

# GIS EDUCATION- EXPERIENCES FROM THE HINDU KUSH-HIMALAYAN (HKH) REGION

Basanta Shrestha \*  
Birendra Bajracharya\*\*

\*International Centre for Integrated Mountain Development (ICIMOD)  
G.P.O. Box 3226, Kathmandu, Nepal  
Tel: 977-1-525313 Fax: 977-1-524509  
Email: bshrestha@icimod.org.np

\*\*International Centre for Integrated Mountain Development (ICIMOD)  
G.P.O. Box 3226, Kathmandu, Nepal  
Tel: 977-1-525313 Fax: 977-1-524509  
Email: bbajracharya@icimod.org.np

**KEYWORDS:** GIS, Remote Sensing, GIS Training, Capacity building

## **ABSTRACT:**

The International Centre for Integrated Mountain Development (ICIMOD) through its Mountain Environment and Natural Resources Information Systems (MENRIS) program has been focusing on GIS capacity building and networking of the national institutions in the HKH region to promote the development of GIS and its application for sustainable mountain development since early 1990. Developing human resources in the field of GIS and Remote Sensing has been a major focus of the program since its inception. In the process, MENRIS has developed a number of training courses suitable to different audiences such as the policy makers, managers and professionals, and conducted these courses in almost all the member countries of ICIMOD, namely Bangladesh, Bhutan, China, India, Myanmar, Nepal and Pakistan. It has also developed many training manuals focusing on specific applications, GIS training CD-ROM and "GIS for Beginners" – an introductory textbook on GIS targeted for schools. At present, MENRIS is working on bringing GIS education to the Universities of the HKH which will be the major centres for developing the necessary human resources in the field. The paper discusses issues in GIS education based on its experience in the HKH countries over the last one decade.

## **BACKGROUND**

Geographic Information Systems and Remote Sensing or the geo-information (GI) technologies have immense scope for wide range of applications in natural resources and environmental management. The Hindu Kush-Himalayan (HKH) region presents many challenges in its natural resources management and sustainable development. GI technology provides many tools to deal with the complex relationships between different biophysical and social processes and the HKH region can certainly benefit from these tools in addressing various issues related to its sustainable development. In this context, the Mountain Environment and Natural Resources Information Systems (MENRIS) of the International Centre for Integrated Mountain Development (ICIMOD) has been working on disseminating the GI technology in the HKH region for more than a decade. Introducing GI technology in the HKH region has not been an easy task as the computer hardware and software were too expensive to be affordable for the institutions in the regional member countries. Besides, the lack of awareness and trained manpower on the technology made it difficult for these institutions to have a broad picture of the technology in the context of their regular job. Spending on GIS was sometimes looked upon as an expensive affair and people were skeptical about its real use in the existing environment of the region. However, GI technology has come a long way since MENRIS initiated its activities in early nineties. There has been major breakthrough in the GIS software architecture and functionality, and the price of computer hardware has dropped steeply with increased performance. The number of people with training and academic qualification in the technology has been increasing. All these factors have contributed to multiplying number of GIS users in the region. Many government and non-government organizations have started using the technology in their regular work and there is a growing demand for the people trained in the technology. A number of universities have already

introduced GIS courses in their curricula and even the private sector has come up with GIS related business.

### MENRIS CAPACITY BUILDING PROGRAMME

Since its inception, MENRIS has been working on capacity building of the national institutions in the HKH region for using GI technology. These activities of MENRIS can be viewed in three phases. In the **first phase** during the first half of the 1990s, the activities of MENRIS were mainly concentrated in generating awareness about the technology among the professionals, scientists and policy makers in region. Realizing that educating the managers and policy makers were the most urgent task, and to fill the gap of people who could really work on the system, MENRIS designed special training packages targeted to professionals, managers and policy makers. In consultation with partner institutions, GIS needs were assessed and nodal agencies in each ICIMOD member country were identified. Memorandum of Understanding (MoU) were signed with the nodal agencies and they were assisted with hardware, software and training to establish GIS facilities in these institutions. Special arrangements with United Nations Environment Programme (UNEP) and Environment Systems Research Institute (ESRI) made it possible to provide GIS software to ICIMOD partner institutes at very reduced prices. This model of combining training program and affordable software made it possible for the trainees to continue working with the system after completing the training.

The starting of the project on “Strengthening of Training Capabilities for GIS Applications in Integrated Development in the Hindu Kush–Himalayan Region” funded by the Netherlands Government can be considered as the beginning of the **second phase** in 1996. This project provided further boost to the capacity building activities of MENRIS. New courses were designed focusing on the four pertaining issues of sustainable mountain development, namely - Application of GIS and RS to Basic Infrastructure and Facility Planning; Mountain Agriculture and Land Use Planning; Monitoring, Assessment and Planning of Mountain Natural Resources; and Slope Stability Analysis and Hazard Mapping (ICIMOD, 1997).

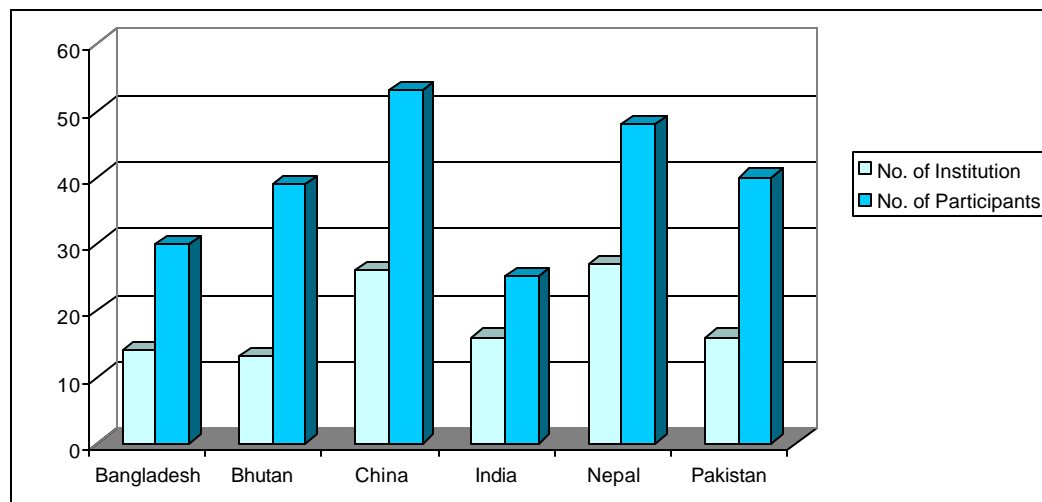


Figure 1: Number of Trainees and Institutions from different member countries (1997-2000)

Regional and National level trainings were conducted on each of these themes in Nepal, India, China, Bangladesh, Bhutan and Pakistan. Under this programme, it had already trained more than 200 people with various professional backgrounds from more than 100 institutions and assisted in setting up more than 25 GIS facilities in these institutions in the region (figure 1).

The period from 2001 can be seen as the **third phase** of MENRIS activities. A significant awareness on the usefulness of the technology had been generated among the professionals and decision makers and there is a growing demand of these facilities in the region. MENRIS has been continuing its regional and national training programmes in response to the continuous demand from its partner institutions. It has improved its course contents with latest technologies

by including Internet Map Services and adopting new software releases. In the year 2002 alone, it conducted training on "Applications of GIS and Remote Sensing for Resources Management" in Bhutan, China and Nepal with one more training being scheduled in Myanmar at the end of the year. It also conducted training on "Sharing Geographic Information on the Internet" in Nepal for participants from Bangladesh, Bhutan and Nepal. Besides these training courses, ICIMOD has also been conducting one-day workshops for the policy makers and a week-long workshops for the managers to generate awareness about GI technology. With the celebration of GIS Day 2000 and the publication "GIS for Beginners", ICIMOD has initiated education on GIS for the school children. Generating awareness about geography, mapping and GIS right at the school level will help the children to develop a habit of thinking spatially and to visualize their tasks in a broader context.

## **OUTPUTS**

The GIS training programmes of ICIMOD have been very effective in introducing GI technology to the professionals and technicians in their mid-career. The policy workshops have also been well received by the managers and policy makers which is very important in introduction and successful implementation of GIS in the institutions. A number of training courses have been designed, tested and refined under the capacity building activities. Training materials focusing on specific applications have been developed using local data. Above all, a network of institutions in the region has been developed which has made it easier to facilitate GIS related activities and exchange of experiences. These outcomes are elaborated below.

### **Training Courses**

A number of training courses were designed since the beginning of training activities. The training courses during the first phase provided the general concepts of GIS. The course for policy makers gave the overall picture of GIS with institutional aspects. The manager level courses included some hands-on exercises. The course targeted for the professionals dealt mainly with operating GIS software such as PC ARC/INFO and IDRISI. These one-month long courses trained the professionals in using the tools for their real applications.

With the beginning of the Dutch project in 1996, the specific courses were developed focused on Mountain development issues mentioned earlier. These four week courses were designed with a modular approach. The first module gave an overview of the thematic area in the context of HKH region. The second module was a common module for all the courses which dealt with the concepts of GIS and Remote Sensing. The theory is supplemented with lots of guided hands-on exercises. The third module presented application cases related to the theme of the training. GIS solutions were worked out with discussions in the classroom in a more participatory approach. The final module was the project work for the participants. A group of three to four participants worked on a GIS project with minimum guidance from the instructors. They were made to do the analysis, prepare maps and submit a complete report at the end of the course. Each group made presentations on their work to a larger audience at the closing ceremony of the training. The training also included field visits and the data from these areas are mostly provided for the project work. The trainings are conducted using the popular software such as ArcView, ERDAS Imagine and ILWIS.

New refresher courses have been designed incorporating the latest software tools. These two week long courses are targeted to the former MENRIS trainees or those who already have some GIS background and need to upgrade their skill.

### **Training Materials**

**Training manuals:** A number of training manuals have been prepared for conducting the trainings. These manuals were refined and updated continuously for each training program keeping in view of the training theme and background of participants. Two manuals, one dealing with the thematic concepts and one dealing with the application cases specific to the theme of the training, were prepared for each course. National datasets of each country were used to develop manuals on application cases. A common manual on basic concepts of GIS/RS and the hands-on exercises were used for all the courses.

**Computer based CD-ROM:** The materials developed for the different training courses are repackaged on computer based training CD on "Applications of GIS and Remote Sensing to Sustainable Mountain Development". This CD contains concepts on the technology, interactive hands on exercises, and supplementary materials to the trainer, all packaged in an Internet compliant format. The CD can be used as a self learning kit, or as an aid in the professional level training programmes.

**GIS for Beginners:** An introductory text book on GIS has been published targeted to the high school children and beginners in GIS (Shrestha et. al, 2001). The book introduces a collection of everyday problems from a spatial perspective and provides an overview of basic mapping concepts. It introduces basic GIS concepts and gives a brief overview of GIS and related technologies. It also briefly discusses how to establish GIS and how it can be used to analyse complex problems. It is divided into two parts: the first explains basic concepts, the second offers hands-on exercises with step-by-step instructions for understanding and working with digital maps. The book provides introductory reading material suitable for a wide-ranging audience, and together with the CD-ROM can be used as the basis for a short training course. Part of the book has been incorporated in recent ESRI publications "A System for Survival- GIS and Sustainable Development" (ESRI Press, 2002) and "Sustaining Our World" published under My Community Our Earth programme.

### **Institutional Network**

A very important outcome of the MENRIS capacity building programmes is the strong institutional network of more than 120 institutions of the region. This has helped in exchange of data, sharing experiences and carrying out case studies. The nodal agencies in each country have played very supportive role in coordinating and successful implementation of training courses. Some of the national institutes have even started regularly offering similar courses on their own with minimal support from ICIMOD. A number of GIS workshops have been organized in the region where such a network has been very helpful.

### **EXPERIENCES FROM HKH**

From the training activities in GI for more than one decade, conclusions can be drawn on a number of issues. GI technology is very dynamic and within this period, we have seen incredible developments in this field. These developments in the global trends certainly have had their effect in the use of the technology in the region. Some of the key issues are elaborated below.

### **Institutional Leadership**

Initiation by the leadership of institutions played a vital role in the successful implementation of GIS. GIS activities at Local Government Engineering Department (LGED) in Bangladesh, Land Use Survey Section (LUSS) of the Ministry of Agriculture in Bhutan, Geography Department of Tribhuvan University (TU) in Nepal and Tibetan Academy of Agriculture and Animal Sciences (TAAAS) in Tibet, China are good examples of such initiation. The encouragement by the leaders of institutions creates conducive environment for the professionals to learn and apply the technology in their activities in a meaningful way.

### **Staffing**

Selection of right people for assigning GIS jobs and training them is crucial for long term success of the programs. The institutions should make sure that the people from the departments related to GIS are sent for the training and they should not be transferred to other departments soon after getting the training. As GIS is an emerging field in the region, many young professionals are enthusiastic about getting these trainings to enhance their own professional value. It has also been observed that these trained manpower get better job opportunities and the turnover rate may be relatively higher. The institutions should make a strategy of training a pool of staff so that GIS implementation does not suffer due to a few staff leaving the organization.

## **Software and hardware**

Resources for GIS Software and hardware were the major problems during the initial phase of the capacity building. The drastic drop in prices and improved performances of hardware and the emerging of desktop GIS software have made more organizations to come forward for GIS applications. Many organizations have increased their allocation of resources for IT which has eased off GIS implementation to some extent. Besides, the policies of big software vendors like ESRI and ERDAS to provide huge educational discounts or software grants has greatly helped to promote GIS in the universities.

## **Training approach**

From the experiences of the trainings conducted in different countries of the region, the four-week long training course with a modular approach has been found very effective and flexible to fit in the needs of diverse group of participants. The use of local datasets and the field visits gave the participants a feeling of working on real projects. The extensive hands-on exercises supplemented with application cases and the final independent project work gave the participants enough confidence to work on the system after completing the training.

The recently designed refresher courses of two weeks further helped to update the former participants who have not got an opportunity to use the systems extensively. This type of regular training programmes with periodic refresher courses has been in demand from the national institutions, which is quite necessary for a growing technology like GIS. ICIMOD's strategic approach has been to train the trainers with many of participants being university teachers. This approach is believed to have a multiplier effect in generating trained manpower. It has been found that with the growing demand of the technology, institutions are willing to co-finance the training programmes which otherwise have been solely financed through ICIMOD's project funds.

## **Continuing GIS programmes**

Human resources development is a continuous process which evolves with developments in technology and needs of users. The training conducted by ICIMOD is a very good starter for the professionals to enter the field of GIS. Although a number of advanced tools are dealt in these trainings, it is up to the participants to develop their skills upon what they have learnt by continuing to apply the tools in their regular work. Many times the participants often point out the need for trainings of longer duration which may not be practical for an institution like ICIMOD. Keeping this in mind, ICIMOD has been working on supporting GIS curriculum in the Universities. These are the places where the work force needed for all disciplines are produced. Starting GIS education in the universities better ensures the continuity in human resources development in the field. Many educational institutions in the HKH have already started GIS courses in some way and this is a very positive sign for GIS development in the region. It can be hoped that the universities will produce manpower knowledgeable in core concepts of GI science which will ultimately contribute to the mountain focused research in applications of the technology.

## **THE FUTURE**

ICIMOD's capacity building activities have been carried out with a long term vision of developing a Regional Spatial Data Infrastructure (SDI) for the economic and effective use of spatial information which is accessible to all the professionals working for the development of the region. Spatial data infrastructure (SDI) has been conceived as an environment where - the core geo-datasets are easily available; existing geo-information are well documented; available geo-information conform to accepted standards; policies encourage exchange and reuse of geo-information; there are sufficient human and technical resources to handle geo-information.

Through its training and support activities over the last decade, many national institutes in the region have become self sufficient in the use of GIS technology. Many of these institutions now have GIS programmes supported by other donors or resources. At this stage, ICIMOD has emphasized its capacity building activities towards universities and schools. By entering into the academic sector, it hopes that the efforts will have multiplier effect. With GIS becoming a part of

academic curricula, the future generation of the region will have better understanding of the technology and therefore its better adoption in all the fields can be hoped in the coming years.

ICIMOD plans to continue upgrading its training programmes by following the development trend in the technology. It has already initiated Distance Learning programme on GI technology for environment and natural resources management. With the increasing use of the Internet in the region, it is hoped to become a cost effective means to share geographic data, information and knowledge.

## **CONCLUSION**

GI technology has come a long way and its potential in sustainable development efforts in the mountains has been well recognized. ICIMOD through its MENRIS programme has been engaged in capacity building of the regional institutions of the HKH in GI technology since last one decade which has generated significant awareness and created a strong network of GIS users in the region. The lessons learnt from the long experience in GIS in the region will certainly help in successful application of the technology for better policies and decision making. The initiation of GIS education in the academic sectors can be expected to have a very big impact in the human resources development in GI technology, which is foundation for regional spatial data infrastructure.

## **BIBLIOGRAPHY**

- ESRI Press 2002. A System for Survival: GIS and Sustainable Development. Environment Systems Research Institute (ESRI), Redlands. <http://gis.esri.com/esripress>
- ICIMOD, 1997. Training Manuals on Application of GSI and Remote Sensing for Sustainable Mountain Development, ICIMOD, Kathmandu.
- Shrestha B. and B. Bajracharya, 2001. ICIMOD's Approach Towards a Regional Geo-Information Infrastructure (RGII) in the Hindu-Kush Himalayan (HKH) Region, National Geospatial Data Infrastructure: Towards a Road Map for India, 5-6 February, New Delhi.
- Shrestha B., B. Bajracharya and S. Pradhan 2001. GIS for Beginners – Introductory GIS Concepts and Hands-on Exercises, ICIMOD, Kathmandu.