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Space Science and the Developing World

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Space science and technology have changed the face of the earth. With this statement, I am not primarily referring to the space programmes of the USA and Russia e.g. the former USSR, even though the more visible achievements of these programmes are highly admirable from a scientific and technological viewpoint. What I am referring to are the advances in information and communication technologies that we are all witnessing today, and the applications of remote sensing and spatial information technologies to the management of the rural and urban environments.

These technologies are as relevant to developing countries as they are to high income countries. In fact, they may even be more important to developing countries, because of the tremendous pressure on the natural resources in these countries and the need to increase food production to feed a rapidly increasing population, while conserving the quality of the environment and making rational and socially acceptable use of non-renewable resources.

At this point I would like to note that it is somewhat embarrassing to refer to the South and East Asian region, which is the cradle of some of the greatest civilizations and cultures of mankind, as 'developing countries', but it will be understood that the notions 'developing' and 'developed' primarily refer to the economies of the countries concerned, as measured in terms of per capita gross national product or some other suitable economic parameter. To stress the later point I have replaced the term 'developed' by 'high-income' in most of this text. However, as not all 'developing' countries referred' to here are 'low-income' (i.e., per capita GNP less than US$ 760), I have maintained the term 'developing'.

The general public associates the notion of space science and technology often with the more spectacular aspects of these programmes, such as manned space flights, landings on the moon, and the exploration of mars or venus. In addition, space science is, of course, associated with the development of military hardware and technologies, in particular during the period of the cold war. Because of these associations, large sections of the population in high-income countries feel that space science may not be relevant to developing countries as they are not aware of the enormous potential that space technology has for improving living conditions in countries of the third world.

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Unfortunately, a number of funding agencies in high-income countries also do not seem to be fully aware of the potential that space science has for improved natural resource management, infrastructure development, urban planning and management, information and communication technologies, management of natural disasters, exploration of mineral resources, conserving biodiversity, and other important areas in the developing world. As a result, there has been some reluctance on their part to support initiatives aiming at disseminating the benefits of space science and technology in developing countries, and to train professionals in the use of these technologies. It is high time that these perceptions about the relevance of space science to developing countries change.

This problem was clearly understood by the founder of the Indian space programme, Prof. Vikram A. Sarabhai, who stated as early as the early 1960's that: *"There are some who question the relevance of space activities in a developing nation. To us, there is no ambiguity of purpose. We do not have the fantasy of competing with the economically advanced nations in the exploration of the moon or the planets or manned space-flights. But we are convinced that if we are to play a meaningful role nationally, and in the community of nations, we must be second to none in the application of advanced technologies to the real problems of man and society."* It is thanks to visionary scientists and leaders such as Prof. Sarabhai that space science worldwide has developed into a science that indeed has a lot to offer to the common man in developing countries.

Although it is well-known that developing countries are facing enormous challenges in trying to improve the living conditions of their populations, the extent of the problems they are facing may not always be fully understood by those concerned with development cooperation in the high-income countries. To illustrate this point, I have summarized some information from the "World Development Report 1999/2000" (World Bank, Washington DC, 1999) in the following table:

Item	High Income	East Asia & Pacific	South Asia
GNP per capita (US$)	25,510	990	430
Official development assistance (US$ per capita)	-	3	4
Population density (number of people per square km)	29	114	273
Total population (Millions)	885	1,817	1,305
Population growth (annual %)	0.7	1.5	2.1
Freshwater resources (cu meters per capita)	[8,338][a]	[2,282][b]	4,085
Arable land (hectares per capita)	0.41	0.11	0.16
Deforestation (suare km per annuam)	-11,694	29,956	1,316

[a] world average, [b] China

The most striking fact in this table, in my view, is the enormous difference between the per capita gross national product (GNP) of the 'high-income' countries and the countries of South Asia and East Asia and the Pacific (S&E Asia): a factor 2550. This problem basically dwarfs all other problems. The official development assistance (ODA), although much appreciated, does not do much to make up for the difference in per capita GNP between the high-income countries and S&E Asia. Hence, it is clear that the financial resources that can be made available to deal with urgent environmental problems are extremely limited in the S&E Asian countries.

The population densities in S&E Asia are a factor 5-10 higher than those in the high-income countries, and the annual population growth rates are 2-3 times higher. Hence, the much higher population densities and associated higher growth rates are another major difference between high-income countries and S&E Asia. This implies that there is much more pressure on the natural resources in S&E Asia and it is therefore more difficult to protect the environment, conserve biodiversity, etc. Many of the environmental problems are exacerbated by the sheer numbers of people involved: more than half the world population rives in this region.

Similar trends can be seen in the environmental items in the table: For example, the per capita freshwater resources of South Asia are less than half the world average, whereas in China freshwater is even scarcer. The availability of arable land per head of the population is a factor 3-4 higher in the high-income countries than in S&E Asia. Deforestation rates are currently negative in the high-income countries (i.e., forest cover is increasing), but still significantly positive in S&E Asia, in particular in East Asia.

In summary, it may be concluded that the problem of conserving the environment and protecting biodiversity is an order of magnitude different between the high-income countries and S&E Asia. One of the implications of this is that the often capital-intensive technologies used in the high-income countries to deal with complex environmental problems or natural disasters, may not necessarily be applicable to the developing world. Countries in S&E Asia will have to develop their own scientific as well as indigenous knowledge base and low-cost technologies for sustainable natural resource management, for the rational and equitable use of non-renewable resources, for the use of the multifunctional urban and rural space, and for solving many other urgent problems.

Space science and technology, as well as geoinformatics and geoinformation management could play an important role in developing relatively low-cost systems for earth observation and monitoring of the environment, as well as alternative management systems. The existing infrastructure in space science and geoinformatics should be used to the full, for the benefit of the entire S&E Asian region, and the proven ability of the people of S&E Asia in developing excellent software may be expected to be of great value in this endeavour.

Education and training in space science and geoinformatics, and their associated technologies, are of prime importance in this respect. It is also in this area that the CSSTE-AP has a major role to play: adequate training and education in space science and geoinformatics is essential for realizing virtually any scenario for sustainable development in S&E Asia. In addition, low-cost alternative technologies for the management of natural resources and the multifunctional rural and urban environments should be developed, using advanced scientific as well as indigenous knowledge and capacities. M.Sc (and Ph.D) research programmes under the aegis of the CSSTE-AP, possibly in cooperation with advanced research institutions in high income countries, could stimulate this development.

Agencies for international cooperation in high-income countries should be sensitized to the fact that developing 'national' solutions for environmental problems in S&E Asian countries may be more useful than simply exporting capital-intensive technologies developed under entirely different conditions. In addition, technologies are only tools and ' tools by themselves do not solve problems. It is the qualified people that use these tools in an intelligent fashion that may solve problems. Therefore, irrespective of the nature of a technology employed, people will have to understand the scientific background and application domain of a technology and will have to be trained in the use of these technologies. Therefore, UN-supported' initiatives, such as the CSSTE-AP, are of key importance for the success of ventures aimed at realizing sustainable development in the developing world.

Fourth RS and GIS Course

The fourth CSSTE-AP Post Graduate course in Remote Sensing and Geographic Information System (RS & GIS) started at Indian Institute of Remote Sensing (IIRS) from October 1, 1999. 17 participants from 11 countries (including three from India) of the Asia-Pacific region are attending this course. This course is divided into three modules each of three months duration. The Module I covers concepts of Remote Sensing and GIS technology and the Module II deals with both optional and compulsory streams. The optional stream covers several disciplines of RS & GIS applications such as Agriculture and Soils; Forestry and Ecology; Geosciences; Water Resources; Human Settlement and Urban Analysis and Marine Sciences. The topics covered in Compulsory stream are advances in RS & GIS, Satellite Meteorology, Earth Processes, Sustainable Development and Integrated Resource Management and Environmental analysis, monitoring and management and Global issues. The Module I ended in December 31, 1999 and Module II is closing in March 31, 2000. The core faculty of the course consists of experienced faculty of IIRS. Some specialised faculty from several Indian organisations were also invited to deliver guest lectures on specific topics. Several international distinguished Scientists viz. Prof. Shunji Murai, Tokyo University, Japan; Dr. Karsten Jacobson, University of Hannover, Germany; Dr. Didier Giacobbo, GDTA, France; Dr.Christine Pohl, and Dr. Gerrit Huurneman, ITC, The Netherlands also delivered number of lecturers.

In addition to class room lectures and practical and tutorial sessions, a number of field visits were arranged to demonstrate the participants the practical aspect of field data collection and analysis. Written examinations, class and practical tests at periodic intervals during these two modules were conducted to evaluate the academic performance of course participants. At the beginning of the course an orientation course of one week duration (during evening period) was organised to make the participants familiar with social, cultural, geographical and tourism aspects of India. As part of educational tour participants undertook a technical visit during February 20 - 29, 2000 to ISRO Satellite Centre (ISAC) and Regional Remote Sensing Service Centre (RRSSC) of Southern India at Banglore and National Remote Sensing Agency (NRSA) and Satellite data receiving Earth Station at Hyderabad. The course participants also attended the International Science Symposium on "Space Technology for improving quality of life in developing countries : A perspective for the next millennium" at Delhi, during November 14-17, 1999.The participants also had a glimpse of India's diverse rich culture and heritage during their excursions in different Indian cities such as Delhi, Agra, Hyderabad, Bangalore and Mysore.

Short term course on Digital Image Processing

A short term international course on "Digital Image Processing for Environmental Management : a remote sensing perspective" of CSSTE-AP was conducted at Indian Institute of Remote Sensing (IIRS), Dehradun during August 30, 1999 to September 24, 1999. 22 participants from 11 countries viz. Kazakstan, Ghana, Nigeria, Uzbekistan, Syria, Madagascar, Mauritius, Nepal, Mongolia, Vietnam and Azerbaijan attended the course. The objective of the course was to make the middle level resource managers familiar with techniques and applications of Digital Image Processing (DIP) of remotely sensed data for sustainable natural resources and environmental management in cost effective manner. The course was modular in structure and provided a balanced treatment of theory, application and practical hands in experience. The major topics covered in this course: fundamentals of DIP, advanced concepts in DIP and DIP applications in environmental management. The valedictory function was held at IIRS on September 24, 1999 Dr. D.P. Rao, Director, National Remote Sensing Agency, Hyderabad delivered the valedictory address and distributed the certificates to the course participants.

CSSTE-AP in UNISPACE III

(following excerpt is paragraph 464 from report of UNISPACE III, chapter III Rref : A/conf. 184/6)

Several representatives welcomed the efforts of the United Nations in establishing the regional centres for Space Science and Technology Education in Africa, Asia and the Pacific and Latin America and the Caribbean. Some speakers from the region of Asia and the Pacific expressed satisfaction that the centre in the region had already provided benefits, while other speakers pointed out that the centres in their regions would contribute greatly to strengthening the indigenous capabilities of countries in the field of space science and technology. It was suggested that the centres should also become the focal points for technical assistance and constituency in their respective regions and should provide advice in support of efforts to develop space activities in various states. Some speakers felt that the activities of the centres needed to be strengthened further. It was suggested that a similar centre could be established as part of the network of institutions set up in central, eastern and south-eastern Europe.

Forthcoming Courses/ Workshop

PG Course

- 9 Months PG Course in Satellite Meteorology and Global Climate commencing on July 1, 2000 at SAC, Ahmedabad
- 9 months PG Course in Space and Atmospheric Sciences commencing on August 1, 2000 at PRL, Ahmedabad
- 9 months PG Course in Remote Sensing and GIS commencing on October 1,2000 at IIRS (NRSA), Dehradun.

Short Course/Workshop

- **Land Use, Land Cover Changes in Coastal areas**
  April 17-20, 2000 Sponsored by ICS-UNIDO in collaboration with CSSTE-AP, COSTED and TERI at Chennai
- **Satellite Communications Applications for Development**
  July 17-21, 2000 Sponsored by Centre for Science and Technology of the Non Aligned and other Developing Countries at Ahmedabad
- **International Training Course on Remote Sensing and Geographic Information System - Technology and Applications in Natural Resources and Environmental Management**
  August 28, 2000 to September 22, 2000 at IIRS (NRSA), Dehradun.

CSSTE-AP hereby requests all the past course participants of its educational programmes to send a brief write-up on their present activities and achievements. Please also mention if you have received any award or recognition for your recent work. Excerpts will be published in the Newsletter.

Director Speaks

The Millennium euphoria is just over and the millennium bug too has been well tamed. In all the stories of man's victory over the evil, this one has had a technical edge in the sense that it has been an emergence of technical evil for whose vanquishing, the technical weapon was used. This is also a clear indication of the coming of age of Information Technology and Communications and the global spread of our problems and their mitigation efforts.

As we turn to prioritising our efforts in the ensuing decade, I wish to focus on a long standing evil that has defied our efforts to eliminate its presence - the natural hazards and disasters. Year after year, we are haunted by the spectre of disasters and unless we focus our efforts with modern technology towards their mitigation, future holds bleak prospects. The just ended International Decade for Natural Disaster Reduction has only been able to draw our attention on a burning issue but the actual work lies ahead.

The centre, with its associate Institutions would like to prioritise Remote Sensing, GIS, Satellite Communications, Satellite Meteorology and Space Sciences towards identifying, charting predicting and mitigating the effects of natural disasters in this decade.

People often talk about man made disasters too. In my opinion, our complacence towards prioritising technology for natural disaster mitigation would be the biggest man made disaster.

-Prof. B.L. Deekshatulu

Course Concluded

CSSTE-AP 9 months second Post Graduate Course in Satellite Communications with participation of 18 candidates from 8 countries of the Asia Pacific Region concluded at Space Application Centre, Ahmedabad on March 30, 2000.

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CSSTE-AP welcomes the views and opinions of the readers of the newsletter. Short communications on space science and technology education which may be relevant to Asia Pacific region are also welcome. Views expressed in the articles of the newsletter are those of the authors and do not necessarily reflect the official views of the centre.