B Z DIAMANT

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developing countries

The introduction of environmental health engineering studies in higher learning institutions in developing countries.

INTRODUCTION

The growing interest in the quality of the human environment in recent years has highlighted the important environmental health engineering role in preserving and maintaining this environment. In the developing countries where environmental health engineers were always very scarce, the need for this manpower has become urgent, due to the recent fast national development trends. In addition to the conventional basic problems of providing safe drinking water and wastewater disposal facilities, new sophisticated environmental problems have risen in recent years, such as prevention of water resources pollution with industrial wastewater and controlling the spread of water-borne diseases in the course of developing large-scale irrigation schemes.

Developing countries have been facing tremendous social, economical and environmental problems during their relatively short period of independence. Industrialization has been generally adopted as the magic solution to the chronic economical and unemployment problems and the growing need for food supplies could be satisfied by modern agricultural development, involving large-scale water resources projects such as hydro-electric dams, river regulation and irrigated agriculture.

The environmental aspects of such sophisticated development projects must be controlled by competent environmental health engineers, if severe environmental deterioration is to be avoided. This risk has not been under-estimated by the authorities in most developing countries and while local environmental health engineers were not available to control and eliminate the environmental hazards, reference was made to bilateral and international bodies for assistance. In most cases this assistance, in the form of foreign environmental health engineering experts, has been provided for various lengths of time.

However, such assistance can be considered only as a temporary measure until local manpower is trained to take over and continue the task. This was the reason why all agreements between Governments and the

bilateral or international bodies, required and committed the Governments to provide national counterparts to the experts during their stay in the country, so that the former can carry on upon the departure of the experts. These counterparts were required to have basic engineering training, preferably as civil engineers, in order to be able to cope with the technological problems under the guidance of the assisting environmental health engineer. Unfortunately, this basic and logical requirement has very seldom been fulfilled, mainly due to the fact that national engineers were simply not available for this purpose. The consequences were, therefore, very discouraging, in a way that as long as the foreign professional manpower was available, adequate services were provided, but when such left the country, there was no continuation and the whole framework collapsed.

This situation must have been among the main reasons that shifted the emphasis in recent years, from the previous inservice training in environmental health engineering, to direct academical training. This move has been agreed upon and accepted by both the local authorities and the foreign assisting bodies. Stress has been, therefore, laid in recent years on the training of environmental health engineers in developing countries, in higher learning institutions located locally or abroad.

NEEDS AND SCOPE

The scope of environmental health engineering manpower development depends on present and future needs. These needs are directly related to the size of the serviced population, as well as to the general environmental state of the country. The World Health Organisation has recommended the ratio of one environmental health engineer for each 100 000 people living in developing countries*. Accordingly, a developing country with a population of 10 000 000 will need 100 such engineers. The present situation in most cases does not provide even a tenth of this ratio. A massive training programme will have to be stretched over a period of at least 15 years, in order to close this wide gap. This can be performed in 3 stages lasting 5 years each. During the first stage the number of environmental health engineers can be increased from the initial 10 to 20. This manpower will be distributed to provide professional services to the following Governmental, local and private bodies. The distribution is based on approximate estimated needs.

Health Offices	4 engineers
Water Corporations	2 engineers
Public Works Departments	3 engineers
City Councils	4 engineers
University teachers	3 engineers
Private enterprises	4 engineers
Total	20 engineers

The above breakdown can serve as a general guide for assessing the short-term needs in environmental health engineering services in various relevant disciplines in developing countries. Manpower training in future phases will follow, more or less, the same distribution and will include the population growth aspect, according to the above mentioned ratio. National counterparts to environmental health engineering foreign aid projects can be assigned out of any of the above mentioned disciplines.

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* Personal correspondence with WHO H Q, Geneva.

DUTIES AND RESPONSIBILITIES

An environmental health engineer is considered to be at present a civil, or chemical engineer who completed successfully a postgraduate study in environemntal health engineering with a degree of Master of Science. The required training for environmental health engineers has been outlined by a WHO Expert Committee on "Professional and Technical Education of Medical and Auxiliary Personnel"* as follows:-

> "Environmental Health Engineers should possess basic education and training in engineering, followed by at least an academic year's specialised education and training. The latter should include the science of bacteriology, chemistry and human physiology, as related to problems of environmental health engineering interest. Also the principles and practices of engineering analysis, design and operation as applied to works of water supply and purification, sewerage and sewage treatment, the collection and disposal of municipal, rural and industrial wastes, insect and rodent control, the engineering and administrative phases of food and milk sanitation, the sanitation of buildings, including ventilation, air conditioning, heating, plumbing and illumination, housing, industrial sanitation with particular reference to those industrial hazards, the correction of which is an engineering problem, should be considered.... The postgraduate training of the engineer should include adequate instruction in public health, including public health practice, epidemiology, health statistics and health education of the public".

The(British) Institution of Public Health Engineers defines environmental health engineering as "the art, science, technology, profession and practice of designing, supervising, executing, undertaking, advising upon and administering works intended to assist, develop and control the forces of nature, in order to maintain and improve the health of the community"**.

The duties and responsibilities of the environmental health engineer have been described by WHO as follows***:-

> "Environmental health engineers are assumed to have a broad and thorough understanding of the whole range of environmental conditions that affect human well-being, to be well qualified by aptitude, training and experience, to serve as true professionals at the various levels of responsibility relating to the environment in public health and associate organisations and in the upper echelons, to be able to take their place alongside their counterparts in other professions, in assuming responsible administrative duties and other public health functions. In addition, they should possess the skills required to prepare the design and to supervise the construction and operation of sanitary works".

The (British) Institution of Public Health Engineers**** defines the environmental health engineer as "one who among other things is, by education, training and experience competent in this field of engineering and who is particularly concerned with the development of both the built and the natural environment, as they affect the health of the community".

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* Wld Hlth Org.Tech.Rep.Ser.No 28, 1950, Geneva.
** I P H E Regulations, London.
*** Wld Hlth Org.Tech.Rep.Ser.No 47, 1950, Geneva.
**** I P H E Regulations, London.

It is quite clear from the above definitions that environmental health engineering is a high quality and large quantity study that embraces a wide range of environmental fields and requires a great deal of public responsibility. When such study has to be newly introduced in an existing higher learning institution, it will be technically almost impossible to include all various fields of the study at once and priority of fields might be required. In view of existing environmental conditions in most developing countries at present, it is suggested that priority is given to the fields of safe water supply and proper wastewater disposal. This means that when the study of environmental health engineering is newly introduced, only the two priority subjects will be included in the first two or three years of teaching the study, whereas other fields, such as air pollution, food sanitation, industrial hygiene and vector control, will be gradually added to the curriculum in later stages of the study's development process in the institution, as described ahead.

ENVIRONMENTAL HEALTH ENGINEERING EDUCATION

The education of environemntal health engineers in developing countries can be performed locally or abroad. The latter possibility might be less time consuming, when suitable national candidates are given fellowship and sent abroad for studies in an adequate university in a developed country. However, the possibility is quite costly and also risky to a certain extent, because experience has shown that some of the candidates were reluctant to return back home after completing their studies and preferred to stay abroad. But the main disadvantage of obtaining the education abroad lies in the foreign curriculum, that does not always fit the special needs of developing countries. For example, prevention and control of air pollution is a major subject in environmental health engineering curriculums in developed countries, whereas in developing countries this subject is of minor importance compared, say, to purification of drinking water. In local education and training institutions that teach environmental health engineering, the curriculum is designed according to local needs as it is done in the developed countries. It should be noted, however, that some leading universities abroad, have started to design in recent years, modified curriculums for students from developing countries, to meet their special needs. For example, the University of Technology in Loughborough, England.

In view of the anticipated growing needs for environmental health engineers in developing countries, the best long-term solution to this manpower shortage problem will be the establishment of local training facilities.

Local Training Facilities

The local training facilities in environmental health engineering in developing countries can be divided into 3 categories, according to the nature and characteristics of the host institution.

a. Newly planned universities.
b. Existing universities without engineering studies.
c. Existing universities with faculties of engineering.

The establishment of higher learning institutions in developing countries has been an important component in most national development programmes. In establishing a new university, it is easier to start with studies that do not need laboratory services, such as fine arts. However, in view of the urgent need for environmental health engineers, it is important to include for new universities planned in the national development programmes, at least the study of environmental health engineering in the very first stage of development.

Existing universities with functioning faculties of engineering form the best background for the introduction of environmental health engineering studies. Faculties of engineering usually include civil engineering studies, of which environmental health engineering is a branch. The introduction of environmental engineering studies in the university will have to be performed, therefore, through the department of civil engineering.

THE INTRODUCTION OF THE STUDY

Environmental health engineering is a relatively new branch of civil engineering. Traditional civil engineering studies never paid much attention to environmental health issues, which were considered as medical interests. The subject was slightly touched in the course of studies, as far as basic hydraulic matters, such as diameter of piping and capacities of pumps, were concerned.

Introducing environmental health engineering as a separate study in civil engineering, has to be, therefore, carefully and gradually approached.

It is suggested that the introduction and establishment of the study should follow a long-term procedure, which has been already successfully practised, along the following development stages:-

Stage - I : establishment of optional studies.
Stage - II : establishment of compulsory studies.
Stage - III: development of service courses.
Stage - IV : establishment of postgraduate studies.
Stage - V : formation of a department.
Stage - VI : setting up a reference centre.

Optional Studies

Most universities practise optional courses in the final year of studies. The final year student can choose, in addition to his ordinary compulsory courses, an option course from a group of subjects in various fields related to the main study (civil engineering).

The final year student also has to prepare a final project report, on a civil engineering topic. In most cases the student is allowed to choose his topic for the final report, and these topics are, more or less, identified to the optional subjects. Unlike other options which have already been discussed with the students in previous years, such as structures or hydraulics, environmental health engineering is almost entirely a new matter and the optional course will have to be designed accordingly, in particular in respect of new sciences like microbiology of water and wastewater.

The first introduction year will contain only the optional study and towards the second next year, environmental health engineering subjects can be proposed also for the final year research projects. These subjects will, of course, concentrate on the fields of water supply and wastewater disposal only. The optional study and the research project reports in environmental health engineering will compose the first stage of introduction, lasting for two years, towards the start of the second development stage of establishing ordinary compulsory courses in the study.

Compulsory Courses

Based on the experience achieved during the two-year period with the optional course, the study can move now towards its second development stage. It should be noted that the Compulsory Course is not intended

to replace the already established Optional Course, but to supplement it. The Compulsory Course should, therefore, be introduced in the study year preceeding to the final one.

The compulsory and optional courses in environmental health engineering, require the services of sanitary chemistry and microbiology laboratories. Preparations for the establishment of the laboratories must start from the very first stage of the optional study. However, since the setting up of such laboratories is time consuming and fund absorbing procedure, temporary use can be, meanwhile, made of the already existing laboratories in the university, in the Departments of Chemistry and Microbiology.

Service Courses

Environmental health engineering embraces the whole of the human environment and, therefore, the study is related to many relevant fields, such as medicine, agriculture, education etc. The study can be, hence, spread over these related fields of study in the university by means of service courses. A service course in a specific subject is provided normally to a related study, where this subject can be supplementary to the main subject of the study. For example, veterinary-medicine students must obtain a certain knowledge in environmental health, in areas related to their major field of study, i.e. abbatoirs and animal wastes disposal. As a supplementary study, it does not justify to employ a special lecturer in the department of veterinary-medicine, to deliver this study. The department of civil engineering can provide in such case a service course in environmental health engineering, specially designed for the needs and the character of the recipient study. The service course is provided at a rate of 1 - 2 hours per week for one or two terms.

Due to the wide scopes of environmental health engineering, it can be applied in the form of service courses, to a large number of related departments and experience has shown that these departments' authorities, in most cases appreciated the need for the proposed service course and readily included it in their curricula. It is important to point out that service courses in environmental health engineering should be provided to the various Departments only on the basis of a fully recognised and scheduled curriculum course, that requires a written examination paper, or be part of such paper. A free "voluntary" course should be rejected, because experience has shown that free courses were considered by students as less important studies, that did not require much attention. This might develop wrong attitudes towards environmental health engineering which is, as a matter of fact, a very important study.

Medicine

Medical students can have the service course within the framework of their community-medicine studies. The design of this service course will include mainly rural environmental health aspects, such as safe drinking water and human waste disposal, emergency disinfection of water and installation of pit latrines, housing and vector control. The programme will include field visits to a water treatment plant and a wastewater treatment plant.

Veterinary Medicine

Many environmental health problems are involved in practising veterinary medicine. The service course for this discipline will be designed to include rural and farm sanitation and in particular the planning of abbatoirs and their maintenance, the disposal of animal wastes and the protection of water resources, as well as special problems involved in the planning and sanitary running of meat packing plants, butcheries and markets.

Agriculture

Modern agriculture has a strong impact on the quality of the environment, in particular in the fields of water pollution control and the use of the large variety of insecticides, which are, in many cases, dangerous to people. This service-course should include, in addition to the above aspects, mainly principles of rural sanitation and problems involved in irrigated agriculture, with fresh water and also wherever applicable, with treated wastewater, as well as the use of organic fertilizers, such as compost.

Town Planning

The efficiency of urban sanitation is determined to a large extent by the adequacy of the town planning for the town or the city. The service course in environmental health engineering for town planning students will include mainly urban sanitation aspects, such as the principles of housing sanitation, design of markets and public institutions, adequate separation of residential zones from industrial zones, by green belts and commercial zones, air pollution principles and causes and topographical considerations to enable proper sewerage systems, population density and noise control aspects. Emphasis should be laid on the importance of preventing the sacrifice of environmental issues for architectural considerations.

Education

The curriculum of education studies has always included a course in so called "Hygiene". This course contained mainly matters of preserving personal hygiene aspects, such as brushing teeth and cutting nails. In view of the severe environmental conditions in developing countries, this limited scope must be widened to include the importance of consuming safe drinking water and using proper human waste disposal means, the transfer of basic communicable diseases such as malaria and bilharzia and principles of food hygiene and housing sanitation. Teachers have a prominent position in the rural areas of developing countries and they are usually well obeyed by the students and their parents. They can obtain, therefore, a strong influence on the quality of the environment in their duty-stations, provided they have the basic necessary knowledge of the subject.

POST GRADUATE COURSES

Qualification in environmental health engineering normally requires successful completion of a post-graduate course in this study, after graduating in civil engineering or in chemical engineering. A post-graduate course can be accomplished by study and last one calendar year, or by research when it lasts two years.

The research course requires the performance of a comprehensive research work on a selected environmental health engineering subject, during a period of two years. The study course consists of a regular study programme accompanied by a final research project.

It is therefore recommended to start the post-graduate development process with a research course as a first stage, followed after a year or two, upon the availability of suitable candidates, by the study course.

The teaching load required for the above mentioned development stages can be summarized as follows. The teaching manpower can be assessed accordingly.

ENVIRONMENTAL HEALTH ENGINEERING TEACHING LOAD

Course	Department	Year	Lessons Per Week		
			Lectures	Lab	Total
Option	Civil Engin.	Final	2	3	5
Compulsory	Civil Engin.	2nd	2	6	8
Post Grad.	Civil Engin.	1 & 2	12	6	18
Service	Medicine	3rd	2	-	2
Service	Veterinary	3rd	2	-	2
Service	Agriculture	2nd	2	-	2
Service	Town Planning	Final	2	-	2
Service	Education	Final	2	-	2
Total			26	15	41

THE DEPARTMENT OF ENVIRONMENTAL HEALTH ENGINEERING

Environmental health engineering is a dynamic and versatile study which embraces a wide range of various environmental fields. As long as the study is part of a general civil engineering curriculum, it will be practically impossible to cover even a small part of the above mentioned fields. However, the wide range of the study, which covers almost all aspects of human life and environment, justifies the establishment of a separate Department of Environmental Health Engineering, as an independent engineering branch in the Faculty of Engineering. Some leading higher learning institutions in various parts of the world have already reached this conclusion and established such Departments. The issue is in particular important in the developing countries, where the services of environmental health engineering are most needed.

THE REFERENCE CENTRE

The establishment of an environmental health engineering reference centre attached to the university will be the final stage of development in the introduction of environmental health engineering studies. This will take place when all previous stages, including the establishment of a functioning department, have already been well operating and practising.

The Reference Centre will have to be recognised as the supreme professional authority in all matters pertaining to environmental health engineering. It is preferable, but not obligatory, to have the Centre located in the University, but it can be erected elsewhere and maintain close links with the University, and in particular, with the Departments of Civil and Environmental Health Engineering. Such a Centre will normally be providing the following services:-

1. Advice. Provision of advisory and consultantship services, performance of professional investigations and assessments based on laboratory tests and analyses.
2. Research. Organising advanced research activities in the various fields of the study, for public and private sponsoring bodies. Assistance in carrying out post-graduate research will be provided to the Departments of Civil and Environmental Health Engineering in the University.
3. Standards. Establishment of national environmental health engineering standards, in line with existing international standards, adjusted to local needs and conditions. Provision of laboratory testing services.
4. Advanced Studies. Planning and performance of advanced and refresher courses for environmental health engineers and related

professionals, in cooperation with the Department of Environmental Health Engineering.

5. Conferences, Seminars and Workshops. Organisation of conferences, seminars, symposiums and workshops on actual environmental health engineering topics, designed for environmental health engineers and related professionals, such as doctors, sociologists, teachers, town planners, biologists etc.
6. Library. Development of an environmental health engineering library and organisation of dissemenation of material for reference and research purposes.
7. Publications. Publication of professional periodicals and books and organisation of a distribution system.
8. Legislation. Assistance in the preparation of environmental health engineering legislations. Provision of advisory services in all matters pertaining to legal matters of the profession and the professionals.
9. National and International Relations. Maintaining mutual professional relations with similar Centres located in or out of the country, for obtaining current exchanged data and experience.

The preparations for the establishment of the Reference Centre, will start in a later stage of the functioning of the Department of Environmental Health Engineering. With the constant expansion of activities in the numerous fields of the study, the establishment of a Reference Centre will be only a normal step forward in reaching a full development of the introduction of environmental health engineering studies in higher learning institutions in developing countries. This development will be, hence, composed of six consecutive stages: the optional study, the compulsory study, the service courses, the post-graduate studies, the development of a Department and the establishment of a Reference Centre. It is estimated that the whole development process will require a minimum period of 5 - 7 years, during which the first groups of environmental health engineers will start to function in the country. In view of the deteriorating environmental conditions in most developing countries, the urgency of the matter is growing steadily and all efforts should be made by the relevant Governments and by the numerous bilateral and international assistance organisations, to promote and alleviate this vital issue, according to the above mentioned recommendations.

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