Fostering sustainability through education, research and practice: a case study of TERI University

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Suresh Jain*, Preeti Aggarwal, Neeraj Sharma, Prateek Sharma

Department of Natural Resources, TERI University, 10 Institutional Area, Vasant Kunj, New Delhi 110070, India

ABSTRACT

This paper reflects the philosophy of TERI University of intrinsically building the concept of sustainable development (SD) through higher education and research. This has been illustrated by taking up an example of its flagship postgraduate program in Environmental Studies and Resource Management. The program is built by seamless integration of sustainability concept that incorporates social, cultural, economic, scientific, technological, legal and policy perspectives to address issues related to environment and resource management by laying strong emphasis on experimental/empirical evidence. The pedagogy of the program is based on blended learning using face-to-face interactions, live case studies, field visits, conferences, seminars and active use of information and communication technology. The curriculum has been designed by seamlessly integrating the principles of SD in an interdisciplinary framework. This has resulted in creation of a cadre of motivated and trained students who have taken the initiative for achieving sustainability on the campus through an environmental management plan and policy that focuses on five key environmental aspects — energy, resources, waste (solid and hazardous), ambient/indoor air and landscaping.

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1. Introduction

Education is the most powerful instrument that can be used to change the world. It is perceived as an engine of economic growth, the repository and defender of culture, and an instrument for the realization of collective aspirations (Johnstone et al., 1998). Inclusion of higher education as one of the paths leading to sustainability in Agenda 21 of 1992 Rio Summit re-emphasized its ability to bring change. The United Nation's initiative on Education for Sustainable Development (ESD) recognizes the importance of appropriate education, training and public awareness in achieving sustainability in all sectors of society.

The TERI University (TU) in 2012 has signed the "Rio+20 Declaration of Higher Educational Institutions (HEIs)" and declared its sustainability project for the years 2012–2015. The HEIs play a vital role in the training of teachers and reorientation of the curricula in addition to the promotion of ESD in formal, non-formal and informal learning environment on a lifelong basis. Further, HEIs could play a more significant role by producing "rational-citizens"

and achieving 'sensible' future for the upcoming generations (Ravio, 2011; UNESCO, 1978). Sustainable Development (SD) for TU is "Development using principles of — equity (regional, temporal, gender, intergenerational, ecological and economic), efficiency (optimization, minimization and conservation through use and advancement of technology), feasibility (economic and social acceptability), interdependence and integration, durability (through change in lifestyle and innovation), and decentralization (for planning and implementation)". The education at TU integrates the philosophies of "Learning for Sustainable Development" and "Learning as Sustainable Development" as proposed by Scott (2009). It has also been quoted:

> "An exemplary example of combining traditional values of conservation and preservation of energy while building a state of the art campus."
>
> Former President of India, Smt. Pratibha Devisingh Patil

> "The course curriculum design combined with work exposure in terms of major and minor projects in industry, NGO's and corporates have given us an edge in sphere of ESD".
>
> Romit Sen, Alumuni

Hence, TU follows both approaches by inculcating values of SD that facilitates to deal with the problems of present by bringing

* Corresponding author. Tel.: +91 11 2612 2222; fax: +91 11 2612 2874.
  E-mail addresses: sureshj@teri.res.in, sureshjain_in@yahoo.com (S. Jain).

shift in students' behavior, incorporating green lifestyle (such as use of bicycle, optimal use of resources, use of public transport, energy efficient appliances) into their exhibit and change in habits (such as turning off lights in empty rooms, practice the 3 "R's" — Reduce, Reuse, Recycle). This will help students at TU to critically think about various problems and apply or test the knowledge of SD for developmental activities.

This paper aims to present an innovative higher education approach of TU, which aims at developing students as sustainability "change-agents". The holistic education approach employed in M.Sc. Environmental Studies and Resource Management (ESRM) program is elucidated through its education philosophy, curriculum design and pedagogy. The TU started its environmental education program by integrating sustainability issues throughout the curriculum, adopting sustainable operations, and building green facilities in the campus. The program displays a uniqueness as it integrates an interdisciplinary approach blended with theory, practical components using case based examples from live projects, research assignments, global classroom teaching, interactive sessions etc. The significance of developing, understanding of sustainability issues and ability to react to present and future problems through critical thinking and innovation among the students is also reflected.

2. Methodology

The study uses exploratory approach for understanding the aim behind inception of the ESRM program and explanatory approach for understanding its benefits and unique selling proposition (Yin, 1993). In-depth review of TU's history, institutional relationship, program philosophies and structure were carried out to understand and delineate various aspects of the ESRM program. The information related to ESRM program was collected from the institutional documents including program brochures, course curriculum and annual reports (TERI, 2011). Further, face-to-face interviews and group discussions were carried out to capture the essence and impact of its implementation. For successful assimilation of SD principles as integral part of course curriculum, the involvement of top management is very important (Lozano et al., 2013). Hence, the target audience included senior management (Vice Chancellor and Registrar), faculty members, current students and alumni. About 72 people were involved in this exercise, with 30% faculty members, 41% current students and 25% alumni. The information was analyzed to present uniqueness of the program for building the concept of SD through higher education and research.

3. ESRM Program: philosophy, objective and structure

The TU was set up in 1998 with a vision of disseminating the vast knowledge created in the realm of energy, environment and SD by The Energy and Resources Institute (TERI). In its 13 years of functioning, TU has achieved significant progress in creating an institution of higher learning with a strong foundation of research and innovation. It is registered with the University Grants Commission (UGC), India and operates at its 'green campus', located at Vasant Kunj, New Delhi. Currently, there are 11 masters' level programs, 2 post-graduate diploma programs and 4 doctoral programs in science, policy and management offered by TU (Fig. 1). There are about 125 Ph.D. students at TU and over 550 students at the masters' level.

The TU firmly believes that students should be given space to think-and-innovate as well as opportunities (annual festivals and field trips) to unwind and relax. For example, students at TU organize theme based programs (such as waste management, water conservation, plastic: boon or bane) involving students and professionals from other universities and colleges. As a result, students get a chance to work together with experts and test their acquired knowledge from ESRM through these interactive discussions. It trains the students such that they practice sustainability as they go along with the education and become global citizens: responsible to environment, to the nation and community.

The TU's ESRM program is an optimal blend of theory, practical components complete with an interdisciplinary approach. It has been designed with an emphasis on research and application to create a cadre of professionals who are equipped to deal with scientific, technological, legal, socio-economic and policy aspects related to environment and resource management (Table 1). The ESRM curriculum looks at the seamless integration of the sustainability concept in an inter-disciplinary framework, aiming to address the growing need for the best management practices and
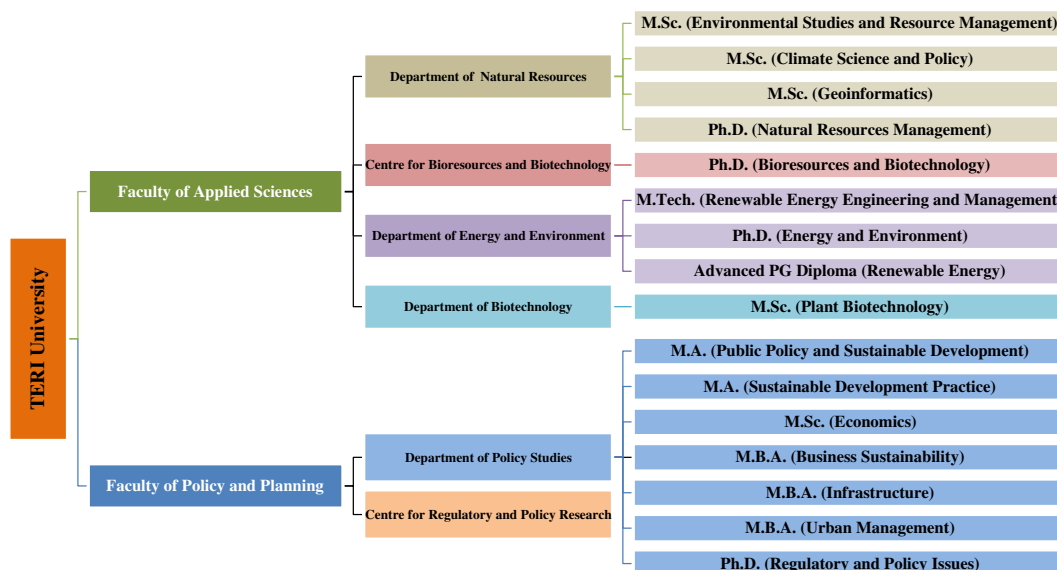

Fig. 1. Programs offered at TERI University.

Table 1
ESRM course details showing concept of inter-disciplinary.

Course no.	Course Title	Credits	Course no.	Course title	Credits
Semester I			*Semester II*		
NRE 121	Ecology	3	NRE 144	Environmental health and risk assessment	3
NRE 131	Environmental Chemistry and microbiology	3	NRE 112	Multivariate data analysis	3
NRE 155	Environmental law and policy	3	NRE 134	Air quality management	3
NRE 111	Environmental statistics	3	NRE 123	Biodiversity assessment and conservation	3
NRE 173	Research methodology and thesis writing	2	NRE 132	Environmental pollution and control	3
NRE 139	Environmental geosciences	3	NRE 162	Hydrology	3
NRE 138	Environmental monitoring laboratory	3	NRE 189	Solid and hazardous waste management	3
NRE 165	Introduction to sustainable development	1	NRE 185	Water conservation	3
			NRE 104	Minor project	3
Semester III (compulsory and electives)					
NRE 161	Urban ecosystems and sustainable cities	3	NRE 153	Environmental biotechnology and social concerns	3
NRE 127	Cultural ecology and development	3	NRE 167	Integrated watershed management	3
NRE 183	Energy and environment	3	NRE 169	Landscape ecology	3
NRE 147	Environmental economics	3	NRE 122	Vegetation science and site classification	4
NRE 133	Environmental management system	4	NRE 174	Water and wastewater treatment processes and design	4
NRE 171	Environmental modeling	4	NRE 176	Water resources optimization and water quality modeling	3
NRE 125	Forest Management	3	NRE 128	Aerosol science	4
NRE 175	Geoinformatics for resource management	4	NRE 135	Climate modeling	4
NRE 149	Governance and management of natural resources	3	NRE 146	Economics of climate change	3
NRE 163	Groundwater hydrology and management	3	NRE 126	Ecosystem dynamics and climate change	3
NRE 105	Independent study	3	NRE 136	Glacier hydrology	3
NRE 145	Integrated impact assessment	4	NRE 148	Governance and climate change	3
NRE 143	Resource economics	3	NRE 177	Spatio-temporal data analysis	3
NRE 129	Industrial ecology	3	NRE 164	Sustainable urban habitat and climate change	3
NRE 151	Wildlife conservation and management	3	NRE 153	Environmental biotechnology and social concerns	3
Semester IV (major project − thesis)					
NRE 107	Major project (Part 1)	2			
NRE 102	Major project (Part 2)	18			

innovative solutions for a sustainable future. It also brings inter-disciplinarity by integrating different aspects of science, management, policy and applications of ICT using three pillars of sustainability in higher education i.e. teaching, research and learning as illustrated in Fig. 2. True to its motto, TU aims to provide glory through reaching new horizons, exploring new ideas, and mastering the proven ones; to develop a holistic approach to environmental and resource problems for students coming from diverse academic, professional and cultural backgrounds.

The courses are designed keeping the objectives of program in mind, with the help of expert opinion and after undergoing continuous evaluation and modifications. The program consists of a set of core courses, taught during the first and second semesters. This is followed by a minor project (aspects of environment and SD) to be completed during the summer. A set of elective courses, taught in the second and the third semesters, allows students to gain in-depth knowledge and experience in their chosen field of specialization. In the fourth semester, students undertake a major project enabling them to understand interdisciplinary relationships and applying the same to issues related to environment science and resource management. The students carry out this project in collaboration with an industrial, research, government, or non-governmental organization, working in the area of environmental resources management and SD. The major project is guided by a TU faculty member as well as researchers in the industry.

4. Education, research & practice: pedagogy

The research and education programs at TU are at the leading edge of this shift (ESD) that is taking place across the world. Our
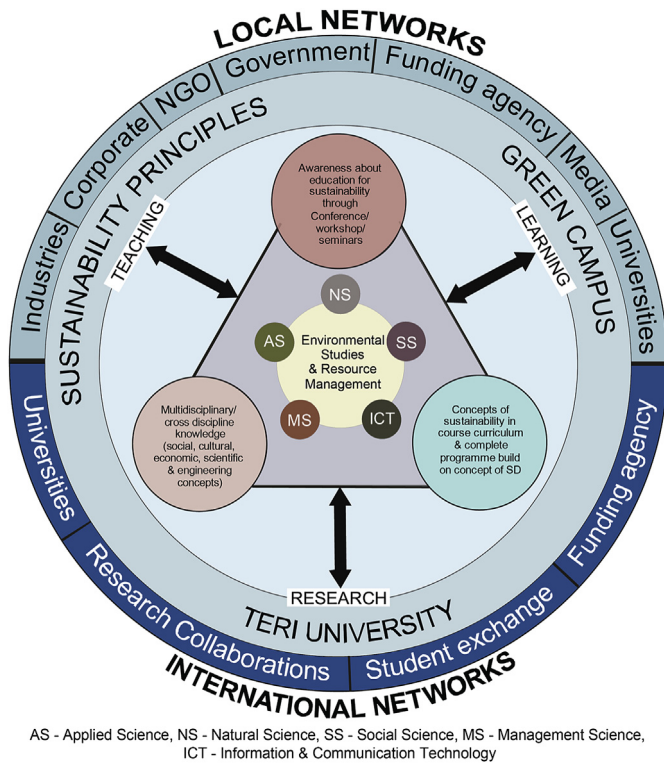
AS - Applied Science, NS - Natural Science, SS - Social Science, MS - Management Science, ICT - Information & Communication Technology

Fig. 2. Approach behind the ESRM Program.

use of ICT applications, which strengthen global ESD linkages to provide a platform for all-time learning. For example, without access to affordable energy, it will be impossible to eradicate extreme poverty and hunger; achieve universal primary education; promote gender equality and empower women or even reduce child mortality and improve maternal health. The Lighting a Billion Lives (LaBL) campaign, a TERI initiative, intends to brighten the lives of the masses by making concerted efforts towards addressing these critical issues as well as bringing about innovations to facilitate interventions, enabling energy access for all. This and several other examples (such as improved cookstoves for rural areas) are converted into live case studies, and used in ESRM program to enhance student's understanding of a problem from grassroots level to implementation of appropriate solutions. The TU and TERI have complemented each other to great effect, influencing the evolution of the academic units, leading to collaborative research activities, joint studies, and mutual support for seminars, symposia, and conferences on various aspects of energy, environment, climate change and sustainability. TERI has 25 years of research experience and ample case studies, a legacy that is passed on to TU; thus translating the experience of researchers into unmatched learning for the students.

The ESRM program of TU follows an approach, where education is imparted through curriculum, research and practice integration with development of the education values from active interaction of the TU system and surrounding environment (Fig. 3). The program helps in building critical thinking in their students by providing new knowledge and skills, and allowing them to work on grassroots problems, industry and corporate on various environmental issues, awareness through conference and workshops. This has resulted in the creation of a cadre of motivated trained students who have taken the initiative for achieving sustainability on the campus through an environmental management plan that focuses on five key environmental aspects — energy, resources, waste (solid and hazardous), ambient/indoor air and landscaping (Jain and Pant, 2010). The conscious decision of the founding members to go for energy efficient heating and cooling systems such as earth air tunnel, thermal mass storage and variable refrigerant volume system has resulted in energy savings of the order of 60% as compared to a conventional building design and lighting system sets the tone for students to inculcate the spirit of sustainability at the very outset when they join the university. The students have enthusiastically made steady efforts to implement the environmental management system within the campus, which has resulted in a
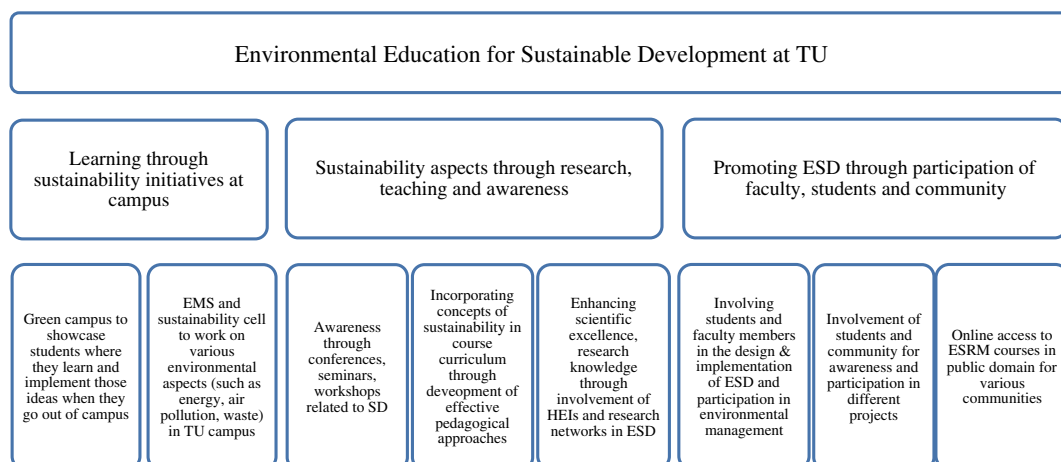
program cuts across disciplinary boundaries, integrates a holistic view with traditional fields, and is a step toward overcoming the failure of merely traditional approaches to meet the challenges of sustainability. In general, the pedagogy for education for SD should include the interdisciplinarity, experimental approach (sharing experiences), multi-sensoriality (real experience of the environment in the current field of study), problem solving approach and case-study methodology (Luppi, 2011). Various researchers claim that sustainability in education can be imparted through location-based education, direct-indirect involvement of students in problem-based learning, practical work, fieldwork and community teaching (Mcnamara, 2008). The pedagogy of ESRM program at TU uses blended learning involving face-to-face interactions, live case studies, field visits, conferences, workshops, seminars and active

Fig. 3. Pedagogical framework for providing environmental education for SD at TU (adopted from Jain and Pant, 2010).

drastic reduction of resource consumption (Jain and Pant, 2010). The program encourages exchange of ideas, cultural understanding and a wide range of knowledge that would result from international perspectives. To achieve this, ESRM at TU is involved in academic collaborations with many pioneer national and international universities, which provide for joint curriculum development and exchange of faculty and students. Further, TU and TERI organize mega educational events such as Delhi Sustainable Development Summit (DSDS), which is one of the leading forums on issues of global sustainability. The Summit witnesses' participation of various experts from different areas such as academia, research, heads of State and Governments, thought leaders, policy makers etc. to discuss various issues related to SD and myriad issues. The TU students participate actively in these events, which help in developing better understanding the concept and relevance of SD in overall development. The learning experience from this program empowers students with skills to address various problems in the real world. The interaction with various intellectual in their respective fields enrich the knowledge database of students, thereby enabling them to understand the burning issues related to environment and SD, and grassroots level to end-of-pipe solutions.

Pedagogy of blended learning at TU aims to create and share knowledge in the field of energy, environment and sustainable development using innovative learning tools, thereby enabling learners to enhance their capabilities and foster their intellectual growth in a truly virtual environment. Various collaborations with Global Development Learning Network (GDLN) and its affiliates, as diverse as the Asian Institute of Management, the Ethiopian Civil Service College, the Islamic Development Bank, and Pontifícia Universidad Católica of Peru are instrumental in providing global knowledge in a virtual environment. The TU and its international collaborators offer various courses such as Global Classroom-Integrated Approaches to Sustainable Development Practice. The course topics are grounded in a practical, multidisciplinary approach that focuses on the interdisciplinary aspects of ESD. The course also leverages innovative web-based technologies to share lectures across countries, and facilitates international discussion and collaboration among students at participating universities. TU is also the leading member of ProSPER.Net (Network for the Promotion of Sustainability in Postgraduate Education and Research) which is the ESD Program at UNU-IAS for Asia and the Pacific countries committed to work together to integrate SD into their postgraduate courses and curricula.

5. Conclusion

TU was conceived to cater to the need for disseminating the vast reservoir of knowledge created by TERI in the realms of energy, environment, and SD. Its genesis is rooted in the comprehensive research, consultancy and outreach activities. Creating innovative solutions for a sustainable future is the guiding principle of various activities in which TERI is involved. This association has propelled and influenced the evolution of TU's academic units. Moreover, the relationship that TU has with TERI provides a unique opportunity to bring an optimal mix of theory, practice and research into its curriculum focusing primarily on the broad principle of SD. The involvement of faculty members in the research projects, on which the students get an opportunity to work, from the inception to the final report writing stage enhances the academic rigor of these projects. Similarly, practical inputs provided by the TERI professionals in the ongoing programs and courses therein, at every stage give the necessary real-world flavor to them. This may be seen in context of the main constraint that has been identified in the promotion of sustainability and environmental management in institutions of higher learning, which primarily include participation of faculty and researchers during the planning, application and implementation of environmental projects. The TU campus also provides a good live illustration of energy efficient building nurturing sustainability, which provides necessary motivation to the ESRM students who have taken the initiative to draft and execute the environment management plan for the campus.

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