



Sustainable Development

Water Resources

Urban Development

Road Construction

Health

Education

Agriculture

Marine and Coastal

Environmental Resources

Land Conservation

Park Management

Wildlife Protection

GIS for Africa

ESRI Brings International Communities Together



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ESRI supports many sustainable development efforts on the continent of Africa. Information management systems give policy makers and planning agencies the foresight to manage growth and change today in a way that is useful for tomorrow. As Africa's various regions expand in resource development and urban, industrial, technological, and agricultural growth, geographic information system (GIS) technology offers solutions for conservation and urban planning. GIS is computer software that allows its users to manage and manipulate geographic data. By using GIS, analysts are able to establish the patterns and processes of development that work and that do not work. Policy makers are then in a position to create the foundation for ensuring the longevity of ecological habitats, conservation of resources, and thriving communities.

An important tool for managing the earth's resources, GIS technology has the sophistication to go beyond mapping as simply a data management tool. GIS can integrate georeferenced imagery as data layers or themes and link them to other data sets to produce geospatial representations of data. These geographical pictures not only depict geographic boundaries but also offer special insight to planners across disciplines such as health, agriculture, urban infrastructure, power resources, telecommunications, and transportation. Whatever people can imagine that needs mapping, GIS can do.

Sustainable Development Enlists GIS

Obtaining the goal of sustainable development within Africa's diverse communities requires that analysts and decision makers understand the characteristics of resource use as well as human conditions. GIS also helps users to plan for future events through various techniques that can be used for forecasting and what-if scenarios. Examples may include drought repercussions on wildlife, dam influences on urban and agrarian economies, burn clearing strategies on flora and fauna, and even the spread of communicable diseases. GIS can be used for researching the impact of population growth on a township's economic development, a school district's growth by grade level, or a nation's GNP.

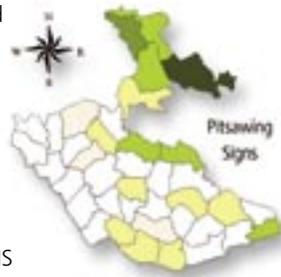
People need to understand the underlying processes of disaster, hunger, disease, and poverty. GIS is an important tool for helping people map out plans for successfully achieving management strategies that are sustainable both at local and global levels.

AFRICA

Open Standards Create Open Access

Because GIS has the ability to analyze the inherent overlapping spatial nature of sustainable development issues, the World Summit on Sustainable Development (WSSD) includes GIS as a key element in its plan of action for helping Africa design and implement more sustainable management strategies. The Geographic Information for Sustainable Development (GISD) prospectus states, "Sustainable development decision makers are highly dependent on the availability of and access to geospatial information." Coordinating with the AFRICA GIS Conference, the WSSD focuses on the importance of building data partnerships and technology standards for sharing geographic information among many agencies across the continent. Its hope is to make GIS accessible at all levels of enterprise so information is readily available for making fast and clear decisions and policies.

Since GIS has become accepted on nearly every front and in every country in the world, users have been calling for consistency in industrial and international geographical data and technological standards. Many people working in the sustainable development arena acknowledge that common information and technology standards are an essential element of any sustainable development strategy. These common standards will allow GIS users to integrate an infinite number of geographic themes in open and interoperable environments.



g.net Builds Sustainable Communities

Realizing that geographic data needs to be placed in the hands of the legislature, policy makers, and decision-level managers, the GIS community is facilitating global efforts to share geographic information across the Internet. Scientists, policy makers, and stakeholders at all levels are realizing the need for sharing their geographic information.

With this in mind, ESRI has developed an Internet infrastructure called g.net, which is used by the Geography NetworkSM. The g.net architecture facilitates GIS collaboration between agencies. By using the g.net architecture, organizations can openly share and directly use GIS information from many distributed sources in a given network at the same time. This architecture is based on providing and using geographic information services through open, Internet-based protocols. The architecture works with any performance scale and in organizations of any size.

GISD is a collaborative project between public, private, and nongovernmental organizations. This initiative outlines a U.S.-led international collaboration and alliance whose objective is to

apply a new generation of earth observation data, state of the art GIS-linked technologies, and field-tested geographic knowledge to ongoing sustainable development problems in diverse target areas within Africa. This alliance is being done in collaboration with activities and funding by many partners both within and outside the continent of Africa (www.opengis.org/gisd). The aim is to assist local, national, and international agency users working in Africa to better address long-term challenges such as disaster mitigation, natural resource management, trade, and poverty alleviation. The results and lessons learned will demonstrate the value of international collaboration in using geographic information for a broad range of sustainable development challenges over the next decade and provide more accessible geographic information to decision makers in Africa.

These Web sites are well worth visiting to learn more about GIS in Africa.

- The Geography Network: www.geographynetwork.com
- Geographic Information for Sustainable Development: www.opengis.org/gisd
- Network for environmental information in Africa: <http://www.eis-africa.org>

United Nations Launches UNEP.Net on ESRI's Geography Network

Using the ESRI[®] Geography Network portal as well as ArcIMS[®], ESRI's Internet-enabled geographic information system software, the United Nations Environment Programme (UNEP) has launched its Environment Network Web site, UNEP.Net. Geography Network Explorer technology is the principal spatial search engine for finding data on the Environment Network Web site. In addition to its own data sets, UNEP.Net uses data published through the Geography Network and data from the European Environment Agency, World Conservation Union, U.S. Geological Survey, and World Wildlife Fund.

Thematic maps created for the Environment Network are extensive and include Kyoto Protocol greenhouse gas emissions, indigenous peoples and ecoregions, nuclear power sites, threats to the Mount Kenya wilderness preserve, and UNEP partners around the world. They also include African tribes and civil conflicts, global population density (four to five decade time series), global land cover classification, global assessment of soil degradation, geography of Nepal and Bhutan (with new glacier data), basic geography (global), annual average temperature (global), annual average precipitation (global), and freshwater lakes and rivers (global).

UNEP's Environment Network Web site is available at www.unep.net.

GIS for Conservation

Ornithological Society Geodatabase, Malawi

More than 600 bird species roam the mountainous greens and the rolling hills of Malawi. Those that scout the savanna land, such as the ground hornbill, do so majestically. Those that take refuge in the lake do it with glamour. But there are also those that are rare and must painstakingly survive the disparaging forces of the human world.



The Malawi Ornithological Society (MOS) was formed in 1996 with the hope of promoting Malawi ornithology, avian recreational activities, and conservation and preservation awareness. MOS has also been working on putting together an ornithological research and development database bank. It believes that centralized ornithological data would not only help to achieve the society's own goals and objectives but also globally help the world of ornithology and avian conservation. The MOS database system is called the National Ornithological Database Bank of Malawi (NODAB).

MOS is just beginning to use GIS to map the variety of bird species in Malawi. MOS's GIS not only gives accurate data but also helps to begin determining precise species' status. To do this, MOS has distributed global positioning system (GPS) units to local birders. They enter the coordinates of each and every observation they encounter. GIS combines these coordinates with the existing database. The first product of the GIS will be a highly detailed GIS-based bird atlas of Malawi.

Information provided by Lawrence Lubanga

Bringing Together Research Data Sets, Madagascar

The Island of Madagascar has interested numerous naturalists and biologists for a very long time. Scientists have collected voluminous research data sets. Unfortunately, access to these data sets has been difficult as they are in the individual archives of numerous local and international researchers. It is ironic that, although Madagascar's habitat is extremely well-documented, environmental data management has remained underdeveloped. Today, the islanders are diligently at work using the technology of GIS to coordinate the data sets about their island and begin analyzing them for decision making.

The Madagascar Biodiversity Plateforme D'Analyses Project, locally known as PDA, aims to create a network of biodiversity databases through which data can be accessed and shared. GIS analysis tools will enable users to conduct advanced spatial analyses. The GIS combines Microsoft® Access and ArcView® as well as various GIS extensions.

The first GIS task was to compile a fully georeferenced and taxonomically classified ArcView biodiversity database for Madagascar. The next task was to create spatial representations. Routines already incorporated in the tools include plotting observation points of a given species or group of species on the map, generating a list of species for a given site, and calculating patterns of biodiversity richness or endemism. A GIS extension for predicting the range distribution of a given species was also incorporated. This plots not only real data points where the species was observed but also its ecological requirements.



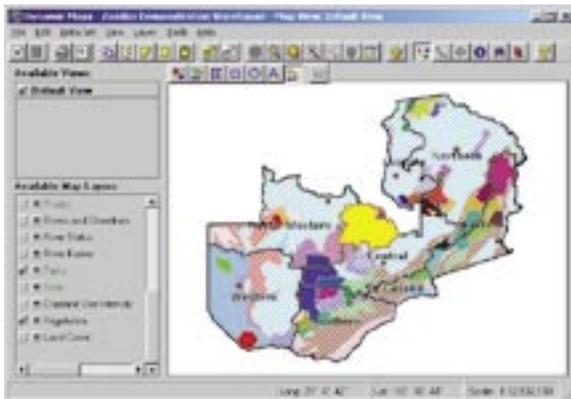
The distribution of the indri (Indri indri), the largest of all lemurs in Madagascar, in 1972 and 1992. The light blue areas in the map represent the loss of habitat for the indri between these two periods.

Environment Management Goes Digital in Zambia

One of the biggest challenges of African nations is to lead their economies to a sustainable development path without depleting natural resource capital. This requires, among other things, proper stewardship over natural resources, regulation of air and water pollution, and managing agricultural practices.

The Ministry of Environment and Natural Resources is an initiative of the government of the Republic of Zambia for the purpose of analyzing existing natural resources and planning management strategies for future development. Zambia's Environmental Support Programme (ESP) has developed the National Environmental Action Plan (NEAP). Currently, this plan forms the policy framework for environmental intervention and management.

To address environmental issues at the national level, a large amount of geographical data collection, monitoring, and evaluation is required. GIS assists regulatory agencies in reducing the environmental reporting burden. This results in more comprehensive environmental information for both policy makers and the stakeholders.



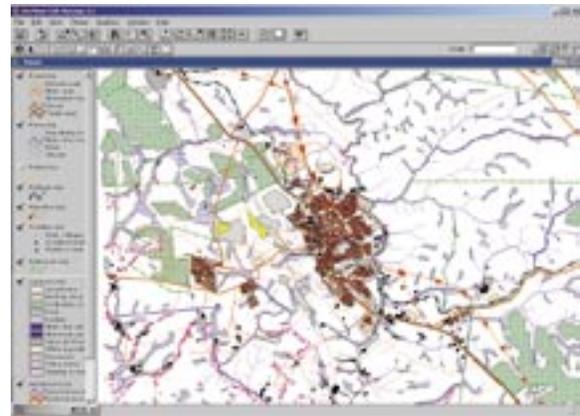
The highlighted area represents the Copperbelt Province's hub of mining activities in Zambia over the past decade. The Mufulira District is the pilot area for industrial air pollution.

GIS was useful in supporting Environmental Information Systems (EIS) as the agency addressed NEAP's priority issues. However, EIS discovered an immediate need for up-to-date basemaps. A base-map is a map depicting geographic features, such as landforms, drainage, roads, landmarks, and political boundaries, that are used for location reference.

The district-level EIS is focused on producing and updating the 1:50,000 basemaps currently under circulation for the pilot districts. To accomplish this task, Landsat 7 Enhanced Thematic Mapper (ETM) and Panchromatic SPOT satellite imagery are being used to update the digitized data.

Accomplishing such a mammoth task requires not only heavy investment in satellite data but also in skilled GIS analysts, customized program design, and scalable GIS technology. Consultants from Swede Survey AB worked closely with the Zambia Survey Department (the national mapping agency) to produce a national map series. This series covers prioritized areas of national concern.

One of the products of the basemapping process is vector data based on the standards document. An example of the results is an EIS air pollution map that was created from using the standards-based georeferenced data.



Vector data sets are developed for the Mufulira District based on the 1:50,000 digitized basemaps and updated using Landsat 7 ETM satellite imagery.

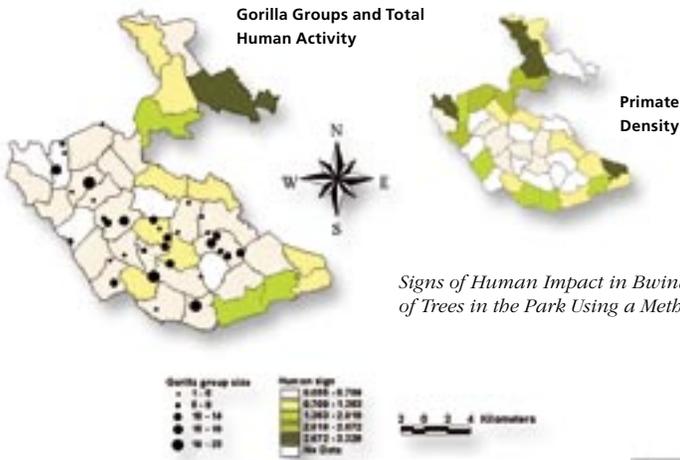
The spatial data generated by the NEAP project will hopefully be an outstretched hand of support for the country's growing demand for the digital mapping products and data standardization throughout its regions. Furthermore, the ESP hopes that the private sector of the economy begins to share its databases and mapping services by joining the data sets generated at the national level and implementing the national standards set in place by the NEAP project. This should set the stage for a holistic approach in building appropriate information systems to address the societal needs at large.

*Information provided by Victor Mbumwae, IT/GIS expert
Environmental Information Network & Monitoring System of Zambia*

GIS for Conservation (continued)

Distribution of Gorillas —Bwindi Impenetrable National Park, Uganda

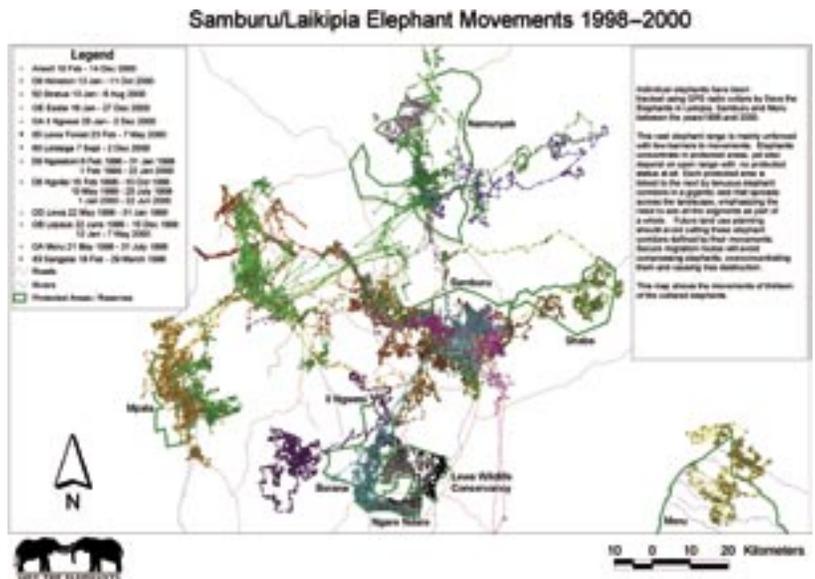
Researchers carried out a distribution census of mountain gorillas and other species. GIS has been useful in mapping the spatial distribution of species in the park and the spatial distribution of human impact. GIS showed that gorillas tended to avoid areas of high human impact but could tolerate low levels of impact.



Signs of Human Impact in Bwindi—In This Case, Illegal Cutting of Trees in the Park Using a Method Known as Pitsawing

Save the Elephants, Kenya

Save the Elephants has helped the Kenya Wildlife Service conduct regular aerial and ground surveys of Kenya's elephant population. GPS collars provide insight into the elephant mind. Using GIS and GPS to track elephant movement patterns provides information required to decide on the best management options.



Mapping Predators, Laikipia

The Laikipia Predator Project tracks lions, hyenas, wild dogs, and other large African predators outside protected areas using radio tracking (both aerial and satellite). GIS correlates predator movements and ecology to alternative land uses that range from intensive agriculture to traditional pastoralism and commercial ranching. GIS indicated that lions avoid densely settled areas, confining themselves to commercial ranches that have very low human density.



Safe Water Project, Madagascar

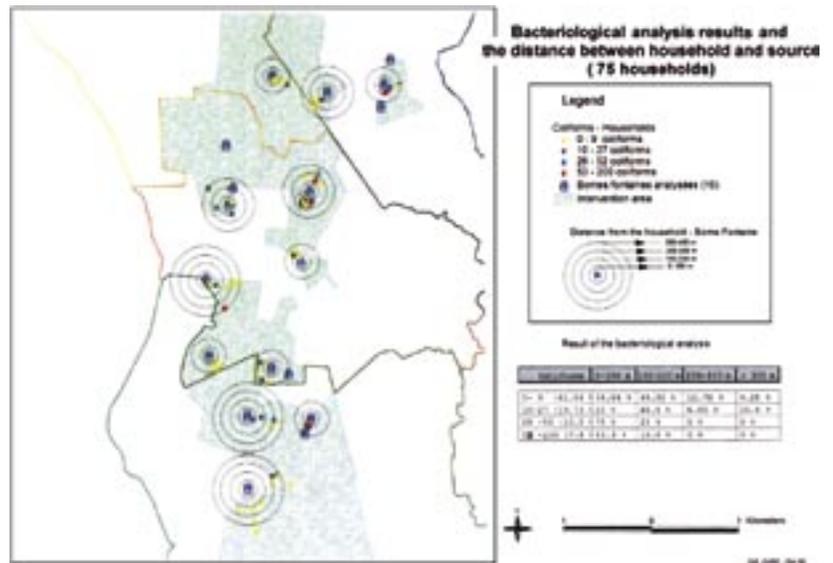
Madagascar's Safe Water Project, Care Madagascar, provides analysis of water quality problems and community constraints. ArcView was used to produce a bacteriological analysis, showing water quality in each location.



Cheetah Conservation Monitored, Namibia

The Cheetah Conservation Fund (CCF) in central Namibia is amidst the largest population of wild cheetahs remaining in the world. The CCF strives to reduce conflicts between cheetahs and livestock ranchers through the development and implementation of sound livestock management practices. The agency uses its GIS program in mapping its cheetah study area including the habitat mapping of ranches in the vicinity.

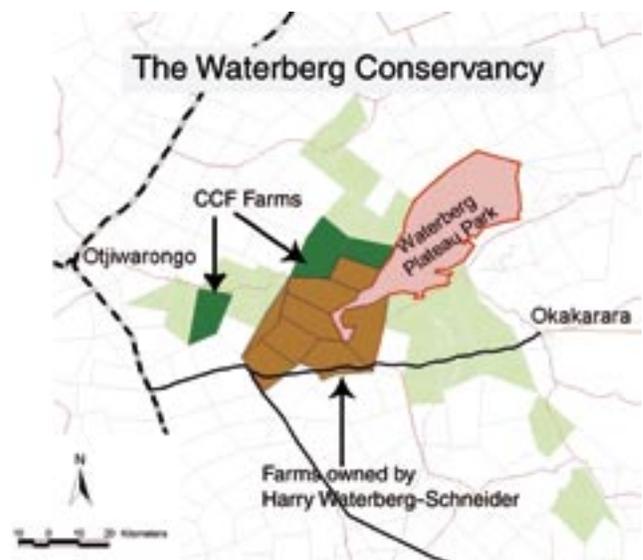
Visit the Cheetah Conservation Fund Web site at www.cheetah.org.



Identifying Conservation Areas—Nyungwe Forest Reserve, Rwanda

Rwandan researchers used GIS to identify areas of conservation importance. From the data they collected, they were able to calculate species richness, diversity, and the number of Albertine Rift endemic species for each site. The rankings of sites helped to provide an overall zoning plan for the forest.

*Information provided by Dr. Andy Plumtre
Wildlife Conservation Society, Africa Program*



GIS for Water

Working for Water, South Africa

South Africa's early colonists found the area suitable for farming and, in addition to importing seeds for grain and vegetable cultivation, planted decorative European trees and shrubs and more exotic plants purchased from passing trading vessels. In addition, commercial logging companies imported quick-growing pines for the burgeoning timber products industries. Unfortunately, some plant life "escaped" from their cultivated habitats and found a receptive environment near local creeks and streams. Thus were sown South Africa's seeds of hydrological disaster.

Streams that had formerly flowed year-round were now dry as pine, poplar, and gum trees drove tap roots deep into river beds and banks with their insatiable thirst.

In the early 1990s, the South African government began formulating a long-term plan aimed at eradicating invading alien plant life. Today the Working for Water (WFW) program employs approximately 20,000 people in a 20-year initiative to clear more than 10 million hectares of land. It is anticipated that this effort will release four billion cubic meters of water per year, or more than 7 percent of the country's entire water supply, which is currently consumed by alien plants. The project has also had a powerful socioeconomic impact in the country because the program is aimed at providing employment to the most marginalized in South African society—women, youths, the disabled, and the single head of households.



The WFW contacted GIMS, the distributor for ESRI software products in South Africa. GIMS developed a GIS-based project information management system for WFW to help keep track of the more than 250 projects being simultaneously conducted across the country.

"Each of our 250 projects has a business plan with a set of key performance indicators for the year. The indicators include variables such as the number of people employed, areas cleared during the month, and related financial figures," commented Jacqui Coetzee, mapping coordinator for WFW.

"GIS tools have been developed to help us manage all of this data more efficiently," she continued. "An Alien Catchment Management System, developed by the Council for Scientific and Industrial Research (CSIR), helps managers prioritize areas to be cleared, determine costs, and estimate water use of the alien vegetation in a catchment area. Other applications provide report generation and contract management capabilities, and we are undertaking an extensive mapping exercise to capture all of our historical vegetation clearing information."

All applications are based on ESRI's ArcView software and integrate systematic data capture, reporting, modeling, monitoring, and management tools. They are used to manage information on a day-to-day project level, produce monthly reports for provincial project leaders, and produce summary reports for program management at the national level.

A clean, reliable water supply is not only vital for a nation's economic and social development, it is essential for life itself. The conscientious efforts of the thousands of dedicated people involved in the Working for Water program are assuring young South Africans a secure future.



Water Resource Modeling, Republic of Botswana

Because water is the earth's most valuable resource, monitoring and planning water conservation is vital for both humans and nature. By analyzing spatial relationships between factors in society, drought conditions, and watershed behaviors, Africa comes closer to mitigating water resource imbalances.

Hydrologic process and water resource issues are commonly investigated by the use of distributed watershed models. These watershed models offer information about channel network, location of drainage divides, channel lengths and slopes, and sub-catchment geometric properties.

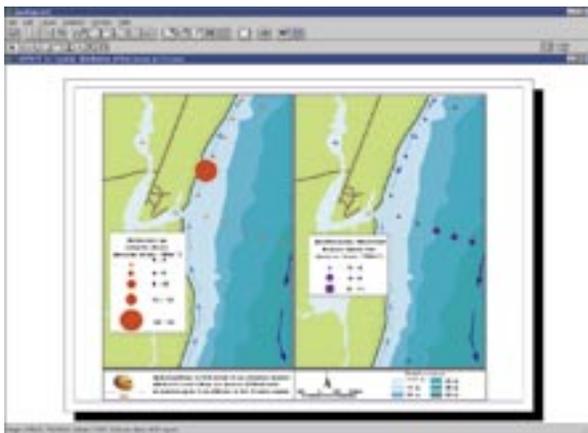
Time series modeling is also a useful GIS tool for water resource analysis. Paul Sheller of Botswana's Kgeikani Kwani project is using ArcInfo™ for time series modeling to analyze the effects of the severe droughts that plague Botswana. The model can also be used to determine the effects from dredging the Okavango Delta and predict the effects of regulated releases of water from a series of dams on the lower Boro River. GIS indicated the environmental impact these actions would have on the nature of the vegetation and wildlife including rare and endangered species that will be displaced from the area as their habitat is lost. GIS shows the channels that are most impacted and highlights the at-risk areas needing project engineers' attention.

Using ArcInfo, Sheller hopes to establish an Okavango environmental monitoring and research center for the delta biosphere. If successful, a similar center will be established for the Kalahari Desert. The group plans to develop different biospheres and then integrate them all into a monitoring and research area that would combine all the data into a national system. Ultimately, they hope to integrate all of the southern African countries into a comprehensive monitoring and research region.

Coastal Marine Management, South Africa

Marine GIS has been used in many ways to offer information about the earth's oceans, seas, and watersheds. Near shore and deepwater phenomena, such as current, salinity, temperature, biological and ecological mass, and density, all play integrated roles in offshore and coastal management. Some of the areas of marine GIS development include oceanography, coastal zone management, navigation and charts, ocean industries, and conservation.

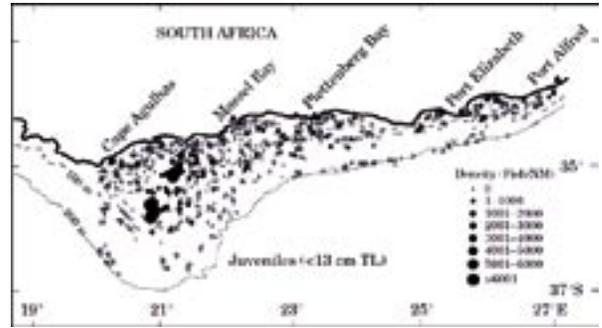
Management and remediation decisions about marine fisheries are more easily made using spatial analysis. Geographical representations of fish populations make planning and resource management more accurate. In the St. Lucia region, fish larvae of an estuarine-dependent species, *Ambassis*, are particularly abundant at the station near the estuary mouth; conversely, the deep sea species, *B. fibulatum*, is more abundant further off shore.



Abundance of Fish Larvae in the Offshore Waters of St. Lucia

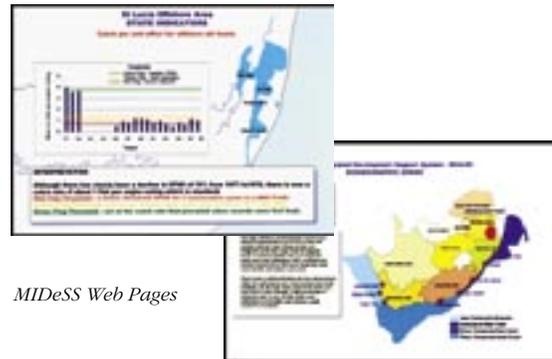
Oceanographer Dr. Tony Booth has applied GIS to a commercially important sparid fish, *pterogymnus lanarius*. Using GIS for modeling, Booth mapped the distribution of three size categories of sparid fish on the Agulhas Bank. He has also used the GIS to analyze the relationship between fish mortality and fishing effort, creating a spatial perspective on the status of the fish population.

*Information provided by
Dr. Shael Harris, Geographic Environmental Solutions*



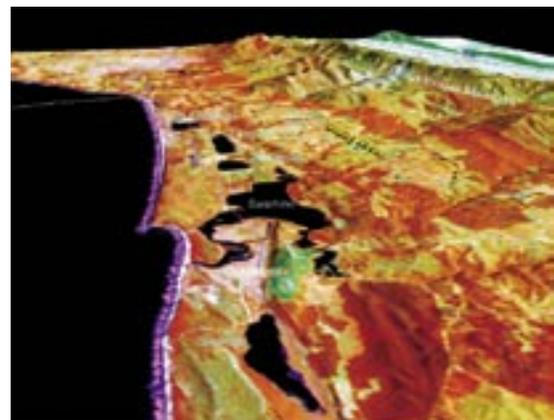
Spatial Distribution of Juvenile P. Lanarius on the Agulhas Bank

The South Africa Coastal Information Center also has an interactive GIS coastal mapping Web site that is a virtual spatial library. The site is part of the country's coastal management awareness campaign.



MDeSS Web Pages

The Chief Directorate of Surveys and Mapping of South Africa developed the research project Oteniqua Coastal Decision Support System. This GIS uses satellite imagery to create a variety of sensitive representations of coastal areas. These maps are used by organizations needing vegetation and land use information.



Coastal Three-Dimensional Model

GIS for Communities

GIS Innovators in Africa

Across the African continent, people are applying GIS in a multitude of ways. Whether at the legislative level or at the student level, for the health planner or for the conservationist, GIS offers people clear perspectives for managing the many worlds of Africa.

Botswana

The Department of Surveys and Mapping has converted all of its analog maps to digital and has produced digital products formatted for GIS applications. Using GIS in a collaborative effort with the people and agencies of Botswana, the Department of Surveys and Mapping is currently working on an application to create a national atlas.



Ghana

The Centre for Remote Sensing and Geographic Information Services (CERSGIS) of the University of Ghana assists all sectors of Ghana's economy to utilize GIS tools in their management information services. CERSGIS assists the Ministry of Food and Agriculture to create a GIS database. It will be used to assess various rural communities' capacity and capability for agriculturally related development. CERSGIS also works with the Community Water and Sanitation Agency to help rural communities develop and maintain potable water supply systems under acceptable sanitary conditions.



Kenya

The Department of Resource Surveys and Remote Sensing (DRSRS) of the Ministry of Environment and Natural Resources collects data and information on land resources. The facility maintains one of the best and most reliable databases on natural resources in Kenya. Its GIS productions have influenced policy and management decisions in the sustainable management of the environment and natural resources.



Somali Republic

The GIS Lab of the United Nations Development Programme (UNDP) has accomplished an enormous feat in mapping and storing the main geographical layers of the Horn of Africa including settlements, road networks, schools, health facilities, and water sources. This information is vital in analyzing accessibility to needed services and infrastructures. The UNDP GIS databases are instrumental in planning large campaigns such as vaccinations and the rehabilitation of water wells. The lab also helps organizations working in demining to map the contaminated areas and to support the mine awareness campaigns.



Mozambique

The Centro Nacional de Cartografia e Teledeteccção's Land Cover project took visual satellite data of areas of natural vegetation and land areas in use and combined and digitized them into a single GIS database. From the database, CENACARTA creates detailed, comprehensive maps that are available to the public. Planners, decision makers, and developers use this valuable resource in completing projects throughout Mozambique.



South Africa

The Cape Metropolitan Council (CMC) uses GIS as an information source in the management of municipal infrastructures, roads, pipelines, and cables. GIS expertise is also used for gathering and mapping data about local criminal activity. This information allows officials to analyze patterns and trends as well as highlight and spot priority areas to deploy resources to combat criminal activity.



Uganda

The National Biomass Program uses GIS for monitoring the forests of Uganda. GIS technology provides an ideal environment from which to describe, analyze, and model ecosystem processes and functions. The NBS utilizes this aspect of GIS to collect vital information on Uganda's forest biomass, an important source of Uganda's fuels.



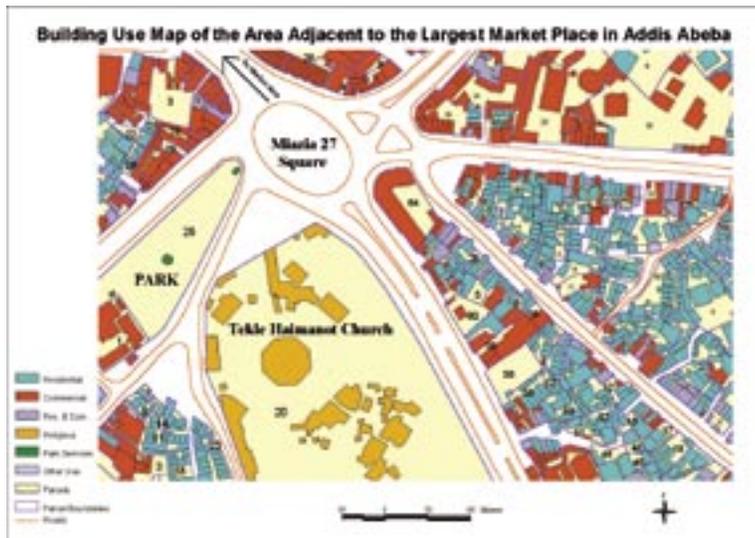
Urban Development GIS Reaps Big Revenues

Addis Abeba, Ethiopia

GIS offers city agencies powerful tools to manage growth and redevelopment projects. Agencies use GIS to identify problem areas, quantify problems, and administer programs.

City officials of the City of Addis Abeba, Ethiopia, decided it was time to take advantage of the potential of GIS technology. Up to this point, the City had been severely lacking vital information, thus hampered in its ability to create urban development plans, efficiently manage services, and collect tax revenues.

City administrators began their project by developing a geodatabase that would eventually include various socioeconomic and housing status data on the City's nearly 3 million residents and about 400,000 housing units. As the majority of the City was built in an unplanned manner with slum areas and illegal housing in every part of the City, the task was assumed to be massive. Thus the work was organized under a project named "Information for City Development" and was overseen by the City's Urban Works and Development Bureau (UWDB).



The Task of Data Collection

The City of Addis Abeba is divided into administrative units called zones, weredas, and kebeles. Nearly 4,000 data collectors were deployed, visiting each household in the City and filling out the questionnaires designed to collect the various types of data that the City needed. These surveyors also took measurements of buildings and parcels, and based on these measurements, sketches were drawn. Once the completed questionnaires began coming to the project office, about 240 data encoders began encoding the data into the computer using database software. It took data workers a total of 10 months to complete the data collection work for the whole City.

From Collected Data to Productive GIS

Project administrators hired professional consultants Information System Services (ISS) to establish GIS in the City's Information for City Development project.

Based on a needs survey, the ISS team compiled a list of equipment and software needed for the project and then procured and installed this equipment. They also trained employees who soon became proficient in a range of GIS tasks from editing to performing analysis and producing maps. Once the project was well underway, various departments of the City's administration sent their employees to be trained in performing various analyses pertaining to their own work using ArcView software.

Now, the newly established department of the Administration Urban Land Information Center manages all of the City's GIS-related projects. This department manages the land-based information of the City. Its major work is the regular updating of the alphanumeric and GIS data and providing the various bureaus and departments of the City with this information.

Once the project began functioning smoothly and producing outputs, the demand for outputs by the various departments of the City Administration became very high. The immediate users of the outputs so far have been the UWDB and the Finance Bureau of the City Administration. The UWDB has now started issuing title deeds and title books for property owners in the City. GIS provides accurate property transaction information; therefore, in just the first year, it has been able to increase the revenue generated for the City Administration from Ethiopian birr 5 million to 36 million per year.

Using this data set, the Finance Bureau evaluates all taxes related to land and, again, has been able to increase the City Administration income. With the watchdog GIS in place, property owners can no longer misrepresent their actual holdings. This benefit alone significantly adds to the return on investment for GIS.

Other offices of the City Administration, such as the Master Plan Office, Bureau of Planning and Economic Development, are requesting geospatial data for their own urban planning activities.

Monitoring Road Development

Zambia

The department of surveying at the University of Zambia completed research assessing the impact of widening and rehabilitating the Great East Road (GER). The GER carriageway is the main road into the capital city, Lusaka. GIS was involved in depicting existing infrastructure along a 14-kilometer stretch of the road.



Spatial and Statistical Data Interaction in ArcView

GIS for Communities (continued)

GIS was also involved in the more complex quantitative predictions for determining the number of land parcels that would be affected by the expansion, which water and sewer lines would fall directly below the newly expanded road, and what other utilities would have to be displaced. The study needed to take in other considerations as well. The planned road width needed to be within the limits of the current right-of-way to keep compensation for house relocation to a minimum and to ensure the smooth progress of the rehabilitation project. Furthermore, it was important to reduce the effect on public utilities. ArcView was used in the study because of its capability to query data and find attributes based on their proximity to other attributes. ArcView software's spatial analysis feature was used to depict the interactions and consequences of different combinations of data sets.

Information provided by Kelly & Kelly, Zambia

Monitoring Communicable Disease

Cape Town, South Africa

GIS can be used to study how disease spreads from place to place. It can also spatially display the impact that health care services, or lack of health services, has on a community. Epidemiology, the most familiar type of geographic study in medicine, maps the progress of diseases, famines, toxic spills, and other health disasters. Because these dynamic health incidences require information analysis about a specific place, GIS has become an integral tool of public health management.

GIS offers enormous potential for improving health service outreach to communities. Moreover, GIS creates a new approach for research in the study of communicable disease.

In a project being conducted by Robyn Wood of the Clinical Research Unit at Somerset Hospital in Cape Town, South Africa, GIS is being used to improve health programs and education strategies within a small settlement. Located in Cape Town's South Peninsula, Masiphumelele contains a low-income population of 14,000 people. Because of its localized nature, it is easier for health analysts to perform rigorous research on the Masiphumelele population than on larger settlement populations.

Terramare Environmental Data Systems and RM Business Systems support the hospital's research project through collaborative technical systems development. Public health researchers perform a paper-based collection of HIV and TB data that is entered into the geodatabase. Scientists then analyze this data in the context of other demographic and spatial data by inputting database reports into ArcView.

Today, a growing number of health agencies use GIS to publish their health statistics online by using the GIS Internet mapping software, ArcIMS. This wealth of information furthers the success of epidemiologists to determine the source of disease and take action to stop its spread.

GIS in Higher Education

University of the Western Cape

In recent years, GIS technology has grown tremendously, creating many job opportunities in both the public and private sectors. This demand for GIS expertise has compelled many universities to offer technical certificates as well as associate and graduate-level degrees.

GIS courses are offered at the University of the Western Cape. The University's GIS broadcasts to all five of its university institutions by using high bandwidth Internet linkages (funded by the Adamastor foundation). The University deploys the GIS Web site to develop and deliver Web-based educational resources.

For example, students can receive Web-based training specifically in conservation evaluation. This curriculum includes a review of global conservation and socioeconomic conditions, a coastal planning exercise along the Eastern Cape Coast, a review of different imagery processing techniques for conservation planning in the Western Cape, and an exercise in contingency planning for an oil spill anywhere along the South African coast.

Students learn how ESRI's ArcIMS provides traditional GIS functionality such as zooming, panning, and switching layers on and off. The power of GIS expands as students combine GIS outcomes with Internet searches by using word search and Structured Query Language (SQL) statements.



Professors find that almost all viewing aspects of a GIS can be taught by using any Internet-connected computer running a Java-enabled Web browser. When students customize the interface, they can create user-defined thematic maps and hyperlink map features such as countries to other Web sites, thus having full database integration within a single application.



By customizing the interface, students make GIS more specific to their particular applications. Furthermore, data for courseware can be centrally managed and updated. By hyperlinking map objects to other Internet sites, learners have access to a wide breadth of updated information. Using MrSID® software to compress satellite images saves disk space, while using ArcIMS makes the images more accessible.

These GIS-enabled Web courses have been tested within the University of Western Cape's network connections as well as to their network connections with the Department of Conservation Ecology and outlying universities. For an example of the University-generated GIS Web site, visit the University Botany Department's Web page at <http://sacoast.uwc.ac.za>.

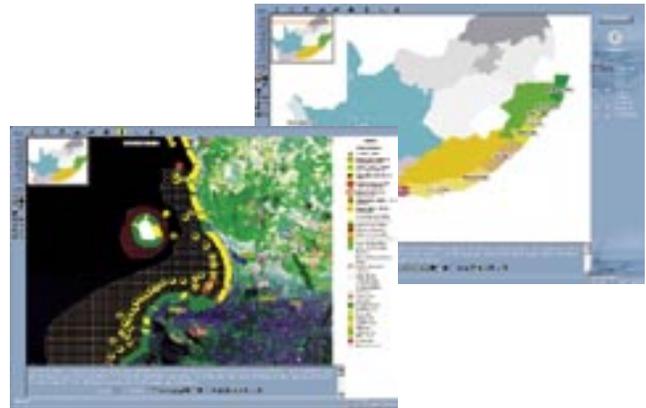
Screen shots were produced using Landsat (28 m) resolution for the 3,000 kilometers of the South African coastline.

Umlindi Information System

South Africa

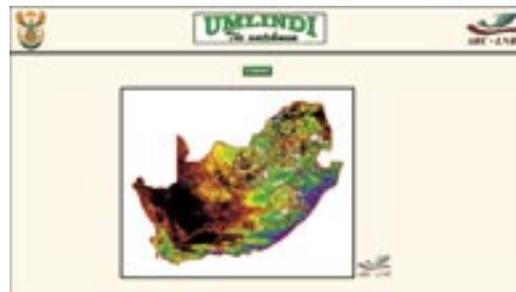
South Africa's climate is characterized by severe fluctuations in rainfall. This affects both crop production and the economy. Policy and decision makers need to base their response actions to drought, flood, and other disasters on sound scientific information.

South Africa's ARC-Institute for Soil, Climate and Water calls its GIS "Umlindi Information System." Umlindi is the Zulu word for "the watchman." This GIS is used to keep a watchful eye on agricultural factors and publish maps on a Web site. Acting as



a watchman, the Umlindi system attempts to inform decision makers of current drought conditions, fire risks, and vegetation growth. Using ArcView 3.2 Spatial Analyst, the GIS also produces rainfall and crop growth maps.

The fire map shows sites where active fires occurred in a 10-day period. The active fires are derived from the midinfrared band using Chips for Windows. The image is then displayed according to the required legend in ArcView and exported to the Web site. The ARC-Institute for Soil, Climate and Water is the South African node for the World Fire Web. Active fires are detected on a daily basis and sent to an Internet server. Maps can be seen at www.gvm.sai.jrc.it.



Rainfall maps show rainfall for a 10-day period. The long-term average rainfall surfaces are very accurate. Attributes such as altitude, slope, aspect, distance to sea, position in local terrain, and rain shadow effects are used to create these maps.

Vegetation activity maps are GIS-processed satellite images that show vegetation activity. The Normalised Difference Vegetation Index images are derived from the red and midinfrared bands of NOAA images using Chips for Windows. This image is created with the required legend using ArcView and then exported to the Web site.

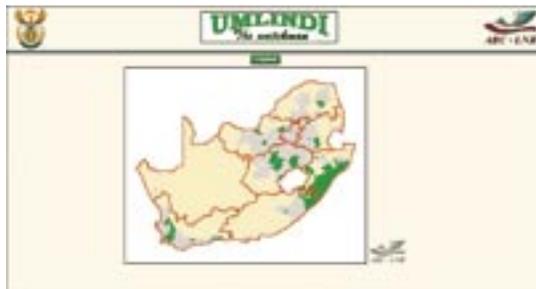
GIS for Communities (continued)

Crop growth and drought maps indicate whether a specific crop has received sufficient water over the season up to the present or if it has suffered from a lack of water. The Water Satisfaction Index is calculated with ArcView Spatial Analyst from evapotranspiration and rainfall data.

Users of the Web site are required to select a province, date, and type of query to allow the system to provide information accurately. The various types of queries return fire, rainfall, vegetation activity, crop growth, and drought information. Similar systems are planned for all South African Development Community countries in the near future.

Explore the site at www.agis.agric.za/agsisweb/umlindi.html.

ARC-Institute for Soil, Climate and Water is funded by South Africa's National Department of Agriculture.



Agriculture Industry Joins Geography Network

South Africa

Today's farmers want immediate information about crop analysis, agricultural conditions, and planting information. Therefore, South Africa's National Department of Agriculture, Agriculture Research Council (ARC), and the provincial departments of agriculture have worked closely to develop the Agricultural Geo-referenced Information System (AGIS).

The vision is to coordinate, acquire, describe, and manage all relevant information on agriculture in South Africa in an integrated system. The GIS will provide agricultural information at national, provincial, and local levels. The project's decision support systems will be accessible through the Internet, providing decision makers and land users with timely, current, and relevant information online.

The AGIS data and serving infrastructure have been built on ESRI technology and supported by GIMS, ESRI's distributor in South Africa. The multiple agriculture-related layers are stored in ArcSDE™/Informix®, and the data served via mapping services and viewers is based on ArcIMS technology. All Web pages are developed, stored, and managed in Informix Web DataBlade technology, which enables Web developers to create Web pages even from remote areas in South Africa.

Those accessing AGIS will find a system that offers them

- Structured and online GIS databases
- Metadata
- Learning modules
- Online models
- Links to online experts
- Online books
- Atlases



See AGIS on the Geography Network at www.geographynetwork.com or go to www.agis.agric.za.





ESRI provides geographic information system software and related services to clients worldwide. Headquartered in Redlands, California, ESRI also has U.S. regional offices, overseas subsidiary companies, and distributors doing business in more than 189 countries. ESRI's flagship product, ArcInfo, a high-end GIS, has capabilities for the automation, modification, management, analysis, and display of geographic information. Several related products developed and marketed by ESRI include ArcView, an affordable geographic data query, display, and output tool for the desktop; ArcSDE, a high-performance object-based data access engine; and MapObjects®, embeddable GIS and mapping components for application developers.

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