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SADASIVAN MEMORIAL LECTURE, 1984
University Education in Environmental Science

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It is a great pleasure and privilege to deliver Professor T S Sadasivan Endowment Lecture under the auspices of INSA-Varanasi Chapter. Professor Sadasivan is known for his deep insights into the ecology of host-parasite relationships. He was instrumental in initiating the University Grants Commission in 1971 for the institution of the Advanced Centre of Studies in Ecology at Botany Department of the Banaras Hindu University where I have taught and learnt the subject for about 40 years. Hence I am indebted to INSA and Professor D P Burma, the convener of the local Chapter respectively for awarding me the Lectureship and arranging the lecture at my 'alma mater'.

Few will disagree with the need of environmental education as aid for reorientation and support of our life style. Nevertheless, much deeper philosophical questions to which complete answers are not available at the moment, are involved in making the decision about the scope and content of such education. Our divergent views on the subject and intra- and inter-departmental rivalries are responsible for stalling action, especially at the University level. What kind of expertise, understanding and behaviour are expected of scholars and tomorrow's leaders in a society beset with consumerism leading to urbanisation and industrialisation in an era of ecological

scarcity? An attempt is being made to meet this challenge through relevant and effective environmental education.

Society and environment are always in transition. Political, administrative and legal institutions are created to make the transition as smooth as possible. Education particularly in the Universities provides leadership for the purpose.

Environment is not only a matter of perception but an objective reality in which we are embedded for functioning. In turn the way we develop values and attitudes interacts, impacts and modifies the environment including ourselves to the extent of the experienced stresses. Thus environment is a web of perceived systems and factors which we can indicate, qualify and/or quantify for manipulating it to sustain a more spiritually and materially satisfying life. We use ecology as tool for understanding the environment as a system. Ecology is growing rapidly by internalising the different disciplines of natural and more recently social sciences. These other disciplines have also gained from ecology by applying many of its principles to their own discipline. Since ecology is rooted within the life sciences, interdisciplinary rivalries in the University system have made many scholars blind to its fertility in promoting a healthy growth of their own sciences. Indeed no discipline

has ever progressed without seeking information from other parts of knowledge as the latter is indivisible in the ultimate analysis.

When we encounter human environment and develop human ecology on the principles based on life sciences a reorientation of knowledge from all the sources is demanded. The skill for doing so makes ecology in the broadest sense like the skills we develop through education within each of the disciplines traditional to the University. These traditions have been zealously guarded according to predisposition of the scholars and the limitation of time devoted to training. Nevertheless every now and then Universities come up with proposals for instituting hybrid departments such as biochemistry, biophysics, econometrics, business management, etc. etc. thus breaking the barriers among the chosen disciplines.

Realising the importance of ecology and newer avenues of expanding knowledge traditional disciplines have incorporated in their studies environmentally oriented courses such as environmental biology, environmental physics, chemistry, geology, law, politics, engineering, etc. etc. In fact all the 120 teaching departments of the Banaras Hindu University interface with the environment in their respective fields. So a host of environmental courses are being administered. These activities though sectoral are highly desirable and as important as the schools of environmental sciences established at the Jawaharlal Nehru University, Andhra, Kerala (agriculture), Annamalai Universities etc. trying to understand the impact of specialised disciplines on the environment. Suitable degree and diploma courses as well as those related to inservice and public administration oriented courses are designed for appreciation and reorientation in matters related to the environment and its enhancement. Nevertheless, they do not impart in-depth training in the management of ecosystems.

Managers are required to foresee the impact of human activities on the environment from holistic approach and even advise specialists where they worsen the situation on account of their fragmentary knowledge and zeal for improving the environment. Very often well intentioned steps to reduce pollution, improve irrigation or drainage, plan human settlements, etc. etc. become counter-productive to the suitability of the whole environment because either the scale or the holistic approach of the ecologist has not been taken into account. Slogan shouting and agitations raised by the public are also focussed on political and so called ecological issues which are not examined in the context of the whole resulting into disproportioned growth spawning more and more difficult problems of the environment, since these are devoid of perspective ecological planning on a suitable scale of time and space. Hence, we need leaders and managers for environmental management. This task needs a thorough grounding in ecology and relating social trends with the way resources are used and consumed.

In view of the above discussion it is proposed to instal a full fledged two year M.Sc. course in environmental science which has to be erected as a single discipline training the mind to simulate environmental systems by transcending related traditional disciplines. Ecology has opened the door for such graduation. The subject oriented diploma and short term fragmentary courses are not relevant to either policy making or environmental designing for improving or maintaining the dynamic human environment as a whole.

Obviously environmental science as a single discipline cannot be the sum of all the environmental sciences including arts, physical and biological sciences, social sciences, etc. It ought to train the mind to establish linkages of interactions among them as observed in man's real world.

The real world can be observed as a set of phenomena in three distinct ways: (i) as discrete events, (ii) as sets of repetitive phenomena, similar individuals or populations or even aggregates of dissimilar populations, and (iii) as a set of interlinked processes or system. It is the systemic and holistic approach of ecology which differentiates it from other disciplines based on individuals and populations. Thus environmental education is training of the mind to grasp meaningful dynamics of the system of human societies and environments in transition as a whole. A person so trained can at once link up human activities with his surroundings extending right up to the biosphere. By quantifying the parameters one can develop a predictive model in which detailed processes can be telescoped or transcended according to the object in view such as impact analysis. A system model of any scale can be qualified, described in words or depicted in flow diagrams besides developing mathematical models.

The holistic study demands consideration of the functioning of the whole in relation to the subsystems within it. The meaning of the human environment thus unfolds itself within the context of a hierarchy of systems functioning within the biosphere and the universe. The functioning is achieved through the great biogeochemical cycles from which life has been evolving. The five basics of the cycle remain soil (earth), water, energy, space and air as conceived by the Indians from the Vedic time. The combinations, breakdown and recombinations of elements of these within space exhibit always newer phenomena not possessed by the combinants. The 'Brahmanda' or the Universe is the largest system containing all the real world phenomena. By subsuming the comprehensible systems as subsystems or ecosystems and with the aid of analytical and synthetic exercises we strike at man and his societies as evolving subsystems of the ecosystem of a given environment.

Man is a comparatively recent phenomenon of the biosphere. Besides his physical existence he is conscious of his perceptions of psychosocial, political and economic organizations, centered around the resources of living. He has also developed awareness of yet higher values of life such as spiritual, aesthetic and moral—very often subsumed within religion. These values interact and he expresses them in guiding his conduct through a hierarchy of value systems. Individuals, families and societies are guided by such orientation within the environment and so environment and society ever remain in transition. Thus environmental education has no meaning without an appreciation of the multidimensional man who has become the agent of change in both.

In the past era of ecological abundance science and technology propelled human institutions to exploit the resources of the biosphere. During the past two centuries industrial growth has exponentially accelerated the process. Now we are facing the stark reality of ecological scarcity. Nation states had differentiated during the period of ecological abundance. Those having precedence in resource exploitation have become disproportionately rich and so we have economic disorder leading to confrontation among the North and the South and the West and the East. Meanwhile ecological scarcity is compounded with two side growths of science and technology. These are nuclear power and communication explosion. So the world has become much smaller shivering with the prospect of nuclear holocaust and a much worse ecological scarcity with the denial of social justice. This challenge can be met only by a deeper appreciation, understanding and appropriate action through environmental education using all the means of communication.

It is naive not to recognise the pivotal role of environmental education for bringing about transformation in our political, legal

and administrative institutions designed to run smoothly societies right from village Panchayat to the United Nations organisations for the wise use of systems of environmental resources. We must realise that military threats to our survival are becoming more and more absurd. Never before was mankind capable of destroying itself not only as a possible result of the world-wide arms race but also as a result of the uncontrolled exploitation and destruction of the global resource base. The situation can be averted only by tempering our ego and greed through proper environmental education. It cannot be achieved by technological tinkering of the problems of pollution or settlements. We have to redesign a conservation oriented post-industrial society based on innovative and spiritual values.

In view of the scope and content of environmental education and reasons thereof given above the following suggestions are made for a proposed two year M.Sc. course:

Two Year M.Sc. Degree Syllabus

ENVIRONMENTAL SCIENCE

1. Comprehension of the holistic dimension of the environment and man's place in it. The ecosystem as a web of dynamic relationships.
2. Basic ecological principles. function, structure and evolution of populations and ecosystems. Driving and state variables of ecosystems. Limits to growth. Growth and Development. Density stresses.

3. Natural, man modified and built environments. Resources, their base and use systems. Wastes and pollution. Industrial growth.
4. Public and private enterprises and ecological scarcity. Governmental and social organisations. Global and international institutions concerned with resource management. Depletion of the environment. War and peace.
5. Competitive uses of land, water and air. Environmental problems. Their origin, intensification and sustainable solutions. Conservation, cooperation and coordination for resources use within ecosystems. Tragedy of the commons and the value of sacrifice and love for all beings.
6. Ethics, aesthetics, culture. Spiritual and moral values of life. Place of coercion and education. Value reorientation and environment. Mechanism of social changes.
7. Redesigning society and environment on variable scales. Modelling of ecosystems and simulation exercises.
8. Expectations from the post graduates in the environmental science. Their role in dissemination of knowledge and skill for environmental management. Public awareness, training and education both formal and non-formal about the state of the environment and planning.

Thanking you; I close.