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Access to natural resources

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editorial

ICTs, natural resources and land tenure

At the ACP–EU Joint Parliamentary Assembly held in Bamako, Mali, in April 2005, governments declared that 'the development of agriculture remains an essential component of economic development … Agriculture shall remain the backbone of strategies aimed at improving rural wellbeing provided its own long-term sustainability is addressed by adopting sustainable natural resource management practices'.

Insecurity of tenure remains a critical obstacle to improving agricultural productivity, investment and the sustainable use of resources. To improve rural livelihoods and natural resources management, it is essential that the traditional land rights of farmers and pastoralists, whether to individual farms or communal property, are recognized. Accurate land registration systems need to be established to provide them, as well as informal settlers and squatters, with formal documents guaranteeing their rights to the land they occupy.

This issue of *ICT Update* looks at projects employing new technologies to improve management of land and natural resources. International projects such as Galileo, Europe's global navigation satellite system, will have many applications for agriculture and could foster ACP-EU collaboration. Another is the African Geodetic Reference Frame (AFREF), with its network of Global Positioning Systems (GPS) stations. As Richard Wonnacott explains, AFREF will provide uniform geospatial data and maps that could contribute to resource management, as well as to cadastre and land registration systems. Ann Myles describes the Land Management Programme, introduced by the government of Belize to clarify the land tenure rights of landholders. The programme faces several obstacles, however, including the lack of skilled technicians and an inadequate computer system. As Paul van der Molen notes in the Q&A, unless adequate policies and institutional arrangements are in place, technology alone will not reduce insecurity or improve resource management.

Inadequate human resources, organizational barriers or inadequate interventions also hamper project implementation at the community level. Louis Liebenberg, the Director of CyberTracker, suggests that, for technology to be used effectively by a community, socio-economic issues also need to be addressed. Finally, Sabine Homann and Barbara Rischkowsky describe how they used GPS/GIS tools, combined with participatory methods, to study and map changes in land use in Ethiopia. Pastoralists now have evidence, in the form of digital photos that they can use to advocate for better land management policies.

Projects such as Galileo and AFREF are important for strengthening cooperation and the transfer of technology and expertise. But the applications derived from such projects need to diffuse widely and contribute to project implementation at the local level. Before ICTs can be used to their full potential, for the benefit of both people and governments, major changes are needed at the institutional and policy level in order to address the root causes of socio-economic inequalities. ■

ACP-EU update

Galileo and the ACP–EU cooperation

Galileo is a global satellite navigation system with a network of 30 satellites and ground stations under civilian control. Galileo, an initiative of the EU and the European Space Agency, is intended to complement the existing Global Positioning System (GPS, USA) and GLONASS (Russia). Unlike its predecessors, Galileo has been designed and developed as a non-military application. Although based on the same technology as GPS, it will offer a more reliable and precise service. In addition, unlike GPS, it will be possible to receive Galileo signals in extreme latitudes. The first four satellites will be launched in 2008 and the remaining 26 are expected to be in orbit by 2010. Making Galileo's services available to ACP countries would fall under the areas for regional cooperation, particularly in relation to transport and communication, specified in the Cotonou Agreement between the EU and ACP countries.

Galileo will have many applications, of which navigation and positioning for the transport sector are perhaps the best known. But it will also be of benefit in other fields, including natural resource management and agricultural development. For example, with Galileo receivers, farmers could monitor crop yields, and map high- and low-yield areas to identify target areas for improvement. Galileo could replace the traditional but imprecise and expensive measuring techniques, and the data integrated directly into GIS maps that could contribute to the management of natural resources. Galileo could also be used to track livestock, and to monitor fishing vessels.

As the EU makes progress in completing the development phase of Galileo, African countries have been working together since 2003 to establish the African Geodetic Reference Frame (AFREF; see page 3). With its network of permanent GPS stations, AFREF will become the backbone for the planning and implementation of development projects throughout the region, ranging from infrastructure building to the mapping of water and forest resources. In view of the many other problems facing African countries, however, AFREF is not a priority – and it is certainly an endeavour with many demands. It requires expensive technological equipment that most countries cannot afford, and highly skilled human resources that are scarce. The EU should therefore ensure that sufficient funds, technical assistance and expertise are channelled to support AFREF, so that African countries can make full use of the potential of Galileo when it becomes operational.

So far, the EU has started negotiations with just one African country, Morocco. Morocco's participation in the project will contribute to the establishment of the Galileo system in the western Mediterranean and West Africa. Discussions are now also under way with countries in other regions, including Australia, Malaysia and Mexico. ■

For more information about Galileo and its applications, visit http://europa.eu.int/comm/dgs/energy_transport/galileo/index.htm

The African Geodetic Reference Frame (AFREF) project

Richard Wonnacott highlights the importance of a uniform coordinate reference frame for sustainable regional development.

Any meaningful natural resource management programme requires maps and other geographic information for effective planning and efficient implementation. Just as one does not build a house without firm foundations, any project, application, service or product that is reliant on some form of geo-referencing must have a uniform and reliable coordinate reference frame.

Many of the 50 or so countries in Africa have their own coordinate reference systems and frames that are used for national surveying, mapping, remote sensing, GIS and development programmes. However, the current state of these systems and the extent of their applications vary considerably. The African Geodetic Reference Frame (AFREF) project has been set up to create a unified reference frame. AFREF will be the basis for national and regional three-dimensional reference networks that will be consistent and homogeneous with the International Terrestrial Reference Frame (ITRF). When fully implemented, it will consist of a network of continuous, permanent Global Navigation Satellite System (GNSS) stations such that users anywhere in Africa will have free access to positioning data and would be, at most, 1000 km from such a station.

AFREF will support the goals and initiatives of NEPAD. In particular, NEPAD has included in its science and technology action plan the objective to 'promote cross-border cooperation and connectivity', and actions to 'establish regional cooperation on product standards, development and dissemination, and on geographic information systems'. Geographic information is fundamental to all infrastructure, planning and development projects required to achieve NEPAD's long-term objectives of poverty eradication and sustainable growth across Africa.

Applications

A number of projects have already recognized the importance of a modern uniform geodetic reference frame, including the FAO's Africover project. The purpose of Africover is to 'gather – to a consistent standard – basic geographical information comprising data for future programmes on natural resources in Africa.' Africover has also recognized the importance of using a single geodetic reference frame as a critical success factor in achieving a consistent standard for the mapping of natural resources, planning of agricultural projects and the development of supporting infrastructure such as dams and roads, as well as cadastral systems.

One of the major goals of AFREF is the transfer of skills and to assist in establishing in-country expertise for the implementation, operation, processing and analysis of modern geodetic techniques, primarily GNSS. In this regard, it is essential that experts in appropriate disciplines be engaged to assist with the training of personnel from national mapping organizations that will be responsible for implementing all phases of the project from the installation and operation of GPS base stations through to the final conversion to ITRF of the national reference frames. Once the conversion is complete, historical data based on previous systems will still also have to be converted where necessary. This is particularly important in the case of cadastral records, both for taxation purposes and to ensure the continuity of security of ownership.

Apart from the benefits for geodesy, surveying and mapping, AFREF and the network of permanent GPS base stations, will also be used for atmospheric and geophysical research and monitoring, disaster mitigation and for real-time navigation applications. Of particular interest to agriculturalists, GNSS data could be used to supplement terrestrial and costly upper air meteorological observations for weather forecasting and climate monitoring, water and forest resources management, as well as for monitoring crop and vegetation distribution and animal migration patterns.

International support

AFREF will require technical assistance, expertise and advice from the international geodetic community, primarily through the International Association of Geodesy and its service organizations such as the International GNSS Service and the International Earth Rotation and Reference Systems Service. The project is also supported by numerous other organizations such as the UN Committee for Development Information (UNCODI), the Office for Outer Space Affairs, and the International Federation of Surveyors. An AFREF steering committee has been established within the UNCODI structures. This committee has issued a 'call for participation' in which organizations are encouraged to participate in the project or to assist and support it by contributing appropriate equipment, funds or expertise. An AFREF website has been established and is hosted by the UN Economic Commission for Africa.

The AFREF project will support and satisfy many of NEPAD's objectives. It will provide users across Africa with free and reliable fundamental coordinate reference data for natural resource management and development projects. The transfer of the skills to Africa necessary to undertake a project of this nature and to create a large pool of geodesists, surveyors, IT specialists and related skills is of paramount importance for the future success of similar continental, regional, national or local projects. ■

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Further reading

NEPAD (2001): www.nepad.org/en.html
IAG: www.iag-aig.org
IGS: http:// igscb.jpl.nasa.gov
UNECA AFREF: http://geoinfo.uneca.org/afref/
UNECA CODI: www.uneca.org/codi/

Ethiopia: Analyzing the patterns of herd mobility

Sabine Homann and Barbara Rischkowsky explain how studying past and present herd mobility patterns can improve land management in the Borana lowlands.

The Borana lowlands in southern Ethiopia have traditionally been managed as a common property resource by a number of pastoralist groups. In this variable and fragile environment, mobility was until recently the key strategy to make use of scattered rangeland resources. Communal tenure regimes were developed to coordinate and enforce decisions over access to shared resources. The pastoralists' knowledge of the area, and their social organization, provided the basis for rangeland management strategies to deal with the erratic rainfall, in particular to match the needs of their herds with the available forage and water resources throughout the year.

Over the last 30 years, however, various government and other external interventions have disrupted the traditional way of life, particularly the land use system. The construction of year-round watering ponds attracted uncontrolled settlements and overgrazing of seasonal pastures, and administrative changes led to restrictions on the movements of herds. Rapid population growth and droughts added further pressure, and by the early 1990s more than 40% of the rangelands were considered degraded. The challenge for the future is to develop more appropriate strategies for managing the resources of the Borana lowlands.

Analyzing herd mobility

In cooperation with the Borana Lowlands Pastoral Development Programme, funded by GTZ, the authors have used a combination of participatory methods and modern technology to analyze the pastoralists' land use system and mobility patterns. Between 2000 and 2002 a ground survey was carried out in two locations, Dida Hara and Web, representing high and low levels of external interference, respectively.

First, groups of elders and herders were brought together to discuss land use and herd movements, past and present, and to identify the most important grazing areas and water resources, and their seasonal use for cattle, goats and camels. The informants were also shown satellite photographs of the area and were asked to add information, such as the directions of herd movements in the dry and rainy seasons, and the locations of year-round and temporary grazing areas, wells and forested areas.

The areas of existing encampments and land use categories, such as cultivated areas and fodder banks, and rainy and dry season grazing areas, were then measured using global positioning system (GPS) equipment with the assistance of local range scouts. The GPS data points were used to calculate the areas allocated to the different land use categories in the two locations. In-depth interviews with 60 heads of households were also conducted to gather information on herd mobility at the household level.

Changes in land use and mobility

The participatory approach of mapping the traditional land use system and comparing it with the current situation served to encourage discussion about the drivers of environmental and socio-economic change. This research showed that pastoralists are increasingly abandoning their traditional practices. In the past, the central area of Borana lowlands with permanent water sources was reserved for permanent encampments and for lactating cows and their calves, with separate camps for the more mobile herds. This is no longer the case. Permanent grazing has expanded in all areas and long-distance herd movements have become less frequent. The functional distinction between year-round grazing areas and temporary rainy-season pastures is gradually being eroded, so that rangeland classification no longer seems relevant. With the expanding human population, grazing pressure, especially for the herds of lactating cows, is increasing.

The analysis of current land use showed that new, different forms of land use are emerging in the two locations. Access to land is becoming more restricted, as cropland and fenced-off forage banks expand into formerly communal grazing areas, and herd movements are being limited. At Dida Hara the formerly integrated land use system, with high levels of herd mobility, has generally broken down. As a result of these changes, many households in Borana now depend on additional sources of income and can no longer survive from pastoralism alone.

Future prospects

By combining GPS/GIS technology with participatory methods it has been possible to draw a spatial picture of changes in the lives of pastoralists in the Borana lowlands. The pastoralists can now refer to digital images that show how their situation has changed over the last 30 years. The focus on illustrating changes in mobility – the key strategy for survival in dryland regions – provides a basis for the analysis of preconditions for sustainable land use. Moreover, this approach can contribute to discussions with different stakeholders in the region on future land management strategies, as well as to the integration of pastoralists into the design and implementation of appropriate land use policies. ■

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Botswana: Tracking wildlife in the Kalahari with a PDA

Louis Liebenberg discusses how CyberTracker software is helping a community in Botswana to monitor and manage local wildlife resources.

At Lone Tree, a village in the Kalahari desert in Botswana, CyberTracker is working with traditional hunters and expert trackers to help them gather information about local wildlife populations. Once downloaded onto a solar-powered PC, the collected data can be displayed on screen in the form of maps, tables and graphs, and can be used to establish an index of abundance for each species hunted by the community, so that they can monitor population changes over time.

At present, the Wildlife Department allocates hunting quotas to the community on a yearly basis. However, the quotas are fairly arbitrary since there is no reliable data on how many animals there are. Traditional trackers have a good idea of how plentiful or scarce animals are, even if they cannot quantify their numbers precisely. Using a personal digital assistant (PDA) with CyberTracker software and an integrated GPS receiver, trackers who cannot read or write can use the icon-based user interface to record their observations. CyberTracker version 3 also includes an 'index of abundance' feature that can help to quantify their observations. The software can be customized by users with no programming skills and requires minimal technical support.

Unforeseen problems

Lone Tree is perhaps one of CyberTracker's most challenging projects. Even though it has the backing of the village headman and executive committee, at this stage it is far from being a sustainable community-based project. While supervising the process of gathering data and paying the trackers a daily fee for their work, it became apparent that there are still fundamental socio-economic issues that need to be resolved.

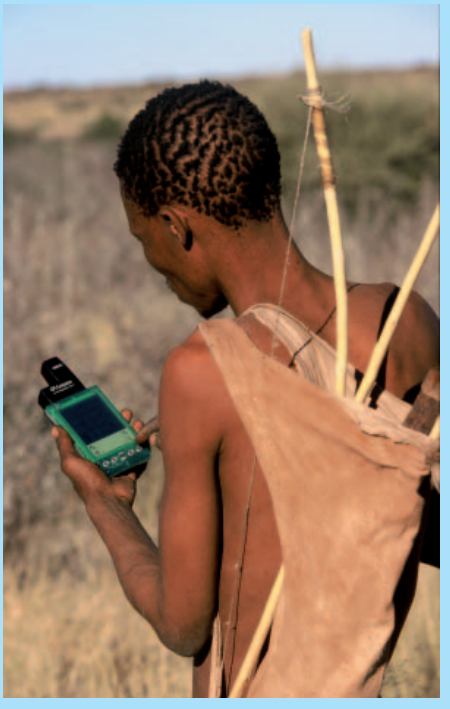
An unforeseen problem emerged, for example, when one of the individuals involved in the project came up with a novel way to make some extra money. He started charging other community members for using the solar panels to recharge their cell phones (a practice that was soon stopped). The fact that just one member of the community controlled access to the solar panels and then asked other villagers to pay to use them caused resentment and conflict. This incident emphasized the importance of ensuring total community participation in even a small pilot project.

The cost and availability of hardware remains a major difficulty. As long as equipment is expensive, it cannot be shared equitably among community members, and the resulting competition for access can result in conflict. The software must also be easy to use and sufficiently robust. CyberTracker 3 is much easier to customize than the earlier versions, and users are increasingly indicating their satisfaction with it. The software has now been downloaded more than 13,000 times by users in over 50 countries.

On the other hand, PDA units have more and better features, but they have become more expensive. However, once smart phones, currently the fastest growing area in the cell phone market, become mainstream, the cost per unit is likely to decrease to the point where communities in developing countries will be able to afford them. In the next five to ten years, smart phones will provide an affordable platform for geo-referenced data gathering. Smart phones also have the inherent advantage that they are a useful means of communication so that communities will readily adopt the technology.

A cultural process

The largest CyberTracker project to date has been the Kruger National Park in South Africa, where many lessons have been learned. The PDA units were used by 120 park rangers to record their observations, as well as by scientists to gather more specialised data, resulting in more than a million records. Even though the Kruger Park had full-time GIS experts and a large scientific services department, it took seven years to get CyberTracker up and running. Adopting new technology involves a cultural process that requires effort to change old habits and learn new ones, and most people are reluctant to change. To make CyberTracker work in the Kruger Park, changes were implemented at various



levels within the park authorities, from the field rangers and the section rangers who manage them, to middle and top management, as well as in organizational policy.

In the Lone Tree project, if the community can gather enough data to establish the abundance of animals, then they may be in a position to negotiate with the relevant authorities an increase in the hunting quotas for some species. Alternatively, if the data shows a decline in a particular species, it would be in the community's interest to hunt fewer of them so that the population can recover. They would also be able to advocate for a halt on the issue of permits to outside hunters. Ultimately, if the community can see the direct benefits of data gathering, I hope that the project will become self-sustaining.

Nevertheless, we must accept that this is a 'work in progress', and that both technological as well as socio-economic problems need to be addressed. This should not, however, stop us from working towards our goal. ■

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feature

Belize: Land tenure clarification using GPS

Ann Myles gives insight into the complex process of creating a computerized land registration system.

In Belize, as in many developing countries, the lack of clarity about land tenure is a major obstacle to the efficient use of agricultural land. In 2003 the government of Belize launched the Land Management Programme (LMP) in order to improve the conditions for agricultural development through enhanced land security.

Few small landholders in Belize have formal rights to the land they farm, and squatters are common. Several factors have contributed to this situation, including complicated procedures for obtaining leases or ownership of land, and a costly mandatory land survey.

Under the LMP, a team of experts has begun surveying three districts of Belize on a parcel by parcel basis, and clarifying the occupants' tenure rights in each case. The aim is to establish a parcel-based title registration system, based on adjudicated rights to parcels in accordance with a new Land Adjudication Act. Each parcel is surveyed using GPS equipment, and the data is used to create digital maps using GIS tools. The team is expected to survey and map a total of 15,000 land parcels in the north of Belize by August 2006.

Data from the surveyed parcels is recorded in the current coordinate system to produce accurate index maps and a GIS map database using ArcCadastre, a software tool for creating digital cadastral maps. ArcCadastre includes a number of special features such as a 'snapping' function, which is used to connect adjacent old survey plans. Control points are geo-referenced using differential GPS, which involves the use of a stationary receiver and a mobile receiver, to take position measurements accurate to within 0.3 m.

Each claim a landholder makes to a parcel and the relevant tenure information are recorded in an Access database and, once the whole process is completed, each parcel is given an identification number. This ID is entered into both the GIS map database and the Access database, so that textual information can be linked to the parcels on maps. Such maps, including the names of approved claimants, are

presented to the community at public displays, where even untrained map readers can find their parcel and confirm the accuracy of the information.

Reactions to the project have been mainly positive. Landholders have turned out in large numbers to claim their rights to the land they occupy. Those occupying previously unsurveyed land have welcomed the free cadastral surveys offered by the LMP. Squatters have shown most interest in the process, as they see it as an opportunity to obtain a lease without having to deal with bureaucratic procedures.

Surveyors have had to get used to the maps resulting from the GPS surveys based on actual occupation. While the use of GPS makes surveying easy, the cadastral map now looks very disorderly, with parcels of all shapes and sizes. Most surveyors have welcomed the change to digital mapping, although there is a shortage of skilled map technicians.

Some local politicians are not entirely happy with the programme, however. Under the current system they are able to influence who gets land, and where. Now, the survey team is able to deal directly with landholders. If politicians object to a claimant being allocated a particular parcel, they are simply requested to make a formal complaint at the public display, just like everyone else.

If the number of squatters is to decrease in the future, as the government wishes, the process of land distribution should be simplified, and less influenced by party politics. Otherwise, land insecurity will continue to hinder the efficient management of land resources. Funds are also needed to train a new generation of surveyors who will embrace new technologies.

In Belize the process of tenure data collection started before a computerized system for land registration was set up and institutional reforms were made. To prepare adjudication records, the team is storing the information in temporary databases, and the documents produced are processed manually by the Land Registry. What is missing is a computerized land register that could record adjudicated rights and produce certificates automatically as soon as the data is downloaded. Instead, an enormous amount of information is building up waiting to be recaptured. System development was delayed for various reasons, but plans for in-house developments are now taking shape.

Concerning the implementation of the land management programme in general, a new (or rather old) strategy is needed – investigate the problems with the present system, set the objectives for a better one, decide on the information and the system demands, design and construct the system, and then start the data collection! ■

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Web resources

This section lists key resources in the field of land tenure and access to natural resources. Additional information is available from the web magazine at http://ictupdate.cta.int

Collective Action and Property Rights (CAPRi)
www.capri.cgiar.org
CAPRi is a CGIAR programme that aims to contribute to policies and practices that alleviate rural poverty by analyzing and disseminating knowledge on the ways that collective action and property rights institutions influence the efficiency, equity and sustainability of natural resource use. CAPRi supports research and collaboration on institutional aspects of natural resource management between the CGIAR centres and national agricultural research institutes (NARIs). Research themes include accommodating multiple uses and users of natural resources; changing market relationships; feminization of agriculture and demographic change; genetic resources; the role of environmental risk; structuring devolution; and technology adoption.

Common Property Resource Institutions Database and Online Information System (CPRI/DOIS)
www.sristi.org/cpr/index.php3
CPRI/DOIS is a database of common property resource institutions concerned with sustainable natural resource management. Developed over the last 16 years, the database currently features 87 institutions in more than 20 countries working in areas such as forestry, irrigation, fisheries, etc.

International Land Coalition (ILC)
www.landcoalition.org
The ILC is a global alliance of intergovernmental, governmental and civil society organizations that assists the rural poor to secure access to natural resources, especially land, and to enable them to participate in policy and decision-making processes that affect their livelihoods at all levels. The ILC website serves as a platform for a global network on land-related issues, including the exchange of ideas, best practices and lessons learned, and information on ILC projects, advocacy activities and events.

IWGIA Indigenous Peoples and Land Rights
www.iwgia/sw231.asp
The International Work Group for Indigenous Affairs (IWGIA) supports indigenous peoples in their struggle for human rights, self-determination, control of land and resources, cultural integrity, and the right to development. IWGIA supports the work of local indigenous organizations to prevent further land loss and to reclaim land that has been taken illegally. Activities include community awareness raising and mobilization on land rights issues, land registration and land mapping based on GPS technology, collective litigation to gain legal title to land, and lobbying national decision makers for legislative and constitutional reforms.

Regional Centre for Mapping of Resources for Development (RCMRD)
www.rcmrd.org
The RCMRD, previously known as the Regional Centre for Services in Surveying, Mapping and Remote Sensing (RCSSMRS), was established in Nairobi, Kenya in 1975 under the auspices of UNECA and the Organization of African Unity (OAU). It is a non-profit intergovernmental organization with 14 member states in eastern and southern Africa: Botswana, Comoros, Ethiopia, Kenya, Lesotho, Malawi, Mauritius, Namibia, Somalia, Sudan, Swaziland, Tanzania, Uganda and Zambia. To date, the Centre has trained over 3000 technical officers in the fields of surveying and mapping, remote sensing and GIS, and natural resources assessment and management.

TalkingTitler
www.geomatics.ucalgary.ca/~barry/Research/
TalkingTitler is an initiative to provide appropriate systems and technological support for land occupation and ownership rights for people in developing countries and post-conflict situations.

It is also aimed at societies where land tenure practices draw on customary systems and informal settlements. Instead of using only written records to provide evidence of rights in land, TalkingTitler evidence may also include (digital) video records, oral recordings, and surveyors' measurements integrated into a land records system. TalkingTitler makes use of the power of the handheld Palm computer or PDA combined with CyberTracker software to collect socio-economic data relevant to the titling process using simple questions or icons. The PDA is also linked to a GPS, so that the locations where data are recorded are geographically referenced.

Landweb
www.landweb.org
Landweb is a network of NGOs working on land issues in Eastern and Southern Africa based in Harare, Zimbabwe. Landweb's website provides access to regular updates on land tenure issues in the region, reports and publications, and a collection of country studies.

TechTip: Smart cards could streamline land tenure registration

A smart card is a wallet-sized plastic card with a small embedded chip that can either process information (microprocessor chip) or store data (memory chip). The data stored on the chip can be read and decoded by a smart card reader. In addition to commercial applications, smart cards are now used for security purposes, such as access control, personal identification (biometric data such as fingerprints, retinal scans, etc.), as well as for storing digital documents, vehicle registration, medical records, wireless subscriber authentication, and many other applications.

Land tenure registration and cadastral systems could also benefit from the use of smart cards. Landholders could be issued with cards holding details of their certificate of title or lease, and containing a digital signature or fingerprint. With a smart card reader attached to a PC or laptop, or even a compact flash connection to a PDA, smart card holders could have secure access to their land records, without having to visit the land registry office in person. Filling out and archiving printed forms would also no longer be necessary, since all the relevant information would be stored on the card.

Smart cards have many advantages. For example, the embedded chip is tamper-resistant, i.e. it is difficult to modify or subvert the information stored in it, even for someone who has physical access to the system, providing secure user identification.
In addition, the information stored on the card can be PIN protected and/or read-write protected.

For more on the latest developments in smart card technology, visit the Smart Cards Group website, www.smartcard.co.uk

Q&A: Computerized land registration systems

Professor Paul van der Molen explains that unless adequate policies and institutions are in place, computerization will not necessarily reduce land tenure insecurity or improve the management of land resources.

Professor van der Molen, you have considerable experience in supporting the process of computerizing land registration systems in developing countries. In Africa, the African Geodetic Reference Frame (AFREF) will become the backbone for the planning and implementation of projects throughout the continent. How will AFREF benefit those countries that are currently struggling to set up digital land registration systems?

Countries that are investing in a digital land registration system obviously aim to benefit in several ways, including through improved land tenure security, land markets and other government activities. Although equally valid for analogue systems, digital land registers make no sense unless in each case the rightful claimant, his or her land rights and the exact location of the land itself are all clearly identified in one way or another.

Using a national coordinate system as a reference for the identification of each land object is a prerequisite, as has been observed everywhere. If the national coordinate system is part of a wider system, even better, because this will allow cross-boundary exchanges of cadastral information in the future.

It is often the case that in the process of establishing a computerized land registration system, data collection starts before the system is fully operational. As a result, large amounts of information become outdated and the project gets out of hand. Is this a common problem, and if so, what can be done to avoid it?

Outdated land records and cadastral maps are a problem in many countries. Over time, as the information becomes less relevant, people lose trust in the system, and this leads to the development of informal land markets. In fact, creating a land registration system is cheap in comparison with the ongoing costs of maintaining it. Governments do not realize that.

Therefore, the best approach is to establish an institutional framework that comprises both land adjudication and system maintenance, in such a way that the project can be financed. Governments tend to make land registry systems too complex and create something that is hardly manageable.

But governments develop these systems with the advice of land surveyors and experts who help them make choices both about the technology to be applied and the implementation of the programme. Why is there a mismatch between the tasks governments set themselves, and what they can actually achieve with the resources at their disposal?

On the one hand, computerization of something that is not clear, like land occupation and land rights, has always been problematic. Land registrars and surveyors need to do their utmost to create efficient systems and organizations. The creation of work processes with good IT support should focus on assisting clients to choose the most suitable ICT applications for their particular context. Consultants should be more innovative in their thinking about what is the critical minimum that needs to be computerized. On the other hand, the poor implementation of a land tenure adjudication and registration programme could be the result of bad legal advice. Of course, there are also examples of governments that are reluctant to implement good advice on institutional and legal reforms. The best remedy is for governments to develop their own land policy that justifies a certain level of investment in system development and technology, on the one hand, and responds to the needs of the people in terms of type of land tenure regime, on the other. Governments, therefore, have to cooperate not only with land surveyors and lawyers, but also with economists and social scientists.

How has the introduction of computerized cadastral systems affected access to common lands and community-managed natural resources?

Computerization as such does not change the contents of the system. If the existing analogue system does not recognize and include common property or customary land rights, computerization will not make the situation any better. However, if these rights are recognized and included in the system, computerization might help to improve access to the data and result in better descriptions of common boundaries, and thus might help to avoid conflicts that can sometimes occur among community members and between communities and outsiders. ■

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