

## WATER UTILIZATION ON REGIONAL DEVELOPMENT

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The role of irrigation in agricultural development is crucial, yet until recently there have been few systematic and integrated efforts in the Philippines to harness the available water resources effectively. Of the estimated 1.25 million hectares of land under irrigation, only a third can be provided with water throughout the year. This well-watered portion, however, happens to be in areas of the Philippines where rainfall is evenly distributed throughout the year. Where rainfall is concentrated in a specific part of the year, water for irrigation is available only during those months.

Water storage facilities for irrigation are still limited. The only major infrastructure for this purpose is the Pantabangan Dam in the Upper Pampanga River in Nueva Ecija which will be in full operation by the middle of 1975. This dam is designed to store water for the irrigation of 77,000 hectares — 72,000 hectares the whole year round.

In the past, irrigation development in the Philippines concentrated on gravity systems, including (1) those in which the level of river flow is raised by a barrage, or low dam, and diverted into canals which distribute the water downstream on low-lying fields, and (2) those in which ground or river water is raised and distributed by gravity flow. The gravity irrigation systems are constructed and administered by the national government, pump irrigation systems are designed and financed by the national government and operated communally or privately by water users, while communal and private irrigation systems are constructed and operated by farmers' organizations or groups of farmers, at times with help from the government. However, since these systems do not have

storage reservoirs, the availability of irrigation water after the rainy season is sharply limited. In most instances only 35 percent or less of the area planted during the rainy season can be irrigated during the dry season. In Nueva Ecija, without the Upper Pampanga River development scheme, an average of only 19 percent of a total of 73,150 hectares of potentially irrigable land could be provided with water during the dry season.

Studies on the size of catchment areas and irrigation potentials of the Philippines are incomplete, although the board outlines have been identified. The major river basins of the Philippines which have been studied include the Agno, Pampanga, Cagayan, and Bicol in Luzon, Ilog-Hilabangan, Panay, and Jalaur in the Visayas, and the Cotabato and Agusan in Mindanao. The Upper Pampanga River, as mentioned earlier, will soon be supplying irrigation water for surrounding areas, and the Magat River, a major tributary of the Cagayan River, will be the site of another reservoir estimated to supply water for 104,000 hectares of farm land. Plans for the development of the Agusan River are also being prepared, and so with the Bicol River. These eight major river basins include almost 50 percent of the land under cultivation in the country. In addition, the Cagayan, Cotabato, and Agusan river basins still include significant areas of land suitable for lowland rice and other crops which can be brought under cultivation.

Other than the above river basins which have relatively large catchment areas, most rivers in the Philippines are small, with correspondingly small catchment areas. The size of the catchment basins is a direct reflection of the topography, size, and shape of the different islands.

*Research on Social Change and Regional Development in Nueva Ecija*

In an attempt to discover the impact of regional development in a specific area where an important physical resource will be utilized, a research project was begun several years ago. Its purpose is to assess the effects of the Upper Pampanga River Project (UPRP) on the growth of Nueva Ecija in Central Luzon.

The UPRP consists principally of the Pantabangan Dam, which will be operational by the middle of 1975. The dam, together with its appurtenant structures, was designed to control and utilize the seasonal flow of the Upper Pampanga River and its tributaries for year-round irrigation of rice fields and farms. It was also designed to provide a domestic and industrial water supply, to generate hydroelectric power, to mitigate flood damage, and to serve as a site for recreation and fish conservation. Last year a portion of the dam was rushed to completion to irrigate about 10,000 hectares of riceland during the dry season.

The research effort is an interdisciplinary approach to the study of social change two years before and two years after the completion of the UPRP. It involves studies of social change and regional development related to geography, economics, political administration, and sociology. The interdisciplinary approach is used because it is felt to be the only suitable method for an adequate study of the conditions of the area and in general of developing countries. The reason for such a contention is that in investigating the developmental process and its determinants, a multitude of complex and interdependent conditions and relations are encountered. Since there are limitations on what a single discipline can conclude, each one must be supplemented by others.

The main emphasis of the research project is the accumulation of baseline data through interviews with the various sectors of the communities in the area, against which future changes will be compared and analyzed. The data will be evaluated at both the "before" and "after" periods in anticipation of reports on the socioeconomic conditions of sample barrios

within and outside the UPRP service area.

More specifically, the study will attempt to provide information on the following aspects of regional development: (1) population growth, spatial distribution and migration in the region; (2) social structure and process, which entail an analysis of community structure and institutions, income, occupation, and other socioeconomic structures, as well as the attitudes, perceptions, and aspirations of the people; (3) economic potential and performance, for which the data will be taken from an examination of existing employment patterns and structure of primary, secondary, and tertiary economic activities, volume of internal and external demands, and so on; based on this analysis, a projection will be made of the economic growth of the area; included as well will be an analysis of the impact of land reform; (4) political organization and administration, in which an evaluation is to be made of the system by which government services are financed in the region; all government institutions operating in the region, the functions and activities they perform, as well as their relationship to one another are to be analyzed; and (5) physical environmental aspects, in which the overall effects of the environment on agricultural development and vice-versa are to be analyzed and in this connection data on prevailing natural hazards and the individual farmer's responses are to be analyzed and evaluated.

To represent the units of study in the area, a sample of 24 barrios were drawn from a total of 531 barrios and poblaciones in Nueva Ecija. From the sample barrios, 900 household heads (including farmers and nonfarmers) were randomly selected to comprise the final sample used in the study. The total respondent sample represents about 11 percent of the households found in the sample barrios. In the selection of these sample barrios seven criteria were considered, namely: spatial distribution (in which a grid system of intersecting latitudes and longitudes on Nueva Ecija maps with scales of 1:50,000 placed at 2.5-minute intervals was used), whether covered by the expected UPRP service or not, extent of existing irrigation faci-

lities, population size, size of cultivated area, whether accessible or not, and microtopographic features.

Government officials from the barrio, municipal, and provincial levels were also tapped as additional sources of information. The barrio captain served as the only respondent on the barrio level. For the town in which the sample barrio is located, the respondents were the mayor, the treasurer, the Bureau of Internal Revenue (BIR) collection agent, the agriculturist, the rural health officer, the school principal and heads of whatever government agencies had local branches there, such as the National Irrigation Administration, the Department of Agrarian Reform, and the Department of Local Governments and Community Development. At the provincial level we interviewed the heads of government agencies, particularly those whose functions pertained to finance and agriculture.

Another type of data gathered consisted of variables related to economic development and community participation for both town and barrio levels. Standard instruments in the form of checklists were used to gather the information.

A hoped-for, positive outcome of the UPRP would be an increased and wider distribution of income among the people in the area, largely because of the expected increase in agricultural productivity. This would have some bearing on the social mobility among the different socioeconomic classes and sectors. However, as to the narrowing or widening of income gaps between the upper and lower classes, it will be known definitely only after the completion of both the "before" and "after" phases of the study.

The effects of the UPRP which are important to administration and subsequent planning will also be considered, to determine their relationships to project operations. This information will be of use to similar regional development projects in other parts of the country. Changes other than socioeconomic brought about by the development of the project, such as in individual skills, attitudes, be-

haviors, expectations, or aspirations will likewise be studied.

One interesting angle of the research work will be the measure of efficiency of the UPRP. The financial cost of the project will be weighed against its benefits, and conclusions reached as to whether or not the project is achieving its goals at the lowest possible cost, and whether or not the individuals affected by the project recognize the benefits of innovation or regional development.

#### *Environmental Quality and Regional Development*

It should be pointed out in connection with regional development that until recently natural-resource exploitation in the Philippines has always been oriented towards utilization, with little thought of, or attempt at, conservation. It has also been observed that the interrelatedness of natural resources, that is, the fact that changes introduced in one have repercussions on the others, is not fully appreciated. The dynamism of natural resources, their being highly subject to change over a period of time, even though they have assumed stable forms, is likewise not too keenly taken into account.

The use of artificial reservoirs for water storage in connection with irrigation, hydroelectric power generation, and flood control creates a number of problems, and the consequent effects on the environment must be recognized. Water reservoirs hold back a considerable part of the materials transported by streams. As a result, sediment-free water flowing out of the dam has a higher erosional capacity to deepen and widen river channels and the destruction of coasts. Therefore, the location of the dam site is important.

Reservoirs also increase the amount of evaporation and thus augment the salinity of the water downstream, which may further affect the aquatic ecosystem. Temperature characteristics of the water in the reservoir is likewise affected. On the basis of the dam design, if water is released from the surface, the reservoir is a "nutrient trap and heat exporter," whereas if the water is released from the bottom, as is generally the case for dams which generate

hydroelectric power, the reservoir is a "heat trap and a nutrient exporter." In addition, for dams with deep water penstocks evaporative loss is increased as a result of storing warm incoming water and releasing cold water. Low dissolved oxygen in the discharged water also reduces the capacity of the stream to receive organic pollutants, and the discharge of hydrogen sulfide and other reduced substances lowers downstream water quality and in extreme cases results in the killing of fish.

The sociocultural impact of the reservoir comes about in the displacement of the inhabitants of the area flooded, as in the case of the town of Pantabangan in the UPRP site. This situation is to be repeated when the dam for the Magat River project is constructed, and in several other projects. In the case of Pantabangan, most of the relocatees elected to settle in an area near the reservoir, and therefore certain risks must be taken into consideration. The crowding in the new settlement area resulted in a relatively high population density, which increases the probability of environmental deterioration owing to the development of a new land-use system in which orchard and vegetable farming, and grazing are emphasized. This likely may happen unless a suitable land-use plan is evolved and properly implemented, wherein agroecological factors are considered. This land-use plan must be an integral part of a reservoir-management blueprint outlining the pattern of all land-uses within the reservoir site.

The greater impact on the environment will, however, occur in the irrigation service area of the dam in the lowlands of Nueva Ecija. The area to be affected is approximately 72,000 hectares in extent; here there will be a shift from seasonal farming dependent primarily on rainfall to year-round farming operations utilizing the impounded water for irrigation. As a result, it is expected that hydrologic changes will take place, that is, the water table will rise because of continuous percolation and seepage. The effects of the increased use of fertilizers,

pesticides, and herbicides upon water quality will likewise become more pronounced. Siltation or sedimentation in the irrigation service area will be insignificant, however, since most of the materials will be trapped in the reservoir. Reforestation within the reservoir site will nonetheless be a must if siltation of the dam is to be minimized. The likelihood of the appearance of certain diseases like schistosomiasis is quite high. Schistosomiasis, a snail-borne disease, may find the waterlogged lands a very suitable habitat.

### Conclusions

The rational utilization of natural resources, preferably preceded by an inventory and survey, should be one of the basic steps in the country's economic development program. Although much is already known about the existence of these resources and the means for their development, more remains to be known about them. A major task in the Philippines, specifically in regional development, is still to determine just what natural resources are available and what are the most efficient methods of using them in a rational way. Natural resources must never be sacrificed for immediate short-term benefits.

The study of the UPRP will attempt to provide some insights into the changes that are expected, as well as unexpected, not only in socioeconomic conditions but also in the physical environment. Not just portions or units of the area will be observed but the *whole*, however broadly, so as to better appreciate the more practical aspects of regional development.

### Note

At the time he read this paper, Telesforo W. Luna, Jr. was director of the Upper Pampanga River Research Project, National Development Research Center, University of the Philippines System.