

International Development Partnership with Bangladesh University of Engineering & Technology in Pollution Prevention

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Abstract

The Chemical Engineering Departments at North Carolina A&T State University (NCA&TSU) and Bangladesh University of Engineering & Technology (BUET) have collaborated in a USAID linkage program to enhance the pollution prevention activities in Bangladesh through joint curriculum development and research project programs. Bangladesh is one of the world's poorest and most densely populated countries. Environmental pollution, especially surface water pollution, is a significant problem with increased industrial activities in the textile and fertilizer sectors. Thus, sustainable planning and management of water resources has become a priority consideration for the future welfare of Bangladesh.

BUET is benefiting from the linkage program in the following areas: faculty development in pollution prevention, curriculum development in pollution prevention, facility and equipment plan development, and development of collaborative research in pollution prevention with emphasis on surface and groundwater contamination and water purification. Cost savings and sustainability of the linkage are being encouraged through an emphasis on the use of electronic conferencing technology. It is hoped that through these activities, BUET would become a national resource for educating engineering students at the undergraduate and graduate levels in pollution prevention, and that as these students enter positions of leadership in industry and government, they will use their training to make wise decisions for the future of the environment in Bangladesh.

I. Introduction

Bangladesh is a Southeast Asian nation that is known as one of world's poorest and most densely populated countries. As a nation with a population of over 130 million on a landmass of 55,813 square miles (about the size of Wisconsin), Bangladesh is known to the West for natural calamity, famine, and poverty. In recent years, Bangladesh has made major strides to produce sufficient food domestically to meet its rapidly increasing population and has made significant gains in export earnings through the ready-made garments industry. However, these gains are being overshadowed by environmental disasters.

The nation is facing arsenic contamination of its water supply. Excessive withdrawal of groundwater for irrigation and massive diversion of natural water flows of the major rivers by building dams has aggravated this problem. In fact, one of the biggest mass-poisoning cases the world has ever known has taken place in Bangladesh. According to UNICEF, the "Bangladesh arsenic problem represents a collective failure on the part of the International Agencies, the Government and other donor agencies which could have acted faster than what we did in getting

a fuller picture and extent of the problem.”¹ This is a problem that needs scientific and engineering solutions using “good” science.²

Excessive use of fertilizers and pesticides has adversely affected the surface water. According to the World Conservation Union (IUCN), the environmental ecology of the country is changing rapidly. Alarming, a large number of fish, amphibians and reptiles, mammals, and birds are now on the endangered and threatened species list.³⁻⁷

The fertilizer and textile industries are considered major contributors to surface water pollution. Bangladesh has a number of urea, ammonium sulphate, and phosphate (TSP) fertilizer plants of multi-million ton annual capacity along the banks of major rivers. Unregulated discharge of waste effluent in the rivers is frequently witnessed by fish kills. In the textile sector, production of ready-made garments for export to the U.S., Canadian and European markets has grown rapidly and now dominates Bangladeshi exports. Bangladesh is the fifth-largest supplier of cotton apparel to the United States and is also a major trading partner in the West European market. This unprecedented growth has been a blessing for the economy, but the damage to the environment has yet to be assessed. Textile weaving and dyeing industries are producing enormous volumes of waste effluents containing dyes, alkali, and bleaching agents, usually as mixed-waste and discharged to open waters.

The increasing population and higher levels of human activities, including effluent disposals to surface water and groundwater, have made sustainable management of water resources a very complex, challenging task for Bangladesh. In addition, per capita demand for fresh water is steadily increasing as more and more people achieve higher standards of living and as lifestyles steadily change. Thus, sustainable planning and management of water resources has become a priority consideration for the future welfare of Bangladesh. In that context, pollution prevention should be a priority in any management plan of its meager water resources.

In the context of the above cited scenario, a linkage program between the chemical engineering departments of North Carolina A&T State University (NCA&TSU) and Bangladesh University of Engineering & Technology (BUET) has been established with a focus on pollution prevention. The BUET chemical engineering department is the only program that offers a B.S. degree in chemical engineering in Bangladesh. Chemical Engineering is a discipline that teaches and trains young minds in purification, separation and isolation in a broader sense for process industries. From an environmental point of view, pollution prevention is the study of contaminant purification (P), separation (S) and isolation (I), which we call PSI. These are the underlying activities that will be used to tackle the contamination problem in its totality. This is a formidable task for a single chemical engineering department in a nation of 130 million people, where meeting the basic necessities of life is by itself a war for existence.

However, a solution to these problems is certainly not possible without strong leadership from the country’s technical leaders. Toward this end, the expected outcomes of the linkage program include:

- Faculty Development in Pollution Prevention
- Curriculum Development in Pollution Prevention at both the Undergraduate and Graduate levels

- Development of Collaborative Research in Pollution Prevention with Emphasis on Surface and Groundwater Contamination and Water Purification
- Establishment of electronic connectivity including video conferencing capability with BUET

II. Participating Institutions

BUET is the premier institution of higher learning in science and engineering in Bangladesh. In a nation of over 130 million population, BUET is the only university that offers undergraduate and graduate degrees in engineering. The University started in 1876 in the British India as the Assam Bengal Survey School. The University presently has an enrollment of over 3,000 students in the undergraduate and graduate levels. The University offers degree programs in Chemical, Civil, Electrical, Mechanical, Industrial and Computer Engineering.

The chemical engineering department offers B.S., M.S., and Ph.D. degrees in chemical engineering. Current undergraduate enrollment in the freshman class is restricted to sixty students. The department operates with six faculty members that all have Ph.D. degrees from abroad. The courses offered in the department are designed within the modern concepts of chemical engineering education and with due consideration to the industrial requirements in the country. The board of studies constantly reviews course contents.

The chemical engineering faculty have offered and are always ready to offer vital consulting service to the growing chemical process industries in Bangladesh. Specially, advice in the fields of corrosion, materials protection, and energy has earned respect and a good reputation for the department. Other areas of expertise are water and wastewater treatment, food processing, techno-economic feasibility of chemical process industries, and technology policy issues.⁸⁻²¹

NCA&TSU is a unique state-supported University. It is the only Comprehensive University in North Carolina that has a College of Engineering and a School of Agriculture in consonance with its land-grant tradition. In addition, strong program offerings are provided in the College of Arts and Science and Schools of Business and Economics, Education, Nursing and Graduate Studies. From its beginning in 1891, the University has developed into a 8,000 student educational complex with a 188 acre campus. Graduate studies at A&T State University have been in operation since 1939. Beginning with one discipline, the School of Graduate Studies has expanded to 37 areas of study. The University presently has an enrollment of over 700 graduate students.

The College of Engineering at NCA&TSU is the second largest of the four nationally accredited engineering schools in the state and the only one in the highly industrialized Piedmont region. It is one of the six historically black engineering schools in the nation. The College of Engineering offers B.S. and M.S. programs in Agricultural, Architectural, Chemical, Civil, Electrical, Industrial, Mechanical Engineering and Computer Science. Currently, Ph.D. degrees are offered in the Mechanical, Industrial and Electrical Engineering programs. The current enrollment in the college is about 1800 students at the undergraduate level and over 300 students at the graduate level.

The Chemical Engineering Department has a history of research activity in the area of environmental engineering and pollution prevention.²²⁻²⁸ Chemical engineering department

faculty lead the multi-million dollar research effort in Environmental Remediation under the Air Force FAST Center and are also a part of the 20 million dollar NSF Science & Technology Center on Environmentally Benign CO₂ Solvents and Processes. Drs. Ilias and Schimmel are designated Lucent Tech Industrial Ecology Faculty Fellow for their work on membrane-based separations in pollution prevention and waste reduction. Since 1997, the department has offered an undergraduate/graduate elective in pollution. Thus, it is logical for NCA&TSU to use its faculty experience in helping BUET with faculty development in the area of pollution prevention and collaborative research in pollution prevention.

III. Partnership Achievements

The two-year project to establish a linkage program in pollution prevention between NCA&TSU and BUET began in March, 2001. The highlights of the activities so far are:

- Official Visit of Professor Nooruddin Ahmed, Vice Chancellor of BUET (April 3-6, 2001)

At the invitation of Chancellor Rennick of NCA&TSU, Vice Chancellor Nooruddin Ahmed visited A&T State University to officially kick-off the linkage program. During his visit, he met Chancellor Rennick and other top administrators. This provided an opportunity to discuss the project implementation strategy and possible future collaboration between the two institutions in graduate research and faculty exchanges. He was also given a guided tour to various research centers and institutes by the respective faculty.

- Global Partnership Conference (April 9-11, 2001)

Both NCA&TSU and BUET were represented at the Global Partnership Conference organized by the United Negro College Fund Special Programs Corporation (UNCFSP), which was held in Washington, D.C. As head of the institution, Vice Chancellor Ahmed represented BUET. Dr. Earnestine Psalmonds, Vice Chancellor for the Division of Research, represented NCA&TSU and was accompanied by the Project Director, Dr. Shamsuddin Ilias.

- Visit to BUET, Dhaka, Bangladesh (July, 2001)

Drs. Shamsuddin Ilias and Keith Schimmel visited BUET to present a teaching workshop on “Integration of Pollution Prevention Topics into the Engineering Curriculum” to the faculty members in science and engineering. Topics covered were learning objectives, learning and teaching styles, cooperative learning, creative problem solving skills, classroom assessment, safety, and the use of technology in education. Twenty-five faculty members from six universities (Independent University of Bangladesh - Dhaka, Islamic University of Technology - Tongi, Bangladesh Agricultural University -Mymensingh, Bangladesh Institute of Technology – Chittagong, University of Dhaka – Dhaka, and Bangladesh University of Engineering & Technology – Dhaka) attended the two-day workshop (July 24-25, 2001). Hard and soft copies of the class notes were made available to the participants. Analysis of survey data showed that a majority of participants liked the workshop both in terms of quality and appropriateness.

The local host (Dr. Quader – BUET) organized two plant visits while Drs. Schimmel and Ilias were in Bangladesh. One visit was a day trip to Jamuna Fertilizer Company (JFC) at Tangail. JFC has a effluent treatment plant (ETP) for treatment of oily wastewater. The plant officials expressed interest in working with BUET to conduct a performance study on the ETP. The other visit was to a tannery plant in Dhaka. A significant number of tanneries are

located in the heart of thickly populated Dhaka City. The waste effluent and odors from these tanneries are of great environmental concern. The possibility of contamination of groundwater from chromium laden tanning effluent is real. Development of technology for treatment of chromium tanning effluent would be an excellent project under the linkage program.

- Preparation of Notes for Pollution Prevention Course (November-December, 2001)

Dr. Quader traveled to NCA&TSU to prepare notes for a 3-credit hour common course for undergraduates in Bangladesh belonging to different engineering and science disciplines. The objective of the course is to provide a broad base and background for appreciating and dealing with the environment and pollution with emphasis on environmental protection and pollution prevention. The course material emphasizes the environmental issues of primary concern to Bangladesh. This course will be offered at BUET for the first time in the Fall of 2002 and course notes will be published. It will then be transported to other technical universities in Bangladesh.

- Workshop: Environmental Protection and Pollution Prevention Issues and Initiatives, BUET, Dhaka, Bangladesh (March 10-14, 2002); Organizers and Presenters: BUET, NCA&TSU, and IUCN (Bangladesh)

The purpose of this workshop was to bring together representatives of Universities and BITs, non-government organizations, industry, and national labs to share their perspectives on environmental problems, regulations, and solutions in Bangladesh. The workshop consisted of both lecture sections and visits to industrial sites.

- Establishment of Videoconferencing Capability between NCA&TSU and BUET (March, 2002)

This capability is expected to facilitate collaboration and result in sustainability of the project goals after the project funding period expires.

IV. Future Activities

Several faculty members from BUET will have opportunity under this program to interact with their counterparts at NCA&TSU through a faculty exchange program to develop collaborative research and then continue the work back at BUET. Future workshops presented by NCA&TSU faculty will include a workshop on Integrating Green Engineering into the Chemistry and Chemical Engineering Curriculums. Materials used will include the US EPA's core curriculum development plan for Green Engineering as well as numerous other sources. Topics to be covered include environmental risk, evaluating environmental releases and exposures, green chemistry, identifying recycling and by-product reuse opportunities, unit operations and pollution prevention, flowsheet analysis for pollution prevention, evaluating environmental costs and benefits, life cycle assessment, and industrial ecology. Drs. Schimmel and Ilias will emphasize the use of membrane technology in pollution prevention.

The NCA&TSU chemical engineering department is in the process of aiding BUET in preparing a survey of the pollution prevention needs of the local industry and government. BUET will administer this survey. Based on the results of this survey along with the backgrounds of BUET chemical engineering faculty, focussed research areas will be developed. NCA&TSU will also

assist BUET to develop a facility and equipment plan for incorporating Pollution Prevention topics in the curriculum.

V. Impact of Program

Continued successful completion of the proposed activities will help the BUET chemical engineering department in developing a Pollution Prevention Program in its curricula. This program will contribute to preparing young chemical engineers to tackle environmental issues of national interest. These issues represent a “long-term slow emergency” with no magic bullet available. Progress will require an open collaborative effort of all interested partners taking action in various fronts: scientific, technical, administrative, social, and economic.

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