and display varying stages of development and levels of water scarcity.

[3]A more recent estimate suggests that pet capita water availability is less than 400 m^3 (Wand and Huang 2001).

Figure 1. Hypothetical development stages of a river basin.



Note: Prepared by M. Samad, IWMI, Colombo, Sri Lanka.

The Upper Pampanga basin is relatively well endowed with water, with per capita water availability exceeding 3,500 m^3. The Deduru Oya basin in Sri Lanka, with an annual per capita water supply of 1,046 m^3, is seasonally water scarce, especially during the peak of the dry season when there is hardly any flow in the rivers. It is also spatially water scarce, especially in the midstream region of the basin, which is predominantly in the drier region of the basin.

East Rapti in Nepal, with an annual per capita water supply of 9,034 m^3, is comparatively well endowed but there is a significant reduction in river flow in the dry season. An added feature of this basin is the need to commit water for environmental purposes (for a national park) and also the need to take into account transnational water transfers. The Ombilin subbasin located in the upper reaches of the Kuantan-Inderagiri river basin in West Sumatra, Indonesia is an "open basin." However, there is intense inter-sectoral competition for water and a high incidence of water-related conflicts.

Demographic Characteristics

Population Distribution and Employment

Table 1 gives the salient demographic features of the basin. The populations in all five basins are concentrated in rural areas. The Fuyang river basin is the most densely populated basin and east Rapti the least. In the Deduru Oya basin, there is a heavier concentration of population in the head and tail areas that are more urbanized than the middle region of the basin. High population growth has been reported in east Rapti and Upper Pampanga.[4] In Deduru Oya, there is an overall decline in the population growth rates but there is evidence of an increase

Table 1. Salient demographic features of the selected river basins.

Characteristics	Fuyang (China)	Inderagiri -Ombilin (Indonesia)	Upper Pampanga (Philippines)	East Rapti (Nepal)	Deduru Oya (Sri Lanka
Total population (million)	15.6	0.7	1.5	0.6	1.0
Population density (persons/km^2)	686	396	450	212	378
No. of urban centers	4	4	3	3	22
No. of villages	9,092	400	325	na	2,807
Urban population (%)	28	na	36	25	10
Rural population (%)	72	na	64	75	90
Per capita availability of water (m^3)	868	na	3,630	9,034	1,046
Urban households having piped water (%)	97	na	27	36	21
Rural households having piped water (%)	77	na	na	na	09
Proportion employed in agriculture (%)	67	59	61	79	40
Proportion of population living below national poverty line (%)	6	na	39	42	60

in population in the more urbanized area suggesting an increase in rural-urban migration.[5] Population growth, especially growth in the urban population, will result in an increase in the demand for domestic water supply.

In all locations, statistics on employment specific to the basin are not available. Yet, employment data from the various administrative areas that fall within the basin indicate that, overall, agriculture is the major source of employment of the inhabitants of the respective basins. The proportion of the population dependent on agriculture varies from 40 percent in Deduru Oya to 79 percent in east Rapti.

Incidence of Poverty

The least incidence of poverty is in the Fuyang basin with only 6 percent of the population living below the official poverty line. In three other locations the incidence of poverty is high: Pampanga, 39 percent; east Rapti, 42 percent; and Deduru Oya, 60 percent. Detailed information on poverty is given only in the Sri Lankan and the Nepalese case studies.

In the Deduru Oya basin, pockets of poverty have been reported from the principal urban center (Kurunegala). The other location where poverty is more pronounced is in the midstream area of the basin situated in the drier region, where there is acute scarcity of water, especially in the dry season. In the latter case, poverty is attributed to low agricultural productivity levels due to the scarcity of water.

In east Rapti, poverty is more pronounced in the rural areas than in the urban centers. Besides location effects, there are also strong caste and ethnic dimensions to the poverty problem. Certain groups identified as “primitive” and leading mostly a nomadic life are among the worst affected. The incidence of poverty is reportedly high among the ethnically disadvantaged groups, especially among fisher communities. This is primarily due to decreasing

[4]2.7% and 2.9% per annum in the two districts in east Rapti (Ghimire et al. 2000) and 2.9% per annum in Upper Pampanga (Orden et al. 2000).

[5]Comparable data on population growth rates for the Fuyang basin and Ombilin are not available.

fish population in the river due to overfishing and also due to water quality problems from the discharge of industrial effluents into the river.

Key Aspects of Irrigated Agriculture in the Basins

Agriculture is the main user of water in all five basins. In the Fuyang basin, groundwater schemes are predominant with some 185,527 schemes irrigating some 874,000 hectares of land or 85 percent of the total irrigated land area in the basin. There is evidence of declining groundwater levels due to overexploitation.

Irrigation in the Ombilin basin is mostly by water lifted from the river with waterwheels. Due to changed river flows, the number of waterwheels has come down from 366 in 1996 to 184 at present. The indications are that more waterwheels will go out of operation in the coming years.

Surface irrigation schemes dominate the basins in the other three locations. In the Deduru Oya basin, aside from three major schemes, there are some 3,600 minor irrigation schemes (with command areas of less than 80 hectares). These schemes are spread throughout the basin and their hydrological endowments vary substantially. Table 2 summarizes key features of the agriculture sector in the basins. The paragraphs that follow highlight some of the key issues in the irrigation sector in the respective basins.

Deduru Oya

A unique feature of the Deduru Oya basin is water scarcity in the midstream region. This area has the highest concentration of small tank schemes in the entire basin. Water scarcity has seriously affected irrigated agriculture in the small tank schemes in this area. Rice is the main crop cultivated under irrigation in both the wet and dry season. In some of the water-scarce areas non-rice crops are grown in the dry season.

In recent years, there has been an increase in groundwater abstraction using diesel/ petrol-powered pump sets. These are primarily for nonagricultural purposes such as brick making. In some places, water pumps are being extensively used to lift water directly from the river for irrigation. Rice and other field crops (OFCs) are the main crops grown by river-lift irrigation in the head and mid regions of the basin. In the tail-end areas vegetable cultivation is the dominant activity.

Farmers identified sedimentation and silting of tank beds, reduction of inflow into the tanks due to blocking of natural watercourses by encroachers, and unplanned development activities in the tank catchments as some of the major hazards in the basin. Unregulated sand mining carried out on a large scale was reported as the major cause of environmental degradation in the Deduru Oya basin. It is the biggest commercial activity in the basin. Excessive sand mining has resulted in the intrusion of seawater, loss of natural ponds along the river, reduction in the groundwater level and disturbance of the stability of the bridges across the river.

East Rapti

Agriculture is the major source of livelihood of the population in the basin. Of the total economically active population of Makawanpur district, 82.7 percent, i.e., slightly more than

Table 2. The agriculture sector in the five river basins.

Characteristics	Fuyang (China)	Ombilin (Indonesia)	East Rapti (Nepal)	Upper Pampanga (Philippines)	Deduru Oya (Sri Lanka)
No. of surface irrigation schemes	3	184 (river lift)	214	37	3,600
No. of groundwater irrigation schemes	185,527	14	2,445	9	2,453
Surface irrigated area (ha)	150,000	32,180	32,388	98,222	47,150
Groundwater irrigated area (ha)	875,000	-	7,743	25,135	1,515
Main irrigated crops	Wheat, corn, cotton, rape seed	Rice, mung bean, groundnut	Rice, maize, wheat	Rice, vegetables, corn, onion.	Rice, chili, vegetables.
Annual cropping intensity (%)	155	na	na	156-Surface water 200-Groundwater	133-165-Surface water 180-300-Groundwater
Comparison of current crop yields with yield 10 years ago	Decline in yield of all major crops	No change in yield of major crops	No change in yield of major crops	Drop in rice yield by 14-21%	Current yields of major crops are higher
Reasons for yield change	Water scarcity, institutional constraints	Not relevant	Not relevant	Climatic changes, pest outbreak	Improved agronomy; Better prices
Responsibility for O&M of groundwater schemes	Individual farmer		WUAs		Smaller schemes-WUAs; Larger schemes WUAs and Irrigation agency
Responsibility for O&M of surface irrigation scheme	Local government authority	River lift schemes; water wheels; individual owners	WUAs and Irrigation agency	Irrigation Associations (WUAs) and Irrigation agency	Individual owners
Multiple use of irrigation water	Yes	Yes	Yes	Yes	Yes

the national figure, are involved in agriculture. In Chitwan, 75 percent of the population are engaged in agriculture. It is estimated that about 26 percent of the total land area in the basin is used for agriculture. Of the total area cultivated some 18 percent is in the river valleys and inner plains. These are the major irrigated farming areas in the basin. The cropping intensity (CI) of these areas is between 200 and 300 percent. Cropping patterns in such areas with year-round irrigation facilities are paddy-fallow-paddy, paddy-wheat-paddy, paddy-wheat-fallow, paddy-legumes-paddy, and paddy-legumes-fallow. However, in areas with seasonal irrigation facilities the cropping intensity approaches 200 percent. The cropping pattern in such areas is paddy-wheat, paddy-legume, paddy-maize, maize-oilseeds, maize-maize, paddy-vegetables, maize-vegetables, etc. Livestock (improved breeds of buffaloes and cows, and poultry farming) is also very popular in the plain areas. Agriculture in the hilly part of the basin is largely rain-fed. The dominant cropping patterns in these hilly areas are maize-millet, potato-millet, maize-potato-fallow, and maize-fallow.

Agriculture in the basin is essentially a smallholder activity. The area of each holding of nearly 75 percent of the holdings is less than 1 hectare. Land distribution in the basin is highly skewed. About 46 percent of the households own only 16 percent of the total available cultivable land. In contrast, some 6 percent of the households own approximately 26 percent of the total cultivable land.

A significant development over the last few years is the proliferation of groundwater development particularly in the plains. A major reason for the rapid spread of groundwater development is the subsidy amounting to 60 percent of the cost for the establishment of tube wells. More recently, the government has suspended the subsidy program. This has slowed down the establishment of tube wells.

Fuyang Basin

Fuyang is one of the most water-short basins in North China. The availability of per capita water resources is less than 400 m^3. Agriculture is the largest user of water, but the share of water used in agriculture has been declining over time, from 81 percent in 1993 to 75 percent in 1998. This is primarily due to the growing domestic demand. Industrial water demand during the same period has increased by only 1 percent.

The total design area under surface irrigation is about 430,000 hectares. In the 1990s, the actual area irrigated was only 41 per cent of the designed irrigated area. Most of the surface irrigation schemes are managed by government agencies, though a contract management scheme has been implemented in some periods. With the decline in the supply of surface water and the increasing water demand for agricultural, domestic and industrial uses, exploitation of groundwater has increased rapidly. Investment in groundwater irrigation was mainly financed by the local villages and townships, with varying extents in government financial subsidies. Prior to the implementation of the household production responsibility system (HRS) initiated in the late 1970s, investment in groundwater was by local government agencies with financial assistance from the government. Farmers contributed family labor for constructing groundwater irrigation schemes. These schemes were under collective ownership. With the implementation of HRS, investment in groundwater was primarily by private individuals.

There is evidence that groundwater tables (both shallow and deep) have fallen by more than 1 m annually in the past two decades. Urbanization, industrialization and population growth have also led to the increasing pollution of groundwater and surface water that, in turn, has further aggravated the water-scarcity problems in the basin.

The main crops under irrigation include wheat, corn, cotton and rice, along with some millet, soybean, peanut and horticultural crops. With the modernization of agriculture since the 1950s, crop yields have increased. Yield of grain crops has doubled. At the same time, yield of ginned cotton has increased threefold.

Ombilin River Basin

The major use of water varies among the three major rivers and lakes that constitute the basin. Water from the Ombilin river is used for irrigation, industry, power generation and domestic purposes. Irrigation and domestic uses are the dominant uses of water in the other two basins.

The development of the Singkarak Hydroelectric Power Plant has significantly reduced the outflow of water from the Singkarak lake to the Ombilin river, affecting the quantity of water flowing in the Ombilin river. This reduced water flow has adversely affected farmers

who rely on the river for irrigation water. Pump irrigation has been adopted by a very limited number of farmers in the last decade.

Marked seasonal fluctuations in the river flow are a major feature of the Ombilin river. For the owners and operators of water wheels, fluctuations in the water discharge of this river have caused several problems in system O&M. The inadequacy and unreliability of irrigation water have adversely affected agricultural production in the basin. Rice yield has declined from an average of 4.2 tons/ha earlier to 3.1 tons/ha in 1999.

Deterioration of water quality is an emerging problem. This is particularly due to the discharge of effluence from a coal plant. This is causing serious health problems to people living downstream who depend on the river for water for domestic needs. Furthermore, the fish population in the river has declined because water quality in the river is unsuitable for some species of fish. This situation has affected the livelihood of these households whose cash income is dependent on fishing.

Competition for Water

Two major nonagricultural uses of water are industry and agriculture. With increasing water scarcity there is a growing inter-sectoral competition for water. The scarcity is highest in the Fuyang basin in North China. But even in the water-abundant east Rapti basin, there is location-specific competition, such as between the water needs for agriculture and environment, recreation and transnational commitments.

In Deduru Oya, the competition for water is within the irrigation sector. Plans to construct major irrigation schemes and haphazard rehabilitation of small irrigation schemes would also have negative impacts on downstream water users and small tank schemes. Industrial demands are not expected to be significant in the near future. However, government proposals to use groundwater and stream water for domestic water supply (drinking, bathing, washing, etc.) for the growing urban and rural populations would lead to competition and water scarcity.

In the Ombilin subbasin, inter-sectoral competition is less intense at present. The most serious problem is the competition between water for hydropower generation and rice production that uses water wheels for irrigation. The economic benefits from hydropower far exceed the returns from rice farming, making it hard to justify priority allocation for the latter.

In the Upper Pampanga, water for domestic and industrial uses is mainly drawn from groundwater. At this stage, however, considering the vast reserve of groundwater in the basin, which is being replenished by rainfall every year, competition from other users vis-à-vis irrigation does not affect agricultural water use. Moreover, results of a field-level study in the UPRIIS area indicate that except for fish ponds, other enterprises like duck and poultry farms consume very minimal amounts of water.

Major Socioeconomic Issues in the Basins

Each of the river basins shows variable levels of socioeconomic development. This section summarizes the salient social and economic issues in the five basins.

Deduru Oya

Deduru Oya is unique in the sense that the wetter parts of the basin are at located at the head reach and the tail end of the river, whereas the midstream area is very dry. The main urban centers in the basin are located in the head and tail areas. These centers have high population density. The urban areas are predominantly service centers. Industrial development is low and industrial pollution is not a major issue at present. Drainage problems and use of the river for domestic waste disposal as it flows through the towns pose serious environmental threats to water resources in the town area.

There is a high incidence of poverty in the basin especially amongst the farming population. The main reason for this is water scarcity and dependency on based paddy cultivation based on small tanks, low productivity, and lack of alternative employment opportunities. Agriculture is the main source of employment in the basin. The majority of the people depend on coconut cultivation as it provides some regular income.

Paddy cultivation is the major livelihood activity of the people living in the part of the basin lying in the dry zone region. Paddy cultivation is gradually declining, especially that cultivated under minor irrigation schemes. The major problem the farmers in this region face is water scarcity due to low rainfall, silting of tank beds, lack of proper irrigation structure, reduced inflow and pollution of water. The cultivation of vegetables and OFCs is a major source of income for the people residing downstream of the river basin. Salinity buildup, due to intrusion of saltwater, is a serious problem for farmers engaged in vegetable cultivation. Salinity control is urgently needed to continue these activities on a long-term basis without damaging the environment.

The potential for the development of animal husbandry in the river basin is very high. The coconut lands available in some areas provide the necessary environment for livestock. The Provincial Department of Animal Production and Health is committed to the promotion of this sector. But some institutional and management improvements and resources are required for further development.

The industries in the river basin are mostly associated with the two main agricultural products, coconut and paddy. These industries do not pose serious environmental threats if they are implemented properly. Sand mining is the major cause of environmental problems. This is an activity carried out with the blessing of politically powerful people. Immediate attention of the relevant authorities is required to regulate this activity through proper institutional arrangements.

Community-based organizations in the river basin were found to be very weak. The farmer organizations face serious problems due to lack of assistance from the relevant agencies. Though the relevant agencies have capability in institution building, they lack interest due to various sociopolitical reasons.

East Rapti

East Rapti is relatively well endowed with water. It is an open basin and is relatively underdeveloped. Two administrative districts cover the entire basin: Makawanpur and Chitwan, with population densities of 128 and 160 persons/km^2, respectively. Chitwan is rapidly urbanizing compared to the Makawanpur district, largely due to the Chitwan national park, which is a major tourist attraction. Migration of hill people to the plains and also rural people

to the urban areas exerts high pressure on the natural resources. The increasing incidence of landslides and floods in the Rapti river and its tributaries due to natural and man-made causes is one of the major environmental problems in the basin.

There is a high incidence of poverty in the basin. It is estimated that around 50 percent of the population in the basin are below the official poverty line. Poverty is more pronounced in the rural than in the urban areas and is concentrated more in the hills than in the plains. Ethnically disadvantaged groups constitute about 18 percent of the population within the entire basin. Such groups inhabit the hills. A major social problem in the basin is the erosion of the traditional fishing rights of ethnically disadvantaged groups, thereby marginalizing them even further. There is also evidence of wide disparities in incomes and access to resources.

The major institutional problem in the basin is the lack of coordination among the stakeholders such as irrigators, domestic water users, foresters, industries, park and people. Uncoordinated interventions in the water-resources sector by government agencies, national and international NGOs and other stakeholders not only duplicate efforts but also add to unnecessarily large costs.

Fuyang

With the intense competition in water use among various sectors at the basin level, more and more surface water is being transferred out of the agriculture sector. Agriculture is becoming increasingly dependent on groundwater. Overabstraction of groundwater has been steadily lowering the groundwater table. With the groundwater table dropping, there has been an increase in the cost of groundwater abstraction. At the same time, grain prices have more or less stagnated, and costs of agricultural inputs have risen, thereby resulting in a reduction in farm incomes.

A noteworthy development in the basin is the change in property rights, especially in groundwater. Collective property rights are being replaced by individual property rights. There has been a notable shift from cultivating grain crops to high-value cash crops, such as vegetables. In addition, dryland agriculture will be adopted by more and more farmers and drought-resistant varieties will become popular. The institutional challenge in the basin is to devise appropriate strategies for demand management and to increase the productivity of water.

Ombilin

The major problems in the basin are the decrease in the river discharge and deterioration in water quality. The decreased discharge of the main Ombilin river has resulted in problems of water quality because of the high inflow from the Selo river where the quality of water is very low. In addition to this, the discharge of industrial effluent disposed from the coal mining company has affected the downstream water quality. This has resulted in serious health problems among downstream water uses. There has been a decline in the total irrigated area and, in some cases, cropping intensity and yield of irrigated agriculture have declined markedly.

Upper Pampanga

Estimates of the water balance indicate that there is a good deal of uncommitted water running to the sea and there are plans to extend the downstream irrigated area. Despite the seemingly ample supply of water, there is a great deal of year-to-year variability in wet-season yields. The 1999 survey of 102 farms in the wet season also shows that yields were lower and much

more variable among farms in certain locations (districts II and III) compared to districts I and IV. One can see that the area irrigated in the dry season has dropped very sharply. The tail end of the scheme has been affected more than the head end. From a management point of view it is far easier to cut off the tail of the scheme than to try to allocate a limited supply of water across the whole scheme. Yields are consistently higher and somewhat less variable from year to year in the dry season than in the wet season. The high cost of fuel and insufficient groundwater discourage the use of pumps.

Farmers in the Upper Pampanga River Integrated System (UPRIIS) experience a great deal of year-to-year variability in production (and income from rice) in the wet season due to weather, and in the dry season due to weather-related uncertainties in deliveries from UPRIIS. The degree of variability depends very much on where the farm is located in the system.

Increased population pressure on land and other resources, including water, is likely to affect the river basin. There is increased water demand for domestic and industrial uses due to increased population and urbanization. Increases in population density could decrease the degree of social interaction or may diminish the effectiveness of water user associations and other collective efforts in water resources management in the basin.

In recent years, the use of pumps has expanded. More than 20 percent of the farmers surveyed had acquired pumps, most of these in the last 5 years although this may be biased upward due to a bias in the sample. However, high fuel costs and insufficient groundwater have slowed down the proliferation of pump irrigation.

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