

Science Education for Sustainable Development in India

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ABSTRACT

Sustainable development based research and education is the back bone of any nation. And sustainable development policies highlight the role of education which has become the need of the day to create the awareness among the students, researchers and teachers as well as in local communities for environment protection. Exponential Growth of Technology in India has played a significant role in all round development and growth of economy in our country. Sustainable development is an emerging area, because it addresses the socio-economic development of every human being. India has opted for a judicious mix of indigenous and imported technology. This work focuses on the key areas of sustainable developments and scientific contributions towards it. This paper also explores the contribution of education to sustainable Development.

The development of any country is almost depends on the advancement in developing the technology in different fields. Countries that take part across this industrial revolution are developed much more than other countries because the machine occupies the work more from men. The new technology with young minds creates a synergy both in knowledge and sustainable development.

KEYWORD: Science education, sustainable development, India, the Government of India (GOI)

INTRODUCTION

As defined by the Brundtland Commission, "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs". The Brundtland Commission, formerly also known as the World Commission on Environment and Development was formed in 1983. The rationale was to have an organization independent of the UN to formulate "a global agenda for change" that would bring together industrialized and developing nations on a common platform to chart out a course of development that would take into consideration the inter relatedness of people, resources, development and planet.

Education, including formal education, public awareness and training should be recognized as a process by which human beings and societies can reach their fullest potential. Education is critical for achieving environmental and ethical awareness, values and attitudes, skills and behaviour consistent with sustainable development and for effective public participation in decision-making. Both formal and non-formal educations are indispensable to changing people's attitudes so that they have the capacity to assess and address their sustainable development concerns.

In 2002, the World Summit on Sustainable Development was held in Johannesburg which recommended that the United Nations General Assembly consider adopting a Decade of ESD. As a result, the 57th Session of the UN General

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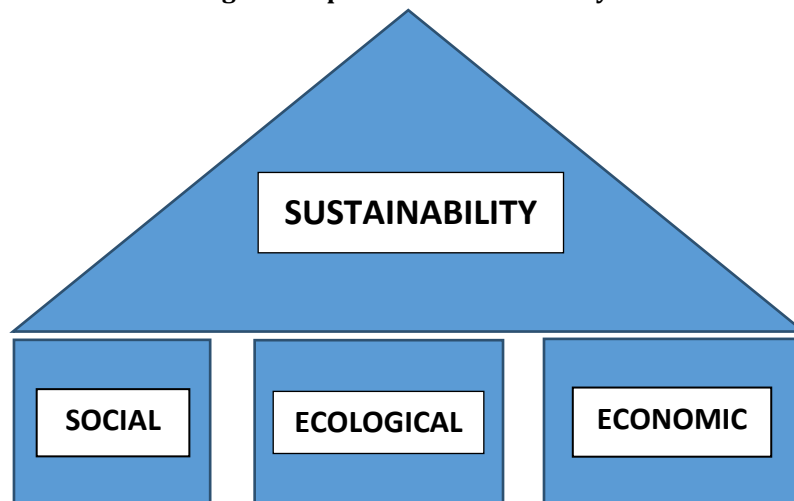


Assembly in December 2002, adopted Resolution 57/254 declaring 2005 to 2014 as the 'Decade of Education for Sustainable Development (UNDES) and designated UNESCO as the lead agency to promote it.

EDUCATION FOR SUSTAINABLE DEVELOPMENT (ESD)

Education for Sustainable Development (ESD) is simultaneously a sub-field of education and a conceptual tool to aid policy makers in authoring educational policies that take into account the present environmental, societal and economic challenges. According to the UNESCO, it is based on all levels and types of learning - learning to know, learning to be, learning to live together, learning to do and learning to transform oneself and society."

It further says that, "Perhaps ESD can be seen as the total sum of diverse ways to arrive at a 'learning society' in which people learn from and with one another and collectively become more capable of withstanding setbacks and dealing with sustainability-induced insecurity, complexity and risks. From this point, ESD is about - through education and learning - engaging people in sustainable development issues, developing their capacities to give meaning to SD and to contribute to its development and utilizing the diversity represented by all people - including those who have been or feel marginalized - in generating innovative solutions to SD challenges and crises."

Fig. Three pillars of sustainability

The three-pillar model of sustainability has been widely accepted, but has also received criticism as to whether or not it represents a satisfactory foundation for dealing with educational issues concerning sustainability[8].

NEED OF ESD

According to the 2010 State of the World Report (published by The World watch Institute), the Ecological Footprint Indicator, which compares impact of human actions on the ecology with natural resources available to supply key ecosystem services, shows that humanity now uses the resources and services of 1.3 Earths. In other words, if humanity continues living the way it is, it would require a third more of Earth's capacity than is available to sustain itself.

In years to come, the number of consumers is only going to increase. This would have a direct impact on the current resources of the world which is already under tremendous stress and depleting at a faster rate than ever before because of the growing world population and ever expanding human aspirations. It is estimated that by 2050, the human population will be 9.07 billion of which 62 per cent of the people will live in Africa, Southern and Eastern Asia. The enormity of unsatisfied human needs threatens social cohesion as well as the survival of important living systems of the planet. So, ESD is needed to meet:

1. CHALLENGES OF DEMOGRAPHIC CHANGES

The demographic structure of many of the less developed areas of the world is still very young, and requires intense investment in order to eliminate illiteracy and improve education at all levels and provide for job opportunities. On the other hand, progress made in health care, improved nutrition and healthier lifestyles has led in many other countries to increased survival and increased aging of the population. The well being and social contributions of a growing number of elderly people requires special attention and innovations will be required if we are to provide advanced health care and allow valuable societal roles for all.

2. CHALLENGES OF URBANIZATION

Some cities around the world are demonstrating potential for efficiently meeting human needs. However, unplanned rates of urbanization in developing economies are putting enormous strains on adequate housing and the management of the resources like water and energy and the provision of

essential services like sanitation, transport, health care and waste disposal. Also, efforts are needed to ensure and protect essential ecosystems in the process of urbanization. It has assumed urgency as by 2050 there will be ~70% urban dwellers globally against ~50% at the present time. Investments in research and innovative new approaches, as well as behavioural changes, are required if we are to make efficient management of scarce resources, and improvements in other areas such as sanitation.

3. PROVIDING WATER FOR NINE BILLION

Water availability is central to agriculture, industrial and energy production and essential for direct human consumption and for critical ecosystems. In view of the current and projected water scarcity and water stress, new ways of increasing the availability of clean water are essential. Therefore, the improvement of water treatment and management systems and technological solutions in recycling and sea water desalination together with other non-technological solutions should be explored. These approaches require the attention and action of governments around the world. Nutritious food is one of the most basic needs of human society. The level of food production and elimination of malnutrition and hunger has to keep pace with the increasing population, continuing land use change, and the future effects of climate change.

This may require more land for food production and certainly improved management of water resources. Newer genetic resources need to be developed, together with other non technological strategies, to meet the challenges of changing climate on crop cycles and yields. Strategies are required to balance the use of synthetic fertilizers and pesticides with more natural equivalents to ensure environment-friendly outcomes. Simultaneous attention is to be paid to the preservation of biodiversity and functioning of ecosystems. Increased food security in part depends on stabilization of international market food prices. Food consumption and production patterns need fresh science, technology and innovation perspectives to promote health, to cut down post harvest losses and reduce waste.

4. PROVIDING ENERGY WITHOUT UNACCEPTABLE ENVIRONMENTAL IMPACT

Essential aspects of human welfare require energy services. At the same time, fossil fuel combustion has to be implemented within environment and health constraints,

and is the predominant driver of climate change, and thus associated impacts including sea level rise, extreme weather events, and ocean acidification. Many studies have identified energy conservation and energy efficiency as essential, multi-benefit, low cost measures. In addition, a range of clean, renewable energy options are needed to meet the varied needs and circumstances around the world. Systems approaches, including storage, smart grids, conversion of waste and biomass into energy, and in some cases carbon sequestration, will also be necessary--and all require further progress in science, engineering and innovation.

5. SUSTAINABLE CONSUMPTION

The aspiration for a better quality of life is universal. Yet the resource implications of providing an improved quality of life for all, could jeopardize the future of the coming generations. Levels of material consumption differ enormously between regions of the world and if we hope to raise the aforementioned 1.3 billion persons out of poverty, the most developed and the emerging economies must stabilise and then reduce material consumption levels through: dramatic improvements in resource use efficiency, including reducing waste and employing improved recycling; and investment in sustainable resources, technologies and infrastructures. Systematic decoupling of economic activity from environment is essential. Responsible and inclusive consumption and production are the key elements of sustainability.

6. TOWARDS UNIVERSAL LITERACY

It includes scientific literacy Universal literacy, especially including women, is well understood to be essential for sustainable and equitable development. But literacy must be better understood to include scientific literacy, since many of the challenges we face will require science and technology solutions. For example, the burden of non-communicable, behavior-related (diet, lack of exercise, substance abuse, etc) disease is rapidly increasing, and evidence-based education is a central tool for addressing such issues. Creative and innovative programs are underway in many countries to further improve learning approaches and to equip teachers with the training and resources necessary. Inquiry based science education is a promising approach on which academies around the world are working in support of improving education systems, and in many cases with support from the private sector. South-South and North-South cooperation in sharing and implementing effective educational approaches are important to deal with the urgent educational needs of the least developed countries.

Keeping in view of the current environmental crisis, the content of education requires restructuring. This means that education systems across the world demands not only to make a person employment worthy, but also it have to capacitate people with values that helps them understand their relationship with the society and environment and enables a person to lead a life of contentment and satisfaction. So, education will have to go beyond mere transfer of information.

Education for Sustainable Development (ESD) therefore is an important pedagogical tool which helps an individual see and recognize the interdependence between human beings and each and every unit of ecology. The Brundtland Report of 1987 also made a very important point in this context

stating, "Sustainable development requires meeting the basic needs of all and extending to all the opportunity to fulfil their aspirations for a better life." The role of ESD, which is based on the three pillars of economy, society and environment, is critical in changing prevalent perceptions and attitudes of people towards self, society and environment.

ESD IN INDIA

Traditionally India has been a sustainable society. A large part of the Indian population still has a lifestyle that is based on the principle of reuse, reduce and recycle. In some cases it is a matter of personal choice but for a large majority, it is necessitated by economic constraints.

The Government of India (GOI) has integrated the principle of 'sustainability' in its various policies and developmental programmes. India's developmental strategic framework is based on a five year planning system. The first five year plan was rolled out in 1951. Presently, eleventh plan is renamed as niti ayog which focuses in a big way on education. The GOI recommended Ministry of Human Resource Development (MHRD) to integrate environmental concerns into all aspects and levels of education.

India is the only country to have passed one of the landmark judgments passed by the Supreme Court of the country directing all education boards to include environmental education (EE) as part of the formal education system at all levels.

Besides the different ministries of the GOI, a large number of government and non-government organizations are diligently working to promote ESD. Most notable amongst them are Centre for Environment Education (CEE) which is the nodal agency for implementing UNDES in India; The Energy and Resources Institute (TERI); Bharati Vidya Peeth (BVP); Centre for Science and Environment (CSE); World Wide fund (WWF); National Council for Science Museums (NSCM) and National Council of Education, Research and Training (NCERT). These organizations work with schools, colleges, youth groups on ESD and conduct training programmes not just for students but teachers, principals, school administrators and policy makers.

Most remarkable fact is that the ESD field in India is also occupied by young and passionate professionals who are working across the country to raise awareness on sustainable development issues. These professionals come from different walks of life like media, architecture, medicine, education, social work, alternative art and literature. A lot of work is being done at the grassroots level involving local communities. The latest ICT (Information, Communication, Technology) tools are being employed to connect with the upwardly mobile urban youth and to reach out to a larger audience. The Multi-national corporations are also contributing by funding projects on ESD as part of their CSR strategy. The last five years have seen a notable increase in corporate spending on CSR in India and it has slowly but certainly helped the cause of developmental initiatives in the country [7].

ROLE OF SCIENCE IN SUSTAINABLE DEVELOPMENT

Science education leads to sustainable development in following parameters:

1. NUCLEAR TECHNOLOGY

Technology can either be developed by own research and development or it can be purchased through imported sources. Radiation techniques are used in agriculture for producing high yields with better crops. The technique called Nuclear Sterilization (NS) is used to eradicate the tests flies and have also been used to control the harmful effects of pesticides for human being. Radiation techniques also have an application to preserve food by eliminating bacteria and pathogens that cause various diseases. It also prevents the harmful effects of chemicals that are being used in fumigation of food. For attaining effective sustainable agriculture and to achieve maximum benefits the nuclear techniques are used to optimize the intake of water and fertilizer-uptake. Nuclear techniques used in mutation-breeding have resulted in producing improved varieties of cotton, wheat, chickpeas, and rice.

2. WATER RESOURCES

Pure and clean water is the basic need all over the world. Increasing awareness in the world that fresh water is a precious and limited resource leads to application of science and technology in management of water resources. Ground water is shrinking due to over-exploitation and being lost by degradation of water quality from pollution caused by human activities. Global warming is also one of the factors for additional demand for water. Sustainable improvement in freshwater resources requires use of technologies like radioactive isotopes and radioactive tracers.

3. INDUSTRY

Non-destructive Testing (NDT) and quality assurance is the key requirement in modern industry. Services using nuclear control techniques are being used in a many of the industries, including oil sectors, fertilizers, chemical plants, hydroelectric and thermal power plants. The quality assurance laboratories using nuclear analytical techniques are essential requirements for maintaining quality standards in industries.

4. HEALTH CARE SECTOR

Health is wealth and it is one of the key factors that must be taken into consideration for achieving sustainable development. Nuclear techniques are used for diagnosis and treatment of diseases. Today it is one of the most powerful diagnostic techniques. Radioscopic techniques are used in the area of health science in treatment of cancer as the cases of cancer which is increasing rapidly all over the world. Gamma irradiation technique is used for sterilizing the medical equipments.

5. INFORMATION TECHNOLOGY SECTOR

Information technology plays a crucial role in today's society. Knowledge and intelligence empowers both people and machines with information. The utilization of machines, men, methods and money in appropriate amount contributes to effective sustainable development. Empowered people are playing the role as responsible citizens to support environmentally sustainable society and also empowered machines have the knowledge to minimize energy and material use, wastes and pollutants. Information technology improves the facilities at faster, cheaper and equitable rate and improving learning environment for people. Internet tools facilitate people to access the information globally and processing, storing, transmission made easier in electronic form.

6. BIOTECHNOLOGY

The fields of biotechnology are a multidisciplinary nature and contain many scientific approaches on it. It began in 70's with genetics and DNA technology [1]. The genetic engineering is covers almost all areas including, Agriculture, Environment Industry and Human Health. The application of biotechnology knowledge gives human kind the ability to alter the structure of life itself. The modern concepts like cloning, Genetic Algorithm, Ant colony optimization, Swarm Optimization and Artificial Intelligence techniques are and new heuristics are developed on nature inspired plants and animals [2], [3]. Biotechnology techniques are boom for the human community and it depends on how it is used and controlled. The genetic engineering has got the industrial revolution when it was introduced and some areas in which it perform well such as produce new and safer vaccines, treating genetic diseases, increase crop-yields, decrease production costs, improve food nutritional values, develop biodegradable plastics and decrease water and air pollution [4].

7. SUSTAINABLE HUMAN RESOURCE MANAGEMENT

Human Resource Development is the most important area for sustainable development of managing the human resources. Something from our own experience and some from experiences of others it's a way of transferring the knowledge and skill to offspring through grooming [5]. The critical factors for sustainable HRD are the population explosion, the rising expectations and the ongoing knowledge revolution. The fields of biotechnology are a multidisciplinary nature and contain many scientific approaches in it. It began in 70's with genetics and DNA technology [1]. The genetic engineering covers almost all areas including, Agriculture, Environment, Industry and Human Health.

CONCLUSION

The area of ESD is very broad. So, it simultaneously becomes a challenge and an opportunity too. ESD provides an excellent pathway to the social, economic and environmental spheres of India and societies to trigger awareness, analysis and action for sustainable development. The path to ESD is an important and countries that use it to their advantage would provide its present excellent and gifts its future generations an environment that would empower them to fulfil their needs and aspirations by achieving a balance between economy and ecosystem. Otherwise, the consequences can be very disastrous. As the noted Indian Economist and scholar, Amartya Sen points out, "a fouled environment in which future generations are denied the presence of fresh air...will remain foul even if future generations are so very rich."

The need of the hour is to identify the key areas in the planning activity for sustainable development. The isolated areas of particular research interest must be combined together and supports the lack of expertise for the individuals. The infrastructure developments on sustainability developments must be addressed with high sophisticated levels. Most of the countries have agriculture based economies and with the use of sustainable technology the crop yields can be raised [6]. So far the development of sustainable technology lacks behind in the areas of human resource development due to resistance to change, lack of awareness, and adoption of technologies using technological development in all the private sectors.

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