Chapter XIV
Building an Environmental GIS Knowledge Infrastructure

Inya Nlenanya
Iowa Resource for International Service (IRIS Inc), USA

ABSTRACT

Technologies such as geographic information systems (GIS) enable geospatial information to be captured, updated, integrated, and mapped easily and economically. These technologies create both opportunities and challenges for achieving wider and more effective use of geospatial information in stimulating and sustaining sustainable development through smart policy making. This chapter proposes a simple and accessible conceptual knowledge discovery interface that can be used as a tool to accomplish that. In addition, it addresses some issues that might make this knowledge infrastructure stimulate sustainable development with emphasis on sub-Saharan Africa.

INTRODUCTION

Technologies such as geographic information systems (GIS) enable geographic information to be captured, updated, integrated, and mapped easily and economically. These technologies create both opportunities and challenges for achieving wider and more effective use of geoinformation in stimulating and sustaining sustainable development through smart policy making. With the start of a new millennium humankind faces environmental changes greater in magnitude than ever before as the scale of the problem shifts from local to regional and to global. Environmental problems such as global climate change and unsustainable developments in many parts of the world are evolving as major issues for the future of the planet and of mankind. Acidification of lakes and rivers, destruction of vital natural wetlands, loss of biotic integrity and habitat fragmentation, eutrophication of surface waters, bioaccumulation of toxic pollutants in the food web, and degradation of air quality contribute some of the many examples of how human-induced changes have impacted the Earth system. These human induced changes are stressing natural systems and reducing biological diversity at a rate and magnitude not experienced for millions of years (Speth, 2004). Also, anthropogenic stresses such as those associated with population growth, dwindling resources, chemical and biological pollution of water resources are expected to become more acute and costly.

The approach in dealing with these environmental issues requires a balanced response in the form of an environmental management strategy. Such a response must utilize the best available scientific understanding and data in addition to an infrastructure that combines both in order to deliver sound science-based solutions to the myriad of environmental problems. In the Fall 2003 edition of the Battelle Environmental Updates, it was argued that such a response would result in a complex decision network. This argument must have inspired the National Science Foundation (NSF) in 2004 to propose a network of infrastructure called National Ecological Observatory Network (NEON). NEON supports continental-scale research targeted to address the environmental challenges by facilitating the study of common themes and the transfer of data and information across research sites (NAS, 2004). This creates a platform that enables easy and quick access to the environmental data needed to tackle the environmental challenges.

NEON is based on the same concept as grid computing. Grid computing eliminates the need to have all data in one place through on-demand aggregation of resources at multiple sites (Chetty & Buyya, 2002). This creates an enabling platform for the collection of more specialized data with the hope of integrating them with data from other related areas. This has particular benefit in environmental data management and analysis since both data and specific processing methods are frequently exchanged and used within various organizations (Vckovski & Bucher, 1996). Together, NEON and grid computing form the enabler for the construction of an environmental cyberinfrastructure that will permit the transfer of data, the specific processing methods and the interoperability of these methods so as to reduce the time wasted in duplication of resources. This infrastructure is necessary especially in the face of unprecedented data availability.

During the last decade, the society has witnessed a tremendous development in the capabilities to generate and acquire environmental data to support policy and decision-making. Furthermore, the rapid and exploding growth of online environmental data due to the Internet and the widespread use of ecological and biological databases have created an immense need for intuitive knowledge discovery and data mining methodologies and tools.

However, in Africa, where according to Song (2005) the bandwidth speed of an average university has the same aggregate bandwidth as a single home user in North America or Europe and costs more than 50 times for this bandwidth than its counterparts in Europe or North America deserves special attention while establishing such networks. This statistics is from a continent where the major issues include hunger, poverty, AIDS, and political instability and these summarizes why sub-Saharan Africa in this knowledge age is still undeveloped and unable to tackle her own environmental problems. Clearly, a survey of the wealthiest nations in the world would quickly reveal that GDP is directly proportional to the volume of digital information exchange. Technology transfer has not been able to make a mark in Africa simply because the proponents ignored the social and economic questions of access to markets, fair wages, water, land rights, and so forth, in favor of purely technical questions and rejecting the indigenous knowledge in the process. Hence with all the progress made in cutting edge technology for data acquisition, there is still a dearth of geographic information exchange in sub-Saharan Africa.

Sobeih (2005) argues that, "GIS is considered to be one of the most important tools for increased public participation and development that offers

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