Education and Training in the Field of Geographic Information Systems in Indonesia

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Abstract

Education and training in the field of GIS in Indonesia have been initiated formally with the establishment of the operator school of remote sensing (Diploma 1) in 1975 at Gadjah Mada University and at the Bandung Institute of Technology. The education gradually then extends into graduate and post-graduate levels in the field of remote sensing. The training, which is mostly provided in government institutions and private companies, covers the field of cartographic digital mapping and its combinations with remote sensing techniques for superimposition analysis, referred to as GIS. Thereafter, the term "GIS" develops into the correct direction, namely information systems based on spatial location. Recently, the developments of GIS modeling in some institutions have involved simulations on Internet platform. The development of GIS is supported by more than 877 people (reported in the year 1994) distributed throughout Indonesia. This paper outlines the brief development of education and training systems in the field of GIS in Indonesia.

Introduction

Recently, the use of Geographic Information Systems (GIS) has been disseminated in Indonesia. Many institutions, both government and private, are developing GIS to support their activities. Although the development of GIS in Indonesia has started since the last 27 years, as briefly explained below, progress has not been as rapid as computer development. Firstly, LIPI (The Indonesian Academy of Sciences) and US National Academy of Sciences held a workshop on Natural Resources in 1972. Discussions dealt with the problems faced by data collection and data management such as the lack of coordination and standardization for the data collected independently by the Indonesian organizations. This situation leads to the overlapping of activities and incompatibility of the data produced, particularly for spatial data, among these institutions. During the workshop, it was suggested that a network system should be developed between data collectors (data producers) and the users. These conclusions were followed up by the development of Natural Resources Information Systems. UNESCO Mission approved this system in 1973, and described it in the publication UNESCO Report No. 6. This system consists of data gathering, geographical reference standards, data organization, data retrieval, and document handling.

In 1975, *Bakosurtanal* (National Survey and Mapping Coordination Agency) in cooperation with the Bandung Institute of Technology (ITB) and Gadjah Mada University (UGM) established Diploma-1 for Photogrammetry and Cartography (in Bandung) and for Satellite Image Interpretation (in Yogyakarta). The program was continued by the development of an Integrated Survey and Mapping System in 1976, and by the development of

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Multi-stage and Multi-sensor Remote Sensing to support the inventory and evaluation of natural resources in 1978. In order to integrate national data references, in 1980, *Bakosurtanal* and Comarc Company (USA) developed *Bakosurtanal* Geo-referenced Information.

At nearly the same time, the Faculty of Geography of Gadjah Mada University established a new division called Division of Remote Sensing. One year later, *Pusdata* (Center for Data Processing and Mapping), Ministry of Public Works in cooperation with JICA (Japan International Cooperation Agency) implemented a Project entitled: "Remote Sensing Project for Agricultural Infrastructure Development in Indonesia". A few years later, *LAPAN* (National Institute for Aeronautics and Space) set up the Earth Resources Ground Station in Pekayon, Jakarta. Gradually, the use of remote sensing and GIS became more popular among government officials, academicians and private companies.

The activities related to remote sensing and GIS have rapidly expanded, as evidenced by the implementation of a national project for evaluating land resources called LREP Project I (Land Resources Evaluation and Planning initiated in 1985) and LREP II (1992) supported by ADB (Asian Development Bank), the declaration of *MAPIN* (Indonesian Society of Remote Sensing) in the late 1980s, the declaration of *MAPETA* (National Society of Mapping) in the beginning of the 1990s, and some training activities in the field of Remote Sensing and GIS. On the other hand, some universities established elementary and advanced courses of GIS or at least they added lectures on Remote Sensing and GIS to their curriculum. Due to the high demand for GIS at the national level, *Bakosurtanal* coordinated the programs of the above institutions to develop SIGNas (National GIS). SIGNas as a platform for data exchange among institutions has been initiated since 1994. Some new GIS and Remote Sensing companies have also been established during this period.

Then, CEGIS (Center of Excellence GIS) as a center of excellence for GIS was founded in 1997. The main purposes of CEGIS are to promote inter-agency collaboration and data exchange, to develop a GIS skill base, to outline the benefits of using GIS, and to exchange ideas and information in the field of GIS. Applications of GIS in many fields increased, until 1997, when four ministries (Ministry of Public Works, Ministry of Mining and Energy, Ministry of Transportation and Ministry of Tourism) developed a National Infrastructure Map for use in Presidential Speeches in Parliament.

Although GIS applications are increasing, data exchanges among national or regional institutions are expanding very slowly. For such reasons, some Ministers and Heads of related GIS institutions held a meeting to discuss problems related to National GIS and National Mapping System in June 1999. Members of the following organizations were invited to attend the meeting. Minister of Public Works, Head of *Bakosurtanal*, Head of *LAPAN*, Head of *BPS* (National Bureau of Statistics), Minister of *BPN* (National Land Agency - represented by Deputy IV), Minister of Agriculture (represented by the Secretary General), Minister of Forestry (absent) and Vice Head of *Bappenas* (National Board of Planning and Development - absent). As a result, it was suggested that the GIS community should actively promote the realization of a National GIS.

In this paper the background, current situation, problems and challenges of education and training in the field of GIS in Indonesia are briefly outlined.

Current situation of GIS education and training in Indonesia

Based on the Directory of Remote Sensing and GIS in Indonesia (1994), many institutions are concerned with and are using remote sensing and GIS data. There are 6 non-ministerial Institutions concerned with Remote Sensing and GIS namely:

1) *Bakosurtanal*,
2) *BPPT*,
3) *BPN*,
4) *BATAN* (National Board of Nuclear Energy),

5) *LAPAN*, and
6) *LIPI*.

Besides, 9 Ministries are also concerned with remote sensing and GIS such as:

1) Ministry of Interior,
2) Ministry of Forestry,
3) Ministry of Defense,
4) Ministry of Public Works,
5) Ministry of Mining and Energy,
6) Ministry of Agriculture,
7) Ministry of Social Affairs,
8) Ministry of Transmigration,
9) Ministry of Environment, and
10) almost all of the 27 Provincial *Bappedas* (Provincial Development Planning Coordination Agency).

More than 24 private companies and 7 National Companies are also concerned with remote sensing and GIS.

Some of the above institutions have implemented training programs in remote sensing and GIS for their local staff members. Some institutions also sent their staff members to study abroad and to attend the inter-institution training programs implemented by some of the above institutions. A few years later *BPPT* and *LAPAN* organized semi-regular practical training in remote sensing and GIS, while Pusdata of the Ministry of Public Works sometimes organizes training in the field of GIS and Internet.

More than 24 Divisions/Faculties are concerned with remote sensing and GIS, such as:

1) Faculty of Forestry, Faculty of Agriculture of Bogor Agriculture Institute (IPB),
2) Faculty of MIPA, Faculty of Industrial Engineering, Faculty of Mineral Engineering, Faculty of Civil Engineering of Bandung Institute of Technology (ITB),
3) National Institute of Technology in Malang (ITNas),
4) Faculty of Civil Engineering of Diponegoro University in Semarang (UNDIP),
5) Faculty of Geography, Faculty of Forestry, Faculty of Agriculture, Faculty of Engineering, Faculty of MIPA of Gadjah Mada University (UGM) in Yogyakarta,
6) Faculty of Engineering of University of Indonesia (UI) in Jakarta,
7) Division of Geology of Padjadjaran University in Bandung (UNPAD),
8) Faculty of Mineral Engineering of Trisakti University in Jakarta,
9) Faculty of Geological Engineering of UPN Veteran in Yogyakarta,
10) Faculty of Agriculture of Udayana University in Bali (UNUD), and
11) University of Hasanudin in Ujung Pandang (UNHAS).

Most of them are only providing lectures with topics related to remote sensing and GIS, except for the Faculty of Geography UGM, and Division of Geodesy of ITB, Post-Graduate ITB, Post-Graduate IPB, and Post-Graduate UI.

Faculty of Geography UGM implements courses as follows:

1) Master Course for Remote Sensing and GIS,
2) Division of Remote Sensing and Cartography for University Degree,
3) Diploma Course on Remote Sensing and GIS, and
4) Training for Operators, Analysts and Managers of GIS.

For these courses, the Faculty of Geography UGM has trained more than 356 participants from both national and regional institutions.

Division of Geodesy ITB manages a Diploma Course on Photogrammetry and Cartography and also a Post-Graduate Course for Mapping, while IPB and UI manage a Post-Graduate Course for GIS and Remote Sensing Studies.

Although, many institutions and universities are involved in remote sensing and GIS, the curriculum for the training courses has not been standardized yet. Therefore, the Faculty of Geography UGM organized workshops on the standardization of the training curriculum for Operators, Analysts and Managers of GIS last July 1999.

It was reported that human resources in the field of remote sensing and GIS did not exceed 877 persons (Directory, 1994). However, the number of persons trained in the field of GIS and remote sensing, may be presently higher. Institutions organizing such training courses such as *Bakosurtanal* have trained more than 4,126 persons up to 1996 (Leaflet, 1996), *PUSPICS* (Training Center for Remote Sensing and Integrated Surveys), Faculty of Geography UGM has trained more than 356 participants (Leaflet, 1996/1997). *LAPAN* and *BPPT* have trained more than 300 participants. The GIS and Remote Sensing units in each Ministry, other universities and private companies have trained their local staff members, and the total number of participants may exceed 400. As a result, more than 5,000 persons have been trained in the field of remote sensing and GIS at various levels. Although some of these trainees originated from various institutions and provinces, most of them were from Jakarta. Indonesia with around 351 cities needs many specialists in this field, particularly to cope with decentralization. If each city (Municipality or Regency) could have 5 institutions related to GIS and each institution could have 4 specialists, Indonesia may have more than 7,000 GIS specialists in the near future.

Major constraints

Although Indonesia has a large amount of data distributed in both national and private institutions, the data are disparate (Lintang Suharto, 1995), not systemically or poorly defined, unstructured, not well documented and nor catalogued. These data are not easy to be identified, accessed or are poorly used. Agencies or institutions use these data for planning and activities based on these disparate data. The discrepancy between existing data (disparate data) and high demand for information results in poor planning, poor output and poor outcome.

Most data have been collected during the period of projects, for project needs and stored on a project basis, without considering the need for building a common database. This large amount of distributed data which are mostly in non-digital format, have been collected by many institutions and in the course of thousands of projects during more than 25 years, but these data can not provide the information expected. The major problem is that there is too much noise and little information, which leads to mismatching combined or superimposed for applications.

The understanding of the GIS concept, particularly data management and applications, aggravates the above problems. As a result, information or lectures should be accurately and fully provided through adequate education and training. Training or lectures should be more practical, rather than theoretical, due to the need to emphasize practical aspects. In this case, the quality of the materials to be presented in the lectures or training courses should be carefully evaluated.

Although there is a sufficient number of skilled GIS experts, the availability of good hardware and capability of hardware management, the high price of software and law product or mechanism are major constraints.

The role of GIS application, particularly map-based analysis, at the national policy level is weak compared with attribute or non-spatial based analysis. Although agricultural activities are still dominant in Indonesia, the role of GIS in supporting agro-environmental policies is not substantial. This situation is reflected in the difficulty to obtain agro-environmental maps in the country and the low level of monitoring activities in the field of agro-environment. As an example, although the area of forest production, rubber plantations, oil palm and coconut plantations is very large in Sumatra, Kalimantan, Sulawesi and Irian Jaya islands, accurate information on such resources is not readily available. Potential land for agro-forestry map, agro-forestry product marketing map, forest management map, etc. are not well distributed, and may not be available. The Ministry of Forestry should promote and speed up the availability and the distribution of such maps. Exchanges of data and information among related GIS institutions are an alternative to solve these problems.

These problems are closely related to National GIS constraints, mainly due to the involvement of various institutions, scale of activities and location of activities as follows:

1) lack of institutional openness and progressive attitude,
2) rules and laws, etc.
3) lack of accuracy of decision-making and delegation of responsibility,
4) lack of technical specification, guidance, standardization, etc.
5) variability of components to realize National GIS,
6) small number of managers and professionals involved,
7) small amount of invested budget, and
8) low commitment of managers in using geographic data.

Challenges and benefits

In order to achieve free competition within the framework of liberalization, particularly in the field of GIS, standardization of training or lectures by certified experts should be promoted. Sooner or later, in the Internet era, openness will become essential for developed or developing countries as well as among institutions or other related communities.

As a result, it is important to enhance the quality of training and education, by improving the use of five main GIS components such as software, hardware, data, human resources and mechanisms or institutions. Exchanges of GIS components among institutions as evidenced by the production of a National GIS homepage (see Figures 1 to 5), along with the understanding and mastering of these components would help GIS specialists to develop an inner confidence for facing the globalization era. Openness and opportunities for new GIS specialists to use available GIS equipment in governmental offices (*magang*) will also enable new GIS specialists to develop their inner confidence. Magang in some institutions is an effective and efficient alternative to bringing new-comers in the field of GIS. This training system could be used to supply and to exchange knowledge among the staff members and at the same time could be emphasized to support the work of the institutions themselves.

In anticipation of the globalization era, improvement of and certification for education and training in the field of GIS in Indonesia should be emphasized. Therefore, the improvement of GIS infrastructure such as software, hardware, regulations and data collection, particularly empowerment of GIS specialists, in cooperation with donor countries is essential.

In line with the globalization era of Year 2000 (AFTA - 2003; APEC - 2010 and Free Market - 2020), education and training in Indonesia should aim at sustaining competition with foreign experts, particularly for acquiring self-confidence and technical ability. Therefore, education and training systems should be improved to complete GIS infrastructure and meet international certification levels (ISO such as TC 211).

Although some universities and institutions have been providing education and training in the field of remote sensing, GIS, and Internet in Indonesia, the curriculum has not been standardized yet. In order to meet the demand for human resources in the field of GIS, education and training in this field should be coordinated at the national level and integrated. Coordination and integration could be applied by the standardization of curriculum, materials, guidance and mechanisms.

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