Application of Information and Communication Technology (ICT) in Ecosystem Conservation in Nigeria

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ABSTRACT

It is becoming increasingly clear that man is unlikely to avoid the environmental challenges resulting from his unsustainable practices; the result of which is already noticeably triggering changes in agriculture; the incidence of forest fires; flood and drought patterns, the movement of invasive species; biodiversity loss, climate change and so on. This review is therefore directed towards evaluating the application of ICT in ecosystem conservation in Nigeria. In the course of the study, it was gathered that ICTs are transformative technologies that put intelligence at the edges of networks, thereby maximizing users' capacity to create and adapt. Such transformation as revealed include using ICTs to improve practices in agriculture and forestry; monitor air and water pollution; improve disaster warning and relief; improve the efficiency of the energy, transportation, and goods and services sectors; and harness social networking for transformative change. Hence, to better manage the environmental challenges highlighted, there is the need to enhance the capacity to predict and track such changes, develop appropriate management and adaptation strategies, and plot a course towards better environmental management in Nigeria.
Keywords: ICT, Ecosystem, Conservation, biodiversity, climate change

INTRODUCTION

Managing the environment in the modern world is becoming daunting and requires the application of modern technology. The rate at which the world is polluted recently with materials released into the environment; and degraded because of the materials withdrawn from the environment are causes for concern. Meeting the diverse and growing needs of the public within the limited environment is a task that calls for more precise planning. The accuracy of the planning will depend on the information available to the planners. In land use, for example, one factor that will affect the ability of land use planners to allocate lands appropriately to different uses will be the quality of the information about the pertinent physical characteristic of the land available to them. Environment such as forest, mangrove forest, deserts and ocean depths are not easily accessible for physical monitoring hence the need for modern communication equipment to monitor them. Air Pollution, green-house gases accumulation and ozone layers depletion can only be accurately monitored with modern communication equipment. Information collected through such equipment can be stored in databases and can be regularly updated and used to draw up Environmental Impact Assessment (EIA). EIA is the major tool for environmental managers. Traditional environmental monitoring and management methods cannot handle a wide range of recent regional environmental and conservation problems. As a result of technical limitation

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encountered in such traditional methods such as obstacles in data collection, dynamic tracking, information processing and analysis, the development of geographic information system has made these jobs less tasking. The purpose of this discourse therefore is to discuss various roles of Information Communication Technology (ICT) in providing relevant information necessary for effective management and conservation of the ecosystem.

Information Tools for Ecosystem Conservation

Tools used in ecosystem monitoring and earth observations are given a collective name of geoinformatics or geographic information system (GIS). These include technologies of Remote Sensing (RS), digital cartography and Global Positioning System (GPS) (Ikhuoria, Ero and Ikhuoria, 2006). Ground stations and monitors where the information systems are monitored are also included among these. Remote sensing encompasses all of those means of examining planetary features that do not involve direct contact. These methods rely on detection, recording, and analysis of wave-transmitted energy (Montgomery, 2000). Data collected through remote sensing may include aerial photography and radar mapping of surface topography. Remote sensing, especially using satellites, is a quick and efficient way to scan broad areas, to examine regions, rugged topography or hostile climate and to view areas to which access is limited.

The Global Positioning System (GPS) is a space-based satellite navigation system that provides location and time information in all weather conditions, anywhere on or near the earth. It is a system of satellites that are mounted to orbit the earth by nations that are wealthy enough to own them. Since 1960 when the United States Navy successfully tested the first satellite navigation system (Wikipedia, 2013), various countries such as Russia, Britain, Canada, India, and so on, have launched satellite into orbit. Nigeria joined the race recently with the launching of NigeriaSat-1 in September, 2003. NigeriaSat-1 was designed to be part of the world-wide disaster monitoring constellation system. Its primary objectives were:

(i) to give early warning signal of environmental disasters;
(ii) to help detect and control desertification in the northern part of Nigeria;
(iii) to assist in demographic planning and
(iv) To give early warning signals on future outbreak of diseases such as meningitis with the aid of remote sensing technology.

Remote sensing and Geographic Information System are providing tools for advance ecosystem management. The collection of remotely-sensed data facilitates the synoptic analyses for earth-system function, patterning, and change at local, regional and global scales over times (Ikhuoria, Ero and Ikhuoria, 2006). Such data also provide a vital link between intensive, localized, ecological research and the regional, national and international conservation and management of biological diversity (Wilkie and Finn, 1996). Information Communication Technology (ICT) is usually defined as technologies that facilitate communication, processing and transmission of information by electronic means. Hence it presents a revolutionary approach to addressing environmental issues due to its unequalled capacity to provide access to information instantaneously from any location across great geographic distances at relatively low cost (Dorvil, 2007). In mining industry that is faced with pollution of groundwater, soil contamination, land deformation and terrain instability, ICT has offered sensors that can help in monitoring mining environment (Chevrel, 2004). Such sensors can produce the Environmental Impact Assessment (EIA) of mining areas. It has also been observed that imaging spectroscopy can make valuable contribution to mapping mining-related contamination and impacts across a large variety of mining environments and in different climatic contexts (Chevrel, 2004). ICT can be used to improve agricultural practices. All stakeholders in agriculture need information and knowledge about crop cultivation, water management, fertilizer application, fumigation, pest management, crop harvesting, post-harvest techniques and so on. In agriculture, the use of GPS provides benefits in mapping survey and geo-fencing. GPS has been used to monitor the movement of large animals, such as elephant, when approaching farmlands (Wikipedia, 2013). Because of the usefulness of GIS in soil analysis and topography mapping, it helps in decision making such as what to plant and where.

ICT is providing data for vegetation and land cover mapping to describe broad patterns of distribution of plant communities. Remote sensing data in combination with other data has been used to predict species abundance (de Sherbinin, 2005). Landsat TM imagery and digital elevation model has been used to predict the total and rare species richness in agricultural landscapes (Luoto, Toivonen and Heikkinen, 2002). As observed by Saveraid, Debinski, Kindscher and Jakubauskas (2001), that multispectral imagery assists in estimating potential habitat for bird species in different montane meadows. The rapid rate of deforestation and forest degradation in developing countries has resulted in the annual loss of about 17-20 million hectare of forest (Flazzel and Magrath, 1992). Lansat TM statellite remote sensing has been used to monitor activities around forest reserves and the result obtained shows that the reserve was gradually reducing (Ikhuoria, Ero and Ikhuoria, 2006). Salami (2006) uses NigeriaSat-1 and other satellites to monitor different forest ecosystems in Nigeria and predict what these forest environments will be in the years to come. Venema, Calamai and Feeguth (2005) observe that proper forest monitoring and management can only be achieved by using remote sensing techniques and creating spatial representations such as maps to know the exact locations and extend of deforestation.

Remote sensing can also be used to measure vegetation productivity and make the information available quickly and timely to land managers. It has been used to measure bird and butterfly species richness (Seto, Fleishman, Fay and Betrus, 2004). It has also been used to measure the presence and population densities of calving ungulates in Kalahari Desert as a function of grass greenness (Verlinden and Masogo, 1997 as reported in Nagendra, 2001). Nohr and Jorgensen (1997) utilize Landsat TM and another imagery device to predict species richness in the scrub savannah region of Northern Senegal. Nagendra and Gadgil (1999) used Remote Sensing to assess angiosperm species distribution in India's Western Ghats. Remote sensing can be utilized to identify areas in need of protection, or to ensure that wildlife migration corridors are preserved between protected areas (Sherbinin, 2005 cited in Xue, 2010). It has also been utilized to identify deforestation zones within protected areas, and to assess areas that are inaccessible due to war or wild animals. Ganzin and Mulama (2002) evaluate forage resources in Nakuru National Park, Kenya with data obtained from Spot Vegetation sensors, available forage forms an important parameter for decision making on wildlife. Remote sensing therefore can help facilitate management decisions and allocation of scarce resources for establishment of survey stations. Missouni, Tadjerouni, Chikh and Tidjani (2005) showed how RS and GIS can be utilized to prevent and manage forest fires. GIS is a useful tool in water management to take accurate and real time measurement of run-off and transit losses at each stage of the water capture and conveyance process. It enables scientific decision-making about infrastructure and other water-related issues. Soil sensors that detect moisture content may also be used to automatically switch on/off groundwater extraction pumps (or canal sources) and send alerts via mobile technology.

Information and Communication Technologies can help achieve significant improvements in solid waste management in low and middle income countries. ICT-based solid waste management can increase efficient use of resources through reduction, re-use and recycling (Dorvil, 2007). Illegal dumping could also be monitored with the aid of GPS. Selection of appropriate landfill sites, precise estimation of solid waste generation and optimum allocation of commercially available containers could be realized through GIS-based analysis (Dorvil, 2007). ICTs can also be employed in waste exchange. Waste exchange system is the one which connects firms discharging, recycling and utilizing industrial wastes. Imai (2002) demonstrates that by using exchange systems, one will be able to monitor solid wastes quality and quantity. The economic importance of ICT in natural resources tourism is also potentially large. It is applied mostly in technically dominated areas such as snow-making or discharge release from rafting (de Jong, 2009). Information Communication Technology networks help professionals in mountain regions to counter natural obstacles inherent to mountain territories. The most important role that ICT plays in mountain territories is the development of interment, which facilitates the exchange of information.

CONCLUSION

Traditional environmental monitoring and management cannot adapt to a wide range of regional eco-environmental problems, and ecological and environmental protection, so, the major obstacle is encountered in the data collection, dynamic tracking, information processing and analysis for ecological environment monitoring. Information communication technology helps to assess the environment better than the traditional methods of monitoring the environment and gives opportunity to prepare ahead of emergencies and facilitates quick response to environmental disasters. In conclusion therefore, it was gathered that ICTs are transformative technologies that put intelligence at the edges of networks, thereby maximizing users' capacity to create and adapt. Integrating ICT into environmental management will minimize deterioration of ecosystems and improve their productivity. Hence, to better manage the environmental challenges highlighted, there is the need to enhance the capacity to predict and track such changes, develop appropriate management and adaptation strategies, and plot a course towards better environmental management in Nigeria.

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