

SUGGESTED RESEARCH AND DEVELOPMENT OF WATER RESOURCES OF THE PHILIPPINES

by

DOMINADOR Z. ROSELL¹

GENERALLY, many people have taken water for granted. "How many of them know what water is about?" asked Dr. William E. Warne, Director of the California Department of Water Resources. "Not one in a million." Yet the people who use water, who pay taxes and vote on the bond issues for water development and economic commitments that will ensure a steady flow of water, do not know much about this valuable commodity. Though it may be considered a gift of God, water must be properly harnessed and husbanded by the people (1).

In a country like the Philippines located within the region of tropical rainy climates and in the tropical rainforest areas (2) water is abundant, throughout the year. Rainfall is high — its mean annual ranging from 77.26 inches (197.24 cm) in the Cagayan Valley (Northern Luzon) to 128.08 inches (315.32 cm) in the Bicol Region (Southern Luzon) and in Western Visayas (Central Philippines). In general there are two seasons — the wet and dry. Wet in summer and autumn, and dry in winter and spring (3). In spite of this condition, however, the water resources in this country is becoming a serious problem to the government.

The population of the Philippines as of July, 1974 was 42,000,000. It is increasing by about a million people a year. There is a good deal for people needing additional domestic supply of water, perhaps at an average of 50 gallons per person. While we have to increase our domestic water use by 50 million gallons per year, yet we have not done much to solve the problem of increasing the supply. The other problem is whether we are trying to utilize the same water supply wisely, without impairing the normal requirements of the people.

Another implication follows. With one million people that are being added every year, substantial amounts of food, clothing, and shelter have to be provided to take care of our people. To produce these requirements would mean either increasing the productive capacity of

¹ Chairman, National Committee on Geographical Sciences, NSDB, Professorial Lecturer in Geography, University of the Philippines, Diliman, Quezon City and formerly Administrator, Irrigation Service Unit, Department of Public Works and Communication.

our soil by improved agricultural technology on the same area of land, or increasing the area to be cultivated. In either case moisture requirements and irrigation facilities are cardinal necessities.

Consideration to these questions can be done through regimental scientific researches on the water resources of the Philippines and the proper coordination of research activities of the country.

PRIORITY IN WATER RESOURCES RESEARCH

Prior right to the use of water according to Western US Standard is arbitrarily listed as (a) Domestic use, (including normal farm and stock use), (b) Municipal use, (c) Irrigation use, (d) Industrial use, (e) Water Power use, and (f) Recreational use. This order of priority is dependent upon geographical location, such as centers of population, activity, and distance from such centers.

In the utilization of our water resources, there is a great need of understanding the inter-related patterns which involve three intertwined dimensions or fields of endeavors that when put together consist of a unified framework for water management policies and decisions (6). Ray Y. Gilda, Jr. further stated that water as migratory resource dependent upon the character of the hydrologic cycle can well be studied and researches conducted on the basis of the synthesis of geographic, economic, and legal disciplines.

GEOGRAPHIC ASPECTS OF WATER RESOURCES RESEARCH

The geographic dimensions of water research points out the range and bounds of physical possibilities in terms of resources and uses of water. Physical facts concerning the rate at which the hydrologic cycle creates water products of a specific quality at a particular time and place are urgently needed in order to evaluate the cycle itself. Geographical data regarding the intensity and variability of precipitation, the water-holding capacity of individual soil type, and the capacity of ground-water storage are of paramount importance.

Eugenio E. Manalo, Chief, Climatological Division, Weather Bureau made a good study on the distribution of rainfall in the Philippines (7). Data gathered in this kind of work are needed for the interpretation of precipitation pattern in the Philippines. Since 1918 it has been accepted, almost without question, that there are four types of rainfall in the Philippines, as follows (8):

Type I — Two pronounced seasons: dry in winter and spring, wet in summer and autumn. (There is pronounced rain period in summer and autumn).

Type II — No dry season with pronounced maximum rain period in winter.

Type III — (Or Intermediate A type) no very pronounced maximum rain period with a short dry season lasting from one to three months.

Type IV — (Or Intermediate B type) no very pronounced maximum rain period and no dry season.

Cruz and Mendoza reclassified the rainfall in the Philippines with emphasis on Agricultural Meteorology (9). They came out with seven types of rainfall.

Agriculture and engineering projects can not be properly designed without appropriate geographic and physical data on quality of soils and capacity of ground water. Infiltration studies on a grassland watershed in Northern Nueva Ecija, Philippines as reported by Angeles (10), is worthy of consideration in undertaking hydro-electric project. Similar research should be conducted in other parts of the country. Sonido's application of geophysical exploitation to hydrological and engineering projects is an important physical and geographical piece of work (11).

In irrigation agriculture, researches on irrigated rice have been done by many agricultural engineers particularly in the College of Agriculture, University of the Philippines at Los Baños and similar studies conducted in other regional stations of the Bureau of Plant Industry, Department of Agriculture and Natural Resources. Rice Irrigation research in the College of Agriculture and Central Experiment Station at Los Baños as reported by Aglibut et al (12) records, among others, a number of previous studies on duty of water for rice in communal irrigation systems and survey of irrigation practices.

Valuable contribution to water research can also be made by cultural geographers. Watershed management problems often involved human problems arising from such action as the destruction of valuable recreational facilities which are used against a background of old fashioned customs and conducts. Mariano and Ursua (13) made observations of the attitude of the farmers utilizing pump irrigation waters to increase the yield of rice per unit area in the Bicol Regions of Southern Luzon.

ECONOMIC ASPECTS OF WATER RESOURCES RESEARCH

The economic dimensions of water research is aimed at knowing how to minimize the satisfaction of human heart. The range of economic practicability is made larger by technological innovations, changes in costs and revenue, and is contingent upon what is physically and institutionally possible. The contribution of economics towards achieving this goal should largely be a matter of collecting and interpreting basic data.

Many of the basic facts necessary to determine the value of water for various purposes are not yet available in our country. However, Cruz and Laudencia (14) in their "Irrigation of Rice by Pumping" gives us an idea of the cost of irrigating rice crops by pump irrigation system and the estimated income for one dry season crop operation. Due to regional variability of labor cost, transportation, and prices of prime commodities, similar work should be conducted on regional basis.

Problem such as the economic advantage of adding an inch of water to specific standing crops has not as yet been solved; and therefore, many irrigations are unable to evaluate accurately the desirability of constructing water control devices. Economics can also contribute in a large measure to cost-benefit studies. As a matter of fact, this is one aspect of research work which should be given prior attention. This type of research is often used in evaluating the economic feasibility studies and scale of development of water management structure.

For the last fourteen years, pump irrigations systems in the Philippines has shown that pump irrigation on rice and other crops pay. Rosell (15) in his "Two years of Philcusa-FOA Pump Irrigation Program in the Philippines" pointed out that pump irrigation pays.

To further realize the maximum benefits in the use of water, researches on losses due to seepage in canal has been worked out using lined canals constructed out of materials locally procured.

INSTITUTIONAL AND/OR LEGAL DIMENSIONS IN WATER RESOURCES RESEARCH

This aspect of water research indicates whether or not human behavior will allow measures that will meet the physical and economic tests to be put into effect. At present, property rights in water or water rights in common usage need to be defined in a precise manner in order to provide the stability necessary to justify long-term investment in water management facilities which the Philippines water right laws have. They have to be re-examined to allow amendment to conform with the present rapid trend of water use and their need in our growing population. Hutchins (16) in his "Water Rights Doctrines in the Western States" clearly defined a number of doctrines which are applicable to the Philippines. Hutchins stated — "rights to the use of water course on both surface and subterranean, are governed by Appropriation and Riparian Doctrines." The Appropriation Doctrine accords a prior right to the person who first diverts water and puts it to beneficial use on or in connection with the land whether adjoining or many miles away from the stream. In the Riparian Doctrine, the owner of the land adjoining a water course has a right to use the

water for beneficial purposes on such land. Ellis (17) in his "Water Rights in the Eastern States," stated that in the case of the Eastern States, Prior Appropriation Doctrine generally has not been applied. The "Riparian Doctrine" is usually applied by Eastern Courts to the use of national water courses. For irrigation purposes and other consumption purposes water use is governed by one or other doctrines such as the Natural Doctrine and the Reasonable Use Doctrine.

These and other laws or doctrines in water use should be studied in the Philippines to update our statute and avoid conflict in the use of water for varied purposes.

Another problem facing our country today is the lack of adequate water terminology. For example, what is a navigable river? What are the riparian rights of an owner of land by the lake, bay shore or by the river bank? These and many other problems in water resources use and conservation should be answered through research on a legal dimension.

THE NEED FOR RESEARCH COORDINATION

In war or in peace, coordination is a vital factor in any operation designed to achieve any desired objective. In research where there is freedom of thought and action, it is even more important to have coordination. "Coordination involves the catalysis and facilitation of the research endeavor through various means of assistance, provisions, and exchanges of information. Necessary tools and utility equipment are secured and supplied to pave and ease the path towards the smooth pursuit and solution of problems thereby posted" (18). Realizing the importance of this fact, the Science Act of 1958 created the National Science Development Board with the important function, among others, of achieving coordination of scientific researches and technological development of the country.

The National Science Development Board besides having under its direct supervision implementing agencies, coordinates research activities of several technical bureaus, corporations, agencies, and offices of the various executive departments of the Philippines. The University of the Philippines, likewise, after discovering herself in a nonwieldy business in research activities has established in 1961 the Office of Research Administration vested with the function among others, of coordinating and supervising all research activities in the University. Lately, it was further reorganized and named "Office of Faculty Research and Extension Service."

Coordination of scientific researches and technological development, therefore, was achieved after the establishment of the National Science

Development Board. The need for full and complete coordination is necessary to achieve economy, effective control, and efficiency.

RESEARCHES ON DOMESTIC AND MUNICIPAL USE OF WATER RESOURCES

No country can be healthy and happy if it is thirsty. It is incumbent therefore of that country that its government provides ways and means of making available, at all times, sufficient quantity of water for domestic and municipal use. The growing demand for water and its effect on total water resources are likely to become the number one domestic issue locally, regionally, and nationally. The City of Manila and its environs have felt this issue. Each year for several years during dry season, water shortage occurs.

Increasing population demand increasing amount in the use of water. This is a normal consequence. Increase in the level of standard of living also increases our capita water consumption.

The per capita water requirement in the Philippines has been conservatively estimated at 50 gallons a day. For 42 million people in the country about 2,100 million gallons of water is required every day. This amount does not include water used in agriculture, manufacturing, and mining industries.

It is possible that the problems involving domestic and municipal use of water resources can be resolved through coordinated research. Problems such as increasing population, inadequate facilities, and availability of water supply on certain time of the hydrological cycle can be resolved if we have determination and coordination in research program other things being considered. The National Science Development Board may provide the leadership and financial assistance of the national research program in this area and aspect of water utilization.

RESEARCHES ON WATER FOR IRRIGATION AGRICULTURE

It has been proved positively that irrigation increase the yield of crops by as much as 50 to 100 percent. Hence, the demand for irrigation facilities in agricultural areas has increased. Today there are more people requesting for irrigation facilities to irrigate their lands than there are water available in the river and other sources.

Aglibut (19) stated that research is essential for improving irrigation facilities and techniques. "Irrigation is a basic factor in increasing the productivity of Philippine agriculture. Research on the use of local materials and on proper methods of lining canals is called for to reduce seepage in conveyance and distribution channels. Re-

search data are needed for the economical delivery of water and its efficient application and the prevention of water logging of valuable fields especially those along canals. The best methods of applying water to the land under different soil conditions and stages of crop growth have to be determined. The merit of flooding, furrow, sub-surface, and overhead sprinker methods under different environments have yet to be evaluated both quantitatively and qualitatively. The practices followed for certain crops in other countries may not be suitable in the Philippines. The result so far obtained in a few research institutions and agencies are still too inadequate for general use. Additional data on crop requirements are needed to enrich existing knowledge on the proper amount of application at the appropriate time for the specific environment would redound to more efficient use of irrigation water."

It is indeed important that such forms of water as gravitational water, capillary water, and hygroscopic water in relation to their availability for plant growth must be studied. The program of research in irrigation agriculture has a wide scope that will involve the governmental agencies mentioned elsewhere in this paper. This will make the research activities a well integrated and coordinated work which are more effective and beneficial to the country. This teamwork approach will give more work done at a minimum cost.

RESEARCHES ON WATER RESOURCES FOR INDUSTRY

The social and industrial problems of water have been the subject of public discussions due to widely publicized recurring water shortages, especially during the dry months of the year. This situation arises simply because of our characteristic climatic conditions of wet and dry seasons. During the dry season, especially when there is a prolonged one, water shortage caused unreasonable destructions to crops and livestock, and a disgusting and uncomfortable stoppage of daily activities causing the lowering of production in industries. Our rapidly expanding industries and the yearly increase in population are sufficient reasons for the scientists and the government to act on this subject.

How much water does industry need to produce a unit of product? This question has been answered already in many parts of the world where manufacturing industries are in advanced stage. We can start from that point and proceed to program our researches. A number of government agencies and private sectors can very well coordinate and organize research teams. Technical men of the following agencies can compose the research team: (a) Metropolitan Waterworks and Sewerage System, (b) National Irrigation Administration, (c) National Power Corporation, (d) Bureau of Mines, (e) Private Well Drillers Association,

and (f) Philippine Atmospheric, Geographical and Astronomical Services Administration (PAGASA).

COORDINATED RESEARCH PROGRAM ON WATER RESOURCES IN THE PHILIPPINES

On the basis of the observation mentioned earlier, the following fundamental facts are hereby given to illustrate how water research is to be carried in the Philippines to show a coordinated research program:

- I. Institutions and agencies that should conduct researches
 - A. Government Agencies
 1. Bureau of Public Works
 2. Metropolitan Waterworks and Sewerage System
 3. Department of Health
 4. National Power Corporation
 5. P A G A S A
 6. Bureau of Mines
 7. National Irrigation Administration
 - B. Private Agencies
 1. Private Well-drillers Association
- II. Some of the major areas of research
 - A. Water Utilization
 1. Geographic and physical aspect
 2. Economic aspect
 3. Legal aspect
 4. Industrial use
 5. Water power use
 6. Recreational use
 - B. Priority in use of water
 1. Domestic use
 2. Municipal use
 3. Irrigation use
 4. Industrial use
 5. Water power use
 6. Recreational use
 - C. Hydrologic aspect
 1. Regional study of hydrologic cycle
 2. Hydrological cycle and vegetation of the area
 3. Precipitation intensity and flood frequency of an area
 4. Revision of the climate types by rainfall of the Philippines
 - D. Survey of surface fresh-water areas
 1. Navigable and non-navigable rivers
 2. Possible supply of fresh water from lakes

- 3. Rivers and their water potential
- E. Survey of underground water
 - 1. For shallow wells
 - 2. For deep-wells
 - 3. Deep-wells for industries
- III. Some of the specific subjects of water resources research
 - A. Geographical utilization of water for industry, irrigation, and water power
 - B. Economic aspect of irrigation by gravity and pump systems
 - C. Study of water rights problems in agriculture and in manufacturing industries
 - D. Hydrologic Cycle and flood control
 - E. Micro-climate studies
 - F. Underground water surveys of Central Luzon areas and in center of population
 - G. Studies on per capita consumption of water in Manila and metropolitan areas and in other centers of population
 - H. Water Pollution and the manufacturing industries
 - I. Water pollution and the agricultural chemical industries
 - J. Water for recreational purposes

SUMMARY

Water at the command and control of man to produce food, to sustain lives, to run mighty engines that provide power and light, to clean the hands of surgeons that save lives, and water that plays an indispensable part in the processing of millions of industrial products enters in an era of complicated use. Once upon a time a valueless commodity, is becoming precious as the world's populations increase several times. The water problem, therefore, becomes bigger and complicated every day.

Realizing this grave situation, the developing nations have enlisted the cooperation of the more advanced nations through the United Nations in the water program known as International Hydrological Decade (1965-1974). During this time the scientists participating countries will coordinate their search for ways and means of utilizing more efficiently and effectively the earth's water resources.

REFERENCES

1. *Time, The Weekly Magazine*, October 2, 1965, pp. 30-41.
2. Espensande, Edward B., Jr., *Goode's World Atlas*. Rand McNalley, 12th Edition, 1964.
3. Manalo, Eugenio B., "Distribution of Rainfall in the Philippines," *Philippine Geographical Journal*, Vol. IV, No. 4, Oct.-Dec., 1956, Special Issue, pp. 104-168 with maps.

4. Rosell, D. Z., "Water Pollution, A Conservation Problem in the Philippines," *Philippine Geographical Journal*, Vol. IX Nos. 3-4, July-Dec., 1965.
5. ———, "Republic Act 2067, Science Act of 1958," Bureau of Printing, 1958.
6. Gilda, Ray Y., Jr., "Synthesis of Geographic, Economic and Legal Disciplines in the Analysis of Water Management Problems," *Journal of Geography*, Vol. LVI, No. 9, December, 1957 pp. 433-437.
7. Manalo, Eugenio B., "The Distribution of Rainfall in the Philippines," *Philippine Geographical Journal*, Vol. IV, No. 4, October-December, 1956, Special Issue, pp. 104-168 with maps.
8. Maso, Miguel Sadura, Rev., "Annual Amount and Distribution of Rainfall in the Philippines," Weather Bureau, Manila, 1918.
9. Cruz, Santiago R. and Teofilo M. Mendoza, "Agricultural Meteorology, Philippine Rainfalls," *Philippine Geographical Journal*, Vol. III, No. 2, April-June, 1955. Reprinted from *Philippine Journal of Agriculture*, Vol. 15, Nos. 3-4, 1950.
10. Angeles, Leonardo D., "Infiltration Studies on a Grassland Watershed in Northern Nueva Ecija," *Philippine Geographical Journal*, Vol. VII, No. 2, April-June, pp. 102-113.
11. Sonido, Ernesto P., "Application of Geophysical Exploitation to Hydrological and Engineering Projects," *Philippine Geographical Journal*, Vol. VII, No. 3, July-September, 1963, pp. 143-168.
12. Aglibut, A. P., A. B. Catambay and Harold E. Gray, "Rice Irrigation Research in the College of Agriculture and Central Experiment Station," *Journal of the Soil Science Society of the Philippines*, Vol. VIII (4th Quarter), 1956, pp. 203-207.
13. Mariano, L., Jr. and Raoul R. Urusa, "The Changing Attitude of Farmers in Pump Irrigation Areas in the Bicol Provinces," *Philippine Geographical Journal*, Vol. V, January-June, 1957, pp. 26-36.
14. Cruz, Santiago R. and Pedro N. Laudencia, "Irrigation of Rice by Pumping," *Journal of the Soil Science Society of the Philippines*, Vol. VIII (4th Quarter), 1956, pp. 208-222.
15. Rosell, Dominador Z., "Two Years of Philcusa-FOA Pump Irrigation Program in the Philippines," *Philippine Geographical Journal*, Vol. III, January-March, 1955, pp. 9-30.
16. Hutchins, Wells A., "Water Rights Doctrines in the Western States," *Farm Policy Forum*, Vol. VIII, No. 2 (Fall), 1965, pp. 17-21, the Iowa State College Press, Ames, Iowa, U.S.A.
17. Ellis, Harold H., "Water Rights in the Eastern States," *Farm Policy Forum*, Vol. VIII (Fall), 1955, pp. 22-26, The Iowa State College Press, Ames, Iowa, U.S.A.
18. Rosell, Dominador Z., "Organizational Set-up of Research Institutions: Government Sector," *Proceedings of the Symposium by Gamma Sigma Delta, Phi Sigma Biological Society and Society for the Advancement of Research*, December 3, 1966, Manila.
19. Aglibut, Andres P., "Editorial," *Philippine Agricultural Engineering Journal*, Vol. VII (2nd and 3rd quarter) September, 1966, p. 14.
20. Ad Hoc Committee on Irrigation, *Irrigation Guide for the Philippines National Committee on Irrigation Research*, Manila, 1966, p. 17 with appendix (mimeographed).
21. Chow, Lee, "Report on a Brief Study on Irrigation in the Philippines," June 16-August 4, 1966. University of the Philippines, College of Agriculture, College, Laguna, August 1966 (mimeographed).