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The workshop was designed to bring together Philippine and American scientists, engineers, educators, and administrators for collaborative identification of problems and issues relevant to the workshop theme, development of possible alternative solutions to the problems, and suggestions for ways to strengthen the host country's capacity to plan and manage environmental education programs. The participants represented an impressive array of experience from universities and other educational organizations, private industry, national agencies for environmental regulation, development planning, and other functions related to the workshop theme, public utilities, and local government agencies. While the NSDB and NAS served as joint sponsors of the workshop, program coordination was carried out by the National Pollution Control Commission (NSDB) and the Board on Science and Technology for International Development (NAS).

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WORKSHOP ON EDUCATION AND TRAINING NEEDS FOR PHILIPPINE ENVIRONMENTAL PROGRAMS

May 27-31, 1974
Manila, Philippines

Published by: National Pollution Control Commission
National Science Development Board

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The sponsors and organizers of the workshop were fortunate in having the assistance and cooperation of a great many people and organizations. Thanks and appreciation are extended to the contributors of the background and information papers, to the Philippine Women's University for the hospitality and entertainment arranged for the participants, to the organizations and institutions which served as hosts during the field trips, and to the workshop Secretariat, whose members worked long and faithfully to provide administrative and logistical support.

The sponsors and organizers are indebted to all the workshop participants for their active interest, lively discussion, and wise counsel.

Participation in the workshop by National Academy of Sciences panel members was made possible through the financial support of the Office of Science and Technology, U.S. Agency for International Development.

The National Academy of Sciences participants wish to express their gratitude and appreciation to their Philippine hosts and colleagues for the warm hospitality extended to them, for the opportunity to exchange views on a subject of mutual interest and concern, and for the chance to learn more about the environmental programs of the Philippines.

Finally, the National Academy of Sciences participants are particularly grateful for having had the honor and privilege of being received by the Philippine's First Lady, Mrs. Imelda Romualdez Marcos. The First Lady displayed a depth of knowledge about environmental concerns and a determination to further strengthen national environmental programs that should be a source of great satisfaction and encouragement for the people of the Philippines.

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SECTION A: INTRODUCTION

WORKSHOP BACKGROUND

The selection of "education and training for Philippine environmental programs" as a workshop topic was influenced by several basic factors:

— As a country with rapid economic development, much of which is based on natural resources, the Philippines faces many potential environmental strains; at the same time, the pace of development has been such that country still has an excellent opportunity to identify many potential environmental problems, develop programs to control or resolve these problems, and plan future development in a manner consistent with sound environmental concepts.

— The Government of the Philippines has demonstrated its concern and awareness of the need to achieve economic development in a manner compatible with minimal harm to the natural environment and with the wise stewardship of natural resources. This concern has been evidenced by legislation, by the establishment of a National Pollution Control Commission, and the Environmental Center of the Philippines, by the formulation in 1971 of a four-year National Environmental Pollution Control Program, and by many existing programs of environmental education and training.

At present in the Philippines the supply of trained environmental scientists, engineers, technicians, planners, and managers in both the public and private sectors is limited. There must be an increase in the numbers of these professionals if national environmental objectives are to be realized. Basic awareness of environmental concerns should be imparted to professionals whose work is outside the environmental sciences but whose attitudes and decisions may have important environmental consequences — planners, industrialists, and public administrators. Public understanding of environmental issues must be developed in order to provide a climate of concern that will serve as a foundation for wise environmental planning and management

The Workshop on Education and Training for Philippine Environmental Programs continues the close scientific cooperation between the National Science Development Board (NSDB) of the Republic of the Philippines and the National Academy of Sciences (NAS) of the United States of America.

This cooperation, begun in 1965, has included four workshops.

The first Philippines — U.S. Workshop on Scientific and Technological Cooperation and Development, held in Manila in November 1965, focused on the challenges and potential for science and technology in the Philippines, scientific manpower needs, requirements for applied and basic science facilities, and mechanisms for increasing scientific cooperation between the Philippines and other countries.

In November 1966, a second workshop, held at Asilomar, California, recommended four areas for further cooperative activity — industrial research, oceanography and fisheries, food and nutrition, and demography. A third workshop (Manila) in December, 1967, addressed problems of fisheries and oceanography, and the fourth workshop (Baguio) in January, 1969, examined problems of industrial research.

During a visit to the United States in 1972, NSDB Chairman Florencio A. Medina began discussions with the NAS concerning future collaborative activities. These discussions were carried on when NAS staff members visited the Philippines in 1972 and 1973, resulting in mutual agreement between the two organizations that a workshop on environmental education should be held in 1974.

The workshop was designed to bring together Philippine and American scientists, engineers, educators, and administrators for collaborative identification of problems and issues relevant to the workshop theme, development of possible alternative solutions to the problems, and suggestions for ways to strengthen the host country's capacity to plan and manage environmental education programs. The participants represented an impressive array of experience from universities and other educational organizations, private industry, national agencies for environmental regulation, development planning, and other functions related to the workshop theme, public utilities, asd local government agencies. While the NSDB and NAS served as joint sponsors of the workshop, program coordination was carried out by the National Pollution Control Commission (NSDB) and the Board on Science and Technology for International Development (NAS).

The broad objectives of the workshop were as follows:

— To identify both immediate and long term requirements for professional and technical manpower needed for planning, management, and regulation in furtherance of national goals for conservation and the quality of the environment.

— To consider the estimated supply of trained manpower related to environmental concerns versus estimated requirements in both the public and private sectors, and to suggest ways of dealing with oversupply or shortages.

— To suggest ways to accomplish the following:

a. strengthen existing education and training for environmental professionals and technicians, emphasizing interdisciplinary approaches to environmental planning and problem solving;

b. begin environmental training programs which are not now offered in the Philippines, but for which there is a need;

c. develop new kinds of environmental training programs which stress conditions and needs in the Philippines and maximize benefit/cost ratios of the training;

d. develop greater awareness on the part of the public, especially businessmen and industrialists, of the physical, social, and economic consequences of environmental damage.

The proceedings and recommendations of the workshop have been submitted to the Office of the President, the National Economic and Development Authority, and other appropriate agencies of the Philippine government for their consideration. The proceedings of the workshop also will be made available to educational institutions, local governments, and industrial concerns.

OPENING CEREMONY

OPENING REMARKS

By DR REYNALDO M. LESACA
Commissioner
National Pollution Control Commission

Dr. Rohlich, Chairman Medina, Mr. Garcia, ladies and gentlemen. This morning marks the opening of the fifth and hopefully not the last workshop between United States and Philippine scientists. Some of you may recall that the first workshop was held here in Manila November 22-26, 1965, on Scientific and Technological Cooperation and Development. The second one was held in Pacific Grove, California. Thus the last one November 6-10, 1966, and also dealt with cooperation in science and technology. The third was held again in Manila on Fisheries and Oceanography in 1967 and the fourth in Baguio City last January 26 to February 1, 1969 on industrial research was held more than 5 years ago.

The present workshop, dealing as it does with education and training needs of environmental programs in the Philippines, may be considered as a logical culminating result of a series of international events.

First of all, the UN conference on the human environment held at Stockholm June 5-12, 1972, focused worldwide attention on the frailty of our biosphere, particularly in the light of present day assaults by man's inventive technology and consumption of non-renewable natural resources. Part of the legacy of Stockholm lies in its now famous "declaration on the human environment". Its principle 19 reads

> "education in environmental matters for the younger generation as well as adults, giving due consideration to the underprivileged, is essential in order to provide the basis for an enlightened opinion and responsible conduct by individuals, enterprises and communities in protecting and improving the environment in its full human dimension. It is also essential that mass media of communications avoid contributing to the deterioration of the environment but on the contrary, disseminate, information of an educational nature on the need to protect and improve the environment in order to enable man to develop in every respect".

As a result of Stockholm, a new UN agency or body was created, the UNEP, both the US and the Philippines becoming members of its 58-member governing council. Among the principal activities of UNEP in its environmental program is the functional task of information, education, training and technical assistance and at its second session held in Nairobi an appropriate resolution was adopted calling for action on this activity area at regional, national and specialized levels.

Thus in a way, this bilateral workshop we are holding today is our pledge and reaffirmation of our continuing commitment to environmental action aimed at promoting the quality of life of the Pilipino. Already the pace of the country's industrialization has accelerated in tempo and the spectre of environmental degradations and pollution has started to rear its ugly head. Under the aegis of the NPCC, one of the operational units of the NSDB, the pollution problem is being identified, analyzed and possible solutions formulated and implemented.

In the process of implementation of possible solutions to these environmental problems, the question of trained personnel quite naturally arises. How do we prepare for the needed manpower on all levels to carry out the national environmental program now and in the foreseeable future? This is a primary topic to which we have to address ourselves for the next few days.

While our overseas guests are within our shores, we hope that they could sample the native hospitality of the Filipino. Although we are under a regime of martial law, you will all note that there are few signs if any of the military around. In the new society we have started to build, we emphasize positive action, creativity, application of native ingenuity and culture but without fear of adopting foreign technology and innovative approaches to problem solving. You will see with your own eyes the current local situation and you can judge for yourself the truth or falsity of whatever our detractors abroad have been saying to discredit the present dispensation.

In the name of the National Pollution Control Commission, may I welcome you to our country, our city, our premises and our hearts.

WELCOME ADDRESS

By BRIG. GEN. FLORENCIO A. MEDINA
Chairman, Philippine Delegation
Chairman, National Science Development Board

Dr. Rohlich, Dr. Lesaca, distinguished scientists, environmentalists, distinguished guests: I am happy that I have been given the pleasant task of welcoming you all to this Workshop on Education and Training Needs for Philippine Environmental Programs. I also welcome you to the Philippines. Sometime in October 1971, I had a stopover in Washington DC, while on my way back to the Philippines from the 16th Conference of IAEA in Vienna. The NSDB Science Attache in Washington, Dr. Lazatin, very graciously consented to get in touch with the officials of the American National Academy of Sciences. Among the things that we discussed were the RP-USA cooperation in typhoon research and the workshop on environmental programs. I am glad indeed that this workshop is to start. There was a lag in time, but we were very patient. Mr. Hurley has been coming to the Philippines several times to help plan this workshop.

There are three (3) objectives of this workshop, namely: to estimate trained manpower needs of the Philippine Environmental Program, to identify immediate and long term requirements for general, professional and technical training, and to recommend measures to improve existing training programs and develop any training program to fill the gaps not covered with the existing ones. The Philippines does not have the monopoly of environmental problems, as is true of most countries, especially the developing ones, or those aspiring to attain sustained economic growth that outpaces the rapid rate of the population growth. There is an increased rate of demand on industrial and agricultural productivity and an insatiable desire for more and better forms of transportation and communication, more urbanization, and centers of population that result in an increase in pollution.

Environmental deterioration, without doubt, is traceable to the manipulation of the environment. Man has done this without the least thought that while he enjoys he also destroys the peace of the environment, that while he is enjoying a life of prosperity the environment is also getting depleted of natural resources. While he is in good health, and while he is enjoying happiness, that happiness cannot be forever.

Let us hope that after this critical assessment of our environmental problems this workshop will be able to attain the objectives that I mentioned earlier. Then, our educational institutions of higher learning will be able to produce the manpower requirements of our environmental programs. I would like to think that these institutions will be able to produce the educated men who are trained and experienced, enriched with a brew of science and technology, seasoned with economic consideration and aged in the specialty of social sciences. This country will be able to undergo change and progress, which is development, with due regard for the environment. Then shall we be able to say to men, lead not this country into temptation but deliver us from pollution. As I welcome you now to our country, let us cooperate with each other in the continuing program. In Pilipino, Mga Kababayan magtulungan tayong lahat sa ikaunlad ng bagong lipunan at sa ikabubuti ng bagong Pilipino. I welcome you all to this workshop. Thank you.

REMARKS

By DR. GERARD ROHLICH

Chairman
National Academy of Sciences Delegation

Chairman Medina, Dr. Lesaca, distinguished members and guests of the workshop, and ladies and gentlemen. It is a privilege for me to be here as Chairman of the U.S. delegation from the National Academy of Sciences to join with counterparts here in the Philippines on this important subject of education and training in the field of environment. Just about a decade ago, as you well know, the environmental crisis or crusade began, mostly as the result of the interest of students and some professors at universities throughout the world. This movement, although initially an emotional crusade is now recognized as having lasting duration and certainly a significant impact on environmental policies and implementation of these policies in all of our activities. It seems to me therefore, that it is particularly fitting and a peculiar responsibility of the educational community to attempt to provide that kind of fruitful contemplation that is necessary in order to transform what was considered a crisis into a positive and lasting movement for environmental control, and for the provision, as Chairman Medina pointed out, of necessary manpower to carry out the environmental programs that will be needed in the future.

We find, of course, many cyclic movements in the training of engineers and scientists, including social scientists as well as natural scientists. We find cyclic movements in the production and in the use of such manpower and this must be considered in our educational programs at the professional level. We find also, of course, that in addition to the kinds of educational programs needed at the university level, there is a genuine requirement for training people at the technician level and also for the general education of informed citizens in order that the solution of environmental problems can be based on sound knowledge and transmission of the attitudes and opinions of the citizen to the decision maker.

I wish to take this opportunity, and it is my privilege. to bring to you the greetings of Dr. Philip Handler, President of the US National Academy of Sciences, and of Dr. Harrison Brown, the Foreign Secretary of the Academy. Both of these scientists have manifested, through many of their activities, a genuine interest in the type of workshop that we are undertaking during this next week.

It is a privilege and honor to be with you this week to exchange ideas with all those concerned. Thank you very much.

SECTION B: WORKSHOP PROCEEDINGS

AGENDA

The value of a workshop lies in the opportunity for candid and lively discussion among participants with a wide range of professional backgrounds and experience. The agenda was planned, therefore, to minimize formal presentations and addresses, and to maximize the life spent on the interchange of ideas focussing on the topic of the workshop.

While the focus of the workshop was on the discussion of issues, it was necessary and helpful, of course, to present certain basic background information and concepts as a context for the subsequent working sessions. These presentations were given on the workshop's opening day, May 27, and are reproduced in Appendix I of this report.

Working group sessions of the workshop were preceded by visits to a number of facilities and institutions with responsibilities for environmental planning, management, or education. These visits helped keep the deliberations of the workshop from becoming overly theoretical and provided an opportunity for workshop participants to test their ideas against the reality of day-to-day operations.

The agenda for the week of the workshop follows:

Monday, May 27, 1974

8:00 AM — Registration

9:00 AM — Opening Ceremonies

National Anthem

Opening Remarks — DR. REYNALDO M. LESACA, Commissioner, National Pollution Control Commission

Welcome Address — BRIG. GEN. FLORENCIO A MEDINA, Chairman, Philippine Delegation, Chairman, National Science Development Board

Remarks — DR. GERARD A. ROHLICH, Chairman, National Academy of Sciences Delegation

Master of Ceremonies

MR. BIENVENIDO N. GARCIA, Executive Officer, National Pollution Control Commission

9:45 AM — Break

10:00 AM — Plenary Session

"Environmental Problems in the Philippines"

DR. REYNALDO M. LESACA, Commissioner, National Pollution Control Commission

"The Environmental Aspects of Economic Development Programs in the Philippines"

DR. JAIME C. LAYA
Deputy Director-General
National Economic and Development Authority

12:00 Noon — Luncheon hosted by Dr. Reynaldo M. Lesaca
Commissioner, National Pollution Control Commission

2:00 PM — Plenary Session
"Educational Programs in Environmental Protection"

DR. JUAN MANUEL
Secretary
Department of Education and Culture

"Environmental Science Courses in Colleges and Universities'

MR. OSCAR MAPUA
President
Philippine Association of Colleges and Universities

"The Environmental and Natural Resource Protection Program of Puerto Rico"

THE HON. CRUZ A. MATOS
Secretary of Natural Resources
Commonwealth of Puerto Rico

3:30 PM — Break

4:00 PM — Open Forum

Tuesday, May 28, 1974

Field Trips (Whole Day)

8:00 AM — Assembly at P.J. Garcia Memorial Hall

Group A — Water Supply and Water Pollution Abatement
Places visited:
1. Magallanes Sewage Treatment Plant
2. Metropolitan Waterworks and Sewerage System Filtration Plant
3. Department of Public Works Transportation and Communication Planning and Project Development Office
4. Bureau of Public Works Water Resources Division
5. Laguna Lake Development Authority

Group B — Air Pollution Abatement
Places visited:
1. MERALCO Rockwell Plant
2. Island Cement Plant
3. Resins Inc.

Group C — Conservation of Natural Resources; Land Pollution Abatement
Places visited:
1. Bureau of Fisheries, Los Baños
2. University of the Philippines College of Agriculture, Los Baños
3. University of the Philippines College of Forestry, Los Baños
4. International Rice Research Institute, Los Baños

Wednesday, May 29, 1974

8:30 AM — Working Group Sessions

Venue
Group A — P.J. Garcia Memorial Hall
Group B — NIST Conference Room
Group C — FNRC Auditorium

1:30 PM — Working Group Sessions

4:00 PM — Plenary Session
Reports by group chairmen and rapporteurs

Thursday, May 30, 1974

8:30 AM - Dialogue with representatives of institutions and agencies involved in education and training

Dr. Fe Agoncillo
Dean, College of Education
Pamantasan Ng Lungsod Ng Maynila

Mr. Mauro Gonzales
Chief, Division of Education and Training
National Science Development Board

Dr. Domingo C. Salita
Dean, College of Arts and Sciences
University of the Philippines

Professor Quintin Tan
Asian Institute of Management
Mrs. Fleur de Lyz Torres
Assistant Director, Social Services Staff
National Economic and Development Authority

Dr. Leandro Viloria
Director, Institute of Planning
University of the Philippines

Moderator — DR. FILEMON A. URIARTE, JR.
Professor, College of Engineering
University of the Philippines

2:30 PM — Working Group Sessions

Friday, May 31, 1974

8:00 AM — Panoramic Tour of Metropolitan Manila

2:00 PM — Last Plenary Session
Final Reports and Recommendations

7:00 PM — Dinner at Coral Terrace, Manila Hilton, hosted by NSDB Chairman and Mrs. Florencio A. Medina

Closing Ceremonies

Remarks by:

BRIG. GEN. FLORENCIO A. MEDINA
Chairman, Philippine Delegation and
Chairman, National Science Development Board

DR. GERARD A. ROHLICH
Chairman, National Academy of Sciences Delegation

PROCEDURES

On the opening day of the workshop, a number of papers were presented to provide background for the participants. The papers addressed such topics as basic environmental problems of the Philippines, environmental aspects of the national development program, and programs and issues relating to environmental education in the Philippines and in the United States.

The workshop participants divided into three groups for field trips on the second day of the workshop. Visits were made to facilities and institutions related to 1) water supply and water pollution abatement, 2) air pollution abatement, and 3) conservation of natural resources and land pollution abatement. The visits provided an exposure to a variety of environmental programs and an opportunity to exchange views with practitioners in the field.

After the activities of the first two days, participants divided into three working groups for a series of discussions aimed at developing recommendations on the workshop theme. On Wednesday morning, the members of each group were the same as for the previous day's field trips. Discussion for the morning focussed on professional level education and training for specialties directly involved with or importantly related to the professional areas mentioned on the field trips. The groups considered the kinds of professionals needed in the particular areas or related areas, and the types of training, research and facilities appropriate for producing them. The groups also addressed such topics as continuing education or in-service training courses or professional programs are needed but are not now available, and aspects of existing training that might usefully be strengthened or expanded.

After the morning session, participants (excluding chairmen, co chairmen, and rapporteurs) were rearranged into three new groupings to achieve a good mix of professional specialties in each group.

The Wednesday afternoon working groups emphasized on general educational needs related to environmental concerns, with discussions on environmental education appropriate to university undergraduates as to students in primary and secondary schools, and to the general public.

In a plenary session on Thurslay morning, a dialogue was held with representatives of institutions and agencies involved in environmental education and training. The session provided an opportunity to hear the views of Philippine educators on environmental education and to engage them in discussion on some of the ideas raised in the working group meetings.

The three working groups met for a final session on Thursday afternoon. Discussions were aimed at preparing recommendations based on the previous plenary and working group sessions, giving attention, where appropriate, to the identification of important issues of policy and implementation.

The chairmen, co chairmen, and rapporteurs for the three working groups were as follows:

GROUP A

Dr. Jose Juliano	— Chairman
Dr. George Lythcott	— Co chairman
Mr. Teofilo Asuncion	— Rapporteur
Dr. M. B. Pescod	— Rapporteur

GROUP B

Dr. Filemon Uriarte	— Chairman
Dr. Gilbert Levine	— Co chairman
Mr. Pepito Abrajano	— Rapporteur
Dr Eugene H. McLar	— Rapporteur

GROUP C

Dr. Ignacio Salcedo	— Chairman
Dr. Lee Talbot	— Co chairman
Dr. Elvira Tan	— Rapporteur
Dr. John D. Costlow	— Rapporteur

Following the final working group session, the chairmen and rapporteurs of each group met to prepare a single, integrated set of recommendations in order to avoid duplication or overlap. This set of recommendations was presented at the last plenary session for discussion by all participants. After appropriate amendments and additions were made, the recommendations were adopted at the plenary session.

SECTION C: RECOMENDATIONS

A broad understanding of man's relationship to his total environment is essential to economic and social development and to the possibility of a more enriching life for citizens of the Philippines, as for all countries. Concern for the environment must be an integral part of the educational process from an early age and must be directed toward the public in general as well as those in schools. At the same time, there is an urgent need for highly qualified professionals to deal with environmental problems and to plan and manage the activities of government and the private sector with sound understanding of the impacts of their decisions on environmental quality.

The workshop participants had the privilege of hearing presentations and comments on a number of significant and varied Philippine programs that now exist or are being planned in environmental education, sciences, and engineering. Moreover, many fine professionals and technicians presently are working in environmental activities. With this solid foundation on which to build, the participants hope that their recommendations will help the Philippines to reinforce and further strengthen its educational programs in this crucial field. Based on their joint discussions, the workshop participants recommend the following:

General Education

1. **An emphasis on environmental education should come in the early elementary grades.** This early emphasis exposes environmental concepts to students who may be unable to continue their education; it also lays a foundation for environmental awareness in relation to further study, and for appreciation for land use decisions made by government.

2. **The important differences between environmental problems that concern rural populations and those that concern urban populations should be reflected in the content and materials of environmental programs for the schools and for the general public.** Understanding of the environment must be related to recognizable practical situations and problems. In the schools, for example, special programs such as poster contests, trash recycling, and composting can link environmental awareness with local conditions.

3. **An inventory should be made of the existing materials, programs, and trained people available for environmental education.** Many fine resources for environmental education already exist in the Philippines and should be made more widely available. At the same time, other educational materials should be surveyed in order to eliminate those that may present anti environmental concepts.

4. **Teacher training should provide a strong grounding in environmental concepts.** The training of aware, responsible citizens for the future depends on enlightened teaching.

5. **The policy of the public schools in the Philippines to include exposure to environmental matters in curricula should also be adopted by private schools.**

6. **Public education programs to create a broad awareness of environmental matters are essential and should be strengthened and expanded.** Important roles in this educational process can be played by the mass communications media, the rural health program of the Department of Health, projects of the Youth Civic Action Program, and barrio officials and mayors. Short courses and seminars could be useful to alert appropriate officials and organizations to the possibilities for public environmental education programs.

7. **University undergraduate programs in all fields of study, not only science and engineering, should include exposure to environmental concepts.** Curricula should be examined to determine the feasibility of combining or modifying existing courses with environmental aspects or of developing totally new courses. Although a variety of existing courses may include a consideration of environmental concepts and problems, many are frequently confined or isolated by traditional boundaries of courses, disciplines, or departments and every effort should be made to revise these to emphasize the dynamic interrelations of environmental concepts. Environmental courses should include historical-social aspects as well as ecological concepts, and might include field studies on actual social and development projects.

Professional Education

8 **A basic course including general environmental concepts and an appreciation of the systems approach should be a prerequisite to more specialized training for a variety of professional areas related to environmental concerns.** A number of such courses are already offered at existing universities.

9 **A comprehensive study should be made of manpower requirements and utilization in the environmental field.** Such a study, which might well be carried out by the National Science Development Board, the National Manpower Council, or the President's Task Force on Human Settlements, should assess the projected needs of government and the private sector for technicians as well as engineers, scientists, and managers involved wit. environmental programs. Where existing data on scientific and technical manpower becomes available, it should be analyzed with respect to professionals actually working with environmental matters. To avoid problems of coordination and duplication among agencies involved in the environmental field. (National Pollution Control Commission, President's Task Force on Human Settlements, Environmental Center of the Philippines, the universities, and others) these agencies should be involved with the study to help assess priorities of manpower requirements and total manpower needs. The results of the study should be used by educational institutions for guidance in establishing courses and student levels.

10 **A task force should be established to review university programs, resources, and facilities to determine how they can be strengthened to better meet environmental needs in the Philippines.** The task force might consider curriculum revision, short-term use of international faculty, and involvement of students with on-going environmental projects (such as the Laguna Lake Development Authority project) as part of their academic program. The task force should use the results of the environmental manpower study suggested in recommendations 9, or it might even be commissioned to carry out the study.

11 **The resources of government, industry, and the universities should be mobilized to strengthen and expand in-service training and short courses for environmental scientists, engineers, technicians, planners, and managers.** The rapid changes in the understanding of environmental problems and in environmental technologies require familiarization and upgrading of personnel practicing in the field. The special resources necessary for such training make it essential to have close cooperation among appropriate government agencies, industry, and the universities. The need to consider the environmental impact of development projects makes it important to provide short courses for industrial personnel with environmental responsibilities, and for governmental planners and decision makers to make them aware of the issues and approaches. In addition to helping with training itself, industry could play an important role by providing scholarships for high quality students to undertake the special training.

12. **An inventory of the existence and use of specialized equipment and materials in government, training institutions, and industry should be made to specify the major need for environmental technicians and identify where they might be trained most effectively.** The inventory also should examine the student capacity of institutions that train technicians and should assess the number of technicians presently being trained.

13. **High priority should be given to the training of managers of environmental control facilities to encourage proper plant operation and maintenance.** Plant operator and training courses in water and waste water system operation are now offered and should be expanded to include training in operation of other environmental control systems. Strong emphasis on good maintenance operations is critical for effective environmental control and for the protection of major investment in plant and equipment.

14. **Provision should be made to select professionals for appropriate advanced training to carry out long-term problem definition and planning in the environmental aspects of development.** Leadership by high level experienced professionals with broad background in environmental studies is needed to assess and evaluate

the long-term environmental impacts of developing programs. It is important that a program be initiated promptly to select and obtain support for individuals to prepare them for the required leadership roles.

15. **The resources and cooperation of appropriate United Nations bodies such as UNESCO or UNEP, bilateral or regional assistance agencies, or foundations should be explored with respect to possibilities of assistance in implementing the recommendations of the workshop.**

16. **Participation in regional and international environmental activities should be continued and strengthened.** The Philippines has much to contribute and much to gain in a continuing association with its neighbors, and also with nations throughout the world. Such associations will provide the Philippines with opportunities

— to keep abreast of the state of the art in the science and technology of environmental protection and improvement;

— to be aware of its responsibility to the community of nations in its continuing efforts to improve its own environment;

— to interchange with environmental agencies and professionals of other nations through participation in meetings and exchange of personnel.

17. **It is recommended that the National Science Development Board form an ad hoc committee to consider implementation of the workshop recommendations.** The committee could consider matters such as disseminating the workshop recommendations, assigning responsibilities where possible and appropriate, and establishing mechanisms for coordinating the agencies and institutions concerned with environmental education and training. Matters requiring policy decisions could be identified. Proposals for the help and cooperation of industry and external assistance agencies could be initiated.

APPENDICES

APPENDIX 1

BACKGROUND PAPERS

ENVIRONMENTAL PROBLEMS IN THE PHILIPPINES

By REYNALDO M. LESACA
Commissioner
National Pollution Control Commission

In recent years, environmental pollution has become a national concern. People have begun to understand its effects on their health and welfare and are starting to demand remedies to stop the increasing deterioration of our environment. This environmental concern, manifested by the increasing complaints against pollution received from different segments of the society, clearly indicates that the problems have reached a point which needs the support of everyone. If we ask ourselves why this issue came to national prominence lately, perhaps the answer that can possibly be offered is that people now are yearning for a change for the better in the quality of life.

SOURCES OF ENVIRONMENTAL POLLUTION

Water Pollution

Generally, the two main sources of water pollution in the Philippines are: (1) domestic wastes from the general public, which includes solid waste and domestic sewage, and (2) trade wastes coming from industry. Water pollution is not so intensive on the national level, and is limited to urban areas with concentration of industrial activity and high population density like the Metropolitan Manila Area, Baguio City, Cebu, Bacolod and Iligan City. Rural areas where isolated industrial establishments such as mines, sugar centrals, oil refineries, pulp mills and distilleries are located are already having water pollution problems as well.

Lately, increased agricultural activities, as part of the national food production program, are contributing to the pollution of our soil, rivers and other bodies of water due to the increasing use of fertilizers, pesticides, fungicides and herbicides to boost agricultural production.

Municipal Wastes

About 12% of the estimated 4 million population of Metropolitan Manila is served by a sanitary sewer system and approximately 67% of the sewered area uses the system. The rest either use septic tanks to treat their sewage or directly discharge it into esteros (canals), creeks and rivers without treatment. It is estimated that the pollution load coming from sewage alone in the area amounts to some 216 tons per day. Since the unsewered population constitutes 88% of the total population, it may be assumed that about 450 tons of pollutive materials are discharged into the esteros, creeks and river systems in the metropolitan area daily. On a percentage basis, this represents roughly 55% of the total pollution load discharged into the waterways. Part of the unsewered population use septic tanks whose effluents do not undergo secondary treatment but are directly discharged into storm drains and finally flow into more than 30 creeks, esteros, and river systems in the Manila Metropolitan Area. Moreover, industrial wastes contribute an additional 300 tons of pollution load discharged by factories, representing about 40% of the total pollution load, while solid wastes account for the remaining 5%.

The biggest of the river systems in the Manila Metropolitan Area is the Pasig River which is about 25 kilometers long. It has two major tributaries, the Marikina and San Juan Rivers. About two million people live in the drainage basins. This river system is grossly polluted during the summer months of April and May because of the low discharge available for diluting the pollution load. The average dissolved oxygen (DO) during this period varies from zero to 2.0 ppm whereas during the rainy season, the DO level increases to 7.0 ppm. Although tidal fluctuations have some effects in improving the water quality, pollutants are literally transported during the negative flow into the upper reaches causing these to be retained in the waterway

until heavy rain washes them off to Manila Bay. The main factors contributing to the pollution of the Pasig River system are: (1) high population density and increased housing activities in the drainage area without provision for the treatment of domestic sewage except septic tanks in individual residences; (2) industries which do not provide adequate treatment of their liquid wastes; and (3) solid wastes that are dumped directly into the different waterways.

Industrial Wastes

The Tinajeros-Tullahan River system which supplies the water needs of hundreds of brackish-water fish ponds is the worst-polluted river in the Philippines today. Its dissolved oxygen throughout the year is nearly always zero. This river is the recipient of domestic sewage from the municipality of Malabon, and industrial wastes from at least 15 factories — 3 paper mills, a brewery, two textile mills, an abbatoir, a wallboard factory, 3 food processing plants and three others located along its banks. The total pollution load being discharged daily into this river is estimated at about 22 tons.

Pollution from the mining industry is also a serious problem in the Philippines. There are fifteen (15) active mines generating about 126,000 tons of mine tailings daily which are discharged into different rivers and creeks. The main pollutants are silt and traces of chemicals such as cyanides, acids, alkalis and salts used in the extraction process. Today, there are seven river systems being polluted by mine tailings, three (3) of which are in the island of Luzon, three (3) in the Visayas and one (1) in Palawan.

The Sapang Dacu River in Toledo City is another river which is being polluted by mine tailings. A copper mine discharges approximately 80,000 tons of mine tailings daily into this river. As a result, the river bed is already shallow due to siltation and the river channel is no longer well-defined.

Other rivers that are suffering siltation and pollution by chemical and mine tailings disposal are the Bued River located in the provinces of La Union and Pangasinan, Taft River in Samar, Sipalay River in Negros Occidental, Sta. Cruz River in Zambales, Mogpog and Boac Rivers in Marinduque.

The sugar mills and distilleries are the next big polluters of our waterways. There are at present twenty-eight (28) sugar centrals and ten (10) distilleries that pollute 17 rivers and other bodies of water. Most of these sugar centrals are located in Negros Occidental, the sugar province of the Philippines.

Most of the wastes generated occur during the milling season which usually starts from October and ends in May. The liquid wastes from sugar mills and distilleries are high in BOD, low in dissolved oxygen, and highly putrescible. These materials rapidly decompose during the hot summer months causing bad odor and nuisance due to anaerobic decomposition. When rivers are polluted by this type of industrial waste, the most adversely affected groups are the fishermen and fish pond owners.

Pulp and paper mills are next in the order of pollution due to the black liquor discharged from their digesters, washings from cookers and thickeners, and heaters and wash waters from the paper machines containing fibers, pigments and clay fillers. The mill wastes reduce the dissolved oxygen of the receiving water and increase its alkalinity due to the soda content in the wastewater. As a result, streams are colored, frothy scum is produced, and turbidity and hardness are increased.

The chemical industry is also an important water polluter in the country. There are more than forty (40) different types of chemical factories in the country. Outstanding polluters are the PVC polystyrene, caustic soda and chlorine plants. Two soda and chlorine manufacturers in Luzon have been identified as discharging a significant amount of mercury in their effluents far above the allowable level of international standards. A PVC plant in Mindanao has been found to pollute the Iligan Bay waters with mercury. This bay is being used for big and small-time fishing by people in the area. The present findings are indeed a cause for alarm knowing the irreparable harm that mercury can inflict on people.

Agricultural Wastes

Problems associated with environmental pollution include, among others, the harmful effects of pesticides, insecticides, and fertilizers in their application to agriculture. The use of chemicals in the control of diseases and pests in agriculture is not directly blamed on these chemicals but rather against their overuse and misuse. This has been due to the discovery, especially, of chlorinated hydrocarbons, and their adverse effects not only on the pests they control, but also on human beings. These poisons serve an unmitigated good if they are applied correctly and in such quantities that their use is justified. Many banana plantations in Mindanao use aldrin and phosphorous compounds. The Commission has found that the rivers and bays draining these plantations contain more than the background level of certain pesticides.

Few people realize that DDT, for instance, has the characteristics of a well-organized metallic poison such as mercury and can be concentrated as it moves in the food chain. Toxic materials cannot be put into either air, water or soil without their reappearing in other media as there is a bewildering degree of interdependence of ecosystems.

Pesticides can also be highly toxic and yet short-lived. Some, like organophosphates, malathion and parathion, last only a month or two but are indiscriminate killers. Still, others are toxic, have a cumulative effect, and as a result, generate a whole variety of delayed consequences which can be difficult to quantify. These are the problems associated with the application of chemicals to control insects and pests in agriculture.

Air Pollution

The NPCC has a continuing project of daily samplings of the ambient air at Plaza Miranda in Manila and six other transportation hubs in the metropolitan area to determine the levels of various pollutants associated with motor vehicular emissions such as carbon monoxide, sulfur dioxide, suspended particulars, lead and oxidants.

Initial results reveal that the most affected area is the Plaza Miranda area where the daily vehicular traffic density varies from 3,400 to 10,000 vehicles per hour. Our findings in this area show that the pollutant levels are still below the hazardous levels of each of the pollutants with the exception of suspended particulates which occasionally register over the 200 ug/m^3 standard previously set for residential areas.

One point upon which little disagreement is left is the size and seriousness of the air pollution problems the car has caused. There are approximately 290,000 vehicles in the Manila Metropolitan Area as of 1972 with an average daily consumption of about 1,540,000 liters of gasoline. These cars emit a total of about 4,000 tons of pollutants consisting of carbon monoxide, hydrocarbons, oxides of nitrogen, particulates anl aldehydes daily.

The contribution to air pollution of power plants and factories is likewise being undertaken by on-the-spot surveys and stack samplings. It is considered that air pollution caused by industry is a problem we have to seriously contend with, especially if we consider the following factors:

1. less than 15% of 300 surveyed and inspected industrial firms have installed air pollution control devices like cyclones, scrubbers, filters, precipitators and incinerator systems;

2. the sulfur content of most bunker oil fuel used by industry exceeds the NPCC standard of 1.5% so much so that some 67 factories were found discharging an estimated 21 tons of sulfur dioxide in one day.

Solid Waste Pollution

Metropolitan Manila has a solid waste potential of 2,670 tons per day based on an estimated 25 kilograms daily production per family of seven. Out of this, 80% are organics comprising about 2,140 tons of decomposable materials. Major contributors are households but it is assumed that the solid wastes from industries constitute a signlficant amount.

Solid waste collection and disposal systems are inadequate, resulting in uncollected refuse which is piled in heaps for weeks attracting flies and other vermin. Due to a rapid increase of population in the metropolitan area brought about by migration, this condition and disposal on a metropolitan-wide basis is adopted using new methods and techniques in solid waste disposal.

One method tried in the handling of refuse is composting, and at one time the city of Manila experimented on a pilot scale. However, a feasibility study showed that composting was not economical. Instead, incineration with power generation was recommended. However, due to opposition from some quarters this was not pushed through. At present, there is an incineration plant in Quezon City but due to technical difficulties, it is not in operation yet. Heretofore employed by local governments are sanitary landfills but lately all available low lands have been used up by real estate developers. If done on a regional basis and within the framework of local governments contiguous with another, landfill or even bay reclamation may yet prove to be the most acceptable method within the bounds of their financial capabilities provided that safeguards are included to prevent and control pollution.

Quezon City with its incinerator costing P13 million may not be getting its money's worth of investment unless it is operated fully within its design capacity of 18 tons per hour. Since the city's solid waste production is only about 300 tons per day, it is unlikely that the incinerator will be operated at its full capacity for some time unless adjacent municipalities turn in their solid wastes and pay for the service. Moreover, either due to inadequate collection facilities, improper maintenance, or both, the city might not be able to maximize benefits out of its operation before it breaks down due to wear and tear.

GOVERNMENT'S PLAN TO SOLVE POLLUTION PROBLEM

As discussed earlier, the two major sources of organic pollution are industrial and municipal wastes. Reduction of pollution from industrial sources, where abatement technology is generally available, is largely a matter of attaining necessary investment levels. In order to help industry in this regard, Presidential Decree 274, was promulgated to give incentives to industries to put up the necessary control devices. The incentives include tax exemptions for equipment and/or devices imported from abroad, and refund or rebate of taxes already paid. The cost of control works may be deducted from the total income of the firms in the preparation of income tax returns. This will encourage industrial firms to put extra investments in pollution control and abatement devices without necessarily affecting their competetive posture. The added investment will not be lost capital after all.

Another important activity designed to control the water pollution of the Pasig River System in the Metropolitan Manila Area, as provided for in the Presidential Decree 274, was the formation of the Pasig River Development Council purposely for the development of the Pasig River as a tourist attraction with the launching of the beautification project.

Although the industrialization program was started many years ago, its ill effects began to be felt during the last few years. The government realized its role in the control of the resulting environmental degradation. As an immediate step to the solution of the problem, the National Pollution Control Commission, in cooperation with other agencies, specifically the Armed Forces of the Philippines, is requiring all violators of the stream quality standards in the Manila Metropolitan Area to construct immediately wastewater treatment facilities. Although the response is slow, we are already getting better cooperation from industry and voluntary compliance to existing rules and regulations.

The Commission also has cooperative arrangements with the Board of Investments so that no new firm can be registered with that agency without securing pollution clearance from the Commission. Under this arrangement, the firm concerned is compelled to put up the necessary pollution control devices. Furthermore, a list of smoke belching vehicles is submitted to the Land Transportation Commission for appropriate action.

Other agencies involved in the anti-pollution campaign are the following:

1. Petroleum Institute of the Philippines — for the prevention and control of oil pollution; we have formulated a contingency plan for coping with an oil spill.

2. Philippine Coast Guard — for enforcement of rules and regulations on pollution of seas and coastal areas.

3. Bureau of Customs — for the prevention and control of pollution of ports and harbors.

4. Department of Health — in the investigation of nuisance and other forms of pollution that are of public health importance.

5. Bureau of Mines — in the siltation of river beds due to mine tailings or disposal of other mine wastes.

6. Bureau of Fisheries — on pollution of inland waters and marine fishing grounds.

7. Bureau of Public Works — in the dredging of esteros and other waterways in the Metropolitan Area.

8. Construction Development Corporation of the Philippines — the reclamation of foreshore areas in Manila Bay.

9. Laguna Lake Development Authority — the overall economic development of the Laguna Bay region.

Routine investigations and inspections of factories are being conducted by the staff engineers of the Commission and violators of the rules and regulations are called to a hearing, and if warranted, the industries concerned are issued orders to stop discharging industrial wastes.

A permit system enables the Commission to review plans for pollution control works before they are constructed so that corrections could be made, where necessary, to ensure satisfactory performance of control devices.

Because of the paucity of information regarding local conditions pertaining to the effects of pollution, the Commission has embarked on a program of research. Among the questions that need to be answered are those pertaining to tolerance limits of local edible fishes. The Commission has at present seven (7) research projects, four (4) on water pollution, three (3) on air pollution and one project on classification of rivers and estuaries. Classification is intended to establish the best usage of the river waters for the common good and will serve as the determinant for the existence of water pollution, while air pollution research gives information of the nature and levels of pollutants in the atmosphere coming from vehicles and stationary sources. Some of these research projects will be of help in the establishment of realistic standards of environmental quality that the Commission plans to adopt in the forthcoming revisions of its rules and regulations.

There are yet many things to be done to solve some existing environmental pollution problems. The basic method of enforcement using the maximum persuasion approach needs to be improved. Information systems must be developed to include specific data on the environment that should be monitored on a continuing basis, coupled with a complete or updated industrial and municipal wastes inventory. Present water and air quality monitoring systems or capabilities are not adequate due to lack of personnel and funds for the purpose. Because of this situation, there is a shortage of data on the amounts and types of pollutants discharged into the environment.

Experience and adequate funding of the Commission's activities and proposed program may help solve some of the problems. We already know what problems need priority of solution. Clearly, we need a much stronger organizational setup than what we have now, including adequate financing. Problems with the magnitude of a Goliath cannot be fought with the size and combat capabilities of a David, which is the present case if the NPCC is not allowed to grow and be strong. The question is when? The NPCC is in the battlefront right now and it seems under attack from all fronts. More logistical support and more people are needed to fight the sophisticated battles of the technological world of the twentieth century and the generations to come!

THE ENVIRONMENTAL ASPECTS OF THE ECONOMIC DEVELOPMENT PROGRAMS OF THE PHILIPPINES

By JAIME C. LAYA

Deputy Director-General
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The main thesis of this paper lies in clarifying why the quality of the environment should be given greater attention in the planning process and what data should be collected and analyzed for consideration in the comprehensive plan for national development. There is need for planners to become aware that systematic analyses of the total environment need to be integrated in the overall planning process, and that efforts to maintain or improve environmental quality be given emphasis in development decisions.

ECONOMICS OF THE ENVIRONMENT

The environment plays a vital and most impressive role in shaping nations and in building a strong and dynamic foundation for economic and social progress. It is recognized that in our ideals and ways of life and in the continuing efforts of our scientists and technologists to harness and control the forces of nature to serve the ever-increasing wants, the far reaching influence of our natural resources are keenly felt.

In the collective task of nation building, scientific and technological utilization of our environment constitutes the vital weapon needed to generate economic progress. With a population increasing at about 3.20 per cent annually, we should produce enough food and other basic needs to meet larger future demands. This requires an intensification of our agricultural productivity program hand-in-hand with a sustained industrialization for an accelerated economic growth. But in our frenzy to mechanize and industrialize, let us establish safeguards against the pollution of our environment.

Although industry exists to help the economic progress of the country and is given every encouragement, it has a primary responsibility of keeping environmental degradation at reasonable and tolerable levels.

Pervasive environmental changes accompanying the development of the country have wrought doubts regarding the significance of uncontrolled interdependence between man and the natural environment. The economic theory of production and consumption not only benefits man through his provision but simultaneously involves the creation of wastes with the potential of degrading his environment because of the vast agglomeration of people and high waste-generating industries in locations with only limited waste assimilative capability.

The Government, therefore, through the National Pollution Control Commission (NPCC) recognizes pollution as one of its fundamental responsibilities and the purpose of pollution control is to preserve to the maximum the quality of atmospheric air and terrestrial waters of the Philippines.

THE NEED FOR ENVIRONMENTAL PLANNING

By "environmental planning," we mean the process of organizing the relationships of the different functions of a specific development program in terms of land use; specifically, areas and locations are assigned for agricultural, industrial or residential use and their relationship to one another is established by means of transport, power, communications and utility networks. The term is also known as "physical planning" or "community planning."

As the national economy advances, the rapid growth and spatial movement of the country's population are accompanied by even faster increase in the scale and complexity of its development requirements. Not only is the population expanding at a high overall rate of 3.2% a year, but it is also continuously shifting over the

country as masses of people flock to urban areas at a higher rate of 3.7% a year. This movement to urban centers stems from at least two major factors. On one hand, the country's drive to upgrade its agricultural productivity results in the displacement of surplus farm labor force. On the other hand, national programs to accelerate industrial and tertiary economic activities lead to the continuous growth of towns and cities which exert "pull" powers over would-be migrants in search of better job opportunities, education and standards of living.

The efficiency of planning dictates the need for rational economy in the disposition of towns and major industrial plants. Safeguards against the possibility of air, water and land pollution should be considered in locating factories. The planning process should consider source and concentrations of pollutants and micro and macroclimatic differences.

With these developments come various environmental problems that beset urban and rural areas alike. In Metropolitan Manila and larger cities and towns, the demands for effective transport systems, cheap land and housing, and dependable utilities and services continue to escalate and out-strip efforts to provide the required supply systems. At the same time, in most rural areas, income levels remain low and infrastructure services are in short supply despite the contributions of plans directed towards rural amelioration.

Therefore, the country's drive for enhanced production and greater equity in living conditions has to be seen against this backdrop. Faced with this situation, the Government must continually take steps to improve its planning process to adapt to and anticipate the multiple problems attendant on a developing economy.

FOUR-YEAR DEVELOPMENT PLAN (FY 1974-1977) AND THE PHYSICAL PLANNING SYSTEM

The declaration of martial law ushered in an era of sweeping reforms encompassing not only improvements in the peace and order situation of the country but also significant changes in the social, economic and political order which are essential to sustain long-run economic growth and development.

The basic government plan for socio-economic development is embodied in the Four-Year Development Plan (1974-1977) showing how the government machinery and resources are committed to specific objectives and growth targets. The integrated approach is pursued at the national and local levels and the environmental resources are not viewed as static physical features but as dynamic and interrelated processes. It was conceived to coordinate sectoral investments and to relate them to all policies concerning land uses, population distribution and densities, employment, public services, community facilities and ecological balance. It seeks to arrange the various land uses so that each area is put to its best use.

In addition to the general development goals of improving the standard of living of the greater mass of the population, the long-run plan objectives are: (1) maximum utilization of the labor force, or more specifically, the promotion of employment and minimization of underemployment; (2) maximum economic growth feasible; (3) more equitable distribution of income and wealth; (4) regional development industrialization; (5) promotion of social development; and (6) maintenance of an acceptable level of price and balance of payments stability.

Essentially, the approach calls for raising rural incomes and achieving self-sufficiency in food production. These are to be attained through food production, and land reform programs, both complemented by the development of cooperatives and infrastructure, particularly irrigation and feeder roads in the rural areas.

Simultaneously, in the industial sector, the thrust will be towards the promotion of employment opportunities through the encouragement of labor intensive methods of production, the expansion of manufacture exports, the strengthening of industrial linkages, and intensified efforts at regional development. Special attention shall be given to the development of export-oriented industries and medium-and-small scale industries.

The overall development effort is supported and sustained by infrastructure development, providing for the setting up of an efficient network of roads, portworks, railways, airports, as well as power generating telecommunications and water resources

facilities. A number of infrastructure projects are tied up with tourism development and will tremendously enhance the industry's prospect for growth.

Man remains the ultimate target of development; thus, social development complements all the other efforts of the government. While providing the proper setting for development in the economy, efforts simultaneously are directed towards uplifting the well-being of the individual through education, employment, housing, social welfare, community development and health services.

Thus, the plan approach includes a program of manpower and educational reforms which are directed mainly towards the development of the needed skills in response to projected future needs of the economy. The manpower training program is of particular importance because of the encouragement being extended to labor-intensive techniques of production and the acceleration of industrial development in the near future which will impose a great demand for skilled manpower.

Family planning is another important aspect of our development program. It is designed for the improvement of the basic social unit — the family. Uncontrolled population growth may lead the economy into stagnation or poverty levels since more consumption growth would mean less investment.

CONCLUSION

The dynamism generated by compulsive conditions under the New Society should bring about beneficial results towards the faster development of projects which previously suffered grievous delays due to factors inherent in the system.

Environmental studies have been used to identify development hazards, but they should have a greater role; they should help the planners prepare plans in which the maintenance of environmental quality is a basic principle. The land development process requires knowledge, appreciation and understanding of the effects development will have on environmental quality, natural processes and man. Destruction of those environmental aspects which support vital natural processes or which otherwise have meaning and value to man is inevitable unless those who guide and control development and environmental quality improvement are conscious of long-range consequences. This will require a major education process free from rhetoric and exhortation, and will require cooperation among a wide variety of professional and scientific disciplines.

The current awakening of concern for the environment is an important step but this is not sufficient. It is necessary to translate this concern into position actions to assure the continued existence of many life-sustaining and life-enhancing processes.

RECOMMENDATIONS

The dynamics of development involve the preparation of a development plan that is based on all its economic, social, physical and other meanings which maintain feasible and realistic dimensions. To achieve a satisfactory pattern of national development, physical planners should be well versed in principles of econometrics, public finance, law and administration. Economic planners, on the other hand, should effectively visualize the dimensional implications of their economic decisions and try to close the existing gap between the formulation of goals of development planning and their implemnetations at all levels. While socio-economic planners should cooperate with regional planners on the physical implications of development proposals, the regional planners should enlarge their field of activities and help the decision makers in formulating policies and assessing the consequences of these policies on the structure and form of urban and regional systems.

With the warm and enthusiastic response of the citizenry to the ideals and objectives of the New Society, the new atmosphere has created an environment of policy changes that will render the government more efficient, in coping with the demands of a dynamic nation, whereby we can effectively push through our development plans and programs to bring about needed reforms for the common good.

EDUCATIONAL PROGRAMS IN ENVIRONMENTAL EDUCATION

By JUAN MANUEL
Secretary
Department of Education and Culture

The world is facing two serious crises — the population crisis and the environmental crisis. There are some people who say that among these two, the environmental crisis is more serious. As a matter of fact, it is said, the population crisis is contributory to the environmental crisis.

Industrialization, science and technology have contributed to the deterioration of the environment. Factories that discharge their untreated effluents into the rivers contribute to water pollution. The operation of hundreds of thousands of smoke-belching cars in the streets and smoke coming from factories and power plants — these contribute to the pollution of the air. The rapaciousness of man in his desire to move the most within the shortest possible time has led to the denundation of our forested areas and the despoilation of our inland waters and seas.

While it is true that the Philippines is still principally an agricultural country and while it is true that many of our cities are still rural in many ways, there are unmistakable evidences of the deterioration of the environment.

We do not have to wait until the situation becomes worse. Therefore, it is incumbent upon all sectors in the country to become involved in the program to protect the environnent, to preserve and maintain what has been called the balance in nature.

Education in this country has a tradition of being involved intimately in the discussion and search for solutions of problems that confront society. This is one distinguishing characteristic of the community school and all schools in this country have adopted the community school concept.

The deterioration of the environment is one such problem. Therefore, appropriate units on the environment are integrated in the curriculum of all schools in all levels to the end that awareness of the seriousness of this problem is aroused. The subject areas where this integration is done is the social studies and science.

One attractive aspect of the community school is provision for action programs to implement and apply solutions arrived at in the classrooms. These are what have been called community service projects which are the natural outgrowth of concepts and decisions arrived at in academic classroom discussions.

There are a number of on-going programs of the Department of Education and Culture which serve to fulfill the purpose and intent of environmental protection. The goals and objectives of these programs serve to focus concern and attention towards the protection of the environment and the enhancement of the quality of human life.

1. In line with the imperatives of the New Society, the curriculum from pre-elementary to college has been geared towards new emphasis and directions. A number of curricular reforms were instituted in an effort to achieve relevance to national development goals. Conservation education, which includes the conservation of human, natural and cultural resources, has been either infused or integrated into the existing scope and sequence arrangements of the curriculum especially in social studies, science, health, character education, and in gardening and industrial arts.

In some instances, especially in progressive school divisions, teaching-learning units on "Environmental Education" which utilize such concepts as pollution, erosion, adaptation, adjustment, resources, exploitation, etc. are prepared and tried. In the curriculum for the secondary schools Social Studies program, one of the threads that runs through from the first year to the fourth year is Environment. High school students are thus exposed to the various concepts of environment.

2. The Boy and Girl Scouts of the Philippines (almost 99% of the membership come from schools) have been undertaking projects on reforestation, as well as beautification and tree planting. These are generally group projects although individual boys and girls also undertake these projects in their own homes. These pro-

jects are also a part of their programs of advancement especially as they are committed to do at least one good turn daily. Other clubs and organizations also participate in similar projects which contribute to healthier and pollution-free environment.

3. The Population Education Program of the Department of Education and Culture includes arrangements that would integrate population education in the curriculum of the elementary, secondary and teacher training levels of the formal school system. This program is designed for the purpose of working toward a reduced Philippine family life-size norm as well as towards more responsible decisions on population matters on both the personal and social levels. It also seeks to develop awareness of the serious implications of too rapid population growth.

In order to provide instruction on population education, it is envisioned that 186,000 elementary teachers, 15,600 secondary teachers and 360 teacher training instructors in the country will be trained in a period of 5 years. Curriculum materials for population education have been prepared, tried and correspondingly revised.

A run-away population with a 3.01% annual rate of growth which will double in twenty years will certainly cause a strain in our economy and will affect production, waste disposal, and the upkeep of sanitation.

4. The Youth Civic Action Program (YCAP) undertaken by elementary, secondary and college students as a prerequisite for graduation comes in a varied assortment of community projects which include reforestation, family planning, relief and rehabilitation work, community development, health and sanitation, home beautification, cleanliness, etc. With proper orientation, these projects can be a potential instrument for the development of much needed environmental understandings.

5. The Applied Nutrition Program includes health and environmental sanitation. These concepts are integrated in all training courses and in all levels of the school curriculum. The goal is not only improved food production and consumption but also improved toilet and water facilities, cleaner surroundings and homes, and eventually healthier, improved nutritional status of the family.

6. The Health Education Program is designed to promote healthful living in the school as well as in the community. It is an integral part of the total school program. It is organized to assure each child a school environment that is conducive to optimum growth, living and learning. It embraces four major phases: healthful living, health services, health instructions, and community coordination for health. These phases support and complement one another.

The activities of the program are geared to existing local problems and needs of pupils and the community. Such activities as the following are well-knitted into the program: provision of health facilities — drinking, handwashing, foot washing, toilet, drainage and composting; health examination, correction of minor ailments and defects, control of communicable diseases, immunization, etc. to mention only a few. All these are geared towards safeguarding children against health hazards in the environment.

7. In view of the increased incidence of drug addiction throughout the land, the Department of Education and Culture has instituted a program of drug education in an effort to curb the rising tide of drug incidence. There are data which show that a great many of our students, even from the elementary grades are affected by drugs peddled surreptitiously in many school campuses.

The program envisions the involvement of school superintendents, selected trainers, and classroom teachers who will spearhead the program. From this corps of trainees, it is expected that through selected curriculum content and strategies the harmful effects of dangerous drugs are brought to classroom scrutiny so that the dangers of drug addiction may be minimized if not eliminated. The desired learning could very well be infused into existing curricular subject areas, thus making content more relevant.

These are some of our educational programs which undoubtedly contribute to environmental protection. But these will suffice if only to prove that we in education are very much concerned with safeguarding the quality of life of our children. It could even be noted that all the subject areas land easily to environmental education.

Already some of our reforestation projects especially in Cebu, Bohol and even in Baguio are boosting other similar projects in other school divisions. Composting has become a general practice in the schools as part of their soil management technique in maintaining the fertility of the soil and intensifying the production of more and better crops. Schools and classrooms have been kept clean and healthful for children. In many instances, the schools have become the center of community activities and functions. The reuse and recycling of paper and other materials are becoming a necessity especially in view of the high cost of these materials. In one school division, an experiment on recycling of garbage is being undertaken in selected schools. In other school divisions, the attention of the people and government authorities have been called, through the effort of the schools, to the death or near-death of rivers and lakes resulting from improper disposal of industrial waste. Some portions of school sites are now veritable gardens and school forests.

The celebration of Clean-Up Week, Arbor Week, Tree-Planting Day, etc., has resulted in cleaner and more beautiful schools and communities. In connection with the Green Revolution program of the Departmrent, the experimental use of animal manure for generating kitchen fuel in a number of agricultural high schools demonstrates that waste can have not only an economic value as fertilizer but also as fuel.

I have just indicated the different programs being pursued by the schools to protect the environment. These programs are undertaken as part of the curriculum.

When we consider the fact that our system of education is highly centralized, policies adopted by the Department are implemented in all school, both public and private, that there are about 12 million youth enrolled in 37,000 public and private schools and that these schools are strategically spread in all 35,000 barrios, it is easy to realize the potential of education in the pursuance of any program of national concern and importance like the protection of the environment.

ENVIRONMENT SCIENCE COURSES IN COLLEGES AND UNIVERSITIES

By OSCAR MAPUA
President
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Among the many colleges and universities in the Philipines, there are only a few which are offering environmental science courses. There are, sad to say, only ten (10) private colleges and universities and only one (1) state university offering these courses. There are eight (8) private schools offering courses leading to the Bachelor of Science degree in Sanitary Engineering and these are as follows and the years that the course was started:

1. National University, Manila 1953
2. Cebu Institute of Technology, Cebu City — 1957
3. University of Southern Philippines, Cebu City — 1958
4. Mapua Institute of Technology, Manila — 1963
5. Feati University, Manila — 1965
6. Colegio de San Jose, Cebu City — 1966
7. University of Pangasinan, Dagupan City — 1967
8. Central Philippines University, Iloilo City — 1968

Among these schools, only the National University offers a master's degree program in sanitary engineering which was started in 1962.

The BSSE and MSSE programs are primarily for the professional training of engineers in the management of the environment. The courses deal with the theories and the application of the principles involved in the control of the physical, chemical, and biological elements in the environment. The presence of certain chemical substances or biological organisms in water, or in the air, or in food, or in sewage, and their relationship to diseases are just a few examples of the basic principles covered in these environmental science courses. Control of the environment through the design, construction and maintenance of engineering structures such as water purification plants, sewage treatment plants, mechanical or other equipment to control air pollution, or safety devices to prevent accidents in industry are some of the practical applications of the fundamental principles learned from these courses.

The practice of sanitary engineering as a profession started with the approval of Republic Act 1364 otherwise known as the Sanitary Engineering Law in June 1954. Prior to the approval of this law, sanitary engineering was a part of the civil engineering practice. To be able to practise the sanitary engineering profession, one has to be a registered sanitary engineer. A registered sanitary engineer is either one who has passed the board examination given twice a year by the Board of sanitary engineering, or one who has registered without examination. As for the latter, the Sanitary Engineering Law provides that a registered civil engineer who has practised sanitary engineering for at least five years prior to the approval of the law can register without examination provided that he registers within one year from the date of approval of the law. It also provides that a registered civil engineer who has taken major subjects in sanitary engineering and who has practised sanitary engineering for at least two years prior to the approval of the law can also register without examination, provided that he registers within one year from the date of approval of the law.

Some private colleges or universities, realizing the need for training technicians, are offering two-year courses in Sanitary Science. These are the National University in Manila, which started the course in 1962, and the Liceo de Cagayan de Oro City, which started the courses offered by some schools. A four-year course leading to

a degree of Bachelor of Science in Hygiene is being offered at the University of the Philippines, while another four-year course leading to a degree of Bachelor of Science in Sanitary Technology is being offered at the National University. The University of Nueva Caceres in Naga City offers only the first two years of the hygiene course.

These two-year or four-year courses are primarily aimed at formal training of technical men in the basic principles of controlling the quality of the environment so that they could be in a better position to assist doctors, engineers or chemists in public health programs. Formerly, the Department of Health used to employ sanitary inspectors even though they are only high school graduates but realizing the need for better trained personnel, this policy has been changed and the Department of Health has undertaken the training of its more than 1000 sanitary inspectors.

To further train professionals engaged in public health, the University of the Philippines is also offering post graduate environmental science courses to public health engineers leading to a degree of Master of Public Health. Formerly, the University also offered short-term courses leading to a Certificate in Public Health but this has been discontinued. In my opinion, this was unwise mainly because the Master's degree program is designed only for those of higher intellectual capacity. Professionals with average intelligence engaged in public health work therefore could not avail themselves of a formal training program unless the University of the Philippines or another school offers the Certificate in Public Health program.

Some private schools like the Mapua Institute of Technology, realizing the need for updating its environmental education program, have seen fit to add additional environmental science courses this coming school year in the Environmental and Sanitary Engineering curriculum. Courses such as Air Pollution, Industrial Waste Water Treatment and Stream Pollution, Solid Waste Management, Environmental Planning, Industrial Hygiene and Sanitation, Milk and Food Sanitation, have been added. The Mapua Institute of Technology believes that such a step taken is in line with the national goal of conserving the quality of the environment.

The holding of this national workshop is therefore timely and it is hoped that more colleges and universities could offer realistic environmental science courses so that they can provide the professional and technical manpower required to attain that goal of conserving the quality of the environment.

TRENDS IN ENVIRONMENTAL EDUCATION IN THE UNITED STATES

By GERARD A. ROHLICH
Professor of Environmental Engineering
University of Texas

During the past decade, there has been unprecedented concern about the degradation of our physical and biological environment. Concomitant with this concern we note the development of a deeper awareness of the complexity of environmental problems and the difficulty in finding solutions to those problems. As Aldo Leopold, Professor of Wildlife Management pointed out many years ago "the greatest discovery of the twentieth century is not radio or television, but the growing awareness of the public to the complexity of the land organism". His definition of the land organism included the water and air resource as well as the land itself. It is not necessary to inform this group that the interchanges that occur amongst the land, water and air resources, and man's activity in altering the environment through urbanization, agricultural and industrial development, and the creation of a "built" environment, obviously creates and develops, to use the words of Hufschmidt, "environmental" stimuli ranging from the physical to the psycho-social."

By definition, the environment is "the aggregate of all the external conditions and influences affecting the life and development of an organism". Thus, it is evident that in this concept we recognize that, as far as man is involved, not only must we be concerned with the physical and biological environment, but also with the stresses and strains of the social environment. As Rene Dubos pointed out some years ago, "the industrial revolution with mass production of energy and its rapid injection into all aspects of social life is everywhere beginning to disrupt the great dynamic processes, which have so far maintained the earth in a state compatible with human life". The further point is made that, as a major institution or ingredient in our culture, the impact of science and technology extends beyond the technological and engineering developments that have resulted from the application of the findings of scientists, and has, of course, a deep and strong influence on social habits.

Some fifteen years ago, Dr. Kehoe of the Kettering Laboratories in a conference on Man Versus Environment made the pertinent statement that "the chief feature which distinguishes man from other animals is an ability to reason, and through his intelligence determine what he does to himself and his environment". How well we are using our abilitities is open to question, but at least some progress is being made in that we, at long last, are beginning to assess the anticipated environmental impacts of planned actions, whereas in the past, activity was often separated from contemplation. We recognize that planning for the future is a much more critical requirement, that urgent measures are needed to correct the existing conditions which are, in a large part, the result of inadequate planning in the past. We have come to recognize that we do not have to accept deterioraiton of the environment as the price to be paid for pregress.

Furthermore, although environmental quality is related to pollution abatement, this is an "after the fact" concept. Future policies, legislation, and educational programs must be aimed at preventive measures. As Cortimer stated, "prophylactic action should be preferable to therapeutic".

The "environmental movement" of the past decade received strong support from our young people as a partial manifestation of their concern for relevant issues in their educational programs. Educational institutions initially responded on an ad hoc basis and we witnessed a series of "Earth Days" and "teach-ins" centering on "Clean Air", and "Clean Water" as dramatic issues to be discussed and hopefully, by some, to be attained quickly and without cost or at least with minimum cost using existing policies. The crisis era has given way to a recognition that simple answers to complex issues do not exist. We must not be led down the path so aptly described by Mencken — "for every problem there is a solution-neat, simple, and wrong".

Even though simple answers were not forthcoming there has been no decrease in the interest of students, and in fact the simplistic approach has been replaced by both faculty and students to develop courses and formulate programs in environmental studies. Student interest in man's relation to the environment remains at a high level and the development of broad and at the same time coherent programs of multidisciplinary research and education is receiving emphasis in hundreds of educational institutions throughout the country. This is not restricted to university levels. Many high schools have developed innovative and imaginative courses in environmental education. As many of these students enter universities, it is likely that the demand for university level courses and programs will increase.

At the university level in the United States, the traditional degree programs in schools of public health and in engineering continue to provide professional environmental education programs particularly at the graduate level. It is of interest to note the changes and developments that have occurred in the education of engineers for service in planning, design, construction, operation and management, for control of environmental quality. Some of these changes are reflected in the titles of three conferences that have been held by engineering educators in the environmental field since 1960. The conference at Harvard University in 1960 was titled "Study Conference on the Graduate Education of Sanitary Engineers". The 1967 meeting at Northwestern University was entitled "Environmental and Sanitary Engineering Graduate Education", and the third conference, held last year (1973), was titled "The National Environmental Engineering Education Conference". So the change from Sanitary Engineering to Environmental Engineering has been a three-step process over the past decade.

The change in educational approaches is more than a name change, which some might suspect was putting a popular label on the same package. There have been substantial revisions in the programs. An evolution of emphasis or changing emphasis has occurred. Until about twenty years ago, the field of sanitary engineering was concerned primarily with water treatment, and wastewater treatment technology. The increasing requirements for humanities in undergraduate programs, coupled with the growing trend for common core courses, effectively reduced the number of specialty courses that could be included in the undergraduate program, and therefore led to the necessity of graduate programs for acquiring depth in any of the fields of environmental engineering. The undergraduate environmental engineering or sanitary engineering programs of the universities of the United States essentially disappeared and there was no effort to provide undergraduate engineering except a course or two in civil engineering curricula. There is now a reverse of the trend, and we are going back, as was indicated in this conference held last year, to the development of undergraduate environmental engineering programs.

Although specialized programs continue to be offered in the major professional field of air quality, water quality, industrial hygiene, and solid wastes, many schools have provided more flexibility so the student may elect a more general program and broaden his background in the social political and economic implications of environmental problems, and the trend of student interest toward greater subject diversity is quite evident. There is, of course, a concern that there is a sacrifice in the in-depth training of engineers in this effort to acquire more general education, and also a continuing argument amongst those in the field as to whether or not we should be training specialists or generalists. Obviously, what has evolved is the fact that we are training both. There is still an opportunity to specialize in-depth in single areas and, of course, also broaden the program and the interests of the students. There is an increasing interest on the part of some students to take dual master's degree programs in which the student earns a Master of Science degree in Environmental Engineering and a second degree in such field, as Urban Planning or Public Affairs.

At the University of Texas, we have just approved a program at faculty level although it has not passed the administration yet, wherein engineering students can attain a master of science degree in a specialized field and a master of public affairs degree in the Lyndon Johnson School of Public Affairs. The interest, on the part of students in this program arises, of course, from the fact that many of the engineers are finding themselves in positions of responsibility for policy making and, consequently, the students have recognized the desirability of course work in public administration and public affairs.

At the undergraduate level, a number of schools have developed environmental study programs ranging from interdisciplinary curricula with team teaching on

selected real-life projects in which students become involved in community environmental affairs, to programs that use existing courses under new titles with a minimum of integration or coherency. How well the latter approach will survive is open to question. In the past, it was virtually impossible to consider the comprehensive integrated approach to the assessment and solution of environmental problems because of the lack of adequate accounting methods to evaluate complex systems. The development of conceptual models for systematic programs has extended our capabilities to study these vast and complicated systems. And as our educational programs develop in recognition that we take a comprehensive view of the total environment rather than approach problems on an individual basis, the current trend to broaden the educational base of the professional, and to provide a program for non-professionals, in order to meet the need for an informed citizenry capable of making decisions on complex issues, will be strengthened.

There is still, as I have indicated previously, a continuing debate in the engineering area as to the desirability of thinning out the traditional engineering programs. I think, however, the trend is unquestionably in the direction of broadening the base for the engineer in the environmental field. The program at many institutions in the past for the Master's degree was a one-year program — in most institutions, a calendar-year program rather than an academic-year program. Very little time of the students during that year was devoted to subjects other than engineering, although most of the students that I have worked with in Wisconsin and Texas were students in microbiology. But this was only to give them more material that would be needed in the biological design of processes in wastewater treatment programs. Now, our students have much more interest in extending their programs beyond the one-year program. I think that you will soon see many of the institutions develop two-year programs in which there will be this opportunity to broaden the base, not only in the economic implications involved in engineering activities but also, of course, in the social studies field and particularly in connection with some of the legal and administrative questions that are involved in the solution of environmental problems.

I have several charts which I will distribute at our work sessions to give an indication of the trends in the increase in environmental engineering programs. One of the things that I wish to note about those charts is whether or not the data are statistically valid. They are open to question because the marked increase in enrollment occurred at the same time that the federal government provided considerable stipends for the students entering these fields. Entirely new programs were developed in many institutions, fostered by funds that were provided by the Federal Environmental Quality Administration initially and subsequently, by the Environmental Protection Agency. For example, a number of schools introduced programs which were entitled Water Quality Management. Students entering these programs were not only engineers but also biologists and economists. The programs were flexible so that a biologist entering them would get course materials in engineering and resources economics if he needed it, while the engineers entering that program had additional courses in economics and biology. So, the programs in some schools were very flexible to meet student requirements. Now these programs, although I think many are quite good, still suffer from the point I made earlier; these, in essence, were packages of existing courses of many institutions did not have the integrated and coherent approach that most of us will agree is the desirable trend.

I am sure that my colleagues will talk to you in detail about undergraduate program which, unfortunately, I am not familiar with. In discussions that I had with the people who instituted undergraduate programs, their problem, for example, at the University of Wisconsin in Green Bay, is to find the proper kind of faculty to handle these kinds of integrated programs. One cannot find many Leonardo de Vinci's anymore, but I am sure if one exists many universities will be willing to hire him at perhaps not most beneficient salary but none-the-less, there is, of course, nim—perhaps not at the most beneficient salary, but there is of course, a genuine need for this kind of person. Consequently, a team-teaching approach based on problem-oriented community activities will evolve. These general remarks I hope will lead us to further discussion at our workshop during the next few days.

THE ENVIRONMENTAL AND NATURAL RESOURCE PROTECTION PROGRAM OF PUERTO RICO*

By HON. CRUZ A. MATOS

Secretary of Natural Resources
Commonwealth of Puerto Rico

There is an old joke about travel, which you may have heard, but which I shall inflict upon you anyway. A woman was describing her vacation in Puerto Rico to a friend. The friend, a bit hazy in geography, asked where Puerto Rico is. "I don't know", the lady traveler replied. "You see, we went in a plane".

For us Puerto Ricans, Puerto Rico, is of course, the largest and most important place in the world. We suspect also that it may well be the center of the universe, although there are those who are brazen enough to dispute this.

As you will notice from this obviously unfair and distorted map, some even regard Puerto Rico as a small island, 100 miles long by 35 miles wide, midway down the Caribbean between North and South America. Columbus thought he discovered Puerto Rico in 1493 on his second trip to what he kept insisting was Japan. Actually, it had been discovered some time before, by primitive peoples wandering up the Caribbean Islands. While they did not have gunpowder, at least they did not think they were in Japan.

Puerto Rico had little gold, and when that ran out, the island became primarily agricultural, with San Juan and its fortifications serving as a gathering point for Spanish gold fleets from the Americas. In 1898, as a result of the Spanish American war, Puerto Rico became a possession of the United States. Our economy continued to be basically agricultural until very recent decades.

In the early 1950's, Puerto Rico achieved a greater measure of self-government as a commonwealth: We elect our own governor and bicameral legislature every four years, have our own court system, but remain U.S. citizens and are a part of the United States economy. At about the same time, our industrialization effort began in earnest. Our leaders then, such as former governor Luis Muñoz Marin, felt industrialization was the only way out of the deep and demoralizing poverty we suffered. And indeed, Puerto Rico was transformed in one of the most rapid and thorough processes of change the world has witnessed.

From being considered a stagnant, poverty stricken backwater of the west, in less than three decades Puerto Rico has come to have the highest per capita income in Latin America. Longevity increased to more than the average lifespan on the United States mainland, and we became the mainland's fifth best customer in the World. All the more remarkable when one considers that we have only three million people, with so little land area — and most of it mountains.

Yet by the mid 1960's, we began to sense that not all the changes in our land were for the good. Some of our growth was too gross ... if you will pardon the expression. We began to wonder if perhaps we had become so intent on increasing the gross product that other, more important, sometimes more subtle, values were being left in the lurch.

Influenced in part by what we were seeing around us with increasing clarity, and in part by the worldwide concern with environmental quality and the need to protect rapidly dwindling natural resources, we began to try to correct some environmental errors of the past, and to take steps to avoid making the same, or other, mistakes in the future. In 1970, our legislature created the Environmental Quality Board, of which I had the honor, and the burden, of serving as first executive director.

The first task of the Environmental Quality Board was to determine the true condition of our environment. We found that existing data was spotty, at best; that

* The address was illustrated by photographic slides.

a hodgepodge of old regulations concerning air, water, land use and other particulars had been largely ignored, in part for lack of funds to build better sewage treatment systems for example, and in part because so much of our intellectual, financial and natural resources had been devoted almost exclusively to getting our economy moving.

Nearly every one of our municipalities burned their trash in open dumps, some of which also polluted rivers and coastal waters. With the increase in income, the amount of solid waste generated in Puerto Rico rose astronomically. At present, our three million people generate around four pounds of solid waste per capita, every day. Nearly all our rivers were polluted, some, for decades, by human wastes, and more recently by industrial wastes of various sorts. Inadequate or nonexistent sewage treatment plants had fostered pollution of many of our bays. The main treatment plant for San Juan, our major city, for example, was obsolete the day it opened, while our second and third cities, as well as five other towns, dumped their sewage raw into ocean.

Careless use of agricultural pesticides, runoff from dairy operations, and trash dumping added still more pollutants to our waters, including the river system and lake that provide drinking water for the San Juan metropolitan area. Examining our air, we found that while, by luck, prevailing winds swept most of the island clean of pollutants most of the time, there were certain 'Hot Spots' where concentrations of sulphur compounds and particulate matter were too high especially in the area of a petrochemical complex on the south coast, and southwest of San Juan, where residential development had sorrounded an old industrial area.

Under the impact of economic growth and modernization, the population of the coastal cities swelled—creating serious problems of urban sprawl with related proliferation of highways and private automobiles, as residents of increasingly far-flung suburbs depended more and more on private vehicles to travel from home to work. Since we had, and still, no effective mass transit system, congestion became increasingly severe, leading to construction of millions of dollars' worth of additional highways,—which to our dismay only spurred the urban areas to spread yet farther from the center, and in turn engender still more massive traffic problems. We had fallen into the same vicious circle that holds many other urban areas around the world in its costly grip.

Other unfortunate effects of our growth included: the destruction of protective coastal sand dunes, which were carted away for our construction industry; the apparently inexorable march of cement across our best agricultural land around the coastal plains; the increasing destruction of mangrove forests, important breeding grounds for many forms of wildlife, as the demand for housing and tourism land continued to grow in intensity; the increasing destruction of our coral reefs, perhaps the most productive part of the tropic ocean, by dredging pollution and vandalism; and the silting of our rivers, caused by careless land management and forest removal. We had economic growth. But the environmental price we were paying was needlessly high — so high, in fact, that it threatened to degrade our environment to unacceptable levels well before the end of this century.

Every problem was compounded by a rapidly expanding population in an already overpopulated island—a problem which our government, earlier this year, decided to attack with a vigorous birth control program. The problems of our urban areas have been aggravated by increasing levels of noise, which adds yet another irritant to an environment growing increasingly more unpleasant.

As I said, the first task of the environmental quality board was to discover the dimensions of the situation. Then, as part of the office of the governor, we had to formulate public environmental policy — and see that the policy was put into action. Immediate action has been required in severe cases. At the same time, we had to institute regulations to correct old problems and avoid new ones, and participate with other government agencies in long-range environmental planning, to fulfill our role as custodians of the environment for future generations. In cooperation with the environmental protection agency of the U.S. federal government, we then prepared a series of regulations setting standards for air, water ,and solid waste management, designed to minimize environmental damage and destruction of nonrenewable natural resources. All new sources of atmospheric emissions, for example, would have to use the available technology to keep emission of pollutants at acceptable levels. And the old sources, built when neither the technology nor the public concern

for control existed had to establish a timetable for compliance — and keep to that timetable, once an agreement was reached.

The same basic approach has been used is corrective and preventive measures for water pollution and solid waste disposal, where we have promoted conversion of open dumps to sanitary landfills, as a temporary measure until we can establish adequate resource recovery centers. Sand extraction along our coast has been brought under far more strict control, to prevent erosion and the loss of valuable dunes and beaches. And in cooperation with our planning board, we are beginning to take steps to protect important natural areas and farmland, while reserving other lands for industrial and residential use.

We have found that the land, especially the narrow coastal plain that runs around the island, is our most valuable resource. At the same time, it is the most pressured, because of the high demand, and consequently high profits to be derived from land speculation and second-home construction.

While these efforts were beginning, we realized that Puerto Rico needed a massive educational effort to awaken as many people as possible to the value of a healthy environment, to the problems of environmental protection, and to ways in which this protection could be carried out. Given the urgency of the matter, we tried to make contact on many levels at once, through a stream of news in the mass media, pilot environmental education in the schools, joint education effort and action programs with local civic groups, educational programs of many kinds in the public and private schools, courses in environmental education basics and special seminars for teachers, for the personnel of other government agencies and in regular university curricula, and special seminars for government officials and representatives of private enterprise.

We also saw that we needed environmental technicians to operate water treatment plants at industrial installations, for example, or to carry out air monitoring work for other enterprises and government agencies. Thus, in cooperation with our department of public instruction, we created two year post high-school courses in environmental technology, to produce people to fill these jobs.

Summing up our education goals, as you may see on this chart, we have aimed for a broad public awareness and support as the foundation, through education programs from grade one, and to adults through the mass media and civic action projects; a level of competent technicians for government and private industry; environmental managers for government and industry, preferably with at least a university education; and a small, competent, highly motivated group of planners with one to three years of post graduate training in planning, and preferably a grounding in general science, for overview and long-range planning.

We also instituted the environmental impact statement procedure, to require private firms and government agencies to consider the impact of their actions on the environment, from the beginning of the planning stage. Proponents of environmentally significant action thus must present a detailed analysis of what will happen if they do what they propose to do; the various alternative courses of action they considered, and why one alternative was chosen over others. These impact statements then are studied, and commented, by relevant government agencies, and they are made available to the public, which also has the right to comment. In cases of particular importance, public hearings are held, to foster the fullest possible evaluation and bring forth the widest available expertise and public opinion on the matter at hand. The impact statement process can be a major tool in helping ensure that environmental costs of economic development are minimized, and if you wish, we may discuss its operation in greater detail later.

In 1973, we advanced yet another step in the process of resource and environmental protection, creating a new agency in our government: The Department of Natural Resources. This department, of which I currently have the honor to be Secretary, is charged with supervision of the use and conservation of our natural resources such as beaches, water, minerals, marine life, and other forms of wildlife and forests. Thus the Puerto Rico Planning Board retains as its function the planning of land use patterns; to ensure that our most scarce resource is used properly for natural areas, farming, residential uses, tourism, light and heavy industry, and other purposes. The environmental quality board remains responsible for regulating the quality of air, water and the disposal of solid waste as well as setting general

environmental public policy. And our Department of Natural Resources is responsible for the wise use, or conservation, of renewable and non-renewable resources such as air, coastal zones, forests, minerals, water and fauna.

That, briefly, is what we are up to in Puerto Rico. We hope that our experiences, achievements and mistakes will be of benefit to you here in the Philippines—especially since your country is so similar to ours in its island-ness, climate, topography, history and other aspects.

In summary, I believe it is important to remember that you can have both economic development and environmental protection, if you have careful planning, a clear definition of goals, and a broad education program such as the one I outlined earlier. In many ways, you have the advantage over us, in that you have the opportunity to make environmental protection an integral part of your development program, from the start. In Puerto Rico, we had unleashed powerful forces and allowed needless environmental degradation in several areas, before we became aware of the need for greater protection of our resources.

As you will recognize, it is far easier, and far less costly, to do thing right from the beginning, rather than try to correct mistakes years later. And some losses are either not recoverable, or take generations to repair.

There is one final thought I would like to leave with you, concerning the goals of any development program.

Many people in Puerto Rico, as well as other parts of the world, are reaching the conclusion that a large annual growth of the gross national product is not the final measure of human happiness. What governments should pursue, in fostering development efforts, is an improvement in the quality of life for their people.

First, of course, that means food on the table, a decent place to live, adequate health care, and education. Starving people do not care too much whether the river is polluted, unless the pollution makes them ill. But once the basic needs are met, people do begin to care about whether the river is clean, whether the air is clear, whether the beaches they use for swimming and fishing are being cut off by private construction or eroded by careless dredging, and about having forests they may visit for the respite man needs from congested urban environments, to put himself back together emotionally. Thus while to some critics of environmental protection, everything but a surging GNP is superfluous, in reality, this way of thinking is very short-sighted.

Gross national product can be misleading, in that it indicates nothing about whether the goods and services produced contribute to the happiness of the community. GNP does not purport, as one book recently put it, to "differentiate between different kinds of production, or investments, nor what goods and services they produced, nor what sorts of jobs were created in the process — missiles, liquor, hair oil, and plastic novelties are lumped together with houses, education and mass transit". Russel Peterson, the chairman of the U.S. Council on Environmental Quality, pointed out that, furthermore, happiness springs from progress toward one's goals. After the basic survival goals are realized, then what?

I regret to say that in Puerto Rico, too many people have allowed themselves to drift into the acquisition syndrome. If you have one car, you suddenly find that you want another. One refrigerator leads to the desire for a larger one, and so on.

Mr. Peterson, and a number of distinguished sociologists in developed countries, suspect that a constantly ascending spiral of acquiring possessions will never bring lasting hapiness to anyone. Rather, they suggest, government should look in the direction of helping their citizens find greater self-realization, perhaps through personally creative activities in the arts, further education, or other activities not centered on material goods.

What does all this have to do with environment?

It means that you should define your own minimum environmental and resource protection standards from the beginning, when it is easier and less costly to do so, because these things will become very important to your people at a later stage, when their basic survival needs have been met. It also help you determine just how

far to go in promoting heavy, capital-intensive industry that often involves great environmental costs and produces relatively few jobs—even though the investment figures look good on year-end charts. It also may help you make decisions about the philosophy of your public education programs. Instead of fostering endlessly increasing consumption of things that may be unnecessary for a happy life, you could choose to do what the government of Guyana is doing, on the northwest corner of south America.

Guyana has decided that its development goals are to be the securing of food, clothing and shelter by 1980 for all its people. Economic growth is oriented toward providing people with basic products, such as soap and cotton. Forest are being managed to provide wood for construction of housing for all the country's citizens. And Guyanese school children are encouraged to have their own vegetable gardens and raise rabbits to provide meat.

So I would suggest, as we are suggesting now in Puerto Rico: Don't let yourselves get 'hooked' on gross national product. Plan for social goals, including a healthy environment, and then seek the economic means to reach those goals. We wish you well.

INFORMATION PAPERS

EDUCATION AND TRAINING REQUIREMENTS FOR WATER AND AIR POLLUTION CONTROL ENGINEERS IN PRIVATE INDUSTRY

By MARIO D. ZABAT

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A major requirement for effective pollution control is technically qualified and competent people to carry out the innumerable tasks that have arisen and those that lie ahead. In seeking to define the education and training requirements for environmental programs in the Philippines, this workshop paves the way for the setting up of the necessary machinery by which the needed manpower can be provided. Hopefully, some reasonable and practical requirements, or at least their bases, will be established in the workshop.

In attempting to identify the education and training requirements of air and water pollution control engineers in private industry, it is necessary to consider and answer a number of fundamental questions. What functions will such an engineer perform? What functions will the engineer be expected to perform by management, by regulatory agencies? What is his background, i.e., is he a civil, mechanical or chemical engineer or an undergraduate engineering student? What is the nature of the preparation that will best meet the needs of this type of engineer and equip him adequately for the functions and responsibilities that he is expected to assume? Should the education and/or training of engineers in, or intending to enter, the industrial pollution control field be limited in scope and deal with only those aspects bearing directly on air or water pollution, or should it be broad and endow the engineer with capabilities for other activities in the sanitary and air resources engineering fields. These questions must be resolved in this workshop to arrive at logical and useful education and training programs.

As a starting point for our present task, we can avail ourselves of the views and recommendations of engineers and engineer-educators that convened in a United States national conference on environmental and sanitary engineering graduate education some years ago. This conference was sponsored by the Environmental Engineering Inter-society Board (EEIB) and the American Association of Professors in Sanitary Engineering (AAPSE), and was held at the Northwestern University in Evanston, Illinois, August 27-30, 1967. Nine study topics were selected and nine task committees, one for each topic, prepared the background materials. Some high-lights from the report on that conference are presented herein to provide some informational material and guidelines for our present purpose.

DEFINITION AND SCOPE OF ENVIRONMENTAL ENGINEERING

In the above mentioned conference, the term "Environmental Engineering" was agreed upon and accepted as an umbrella or **generic term** assuming the meaning of the historical designation "Sanitary Engineering", the latter term becoming the **species**, specialty or professional designation for **water quality management**. Three other recognized specialty designations in environmental engineering are 1) Industrial Hygiene Engineering, 2) Air Pollution Control Engineering, and 3) Radiation and Hazard Control Engineering. A definition of environmental engineering as provided by the Environmental Engineering Intersociety Board is as follows:

> "The term Environmental Engineering means the application of engineering principles and practices to one or more elements of the environment for the purpose of protecting or improving man's health and well-being. It includes the control of the air, land and water resources, man's personal and working well-being, and the design and maintenance of systems to support life in alien and hostile environments".

The following definition was also accepted by the conference.

> "Environmental engineering is that branch of engineering that involves the application of scientific principles to the prevention, control and management of

environmental factors that may influence the physical and emotional health of man and his well-being"

Activities of environmental engineering as spelled out in the conference include the following:

1. Anticipation of the probable effects of proposed actions specifically designed to modify man's living environment, evaluation of proposed urban and regional development plans in terms of man's health, and perception of the possible effects of programs of environmental change which in themselves are not directly related to man's health.

2. The planning, organization and conduct of programs dealing with fundamental relationships between the phases of the environment and man's physical and emotional health. These activities require the engineer to be involved in decision-making processes at all levels and to work with a variety of practitioners from other professional fields, not only physical and biological scientists, but social scientists, lawyers, political scientists, and planners, as well.

3. Management of programs including cost-effectiveness analysis, economics and the budgeting process, and the employment of systems analysis in developing optimally balanced programs. Discussions at the conference stressed the point that the environmental engineer should be familiar with program management processes. This includes knowledge of: (a) decision-making processes as a vital phase in acceptance of a program; (b) systems analysis in the design of optimally-balanced programs; (c) budgeting processes of federal, state and local levels; and (d) legislative processes including steps in the preparation and handling of desirable legislation. Further, it was brought out that these processes can be made tangible and meaningful through use of the internship mechanism, that is, through work experience in urban areas planned as part of the educational process.

4. Study of land use, urban rehabilitation and urban planning, all of which have grown in importance in their relationship to the quality of environment and man's health. In addition to the on-going activities in these areas of concern, the environmental engineer must be active in the design and conduct of studies proposed for so called demonstration or experimental cities. In this regard, it was suggested that the environmental engineer should determine what his special role should be with respect to urban environmental problems involving social and phychological stresses.

5. Deepened recognition of the interrelationship of environmental media such as air, water, and land. This multiphased environment and the integrated, simultaneous impact of all environmental stresses upon man's health, have led the engineer to a constantly increasing use of systems analysis for determination of an optimum procedure achieving a desired quality of environment.

ROLE OF THE ENVIRONMENTAL ENGINEER IN INDUSTRY

On the role of the environmental engineer in industry, it was recognized that the environmental engineer has a role in industry. As a water quality or sanitary engineer, he must be prepared to cope with industry's specialized needs for process water and for waste water disposal facilities, and he must acquire these capabilities with the aid of educational programs that take cognizance of his early academic background in one of the several fields of engineering, especially civil and chemical. As an air pollution or industrial hygiene specialist, he must be prepared in the sciences and advanced technologies pertinent to the practising of these professions. Finally, some engineers will aspire to administrative roles, and if successful will function across the broad spectrum of environmental engineering.

GRADUATE CURRICULA IN ENVIRONMENTAL ENGINEERING

On educational programs for environmental engineers, recommendations made in the conference include the following:

1. The fifth year (sixth year in the Philippines) or master's level of education should be the minimum level for entry into essentially all types of environmental engineering practice.

2 A recommended balanced curriculum leading to the master of science degree in sanitary engineering (i.e., water quality management engineering) should have approximately the following coverage of subject areas.

Area	Percent of Effort Required
Engineering	
Theory	20
Lab (Unit operations and process	20
Design	10
Chemistry	15
Biology, Microbiology	15
Systems Analysis, Statistics, Mathematics, Economics	15
Electives	5
	100

3 A master's degree curriculum in air resources engineering might have approximately the following distribution of academic effort.

Area	Percent of Effort Required
Air Pollution Engineering	25
Physics	10
Meteorology	10
Environmental Health	10
Chemistry	10
Biology	10
Systems Analysis, Mathematics, Statistics	10
Social Sciences or Electives	15
	100

The conference task committee on graduate curricula also sought the counsel of a selected group of successful and prominent consulting engineers, all of whom had been at one time professors of sanitary engineering. Some highlights of the comments made by these engineers are given below and should be of interest and given consideration in the education of environmental engineers.

1 There should be more emphasis on the basic theory of processes in nature and treatment plants than on design courses.

2. Sanitary engineering has too often been taught largely as a cookbook design subject.

3 There are too many sanitary engineering programs and teachers and not enough sanitary engineering practitioners.

4 Too many sanitary engineering teachers are theorists and not enough are practising engineers. All young teachers should be urged to obtain, as a minimum, some part-time experience in engineering practice.

5 More emphasis should be placed on the basic sciences including physical chemistry, biochemistry, and general biology.

6 More attention has to be given to economic analysis and the integration of theoretical principles with design practice.

7 The sanitary engineering profession has over-emphasized academic coverage of public health disciplines and bio-sciences at the expense of advanced mathematics and fluid mechanics.

8 Greater emphasis has to be given to the techniques of operations research and systems analysis as well as to advanced economic analysis.

It is recognized that these comments and observations reflect the needs and experiences in the western situation; however, it cannot be denied that they serve as food for thought in developing educational programs in environmental engineering.

In the following section some details on courses in chemistry and biology, the traditional basic sciences in environmental engineering, and desirable course content are presented.

CHEMISTRY AND BIOLOGY FOR ENVIRONMENTAL ENGINEERS

With regard to the nature and scope of chemistry desirable in environmental engineering curricula, the following summarizes the views of the conference:

1. The environmental engineer should receive substantial formal instruction in chemistry during his initial graduate year.
2. An introductory chemistry course should be taken by engineers in all the master's level environmental engineering curricula. The principal teaching goal of the introductory course should be the understanding of the fundamental concepts of chemical theory. In setting forth the guidelines for the introductory course, the conference task committee on chemistry recognized that the primary orientation was on water and wastewater problems, but it also noted that the chemical principles of aqueous systems apply to all areas of the environment including the air. A general outline of the introductory principles course is as shown in Table 1.
3. A second course of at least three semester hours be offered dealing with the application of concepts of chemistry to water and wastewater treatment or to air resources. The general content of this course is as shown in Table 2.
4. The third course offering in the chemistry sequence for the master's level of environmental engineering should be concerned with laboratory demonstrations of the chemical concepts and principles. It should require one or two semester hours, either in a single course or in a two-course sequence, and should place emphasis on the elucidation of the principles discussed in the lecture courses. It was emphasized that the laboratory should not consist of training in the performance of routine tests as it is not the purpose to prepare engineers as analytical specialists or laboratory technicians. On the other hand, chemistry can be taught during the performance of the standard analyses, providing proper instruction is offered in conjunction with the laboratory.

The following were some recommendations on biology needs in environmental engineering:

1 Engineers in graduate environmental engineering programs leading to the master's degree should receive sufficient education in biology to provide them with an understanding of the basic concepts and a working knowledge of biology. This may be best achieved within a framework of ecology, because a study on this broad field can serve as a unifying or integrating approach for the engineer. The ecological approach to biology, emphasizing environmental biology, offers more utility than an approach based entirely on holistic or molecular biology.

2 The objective of biology in the engineering curricula is to give the engineer an introduction to biological terminology and an awareness of biological concepts and methology, so that he can understand the biological literature and make the most of his association with biologists.

3 In developing a curriculum at the master's level for the engineer, the subdivisions of biology that are generally recognized as essential to an understanding of biological principles have been reclassified into the major essential components. These divisions are: (a) the nature of the living organism, (b) ecology, (c) biochemistry and molecular biology, and (d) public health microbiology.

4 Recognizing the time and content constraints, biological education for environmental engineers should consist of a core course in biology common to all programs and a second course emphasizing biology but concerned with the students' area of specialization, i.e., air, water, industrial hygiene, etc.

The core course should be designed with several considerations in mind. It should emphasize principles having direct application in the several areas

of environmental engineering and should use specific examples drawn from these areas. On the other hand, it should stress the specialty area of the student in programs concerned entirely with a single specialty. It should cover biology broadly enough to serve as a basis for additional courses in several of the major subdivisions of the biological sciences.

5. The second biology course in the master's curricula would probably be selected from the following, according to the student's field of specialization, (a) biology of unit processes, (b) biology associated with water quality and pollution, (c) public health microbiology, and (d) applied physiology and toxicology.

6. Within the one year program of study leading to the master's degree, the biology to be presented in the core course will require at least three semester credit hours to enable the student to proceed along the directions indicated. The content of such a core course is as shown in Table 3. The degree of emphasis or development of particular topics will depend upon the orientation and availability of the subsequent courses in the suggested pattern of development in environmental biology.

7. For the engineer with little or no prior education in biology, it is important that the core course introduces him to the living materials that he will need to deal with, and understand. Laboratories and laboratory exercises could best be organized in two phases, the first associated with the study of the cell and cellular organizations and the second with the presentations in ecology.

CONCLUDING REMARKS

From the foregoing, it is apparent that defining the requirements and the contents of educational programs for the preparation of engineers for careers in environmental engineering, in general, and in industrial pollution control, in particular, are no small tasks and deserve much study. As an engineer in the academic profession but one who has also been exposed to the real world and has had some hand in the solving of real problems in sanitary or environmental engineering, I am of the opinion that industrial pollution engineers should receive some education, preferably formal education, in the basic environmental engineering sciences in common with other engineers aspiring to practise in other specialty areas of environmental engineering. Specialization in a narrow or specific field in any specialty area can probably be better provided through intensive short courses or what are termed continuing education programs designed to meet special needs or dealing comprehensively with selected topics. Such short programs should draw from experts and specialists in the field and learn from the experiences of these professionals.

Present course offerings in local schools and universities should be expanded and enriched. A one-semester program in sanitary engineering beyond the civil engineering program does not prepare a student adequately for a career in sanitary engineering.

Table 1 — Principles of Water and Waste Chemistry (3 semester hours)

A. Review of Chemistry Fundamentals
   - Molecular Structure
   - Nature of Bonding
   - Radioactive Decay
   - Chemical Combinations
   - Stoichiometry
   - Calculations

B. Chemical Thermodynamics
   - Heat of Reaction and Enthalpy Changes
   - Entropy
   - Free Energy Function and Equilibria
   - Fugacity and Activity

C. Chemical Equilibria
   - Phase Equilibria
   - Solution Theory
   - Reaction Equilibria
   - Ionic Equilibria
   - Electrochemistry

D. Kinetics
   - Reaction Orders
   - Theory of Reaction Rate
   - Mechanisms

E. Surface and Colloid Chemistry

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* Second National Conference on Environmental and Sanitary Engineering Graduate Education, Sponsored by the Environmental Engineering Intersociety Board and the American Association of Professors in Sanitary Engineering.

Table 2 — Concepts of Chemistry Applied to Water and Waste Processes or Process Engineering (3 semester hours)

Coagulation, Softening, and Precipitation
Absorption
Ion Exchange
Membrane Techniques
Distillation
Chemical Oxidation
Disinfection
Corrosion Control
Aerobic Biodegradation
Anaerobic Biodegradation

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Table 3 — Core Course in Biology

I. The Cell
   A. Morpohological Characteristics and Organization
   B. Cellular Organization
      1. Colonies
      2. Metazoans
         a. Organ systems
         b. Specialized structures
      3. Taxonomic relationships
   C. Biochemical Evolution of the Cell
   D. Biochemical Functions
      1. Enzymes
      2. Energy sources and transformations
         a. Heterotrophy
            1. Aerobic
               Pathways of fat, protein and carbohydrate oxidation
            2. Anaerobic
               Hydrolysis, alcohol and acid fermentations, methane fermentation
         b. Autotrophy
            1. Chemosynthetic
            2. Photosynthetic
      3. Conservation and transfer of energy in biological systems
   E. Molecular Biology

II. Ecology — The Interaction of Organisms and their Environment
   A. Concept of Ecosystem
      1. Trophic structures
      2. Biogeochemical cycles, C, N, P, S,
         Role of microorganisms and relationships to organic degradation
      3. Food chains
         a. Energy exchange and flow in ecosystems
         b. Productivity
            1. Physical limits
            2. Biological limits
      4. Kinetics of synthesis and growth
   B Freshwater, Marine, and Terrestrial Habitats
   C Public Health Biology
      1. Diseases of man, water and food pathogens
      2. Clean and polluted water biology
      3. Aerobiology
         a. Pathogenic microorganisms
         b. Allergins
         c. Toxic materials

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EDUCATION AND TRAINING REQUIREMENTS FOR AIR AND WATER POLLUTION ABATEMENT PROGRAM IN THE NATIONAL GOVERNMENT

By BIENVENIDO N. GARCIA
Executive Officer
National Pollution Control Commission

ENVIRONMENTAL PROGRAMS OF THE PHILIPPINE GOVERNMENT

Since the creation and operation of the National Pollution Control Commission in 1964, it has launched a nationwide environmental pollution control program aimed at controlling and minimizing enviromental degradation. To fulfill this goal, the Commission has sought the cooperation of various national government agencies such as the Department of Health, Board of Investment, Department of Agriculture and Natural Resources, and private agencies such as the Philippine Chamber of Industries. Academic institutions have also been tapped to give support to this drive as the greater burden of the campaign at its present stage and in the future will be borne by formal education and academic programs.

In context, the environmental pollution control program consists mainly of the following:

a) assessment of existing sources of air and water pollution
b) prediction of future sources of pollution
c) installation by parties concerned of pollution control devices
d) research and development
e) training and manpower development programs
f) public information campaign
g) cooperation with government and private agencies

To accomplish its initial goal, the Commission has classified the industries in the entire country into cement plants, sugar centrals and refineries, chemical and fertilizer plants, power plants, ceramics and asphalt plants, distilleries and breweries, pulp and paper mills, textile mills, flour mills, food processing, wood processing, cigar and cigarette factories, steel plants and foundries, galvanizing plants, soap and detergent plants, mines, tanneries, oil refineries, markets and slaughter-houses. These industries are being survived for the pollutional load of their respective effluents and the resulting quality of receiving water bodies. In addition, the quality of the industrial gaseous emission is being studied.

The Board of Investment has made a part of its policies to desist granting incentives to industries unless prior permits have been given by the National Control Commission to construct and operate waste control devices. The Land Transportation Commission regularly receives a list of vehicles with excessive emissions, the list being submitted by the technical staff of the Commission.

Applied research has constituted a major activity of the Commission. At present, the Commission is undertaking research-funded by grants-in-aid by the National Science Development Board.

Study grants from international institutions have greatly strengthened the Commission's program of keeping its staff abreast with the latest development in environmental sciences. Some of these programs consist of short-term study tour to graduate courses. The Commission has gained the recognition of international environment-oriented organizations through its active participation in various international conferences.

Perhaps the biggest successful program of the Commission in the drive to provide information to the public sectors and also gain their support has been the training course for people directly involved in pollution control in industries. The course covered lectures and on-site studies of basic fundamentals of ecology, sources of pollution control devices and legislation for pollution control. Judging from the active participation and interest shown by the participants, it is highly possible that training courses of this kind could be an effective method of generating support for the country's environmental program.

TRAINING REQUIREMENTS

The success of the above program or any program of ecological concern can only be gauged by the availability of manpower capable of implementing the program successfully. A major problem that has beset the government pollution abatement program is the availability of local manpower technical capabilities.

At its present stage, the country's educational program still has to be redirected towards training environmentalists capable of meeting the country's problems. Environmental awakening started only a few years ago in the country and this could partly be the reason for the delay in introducing environmental science courses in the country. There is an urgent need for educational planners to review and consider their capabilities and adequacy of teaching staff with the view of introducing ecological concepts in existing curricula and formulating entirely new programs.

Because of the very nature of ecological science which embraces a wide range of discipline, it is but logical that an interdisciplinary approach be used in formulating a formal curricula for graduate and undergraduate programs. The undergraduate program must emphasize interaction among living organisms and their environment to provide a broad interdisciplinary base for graduate study and research which could serve as a background for advanced investigation of ecological systems. The basic undergraduate program should consist of chemistry, physiology, biology, ecology, statistics, mathematics and other physical sciences.

Graduate programs should be geared towards specialization in air and water resources, supply, systems analysis, environmental biology, water chemistry and system ecology. Highly developed graduate courses now deal with water and air pollution control and their engineering aspects. Pollution control consitutes a major aspect specifically in air and water pollution abatement. Pollution abatement is highly technical and needs extensive specialization as it involves the design, fabrication, operation and maintenance of control works. A thorough knowledge of engineering and composite background of economics, chemistry, biology, physics and other natural sciences are needed to fully comprehend the theory and operation of pollution abatement programs. The engineering field, it can be said, has pioneered in pollution control and the formal courses in water and air pollution has been modified regularly to meet field requirements. The following courses that should be included and form the core of any graduate course in pollution abatement: waste treatment, environmental engineering design, water quality management, environmental resources systems, pollution transport systems, environmental chemistry, solid waste management, atmospheric pollution, environmental meteorology, and dynamics and thermo-dynamics of atmospheric pollutant transport. All these should be coordinated towards the conservation and management of major natural resources.

Auxilliary fields have constituted major support services to engineering undertakings in most environmental projects. These consist of environmental chemists, aquatic biologists, micro-biologists, botanists, meteorologists, zoologists and other natural science specialists. The scientists have basic knowledge on their respective fields and through specialization courses and training programs could form the backbone of environmentalists in the country. Research is an important area where auxiliary services are of utmost importance.

As a summary, then, the major fields that should be developed for environmental sciences are as follows: 1) environmental sciences education, 2) pollution abatement, specifically pollution control engineering, and 3) auxiliary sciences or the physical sciences. It is suggested that educational planners should consider these lines along which the country's academic program could be redirected.

SOLID WASTE MANAGEMENT AND ITS EDUCATION AND TRAINING REQUIREMENTS

By JOSE MORALES
Chairman
Metropolitan Manila Solid Waste Management Committee

INTRODUCTION

The paper dwells on the solid waste management problems in the Metropolitan Manila Area. The area is comprised of four (4) cities and ten (10) municipalities, namely, the cities of Manila, Pasay, Quezon and Caloocan and the municipalities of Parañaque, Las Pinas, Makati, Mandaluyong, San Juan, Pasig, Marikina, Navotas and Malabon, all of the Province of Rizal and the Municipality of Valenzuela in the province of Bulacan.

It is believed that only through the identification of problems of solid waste management in the Metropolitan Manila Area can we finally arrive at the education and training needs for environmental programs. It may be stated further that the problems of solid waste management existing in other cities and municipalities of the country are almost identical with those of the Metropolitan Manila Area.

BACKGROUND INFORMATION

The cities of Manila, Pasay, Quezon and Caloocan, like all the rest of the other cities in the country, have their own city charters each enjoying their local autonomy in the administration of their city affairs. Municipalities have their own municipal mayors and councils which enjoy local autonomy but are subject to some specific limitations set by the provincial government. There exist political boundaries between each of the fourteen (14) contiguous communities within the Metropolitan Manila Area. The writer knows of no existing memorandum of agreement existing between any of the communities for the administration of common affairs except that of the police forces in the maintenance of peace and order which was very recenly decreed by the President.

The Department of Health during the past fifteen years has been working for the centralization of solid waste collection and disposal for the Metropolitan Manila Area into one office. The World Health Organization in its desire to assist the Department of Health had, during all those years, lent the services of capable consultants who supported the idea of a unified and centralized form of solid waste management agency for the Metropolitan Manila Area.

Through public hearings and conferences with local city and municipal officials, and with the formation of technical and administrative committees, steps were undertaken to soften the attitudes of those who were against the centralized form of solid waste management.

During hearings and conferences, mayors and representatives of local governments expressed their vehement objection to centralized management, claiming that such a move will be an encroachment on the local autonomy of their respective communities.

As a compromise, the Department of Health through the Chairman of the House Committee on Health proposed H. No. 2343 creating a Solid Waste Management Authority. The proposal was aimed at centralizing the collection system, leaving the refuse storage and collection phase under the administration of local city and municipal governments. There was no dissenting opinion and the hiring of personnel was left to the discretion of local officials. The fate of House Bill No. 2343 creating the Solid Waste Management Authority was sealed with the abolition of congress at the advent of Martial Law. Our hope however was bolstered with the thought of a possibility that a Presidential Decree may eventually cause the creation of an authority to handle solid waste problems.

METROPOLITAN MANILA AREA SOLID WASTE COLLECTION AND DISPOSAL SYSTEM

All refuse collection and disposal agencies in the Metropolitan Manila Area are resorting to open dumping and burning. The dumping sites are in a very poor state of sanitation causing nuisances thereby posing health hazards. They contribute to air pollution and traffic hazards caused by smoke coming from burning of refuse. There are no regular control measures for the control of insects and rodents at dump sites.

In the table on the next page, the following can be noted:

1. Total Estimated Population Served ..... 4.5 million
2. Total Annual Expenditures fo the fourteen (14) communities amounts to ..... ₱10,800,000.00
3. The collection and disposal services in the 14 communities are being handled by different offices.

Other findings on the operation of other related activities on refuse collection and disposal are as follows:

1. **Street Sweeping** — In some communities street sweeping is handled by some other agencies or offices other than the agncy handling refuse collection and disposal. Street sweepings amount to about ten (10%) percent of domestic refuse. More often than not, street sweeping services are invariably assigned with the city Municipal Engineers Office which also cleans and improves drainage canals along streets.

2. **Market Sanitation** — Cleaning of markets is an activity often assigned with the city and municipal treasurers office, markets being one entity that earns substantial income for the local treasury. In view of the enormous amount of garbage produced in markets, refuse collection services have to make collections twice daily.

In view of the three related activities on domestic garbage and refuse, street sweepings and garbage accumulation in markets, it is advisable to place these three services under one office to attain proper coordination. Any failure among the three activities affects the overall efficiency of collection and disposal services.

3. **Garbage Collection** — Only a few of the fourteen (14) communities have ordinances authorizing the collection of garbage fees. Public Service offices handling refuse collection and disposal are not very keen on the enforcement and implementation of garbage fee collection knowing that whatever collection is made goes into the general fund whose distribution and allocation falls under the discretion of the city or municipal council. Should a relentless campaign for garbage fee collection be specifically reverted into a special fund primarily collected to support the operation of refuse collection and disposal, it is estimated that a substantial sum can be realized to support the operation of a centralized solid waste management authority.

4. **Salvageable Materials at Dump Sites** — If salvaging of materials at dump sites can be controlled to the exclusive right of the Solid Waste Management Authority, a sizable amount can be converted into cash and can help improve the services.

The scavenging at dumping sites for salvageable materials is made by outsiders and usually managed by organized syndicates. A few communities in the area have started prohibiting scavengers by municipal or city ordinances and penalizing scavengers from street receptacles.

5. **Collection Vehicles** — Most of the collection vehicles are of the open-type dump trucks and garbage is left uncovered during transport causing some nuisance and spillage along streets. Local governments, however, are beginning to procure covered-type collection trucks.

6. **Dumping Sites**— Final disposal is done by open dumping at some six disposal sites. Burning is resorted to, causing smoke emission. One big disposal site is located inside Camp Bonifacio which is the subject of complaints from adjoining housing subdivisions and commuters traveling along the South Superhighway.

GARBAGE STORAGE COLLECTION AND DISPOSAL
METROPOLITAN MANILA AREA
as of August 31, 1973

City or Municipality	Population Served	Office Handling Operations	Annual Operating Expenses	Number of Personnel	Amount of Refuse Collected Tons	Number of Collection Vehicles	Per Capita Expenses	Collection Cost Per Ton/Day	Present Dumping Site	Remarks
Manila	1,510,000	DPS	3,150,000.00	510	660 tons	194	2.42	6 x 365 13.07	Navotas & W. Bicutan	*Contract
Quezon City	920,000	CDPS	2,442,888.35	521	350 tons	35	2.65	19.10	Capitol Site	**Contract
Caloocan City	330,000	CDPS	400,000.00	244	65 tons	9	1.21	13.86	Kalookan	
Pasay City	220,000	DPS	657,000.00	151	252 tons	11	2.29	7.12	W. Bicutan	
Valenzuela, Bulacan	130,000	Municipal Engineer	102,000.00	22	48 tons	4	0.78	5.81	Valenzuela	
Navotas, Rizal	87,262	MNO	90,287.43	18	25 tons	2	1.04	9.90	Navotas	
Pasig, Rizal	252,000	DPS	350,000.00	50	50 tons	11	1.39	1.91	W. Bicutan	
Las Piñas, Rizal	64,759	DPS	68,842.21	54	75 tons	12	1.06	2.54	Las Piñas	
Mandaluyong, Rizal	148,417	MNO	48,000.00	45	43 tons	8	0.99	3.05	W. Bicutan	
Malabon, Rizal	141,609	Municipal Engineer	250,000.00	40	80 tons	8	1.77	8.60	Malabon	
Marikina, Rizal	131,128	Municipal Engineer	518,400.00	54	75 tons	12	3.97	1.89	W. Bicutan	
Parañaque, Rizal	105,933	MNO	454,720.00	28	45 tons	14	4.35	2.83	W. Bicutan	
San Juan, Rizal	119,154	DPS	182,439.00	40	68 tons	5	1.52	8.30	W. Bicutan	
Makati, Rizal	315,000	DPS	1,559,755.00	189	120 tons	40	4.80	3.35	W. Bicutan	
TOTAL	4,475,354		10,784,313.99	1966	1956 tons	265				

A plan is afoot to accept an offer of a private party to operate a dumping site which will employ sanitary landfill. On ocular inspection of this proposed disposal site was made at Madrigal Estate, Muntinglupa, Rizal. The site was found advisable provided the following conditions are included in the contracts:

1. Sanitary landfill will be used for the final disposal of solid waste.
2. Burning of refuse will not be allowed.
3. Regular and periodic application of pesticides will be made.
4. Scavenging will not be allowed.
5. At least two (2) deep wells will be installed at the dump site as emergency measures against fire.
6. The dump site will be fenced.

MAINTENANCE OF COLLECTION VEHICLES

In a course of inspection, not one commendable motor shop for the maintenance of collection vehicles was found. There were no stocks of spares ready for replacement of worn-out truck parts. Repairs of equipment were done mostly by outside motor repair shops. One sad observation is that the collection vehicles are composed of many types and of different makes contributing difficulty in the procurement of spare parts.

Generally, most if not all, cities and municipalities, do not have an adequate number of collection vehicles. As a result, vehicles have to be operated on two 8-hour per shifts leaving no time for the necessary maintenance and minor repairs.

SUMMARY

It can be seen from the facts stated above that the current solid waste management practices in the Metropolitan Manila Area are inadequate by modern standards. Insufficient funding and poor administration have resulted in conditions hazardous to the public health.

It is believed that the management of solid waste collection can best be handled by the local governments, but final disposal, including the provision of auxiliary bulk transportation, can best be handled collectively. The participation of higher government levels is greatly warranted.

FINAL OBJECTIVES

For the purpose of improving solid waste management, there must be a background of desirable standards and aims toward which efforts at improvement must be directed.

To attain such objectives, the following should be recognized and adopted as general standards and policy objectives:

1. Storage of household and commercial refuse for collection shall be covered, fly-tight containers with a capacity of 5 to 30 gallons, furnished and maintained by the householder and shall be set out on the street before the scheduled time for collection. Storage of uncontained refuse, open burning of refuse, and disposal on vacant property, esteros or water courses shall be prohibited. For larger quantities of refuse, such as those from markets, restaurants, apartments and hotels, bigger closed containers of appropriate size and design shall be provided by the user, for loading and removal by special equipment.

2. Collection shall be made on regular schedules with frequencies adapted to the general requirements of the users.

3. Equipment for collection shall be modern, enclosed, low-loading height types of sizes from about 10 cu. yds. to 20 cu. yds., the smaller ones to be used only where street conditions do not permit access to the larger vehicles. Some type of compaction device within the truck body is desirable. Provision for mechanical loading should be included, to be used interchangeably with hand loading without material interference. In the interest of efficient maintenance and repair, standardization of one or a very few makes of equipment is desirable, both for chassis and special bodies.

4 Disposal shall be accomplished by means approved by public health authorities. Authorities provide a disposal or transfer point for local collection equipment within a reasonable distance. So far as is consistent with the foregoing, disposal sites may provide such secondary benefits as reclamation or improvement of land, recovery of salvageable components, and production of useful by-products. Provision should be made for future expansion of disposal sites.

EDUCATION AND TRAINING REQUIREMENTS FOR FISHERY AND AQUATIC RESOURCES CONSERVATION

By FELIX R. GONZALES
Director
Bureau of Fisheries

INTRODUCTION

The development and conservation functions of the Bureau of Fisheries are spelled out in Presidential Decree No. 234, to wit: "For the conservation and development of aquatic resources, including fishery research, fishery activities management, fresh-water and marine fishery development and general administration, it shall establish, complete and/or expand demonstration fish farms, fish nurseries, fry banks, oyster farms, seaweed farms, fish pens, biological research stations and other farms; establish, complete and/or expand ice plants and cold storages; and contribute to the aquaculture project of the Southeast Asian Fishery Development Council".

In this paper, we shall

1) Describe the Philippine fishery and aquatic resources;
2) Strike a happy balance between fishery conservation and developments;
3) Identify types of manpower and training required; and
4) Set up criteria of training and education for fisheries conservation and development.

FISHERY AND AQUATIC RESOURCES

Our territorial waters, a potential fishery resource, await extensive exploitation. Traditional fishing grounds cover an area of 643,243 square miles, while untapped fishing areas total 125,950 square miles. Kyaran (1971) estimated the potential yield of about one million metric tons of pelagic fish from the Philippines' inland and territorial waters.

Inland waters like rivers and lakes are capable of supporting more fish life. There are 126,000 hectares of freshwater fishing areas and 367,000 hectares of mangrove swamps in addition to the 171,000 hectares of developed areas which can be made to produce more. In 1972, the fishpond sector only produced 98,992,490 kilograms.

Our estuarine areas of more than 400,000 hectares are the richest portions of our seashores and serve as nursery grounds for a variety of fishes and invertebrates, especially crabs, milkfish, shrimps, bass, gobies, etc. Elsewhere, the estuaries are considered of great biological importance. Estuarine areas are very important producers of food. Hence, the need for estuarine protection. Fishponds are developed from these areas where many kinds of bivalves can be grown—oysters, mussels and clams.

Coral reefs are scattered all over our country. These are also very productive areas. Not only the coral reef fishes, but also many kinds of invertebrates are abundant in these areas. Numerous food organisms are found here, such as sea urchins, sea cucumber, giant clams, pearl oyster, abalone, and many kinds of algae like **Eucheuma, Digenea, Gelidium** and other green algae for food besides the agar-producing algae.

The round scad, sardines, herrings, anchovies, mackerels, bonito, and yellowfin tuna comprise our pelagic fishery resources. About 25 species of the pelagic fishery make up more than 60% of our total commercial catch. The rest is made up of demersal fishes such as Caesio, groupers, lizard fish, nemipterids, shrimps, crabs, slipmouth, coral fishes, etc.

A BALANCED FISHERY DEVELOPMENT AND CONSERVATION

Development and conservation merely constitute the two opposite and interesting factors involved in fishery management. For us in the Bureau of Fisheries, our activities are directed to a heavy balance between accelerated development and sound conservation.

To illustrate, when our doctor gives us a clean bill of health, everybody is happy. Similarly, whether in the government or in the private sector, accelerated fishery development is welcome news. It connotes new jobs, more income and brisk business. But to mention fishery conservation implies regulation and has overtones of over-fishing and diminishing returns on fishing effort. Then everybody shouts for the doctor to do something about it quick. Therefore, anybody who proposes regulatory measures is apt to be a little unpopular. This was evident after the promulgation of Fisheries Administrative Order No. 111.

Our people should consider fish conservation in the same light as fixing the brake on your car. Taking the simile a step further, for the fishing industry the possibility of restraint at some future date is like having the standard combination of accelerator-clutch-brake. Without this, chances are we would slam our car against another's fenders or dive into a ditch.

Ordinarily, while the fishing industry is still gaining momentum, proper regulation and management are conveniently side-tracked. Feverish attempts are taken to arrest the deteriorating situation only when such unmistakable signs appear as fluctuating stocks or variations in return per unit of fishing effort, etc. In that state, it may no longer be possible to collect information with respect to the original condition of the stocks as well as the reproductive capacity of a fishery, for conservation purposes.

When the landed catch per unit of effort begins to decrease, although the total tonnage brought in by the fleet is still rising, it is the first sign that fishing pressure is becoming a significant factor and one which the industry should not, but casually does, ignore in its long-term planning.

However, when the total tonnage landed begins to fall, it becomes patently absurd to continue inputs of additional units of boats and fishermen to get less tuna or shrimp, or whatever the resources may be.

Boat-building, especially in the Western Visayas, is at a feverish pace nowadays. With the Development Bank of the Philippines now retailing the World Bank's $11.6-million Fishery Loan Fund to investors, additional vessels for the fishing fleet should incorporate new design and increased efficiency. To accelerate fishery development, we cannot afford to subsidize inefficiency. With improved equipment, we can reduce unproductive time spent being tied up for repairs of traveling to and from the fishing grounds. Speedy, labor-saving devices should be introduced and adequate provision made for berthing facilities to handle both large and small vessels of all types.

The potential of fisheries in general economic development is now being realized with increasing foreign receipts from our exports of shrimp, tuna, seaweed, etc. It is also of public knowledge that several nations are fishing in our territorial waters. This is the reason why our fishermen should now tap nearby rich oceanic areas. Taiwanese and Japanese fishermen have now and then been caught poaching in our territorial waters. Increasing catches show virtually untapped resources of tuna and other pelagic fishes to the north, east and southwest of our archipelago.

If our countrymen are to solely exploit our fishery management and conservation, measures should be followed to recover fairly constant yields and enable the fishing ground to recover its natural productivity and return to sustainable levels. Considering, however, that the overall yield of our fishery resources is shared by neighboring countries, then any increase in total yield would not mean a surplus for export, but may even lead to a declining share of the overall catch.

In this specific instance, we need fishermen who could exploit our aquatic resources and derive maximum benefits, otherwise somebody else would literally grab a substantial portion of the national patrimony. The common-property concepts of fishery resources in territorial waters won't be disadvantageous if we have a sufficient number of deep-sea fishermen.

A word of caution, however — development efforts should not give rise to a "gold rush" situation which could nullify conservation efforts and adversely affect the viability of the Philippine fisheries industry.

For this reason, hand in hand with development efforts, conservation measures have been promulgated such as the 5-year closed season of Malampaya Sound; the 5000-hectare fish sanctuary in Laguna Lake; seaweed farming is encouraged, and fish pen culture regulated.

CONSERVATION NEEDED

Conservation suggests "hoarding", as if the idea were simply to ration static supplies so that there would be some left for the future. But what the real conservationist is against is **unplanned development that breaks ecological as well as human laws**. According to Odum, the true aim of conservation is twofold: (1) to insure the preservation of a quality environment that considers aesthetic and recreational as well as product needs, and (2) tc insure a continuous yield of useful plants, animals, and materials by establishing a balanced cycle of harvest and renewal. Thus, a "no fishing" sign on a body of water may not be as good conservation as a management plan which allows for removal of several hundred kilograms of fish from public waters. On the other hand, if the area provides the breeders and juveniles to replenish the resource, then periodic constraints on fishing activity may be a desirable conservation procedure.

Although "hoarding" may not be the long-time aim of good conservation, there are instances in which complete restriction of use constitutes good conservation. The setting aside of natural areas for study and aesthetic enjoyment is an example. With the increase in human population, it becomes more important that adequate samples of all major natural communities be preserved undisturbed for study and enjoyment. Since man established his civilization and his food chains by modifying natural ecosystems, it is important that we have samples of unmodified communities for study; only with such "controls" can be effect of man's modification be properly judged, and unwise practices avoided.

In the face of mounting pollution and environmental disturbance, there is an urgency for fishery and aquatic resource conservation. All must act on the environmental front quickly and with determination. We have to act ahead of events, rather than move from crisis to crisis. Our critical path, in other words, must be laid out ahead of time. We must preserve our wildlife, our fish and our trees. We must renew our renewable resources as quickly and as effectively as we know how.

Obviously, our people should learn the concept basic to fishery conservation of **use but not abuse.**

FISHERY MANAGEMENT — A MULTIDISCIPLINARY SCIENCE

Fishery management is the application of scientific, technological, legal, economic and social-political knowledge to rational utilization of living aquatic resources for maximum permanent benefit to man.

Fishery management is now recognized to be as complex and difficult as any human activity. He is best qualified to become a leader in fisheries who has been exposed to the humanities generally, the arts, and the social sciences. Mathematics is an essential part of fishery training. Fishery management is fundamentally a quantitative science, as biology, ecology, environmental description, the food sciences, and economics are the basic technical subjects on which fishery management depends. Some exposure to the agricultural and forestry sciences is likewise desirable, for many of the principles used are similar to the principles of fishery management. Engineering has many interactions with fisheries, either producing adverse effects that will reduce the harvest or technical applications that can enhance fishery production or quality. Hence, some understanding of engineering principles and methods is desirable.

FISHERY EDUCATION AND TRAINING ABROAD

A study of the fisheries development programs of countries in the Indo-Pacific Region especially that of Japan, Korea and Taiwan, reveals the importance given to training of personnel for the development of the industry.

Japan enjoys a pre-eminent position today in the field of fisheries, gained through almost a century of systematic fisheries education covering all aspects of the industry. The Republic of Korea and Taiwan too, have made significant advances in the field of fisheries established in those countries. These facilities have since been improved upon and extended. It is a fact that Korean and Taiwanese fishermen are navigating distant seas in search of fish. They fish side by side with the Japanese in both the Indian and the Pacific Oceans.

The training of personnel for fisheries development and conservation poses a number of problems: (1) it is difficult, for example, to decide at what level the training facilities should start and what subjects should be included in the syllabus and (2) who are the people to be trained? It is often argued that the industry is at a low level because there are no trained men to handle the job. Thus, a break in the vicious circle has to be made if fish sufficiency is the country's primordial goal.

Another important point for consideration is when should advanced fisheries education and training be started in this country? This can best be answered in relation to the pace of fishery development and the status of ancillary industries. To open up possibilities of oceanic fishing for Filipino fishermen, for example, there is a need to have trained men who could navigate ships of 100-200 tons of fish and load hundreds of miles away from home ports. Fishing technologists, marine engineers and refrigeration technicians able to cope with modern freezing equipment are required. Thus, the breakthrough from traditional coastal fisheries brings in its train a host of technological problems which, although has easy for countries advanced in science and technology to solve, yet present an almost impenetrable barrier to a developing country like the Philippines.

EDUCATION AND TRAINING REQUIREMENTS

In an age of motor power, speed and electronic wizardry, the fishermen no longer depends upon the weather to bring home a remunerative catch. The tools with which to implement the various stages of fishery development can be produced in a relatively short time. But the training of men to handle these tools usually takes a much longer time.

The importance of fishery training cannot be over-emphasized because the best-designed equipment has little value in the hands of a man who lacks the knowledge and skill to operate or handle such equipment.

Fishery education and training must be widely disseminated to develop fishery consciousness among our citizenry in order to attain a national discipline that would condemn wasteful habits and practices, and call a halt to abusive exploitation.

An adequate program of fishery education shall yield tremendous benefits for fisherfolk in particular and the country in general.

Systematic training, on the other hand, must inevitably lead to raising the industry's sights. Technical proficiency leads to economic sufficiency. It is imperative that those entrusted with fishery training programs should wisely utilize limited resources instead of spreading them very thinly and should gear curricular objectives with the fishing industry's requirements and hasten fishery development.

Incidentally, we must not overlook our greatest highway of fishery conservation —the elementary schools where approximately eight million youths can be exposed to a better understanding of the wise use of fishery and aquatic resources. The ideals, knowledge and skills of these school children will have much to do with what happens to our land and its resources now and in the future. As they are destined to play an even greater role in the years ahead, fishery conservation must be stressed to them as a primary duty of citizenship. Through incessant campaigns in fisheries conservation, increased production and proper utilization of aquatic resources, we could enlist active popular support and participation.

Teachers are at the forefront in this activity. A sustained and coordinated effort could yet avert the dangers poised at the nation's very life—its fish supply. Toward the end of a national economy of abundance, fishery education assumes a challenging role. Yet it has never been said that educators shirk their responsibility in the crucial hour. They can yet mend the improvident ways of our people before precious fishery resources are irreparably lost.

In a nutshell, the fisheries industry is still saddled with the following problems:

1. How to get the most out of the available resources;
2. How to maintain the quality of the surplus catch to benefit both producers and consumers;
3. How to reduce the rising operational costs of fishing vessels and

4. How to effect economics on labor costs expended in hunting and catching an elusive prey.

Viewed from the total requirement of proper exploitation, utilization and conservation of the nation's fishery and aquatic resources, the manpower supply is still inadequate. Specifically, the manpower needed includes —

1. Teams of technical experts to regularly assess water quality and its effect on fish, i.e. investigators of operating and proposed industries and other pollution sources who shall advise on abatement and corrective measures, and supporting personnel such as chemists, biologists, and oceanographers as well as special consultants.

2. Upgrading the skills of 500,000 fishermen, to operate bigger boats, and upgrading navigation and seamanship to exploit our non-traditional fishing grounds.

   Next year, we need 7,722 masterfishermen, 2,002 skippers and 6,864 engineers. In 1976, the commercial fisheries will require 8,646 masterfishermen, 2,242 skippers and 7,686 engineers.

3. Oceanographers who understand the dynamics of fish populations and who could eliminate guesswork in the quest for large and profitable catches.

4. Boat engineers whose expertise guarantee that propulsion engines are in running condition.

5. Fish processors who has knowledge on fish conservation.

6. Cottage-industry entrepreneurs to utilize idle labor and raw materials from local sources.

7. Eucheuma farmers who can propagate these species of seaweeds in suitable areas and boost export receipts from one of the country's dollar-earners.

8. Fishery (food) technologists to undertake sufficient large-scale extraction of protein from sea products for use in the human diet and make vigorous efforts to free our rapidly-growing population from the spectre of hunger. Through novel recipes, they could process convenience foods from unwanted species of fish.

9. Fishery workers willing to cooperate with one another in order to reduce the risks inherent in a fishery enterprise and otherwise increase productivity and profitability through collective effort.

10. Hatchery personnel to conduct studies on the life cycle of commercial species; pinpoint spawning and breeding grounds of fishes; establish egg-collecting stations and trappling facilities; and intensify the stocking of inland waters.

11. Extension workers who shall teach and advise fishermen on updated fishing methods and techniques, and arrange for re-training and refresher courses.

12. Fishery biologists who study life histories, distribution and migrations, and population dynamics of species and stocks of fish to determine the effects of fishing on the resource and to recommend management plans.

    Today, we are at a point in fishery research where the classical concept of the fishery scientist must be scrapped. Fishery research is ecological research of the broadest kind. In today's jargon, fishery research and development is a "system" which includes a balanced mixture of all the aquatic sciences, meteorology, engineering, economics, law, and the social-political sciences.

    To solve fishery problems, we need teams of scientists, engineers, economists, legal experts, sociologists, and experts in all other disciplines that relate to resource management and resource use.

13. Decision-makers are needed in applied ecology and resource management. Training in modern management science and systems analysis is just as important as training in biology. Such concepts should be stressed in the common part of fisheries training. Training in descriptive biology does not prepare a man for a managerial position in which his analytical and decision-making abilities determine the success of his performance. Fishery students pursuing their doctorates will specialize in a biological field such as phy-

siology, microbiology, genetics or taxonomy. However, specialists in fields such as economics, statistics and electrical engineering are apt to play equally important roles in the multidisciplinary teams needed to attack exceedingly complex problems in fishery and aquatic management.

14. Production-oriented managers who do not consider fish production only in terms of what can be trimmed from the edge of the naturally occuring population. Had this approach been employed in the art and science of agriculture, man would have been firmly fixed in the Neolithic condition with a standard of living dependent almost entirely on the bounty of nature. This is true of a fisheries science that is based on a philosophy of marine biology in which an extreme conservationist policy dominates. This emphasis has been placed on ensuring minimum disturbance of the natural balance of aquatic population.

Conversely, what we need is effective exploitations, and for this, we require a technology based on a profound knowledge of the biology of the animals which constitute the raw materials and of the environment in which they live.

A complex technology of production more or less successfully blends biology, engineering, nutrition, and even food technology. An anachronism in the Space Age is the naturalist-zoologist who is fascinated more by the rich diversity of marine life and only incidentally interested in the productive capacity of the oceans and of aquatic life to supply the particular needs of man.

The people we need to accelerate fishery development in this country are expected to have a good understanding of marine animals and the environment in which they live; management and utilization of marine resources for human needs; post-mortem biology, processing, and preservation of marine products; and economic and socio-legal factors involved in the entire management-extraction-processing operations.

CRITERIA FOR FISHERY SCHOOLS

Instructional facilities in fishery schools should be adequate to make the training agency a real "threshold" to the occupational world. The conditions for on-the-job training should approximate those of the fishing industry. Instructors should be experts in their respective areas of specialization.

From our fishery schools, we expect to get tomorrow's skippers and mates of streamlined and efficient seagoing vessels; the marine engineers who will operate engine rooms grown highly sophisticated in a world of advancing technology, the marine electronics experts and gear technologists, fish culturists, fish processors, and fishery biologists, who will perform specialized work in the fishing industry.

In general, our fishery schools should upgrade and re-train people in industry, prepare the youth for challenging careers and remunerative jobs in fisheries, train our manpower to its maximum potential and create a new image for the industry that will be in accord with the rising expectations of our people under the New Society.

EDUCATION AND TRAINING REQUIREMENTS TO MEET ENVIRONMENTAL PROBLEMS IN INFRASTRUCTURE DEVELOPMENT

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INTRODUCTION

The post-Martial Law proclamation in the Philippines has seen the rapid advance of infrastructure programs in conjunction with the renewed emphasis on socio-economic development of the country. This accelerated pace, however, is set back by the shortage of qualified professionals to prepare integrated and comprehensive plans for national and regional development.

In a developing country like ours, the planning of infrastructure development and the implementation of specific programs are vital to the overall development of the economy. Infrastructures are basic necessities to complement and/or support other components of the environment. They come in the form of facilities and services which are not directly productive, but without them, industry, agriculture and other social and economic services cannot function efficiently to fulfill the changing needs of society. The unprecedented demand for new facilities, both social and physical, to satisfy the expressed needs of our fast-growing population and the increasing requirements of industry and agriculture cannot immediately be met without proper allocation of our limited resources with optimum efficiency. This is only possible through the availabilty of an adequate supply of professional planners from various disciplines not only to make plans but also to efficiently implement them.

In the past, economic planning seemed to have been the primary consideration in the preparation of overall development programs of the country. However, in recent years, there has been an increasing recognition of the change in planning approaches. The concept of planning is shifting from a predominantly sectoral (economic, industry, educational, etc.) to comprehensive planning. Comprehensive planning aims at integrating the different sectoral plans into a coherent whole capable of adcomodating and indeed facilitating a productive interaction among related development factors. The influence exerted by the infrastructure programs in the progress of the country necessitates the formulation of training and education programs, not only to train those who are already in the government service but also potential professionals who can be trained to fill the immediate manpower requirements and our expanding needs in the future. This educational program is necessary to ensure an adequate supply of qualified technicians who can formulate solutions to serious environmental problems that are already confronting us, and at the same time, prepare long-range comprehensive programs for development to lessen the impact, if not eliminate, future environmental problems as a result of our advancing economy.

ROLE OF INFRASTRUCTURE IN THE ECONOMY

Infrastructure programs have corresponding costs which have effects on the ecology and the human environment. Air, water, soil and sunlight are our natural environment which provide the setting for life. On the one hand, housing, industry, commercial centers, recreation and institutional areas are but a few components of the urban fabric designed to meet our changing needs and other activities. Such components are interrelated and therefore constitute a system. This system in order to function efficiently as a whole, must have its components linked, serviced, and provided with physical and social infrastructures. These two types of infrastructures, which include public services, education, health, transportation, communications, power, hydraulic works, ports, etc. perform auxilliary functions for directly productive activities but have many-sided effects which are both positive and negative. The positive effects cannot be overemphasized. But the negative effects must be carefully avoided. This can only be done through the expert planning of infrastructure programs in relation to the other components of communities.

ENVIRONMENTAL PROBLEMS

Infrastructures influence land use within communities. Their development must be given due consideration both in time and space as they are in a state of constant interaction with the natural environment. To give emphasis in the development of one form of infrastructure without considering its effects on the community as a whole and the changes it would introduce in the natural environment would create serious environmental problems. Some illustrative examples of such problems are: 1) When two buildings are put up close together, the problem of relationships arises, 2) When a highway is built across undeveloped areas, changes in the use of the land generate specific human activities, which as they evolve, produce negative effects against the other components of the community, in general, and to the people, in particular. 3) The construction of irrigation dams, if not properly studied, may disturb the natural channels affecting drainage. The subsoil water table changes, which can cause flooding through seepage of dam water. 4) Improperly planned roads within a central business area create traffic congestion. This situation contributes to air pollution, which is injurious to health. 5) Heavy earth grading, as in the case of many subdivision developments, and cutting of trees to clear land for purposes of development, could cause soil erosion and change the courses of rivers, creeks and other water resources. 6) The building of large dams can result in unforeseen ecological effects. The Pantabangan River Project has caused the relocation of the town of Pantabangan, in Nueva Ecija. The resettlement of the townspeople has greatly affected their living conditions and environment. This kind of community can easily deteriorate if not properly given the necessary social and physical infrastructure support. 7) In the rural areas, out of necessity, the people have constructed ill-designed structures such as small irrigation dams, roads and bridges to improve their livelihood. The existence of such ill-designed structures initially creates conflict with the natural environment. The situation becomes more serious when human activities increase in these areas. The proliferation of privately owned small dams either for irrigation purposes or fishpond development in Central Luzon is a typical example. The dams disturbed the natural drainage channels. As a result, vast areas in Pampanga and Bulacan, and even in Metropolitan Manila, were damaged by floods during the heavy rains of 1972 causing destruction of properties worth milllons of pesos.

INFRASTRUCTURE PLANNING IS A MUST

In general, the provision of infrastructure projects must be programmed so that they are constructed at the proper places and at the right time. In the past, especially during the pre-Martial Law era, infrastructure projects were undertaken on a piecemeal basis without rational consideration of their location and the impact they provided on the living conditions of the people. This situation can now be avoided through better planning and implementation of infrastructure projects.

One important commodity which is a basic consideration in the planning of communities is water. Many of our towns and cities are now obtaining their water supply from far distances because their present water resources can no longer support the demands of their increasing population. Metropolitan areas are the most affected. What the city of Manila is experiencing now will probably happen to Cebu City and other big cities in the archipelago in the next decade or two unless a comprehensive approach to planning is undertaken. Meanwhile, Metropolitan Manila will continue to grow in terms of people and space. The problem of water supply will reach a critical stage which could be tragic. Failure to approach this water problem in an integrated fashion can produce a variety of environmental problems with varying effects to the community.

More often than not, planning is resorted to only after a disaster or calamity has occurred. This practice is curative rather than preventive. Last year, a small fire started in one of the residential areas in Manila. The fire spread so rapidly to the adjoining areas that it gutted several blocks. The fire could not be contained due to inadequate water pressure. This situation was aggravated further by the inaccessibility of fire trucks to the area. Such has been the sad experience of many urban areas because of poor planning.

Water supply and sewerage and drainage go hand in hand. In urban areas, both good and waste water are brought in and discharged, respectively, through

a network of plumbing systems within a building. The waste water is discharged to a system provided with treatment plans. In many cases, as has been the practise for many years, most of the wastewater in residential areas is discharged through individual septic tanks with the effluent finding its way through street gutters and finally into the river. The effluent, which is polluted, mixes with the natural river flow. This river could be the source of water supply of the next community downstream. Unless adequate potable water is made available to every dwelling unit and enough space is provided for healthy living, the universal goal of improving public health cannot be realized.

The preceding comments are an over-simplified presentation of the complexity of the problems of our environment brought about by improper planning of infrastructure in relation to other components of communities.

EDUCATION AND TRAINING REQUIREMENTS

The process of estimating manpower needs for planning as a basis for providing educational and training facilities is a philosophical and theoretical examination of the nature of the changing role of planning in terms of the evolving character and pattern of society, government, the transformation within higher education, and the impact of emerging technology. The entire array of factors in shaping the future and function of planning will elicit sharp academic adaptations. Variations in academic form and content are likely to be the only resource in accommodating the diverse requirements and testing possible academic construction.

In a seminar held at Puerto Rico on training for town and country planning, the participants came out with three major findings and conclusions in connection with the preparation of education planning programs. They are: 1) Planning education must relate physical planning at all levels directly to social and economic goals in order that the whole process of planning in general may affect the pattern of social and economic development. It is emphasized that neither physical planning nor economic or social planning alone can offer workable solutions to developmental problems, because these problems are intimately related and must be resolved in a balanced way. 2) Efforts to advance the general understanding of the role of planning and to create and develop effective planning schools will be most successful where planning has the confidence and support of the citizenry and is an integral part of the government process. 3) Training should be given at different levels. It should include training at the undergraduate level for younger students, post-graduate for those interested in the coordinative aspects of planning, and special courses for persons in responsible government positions concerned with planning. Both academic programs should combine with an established, recognized and well-developed educational institution on whose resources the new school can draw.

While every country must develop its own training strategies to suit its particular needs, Harbison and Myers suggest that policy-makers in various countries must first determine the level of their development before determining their human resources training development programs. The strategies that they have developed, which take into consideration the level of development of the country are: 1) For countries on Level I, where political sovereignty is the dominant imperative, they are urged to concentrate on a schedule of "localization". The logical strategy is to undertake a crash program to expand the output of secondary education. The supporting parts of the entire program are: increasing quality of primary education; placing major reliance on employing institutions for skill development: and rationing opportunities for higher education by government for university training abroad. 2) For countries on Level II, where the economic imperative is to build the base for industrialization while expanding agricultural production, the top priority in human resource policy is the reform and expansion of secondary education. It is urged that greater emphasis be placed on better teaching of the fundamentals of mathematics and science. Next comes the need for expansion of education and sub-professional personnel and technicians. At the same time, in higher education, emphasis should be placed on high quality education in science and engineering and curtailing the expansion of low-quality offerings in the law, arts, and humanities. Then a comprehensive program for upgrading and training manpower in government and private enterprises is essential. Finally, to ensure the success of the entire program of human resources development, an incentive pay scheme must be provided for scientists, engineers, teachers and technicians, and critically needed sub-professional

personnel. 3) For countries on Level III, where the major economic objectives are rapid and massive industrial development, the logical strategy is the reorientation and reform of higher education. What is called for is to give more emphasis to the scientific and technical faculties and improving the quality of instruction in the other fields. Research institutes have to be established to adapt modern science and technology to the needs of the country's modern industries. At the same time, there is need to gear vocational training and adult education to the specific needs of public and private enterprises.

After determining the level of development of the country, the next logical step suggested by Harbison and Myers is the establishment of human resource targets by analyzing the present manpower resources and estimating future requirements. The assessment of the present human resources involves three phases, namely: 1) an inventory of employment and short-term manpower requirements; 2) a general appraisal of the educational system; 3) a survey of existing programs for on-the-job training and the utilization of high-level manpower. In the setting up of human resource targets, they suggested four principles to consider: 1) in the analysis of manpower requirements, care must be exercised in seeing that goals be specified first through checking the legitimacy of the selection with opinion leaders, politicians and others; 2) major reliance should be placed on making reasonable comparisons both within an economy and with other countries; 3) in estimating future requirements, the human resource planner should concentrate on setting targets rather than making forecasts — a target indicates a direction for action and its main purpose is to influence the future course of development; 4) requirements for human resource development should be comprehensive — the closely associated targets for on-the-job training, for the structure of incentives for better utilization of skills ,for creating adequate employment opportunity, and for importing expatriate manpower, should be established along with educational targets.

Corollary to the three levels of development postulated by Harbison and Myers, and on the basis of certain assumptions pertinent to underdeveloped countries, Viloria offered specific strategies for plannisg education programs. These strategies, which are more responsive to the needs of developing countries, are: 1) For Level I countries, the strategy involves three approaches. First, personnel must be used on to man positions in central planning agencies. Their three functions are: operating, consulting and educational. Perhaps half of their time shall have to be devoted to the usual functions of physical planners in national planning agencies. The other half would be devoted to advising key officials of agencies, which have functional programs on the implications of their programs on physical planning. Also, expatriate personnel should assist in setting up in-service training schemes among the functional departments to assure that physical planning is not neglected in the exercise of such functions. Quite related to this, they would be serving as resource persons in seminars or conferences or writing popular articles to inform the general public on the significance of physical planning to community life. Second, an intensive training program and other related adult educational schemes should be inaugurated and pursued with vigor in the functional departments, as well as in the central planning agency and on the lower levels of government. Third, training abroad for selected types of government personnel must be resorted to for some time. The first group of government personnel should be those who are in the higher positions and who have already acquired some experience and possess maturity of judgment. The other group of prospective government personnel should be promising students who may be sent to acquire professional training in foreign schools of planning. 2) For level II countries, the strategy is to start an educational program for planning assistants in the existing university of the country. To ensure that the training program shall fulfill the needs of the country, the training staff must be a combination of university professors and key personnel in strategic agencies. The university, in cooperation perhaps with the central planning agency and a few functional departments, should undertake a modest research program on community planning. A foreign consultant or two may be engaged in connection with the academic and research programs. To complement the formal education program, the in-service training program should be intensified and expanded to include local government officials and personnel. Also, observation trips to foreign countries for ranking personnel should be encouraged, preferably under United Nations schemes and other technical assistance arrangements. Bonded government personnel, primarily performing physical or community planning, should be selected for graduate training abroad. 3) For level III countries, the strategy will be the inauguration of a profes-

sional training program in the existing university of the country. Not only will the school of planning be responsible for research and a full undergraduate program, but also for offering introductory courses in planning in other faculties or departments of the university. The specialist training or post-graduate program in physical planning abroad may now pe confined to faculty members of the school of planning. Short-term foreign consultants may be utilized sparingly either to do special assignments or tasks in the central planning agency and/or in the university. It is expected, at this stage, that the in-service training programs have become built-in and self-generating programs, both in government and private industries, and that the universities' role shall be that of providing research products and consultative services. It is also expected, at this stage, that professional associations shall have started to assert influence and that a healthy competition between and among themselves will be encouraged. More attention will be devoted to the adult education programs at the local government levels and to the introduction of community planning concepts at the secondary levels in the educational system.

On the basis of the discussions on educational strategies presented, it is now easy for us to select which of these is applicable to the Philippines. While the theories and concepts advanced by Harbison, et al are good, they are hardly applicable to suit one's requirement. However, a combination of these concepts or theories can be selected to formulate a more adaptable program for the country. Statistics and research available do not show the inventory of our human resources who are particularly proficient or expert in physical planning to meet the requirements of infrastructure development in the country. Because of this deficiency, it is therefore difficult to make specific recommendations as to the kind of training that must be provided to produce adequate and qualified physical planners. On the basis of personal observation, we have very few professionals who were trained formally in the new concepts of planning. This observation is borne out by the fact that the present demand from government offices cannot be met. The Institute of Planning of the University of the Philippines has so far trained a handful in comparison with the total demand. But the present human resources can be trained, especially those who are occupying key positions, in the preparation and implementation of infrastructure development programs. The strategy recommended to satisfy the present educational and training requirements to meet environmental problems in infrastructure development is:

1. Offer short courses for government employees at supervisory levels who are involved in infrastructure programs. These courses will include pollution control and concepts in planning and ecology.
2. Revise university curricula on engineering and technical courses to include courses in planning, ecology, pollution, etc. In addition, an educational program must be set up at secondary levels and if possible, in the lower levels to give the cause and effects of environmental problems like air, water pollution, etc.
3. Encourage and assist planners in gaining additional professional qualifications such as engineering, economics, and sociology, to study comprehensive planning approaches.
4. Encourage research in universities and institutions on problems of environment and infrastructures.
5. Expand the post-graduate program of the Institute of Planning to encourage the establishment of regional institutes to cater to field personnel.
6. Conduct regional seminars periodically for government and private employees so that they can be provided with basic skills in problem solving.
7. Provide international fellowships and observation tours to senior officials.
8. Use foreign consultants where necessary for guidance with our academic and research endeavors.

The success of this educational program for the country depends upon the incentives offered in connection with the training. Will the old government employees who have not been in school for a long time accept training? If they accept such training, will they be able to apply what they have learned? These are problems involving the understanding of the role of planning which have to be resolved to ensure the successful implementation of the educational and training programs.

ECOLOGICAL AND INDUSTRIAL PLANNING IN PRIVATE INDUSTRY: ITS EDUCATION AND TRAINING REQUIREMENTS

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INTRODUCTION

Writing a paper on this matter is no easy task for two basic reasons. First, because the prevalent thinking, especially in countries like ours, with respect to ecological and industrial planning in private industry is, to our mind, a concern of two conflicting groups of interests; the ecologists, naturalists and environmentalists on one hand, and the private industrial planning sector on the other hand, with no "buts" in between. And second, because the requirements for training and educating the young and those presently involved in industry are still being identified by educator-scientists, in order to evolve a happy medium for these two varied interests to come to a head. This interest has only very recently caught fire, due to the interest generated by ecology and its importance to our lives. In other words, this matter is try on our ecosystem.

DILEMMA OF INDUSTRIAL PLANNING AND ECOLOGY

The motivating force of private industry, as is universally accepted, is profit. In our locale, this is expressed in maximizing the percentage rate of return and translated into pesos every year's end. Accordingly, the establishment of our industries, with some exceptions, has been geared to raising the interest rate of return, with hardly any regard to the ecosystem surrounding their plants' locations. In simpler terms, therefore, the relationship between industry and ecology is that the former treats the latter as the means to its end. The result is obvious; our rivers have become the conveyors of all types of organic and inorganic effluent, and the bays and lakes their receptacle, and there is no end in sight. Surprisingly, we do not lack the proper laws, legislation and decrees to correct and combat the assault of industry on ecosystem.

We do lack, however, the proper attitude on the situation. Perhaps, all this would have been avoided had our industrialization policies after the war been oriented to ',ecological inclinations". But again, this is the biggest "if" of our times.

The biggest dilemma presently confronting countries of the third world, which are experiencing high population growth rates, unemployment and under-employment and the concommitant socio-economic implications, is whether we should have a little more of pollution and other ecological ails as a result of a faster and higher growth of our gross national product, or whether we should allow less degradation of the environment, resulting from low economic growth. Ironically, everyone realizes the need for high GNP with an almost idyllic preservation of the ecosystem. However, this is another myth confronting us.

The price of progress is not always cheap. Somehow we have to sacrifice some of our ideals to attain our plans. Industrial planning, as we see it, approaches the problem of maintaining the ecological balance of the environment in the hope that somehow, after improving the lot of the people in terms of more employment, higher wages, a higher standard of living, the betterment of the environment would follow as a matter of course. This is not pure hypothetical argument. Advanced countries of the world like Great Britain, Japan and the United States have approached the situation in exactly the same fashion as we are doing now but perhaps on a different scale and different tempo.

In the United States, they have what they call the GNP (Gross National Pollution) in addition to their real GNP (Gross National Product) as it is commonly known, Quantifying this, they have come up with a staggering accumulated gross national pollution in the order of some $200 billion. Obviously, this has resulted from the United States' highly developed economy. They are now actually spending hundreds of millions of dollars correcting the situation. In a word, expenditures on ecology and environment should not exceed the capacity of the people to pay.

But this is the extreme case. In our milieu, we have not quantified the gross national pollution in our midst but my judgment tells me that this amount, if quantified, will also be staggering by our standards, in terms of putting back to normal the imbalance we have wrought on our ecosystem. Comparatively speaking, of course, this figure would not approximate that of the United States, but in terms of our capacities to pay it, might well mean the collapse of our economy.

We do not opt for a furtherance of the situation. Rather, it is our view that the recent upsurge of awareness of environmentalism and ecology carries with it a "syndrome" which might very well change the pace of growth of industry.

PROPOSAL

And so, we propose a solution to this impasse — that of moderation and control of the environment and ecological problems and the desire to achieve the desired economic growth.

First, let us by all means maximize our growth rate: feed our people, clothe them, give them shelter and more work, provide them with modern toys, more cars, more luxuries and more amenities. And we do not stop there. We keep on until we have attained the basic aims of economic planning, simultaneously tackling the ecological problem by spending what we judge to be within our means. In a word, the extent and magnitude of the cost of correcting the price of progress will have to be dependent on our capacities to pay. Nobody can criticise us for this. After all, it is still the people benefited by progress that will have to bear the cost. Clean air, more fish in our rivers, absence of slums and squalor, ecological balance, all these can only be had if there is less poverty and less hunger. The pre-industrial revolution period is long over. This is the age of the machine, the age where the world is teeming with people. We can not afford to have utopian ideals in this situation. We can not have progress and yet not have some of the consequences of progress. Who was it who said: "We can not eat our cake and have it too".

And secondly, what we propose is the right kind of education and training in this regard. To propose a set of curricula would be presumptous. We do know that, as we have said earlier, this area of interest would best be left to educator-scientists. They are more knowledgeable in this aspect. But what we propose is "food for thought" for the education-planners in both the public and private sectors in particular, and the rest of society in general.

By and large, our educational system is geared to progress. Except possibly for a handful of very specialized courses dealing with health and sanitation, biology, botany, zoology and the rest of the natural sciences, there has been no concerted effort in educating the youth in questions relating to ecology, and the ecosystem in a comprehensive and integrated method. We are not suggesting that everybody study ecology. What we are saying is that the whole complex gamut of nature's processes should be understood, even in a general sort of way, to be ultimately considered in every human endeavor within the context of our individual fields of expertise.

Largely, we educate our youth with the hope that they ultimately become progressive builders, progressive industrialists, progressive..... ad infinitum. Everything is connotated with progress. Perhaps, it is high time we consider looking over our present educational system to suit the exigencies of our times.

What we are proposing here is to emphasize the importance of maintaining the balance of the ecological system. The task is awesome, involving years of research and study, but I feel it can be done.

To begin with, it must be based on the premise of effectiveness and this can only be accomplished by educating society at all levels on the issue of environmentalism and ecology.

The principles of environmentalism and ecological balance are complex, let alone teaching these principles. Perhaps, what can be done is that these principles be made an integral part of the curricula for all levels of education. In the lower grades, it might be more effective if the fundamentals, such as the basic definitions, the ecological processes and inter-relationships, were taught in the vernacular in a manner and method by which the subject can be made understandable to the students. Progressively, at the high school level, perhaps the more complex processes can be taught in consonance with such subjects as social studies, science and so on. Final-

ly, at the collegiate level, the complexities of the subject matter can be integrated into the basic courses of each discipline. For example, in chemistry and chemical engineering, the effects of certain types of chemicals when released into bodies of water, into the air, etc., could be introduced, as part of the whole discipline. In other disciplines, the same or similar principles could be evolved for dissemination.

These are some of the possibilities for molding the future breed of our people who will take over the present crop of entrepreneurs and industrialists, who, in the final analysis will largely determine the outcome of our ecosystem.

Hopefully, the up-coming breed of industrial planners and entreprenuers might see that the profit motive is not the be all and end all of society, that profit without regard to the environment is just as harmful to them as it is to most everyone, and that profits can still be realized despite the added costs involved in safeguarding the integrity of the environment.

To fall under the category of developing nations has also its blessings, for we are able to adopt trends in development compatible with maintaining the quality of the environment and to profit from the mistakes of developed countries.

On the whole, education and training requirements to correct the imbalance we have caused in the eco-system is a task not only for the educational sector, but also the responsibility of government policy makers, the men in the media, the men in industry and the society at large.

The challenge is great but we are left with no choice.

PRESENT STATUS AND FUTURE NEEDS FOR WATER SUPPLY ENGINEERS

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INTRODUCTION

Man, hundreds of years ago, had a very simple way of life' He did not bother about water pollution because then, the self-purifying capabilities of nature were able to overcome this man-made phenomenon.

The growing concentration of population in our present day cities and the pursuit of myriads of activities therein would be impossible without the availability of water.

Today, "water shortage" is a common problem to Water Supply Engineers. There is water shortage because the water is not where we want it, when we want it, or when water at hand is not of the desired quality. The solution to this problem, therefore, involves the conveyance of water of suitable quality from the source to where it is needed, the removal of objectionable substance from this commodity, or a combination of both.

SCOPE

Control of potable water supply to household faucets and industrial users is a requirement in modern community living. The rising population and trend of our everyday usage require us to exercise prudence in meeting our present needs for water. The control of water pollution and the solution to water shortage involve the determination of the costs of various technically practicable transportation and treatment systems. All of these require great skill in making accurate projections for future needs of potable water.

PRACTICE OF WATER SUPPLY ENGINEERS

Water supply involves various engineering fields. It is a conglomeration of several engineering groups and agencies of the government with specific field specializations. We have hydrologists giving their knowledge of the availability of precipitation in various regions and the Weather Bureau doing its share by reporting the volume of precipitation and preparing projections for specific regions. These greatly help us to formulate policies on our water supply.

Water Supply Engineers maintain proper conduct in the administration of a continuous safe supply of potable water. This includes proper administration of revenues and satisfactory control of expenditures. Under R.A. Nos. 544 and 1364, otherwise known as Civil Engineering Law and Sanitary Engineering Law, respectively, Civil and Sanitary Engineers are authorized or empowered to make designs, prepare plans, specifications, and estimates, supervise installation of water supply, drainage, and sewerage works among other civil works, hence both can be water supply engineers. Both are responsible for the supply of safe potable water. At present, we have about 12,000 duly registered Civil Engineers and 450 Sanitary Engineers but few are engaged in water supply Engineering.

Water Supply Engineers devise methods to improve rivers, streams and lakes to protect the natural environment from pollutants.

Since raw water could be readily classified into certain categories, and acceptable means of treatment could readily be adopted, and since sewage from municipalities were done or less alike, the only challenge to the engineer's resourcefulness was in polishing, perfecting and modifying basically established treatment processes. Thus we developed such things in water treatment as flush mixing, flocculation, and break point chlorination. In sewage treatment, we had tappered and stopped aeration, high rate trickling filters, sludge thickening, elutration and series digestion.

Many of our universities and colleges have problems in their engineering training at advanced levels, such as the high expense per student for laboratories, as well as recruitment. Few students enroll in an Engineering school with the idea of taking

Sanitary Engineering. Except for certain options in Civil Engineering, the subject is not introduced at the undergraduated level. Courses in water supply engineering, therefore, are taught almost wholly at the graduate level.

CHALLENGE OF THE FUTURE

Today, a number of engineers and educators feel that water supply engineering is no longer descriptive of what must be encompassed in the field and prefer to substitute the term "environmental control" for indicating the work in view. Previously, water supply engineers were concerned only with waterworks problems. Now, most waterworks engineers are practicing sewerage engineering also.

As population, agriculture, and industrial growth continue, and as wastewater disposal requirements become increasingly stringent in response to public policy, the necessity for enhanced treatment accelerates and it follows that it is costing more to treat water for proper disposal. It is not at all difficult to visualize a future in which treated wastewater, either industrial or domestic, is literally too valuable to discard.

Ultimately water demands will be such that wastewater renovation and re-use will become both practicable and economical for industrial systems.

Water Supply Engineers must keep pace with the demand for water. They must be ready and equipped with the necessary intelligence, skill, knowledge of equipment and full utilization of logistics.

Proper instructions and training on management, redirection of skills to meet pressing needs for more know-how in water supply, research for reprocessing of used potable water, and survey of subterranean sources of fresh potable water will assure the proper functioning of service, thus making the water supply a perpetual business.

The graduate school must prepare students for work in project conception and design, in industrial hygiene, in food control, in water resources, in bio-medical engineering, in bio-statistics, and in treatment processes in general. The faculty must have a variety of competence in various fields and the students will be oriented towards specialties in the work.

The demand for water is very challenging to water supply engineers. They take water of variable quality and apply methods that will produce a quality conforming to public health standards. Water resources are mainly utilized for these purposes:

a) Domestic Water — The consumption of domestic water supply is always increasing due to the increase of population and also the increase in consumption per capita.

The water supply engineer is responsible for the delivery of safe potable domestic water to household faucets. Delivery of safe water depends upon protection in the distribution system as well as protection of the source and treatment.

b) Industrial Water — Water is used in various fields of industry such as agriculture, fisheries, transportation, and for power, temperature control, chemical treatment and material source.

1. Water for irrigation — Rice culture is the most important part of Philippine agriculture. The consumption of irrigation water has increased tremendously due to the implementation of Land Reform.

2. Water for industrial use — Presently, there is a tremendous increase in the demand for water by industrial users due to the progress of heavy industry which requires large quantities of water. Such industry is now utilizing huge volumes of its own renovated wastewater and treated municipal wastewater for its water supply.

A PROFESSION WITH A FUTURE

Observe the environment that has been created for you by the water supply engineers. You go into the kitchen, turn a tap and you get water because they

designed and built the facilities to bring it there. And the water you get is safe for they have supervised its treatment and assured its quality.

The arid lands of our great country are made to flourish and we all share in an abundance of food, because the water supply engineers were able to provide water where there was none before.

The dream of providing potable water from the ocean may reach economic fulfillment in the next decade. When it does, pipelines will be carrying water inland from the sea for domestic, industrial and agricultural use.

The water supply engineers have already contributed greatly to the general welfare of our nation, and more will be demanded of them in the future. Our expanding population requires more potable, adequate water supply and waste disposal and many new facilities yet to be conceived and dedicated to a better way of life.

Thus, the task of water supply engineers is never to be underestimated for on them depends the economic development of our nation. With economic development comes political stability whereby the common man will find satisfaction with his lot. Then, and only then can Bentham's dream of the "happiness for the greatest number" be realized.

APPENDIX II

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