

Geospatial Technology Education: Capacity Building for Sustainable Development



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Abstract: Sustainable development requires judicious use of resources which can cater for present need and also makes provision for the future. Geospatial technology operates at a regional level as well as micro level by providing a framework for data visualization and analysis which is crucial to the decision making process. Such a platform provides tools that help decision makers analyze complex situations and complete the task with efficiency. Research shows that Geospatial thinking is critical to survive and operate in today's digitized world. Research has also shown that education in Geospatial technology will be crucial to make workforce competent across all sectors of the economy and it will be particularly necessary for achieving sustainable development goals. Geospatial education in India is lagging behind the rest of the world due to the specific constraints of the University structure in running Interdisciplinary subject. Geography education largely restricts to bachelor degree with little or no technological grounding. This paper is an attempt to critically analyze Geospatial education scenario in India with special reference to the experiences of the teaching Geospatial curriculum at Symbiosis Institute of Geoinformatics. This paper also attempts to evaluate the efforts of integrating research on sustainable development with the core curriculum.

Keywords: Sustainable development, Geospatial Technology, Higher Education, Curriculum Development, Geography Education.

I. INTRODUCTION

Starting with United Nations Conference on Human Environment, Stockholm(1972), which recognizes Man's role as both creature and moulder of the environment. It urged nations to be mindful of its actions that might have serious environmental consequences. In all, 26 principles were laid out to guide people and governments to inculcate environmental consciousness in the path towards prosperity. The principle 19 amongst them explicitly mentions the role of education in all environmental matters to be vital [4]. This concept of eco-development was instrumental in the establishment of the World Commission on Environment and Development[12]. Subsequently, at the Rio Summit 1992 the world reached an agreement to accept sustainable development as a goal. Within the framework of Agenda 21, Article 36 emphasizes the education as key to achieve sustainable development.

In the same year International charter on Geographical Education was proposed which has been widely accepted as benchmark documents for education and research all around the world. Haubrich et.al. 2007. UN Decade of Education for Sustainable Development (DESD) 2005-2014 provided a platform to integrate the principles, values and practices of sustainable development into all aspects of education and learning. It encouraged collaborations with private sector media groups to engage youth. It encouraged research in the area of ESD.It provided a forum for governments, multinationals and various non governmental organizations to come together and share best ESD practices and facilitate formation of working groups focused on specific themes. In recognition of this effort The International Geographical Union Commission on Geographical Education in 2007, proclaimed 'Lucerne Declaration on Geographical education for Sustainable Development'[5]. The declaration recognizes the contribution of Geography to education for sustainable development. It also developed parameters for developing relevant geography curricula, and recognizes the role of ICT in education for sustainable development in Geography. The commission proposed a concept of study of Human and environment interaction as a means to achieve sustainable development. This document has paved the way for all Geographical Educational Organizations to take the center stage in developing higher education curricula for sustainable development.

II. LITERATURE REVIEW

The term Geography is rather broad with respect to its scope. Geographers often venture into realm often associated with different disciplines. Geography encompasses themes such as environmental Geography dealing with environmental

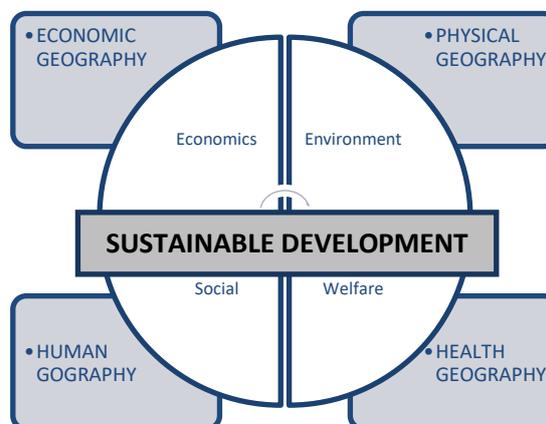


FIG. 1 INFLUENCE OF GEOGRAPHY

Manuscript published on 30 September 2019

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studies, Physical Geography dealing with Earth Science, Human Geography deals with social science, Economic Geography deals with spatial dimension of economics, Health, Geography studies epidemics, etc.. Most of these themes that are involved in the day to day functions of geographers are not specifically geared towards the study of Sustainable development.

But the contribution of geographers towards research in sustainability stems from study of these various disciplines in the context of human environment interactions[1]. Human beings are displaying dichotomous behavior. They are individualistic as well as abide social norms at the same time. The balance between individual freedom and societal conformity leads to progressive society where individual can lead a dignified life. The balance is often the result of socio-cultural foundations[6]. The education of youth, resulting from the principles and values inculcated by culture defines the path towards progress. Geography as a discipline stands at the cusp of various fields of inquiry that allows one to study the development of society. Societies are not static they are ever evolving and the principles or value systems change over time. Geographers although often subconsciously, study this change and can contribute significantly to the education for sustainable development. In India Geography, like any other subject is compartmentalized. At the school level the Geography education does not expect students to analyze or synthesize, but the emphasis is on rote learning. The consequence of such lack of attention given to geography results in lack of awareness amongst students with respect to the potential and significance of Geography as a discipline. At the undergraduate level majority of students undertake Geography to full fill the requirement of courses rather than out of interest. The students opt for majors that are momentarily rewarding or are perceived to be more glamorous or important. The students failed to be motivated enough to take Geography as a major largely due to the way it is taught and the way the content is created [7]-[10], whereas in science stream it is perceived to be secondary subject. In both instances the Institutions fail to get good quality students to opt for Geography. These students often lack even the basic knowledge of Geography. We believe that there are two main reasons for this lackluster reputation. The first is the result of a compartmentalized structure of the University curriculum. Geography is essentially an interdisciplinary subject. In order to capitalize on strength of Geography one needs to support it by rigorous grounding in the arts as well as a science, especially with respect to mathematics and statistics. The Indian education system fails to bring together the nuanced approach required for comprehensive Geography education. At the same time we have failed to delve deeper into the analytical strength of Geography by not employing modern techniques but by preserving traditional teaching learning paradigm. The second reason is the failure to modernize the Geography curricula. Geography has moved away from being just a descriptive subject, noting down the names of countries and rivers, etc. and has evolved into a serious analytical science grounded in a profound theoretical base and complex quantitative analysis. Most of the western world moved towards quantitative Geography after the abandonment of descriptive methods. The discipline of Geography fully embraced the quantitative revolution by adopting mathematics and

rigorous statistical modelling techniques[3]. Geography ceased to be a mere descriptive discipline outlining the physical or social nature of earth to one that is analytical and deals with providing complex information along with tools to analyze and interpret such information in a timely manner [7]. The quantitative revolution has evolved further by advent of computing power. Especially since the late 90s the average person has gained access to computational capacity and tools by which complex spatial analysis and modelling can be accomplished at relatively low cost. The proliferation of mapping products and location based services is evidence that such capacity was the need of the hour. In India we have failed to modernize our Geography curriculum to incorporate these techniques which are collectively termed as Geospatial Technology. These collective technologies of Remote Sensing, Global Navigation System and Geographic Information System has further revolutionized the nature of Geography. Today Geography is at the forefront of all analytical sciences. Geography is essential for everything ranging from weather prediction to predicting epidemics and form micro planning to regional planning. In our experience these modern Geospatial techniques have the potential to bring tremendous spatial analytical power at our fingertips, which will prove instrumental in providing the much needed scientific grounding to problems of sustainable development.

III. METHODS

1. Geospatial Technology and ESD

Thomas J. Wilbanks, The President of The Association of American Geographers has outlined four major challenges in attaining sustainable development. These are essentially the choices between, '1) Conservation versus Growth, 2) Freedom versus Control, 3) Centralization versus Decentralization and 4) Reformism versus Revolution. [12]. The implications of these debates are far and wide. They incorporate differences within and between the nations' culture, heritage, developmental history, resource availability, diversity, socioeconomic stage of development, political structure, etc. Geography as a discipline has the capacity and depth to address such debates and provide scientific or quantitative platform to support decision making. Strength of Geography as a discipline needs to provide the leadership to tackle these complex issues. The strength of Geography lies in its core of analyzing space in human as well as natural context. It has the appropriate tools to study the interlinking of various components of natural and anthropogenic environment. Geographic principles are most useful to access the current situation, but they are also instrumental in analyzing the movements that shape the interaction between man and environment. In order to build a sustainable future we are increasingly concerned about regulating the movement of people and resources. Geographers can map the way these movements shape our society and can provide solutions or increase efficiency and productivity. Geography principles look at a spatial location at local level, mostly on community level studies which are narrow in scope.

At regional level geographic principles can decipher spatial patterns on a larger scale, such as patterns in agriculture or forest, etc. On global level Geographic principles focus on spatial interactions and the connection between global events and issues. (Table 1.)

Lastly, We believe that vast amount of geographic data which available today at very little cost can harnessed to provide solutions at all scales of development may it be local or global.

TABLE I: INFLUENCE OF GEOGRAPHY

Level	Activities	Agency	Geographic Principle
Local	Water Resource conservation, Energy conservation, town planning, local transportation planning, location based services, Waste management, Utilities Management. Provision of basic services.	Municipal Corporations, Local governmental authorities, NGOs, CSR initiatives.	Location Specific
Regional	Agriculture planning, Forest Conservation, macroeconomic planning, implementation of state and national policies, regional transport, Roads and highway management, Land use management	State Government Authorities, State Ministries, Central Government, Central Ministries, NGOs	Spatial Pattern
Global	Participation in global initiatives, evaluation of national policies on global benchmarks, green diplomacy, Development pacts with other nation states	Central Government, Global forums such as United Nation organizations, IMF, World trade organization,	Spatial Interaction

In 2011, Planning commission of India constituted National GIS Ineterim Core group (ICG) to formulate a vision for GIS organization at the national level [9]. Along with ICG many Institutes such as National Resources Information System (NRIS) and National Natural Resources Management System (NNRMS) of the Indian Space Research Organization, National Spatial Data Infrastructure (NSDI) and NationalResources Data Management System (NRDMS) of the Department of Science and Technology, National Informatics Centre (NIC) will formulate the vision and provide a framework for implementation of what will become 'Indian National GIS Organization (INGO 2011)The program and vision document of INGO specifically mentions Sustainable development in its vision statement. Sensitizing the population with sound Geographic knowledge will help people appreciate the value of the environment. As the population becomes more and more Geospatial literate, we will have developed that is environmentally conscious and sustainable. We at Symbiosis Institute of Geoinformatics are building up to a curriculum that will serve the purpose of not only modernizing geography education but can bring modern geographic techniques to the masses.

IV. RECONSTITUTING GEOGRAPHY EDUCATION

With the advent of the technology revolution that is shaping the 21st Century, we need to transform Geography education into Geography Education. In the context of Geospatial Education US National Research Council has articulated

eleven grand challenges. Second among them is a challenge to promote sustainability with all eleven challenges necessitates use of Geospatial Technology. Spatial Modelling and analysis plays a vital role in the study of resource distribution, conservation, and climate change. Geospatial technology helps create knowledge through applied learning [11]. Creating a strong Geospatial curriculum requires sustained efforts to maintain the quality and relevance of the syllabus. There are seven key elements in creating curriculum that is relevant for sustainable development.

1) Periodic revision: The syllabus is updated frequently with a board comprising of all the stakeholders, including representatives from government, non-governmental agencies, academia, corporate and alumni. The regular updating keeps the syllabi relevant to the changing needs of the society. It also allows the program to be adjusted to the changing quality and aspirations of incoming students. Regular dialogue with all the stakeholders is must. It is achieved through invited lectures, one on one meetings, and through the regular filing of feedback forms.

2) Embracing the diversity: Geographic inquiry by nature is diverse. The discipline borrows from and contribute to many fields. The incoming students also belong to diverse fields ranging from Geography, Geology, Environmental Science, Computer science, civil engineering, etc. By embracing the diversity and unified under the umbrella of Geography has increased the utility of the program. By diversifying the course content programs can be tailor made to suit the level and the requirement of the students. We are currently running Master of Science program for full time graduate students along with a diploma for part time working professionals. Tailor made certificate programs are provided for group of students or professionals that caters to their specific needs. For example Diploma / certificate for military personnel, Certificate program for Municipal Corporation Staff, etc. Such programs go a long way to increase awareness and orient them towards the use of modern spatial techniques involved in the planning process.

3) Emphasis on Quantitative techniques: The process of resolving conflicts and making decisions is extremely complex, especially in country like India which has diverse cultural underpinnings. Decision making process at all levels of governance havean impact on sustainable future and thus is required to be grounded in sound scientific platform. Such platform when provided with quantitative back up lends results which are free from bias, can be compared through time and space and can stand the test of scrutiny by stakeholders. It reduces arbitrary and ad hoc decision making. It also provides a safe environment for decision makers and protect them from vigilante activism. 4) Use of ICT: Information and communication technology is extensively used in order to give the stakeholders the ability to act and react to problems especially in decision making. Students are encouraged to learn the use of ICT to enable them to function in the ever digitized world. The technology such as the use of GIS software, Image processing software or global navigation systems are essential for complex analysis and decision making. It is these technologies that provide the efficiency, consistency and reliability to one's analysis. These are critical components of the planning process for sustainable development.



The spatial data visualization techniques in particular are extremely useful in communicating the connotative data analysis.

5) Incorporation of specialized domains: Geospatial technology influences a wide variety of domains such as Infrastructure development, Urban Planning, Rural Development, Natural Resource Management, Public health etc. These domains have their specific requirements that can be catered through use of geospatial technology. Domain specific applications help stakeholders understand the scope and utility of the technology.

6) The provision of hands on experience through minor research: The master's program incorporates Integration of research components with academic curriculum with the objective of capacity building in implementing the application of Geoinformatics in various domains. The gap between the theory and practice on the ground is overcome by this activity. Students undertake 2 months and 6 month project in different organizations in India and abroad. This process of working on a live project which is assessed at the institute gives valuable link of the theory and practice.

7) Collaboration with nationally reputed organizations: Knowledge sharing among faculty and students to give exposure to real time and national importance research areas. Many collaborative research projects have completed on the line of National Development and research papers have been published in peer review journals. This gives faculty and students an opportunity to work with latest Geospatial technology in a specialized domain.

V. OPPORTUNITIES AND CHALLENGES

The Geospatial education must percolate down to school level. Students must be made aware of the potential of this technology. They can be given hands on experience tools available with open source software. As the awareness grows many talented young minds would be eager to embrace this technology. We can then hope to build capacity from the ground up. At the higher education level opportunity to implement 'spiral curriculum' will be very useful, especially since the technology is evolving fast. In spiral curriculum as proposed by Bruner in 1977 [2], concepts can be introduced and reintroduced with increasing level of complexity. Such sequential learning process will help leverage technological advances. Students, for example, can migrate from desktop to web to mobile platforms while revisiting the same concepts, thus reinforcing the knowledge while adapting to ever evolving technology. Such leveraged learning will help us build capacity more efficiently and reduce the requirement for retraining the work force. The major challenge facing geospatial education is to create programs for the diverse needs of stakeholders. This is especially true for people working on planning for sustainable development. Not only the domains vary, but the level of skill set also differs. Institutes both private and government, will have to gear up to train and educate the vast work force right from digitizing to application development. Research methods also have to evolve at University level as our own experience suggests that we have a long way to go in terms of meaningful research output.

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AUTHORS PROFILE



Dr. Navendu Chaudhary is Associate Professor at Symbiosis Institute of Geoinformatics, Symbiosis International (Deemed University). He received his PhD in Geography with specialization in Remote Sensing and GIS from University of Cincinnati, USA. He has worked with The United States Environmental Protection Agency as research contractor. He has collaborated with Ohio Protection Agency for creating Land cover products from Remotely Sensed imagery. He has Masters degree in Environmental Science and Bachelor's in Microbiology. As broadly trained scientist his research interest include Sustainable Development, Urban GIS and Water resource management. Currently working on water resilience for urban environment in the context of localising United Nation's Sustainable Development Goals.



Dr. Pisolkar was awarded with his degree of Ph. D. on 6th, December 2008 by University of Pune. Title of the thesis was - A Geomorphic study of the beach and creek erosion at Devbag, Coastal Maharashtra. After his doctoral research, he is working on eco sensitive part of Sindhudurg district along Maharashtra coast funded by Symbiosis International (Deemed University) and collaborative work with International organisations like Centre for Environment Education (CEE) & Swedish International Centre for Education for Sustainable Development (SWEDES) under the Supporting Urban Sustainability (SUS) programme 2012. Inquiry in 2012 was to understand various social, ecological dynamics and to design stakeholder engagement for Sustainable Development (SD). He still continues to contribute to best of his abilities for SD along Malvan, Tarkarli, Devbag Coast.