Module 15: USING ICT TO IMPROVE FOREST GOVERNANCE

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IN THIS MODULE

Overview. Information communication technology (ICT) applications can be harnessed to enhance public participation and transparency, make law enforcement more efficient, and improve forest management. The module uses the World Bank Framework for Forest Governance to assess the potential of ICT applications to address different aspects of forest governance.

Topic Note 15.1: Pillar 1—Transparency, Accountability, and Public Participation. Approaches to increasing transparency, accountability, and public participation for forest management through ICTs include e-government services and open government applications, advocacy campaigns through text messaging and Internet social networking sites, community radio, crowdsourcing, and collaborative and participatory mapping.

- Participatory Mapping in Cameroon
- The Central Vigilance Commission Website—India
- PolMapper in Kenya

Topic Note 15.2: Pillar 2—Quality of Forest Administration. Comprehensive forest management information systems have been seen as the ideal solution, yet it is possible to deploy smaller-scale ICT solutions to manage information requirements in key areas, such as management of fires, inventories, and wildlife tracking.

- Fire Alert Systems Integrating Remote Sensing and GIS
- Kenya: Solving Human-Elephant Conflicts with Mobile Technology

Topic Note 15.3: Pillar 3—Coherence of Forest Legislation and Rule of Law. Effective law enforcement systems in the forest sector usually follow the steps of prevention, detection, and suppression. Technology has an important part to play in each of these steps in the efforts to curb illegal logging, transportation, and processing of timber and illegal trade in wildlife.

- Ghana National Wood Tracking System
- Liberia: LiberFor Chain of Custody

Topic Note 15.4: Pillar 4—Economic Efficiency, Equity, and Incentives. ICT applications can promote business transactions with the private sector, as with the online auction of public timber, or e-auction. ICTs such as RFID chips can increase productivity and improve efficiency in the supply chain.

- RFID Chips for Efficient Wood Processing

OVERVIEW

The management of forests is very dependent on information, knowledge management, and the capacity to process information. This module presents lessons learned on the use of ICT to promote good forest governance. The main focus is on institutions, their interaction with stakeholders, and how their performance can be strengthened. It does not cover forest inventories and technical resource assessment. While the module is intended to be comprehensive on particular subjects, it does not present all possibilities and current practices of ICT use in forest governance. The objective is to demonstrate the range and diversity of approaches and feasibility of using technology in forested areas (see image 15.1).

Forest Governance as a Development Challenge

Good governance is a vital ingredient in development and sustainable resource management (Collier 2007); investments in sustainable development are widely recognized to yield better development outcomes within conducive governance environments. Poor governance in the forest sector manifests itself in several ways. Forest crime—such as illegal logging, arson, poaching, or encroachment—is a problem in many areas. In many countries, corruption in the forest sector and rent seeking has caused forest agencies to lose both revenue and credibility. It has created an uneven playing field for legitimate private sector actors due to price undercutting and unreliable access to forest resources. The unpredictable business environment has also led to short-term profit maximization and has discouraged socially and environmentally responsible long-term investments in the forest sector.

The Impact of Poor Forest Governance

Poor governance in the forest sector is an impediment to achieving good development outcomes within the sector. In developing countries, an estimated 1 billion rural poor depend at least partially on forests for their livelihoods, and about 350 million live in and around forests and are heavily dependent on them for economic, social, and cultural needs.

In developing countries, illegal logging in public lands alone causes estimated losses in assets and revenue of more than US$ 10 billion annually, more than eight times the total official development assistance dedicated to the sustainable management of forests. As much as US$ 5 billion is lost to governments annually because of evaded taxes and royalties on legally sanctioned logging. In addition to financial and economic costs, the equity impact of poor forest governance and illegality are considerable. These rough global estimates give an idea of the magnitude of the problem but mask country-specific variations. Despite the grim global estimates, the situation has improved in some countries. For example, a recent Chatham House mapping shows that illegal logging has fallen more than 50 percent in the past 10 years in Cameroon, the Brazilian Amazon region, and Indonesia.2

Using ICTs to Reduce Emissions from Deforestation and Forest Degradation

All schemes to reduce emissions from deforestation and forest degradation (REDD+) emphasize the fundamental importance of good governance. Forests ensure the sustainability of environmental services—biodiversity conservation, carbon sequestration, and watershed protection. All these services are at risk if forests are not managed in a sustainable manner.

Pilot projects around the world are currently testing different approaches to REDD+. Some projects are focusing on increasing the involvement of and benefit sharing with indigenous and local communities, especially in terms of mapping and measuring forest boundaries, degradation, and carbon levels. Interesting examples are the Community Carbon project in Mexico (Peters-Guarin and McCall 2010) and the Surui Indigenous Peoples project in the Brazilian Amazon.3 Both projects experiment with smart phones/PDAs with preloaded software for data collection on biomass from sample plots and boundary demarcation using global positioning system (GPS) functions. These projects are training local communities to update data and use simple interfaces on the devices to convert the data into carbon estimates.

2 Information in this section was drawn from World Bank 2006a and Lawson 2010.

A pilot project in Ethiopia also tried to have farmers access the international carbon offsets market and receive payments directly, through a mobile phone. In this case, smallholders near Bahir Dar were asked to measure the diameters of trees on their land twice a year and put the information into a text message, which was sent, along with each farmer’s unique identification code, to the regional Watershed Users’ Association office. Standard software computed the amount of carbon stored on each farm as well as the change from the previous measurement; any increase in stored carbon dioxide was converted into cash using the going rate of carbon dioxide on international markets, and farmers were paid by their local association.

**The Pillars of Forest Governance**

It needs to be recognized that even legal activities may lead to unsustainable management of resources and that good governance and legality do not always deliver sustainability. The opposite also holds true: not all technically illegal activities are unsustainable. Development outcomes in forestry depend on many factors both inside and outside the sector. To help improve forest governance, the World Bank has developed a conceptual framework for forest governance that consists of five pillars or building blocks, each with two to seven subcomponents (World Bank 2009a) (see box 15.1). This module analyzes each principal component and assesses how information management and ICT can be used to promote the specific dimension of forest governance. It is clear that governance cannot be promoted by knowledge management and technology alone: fundamentally, it is a matter of political choice and the capacity to implement those choices. Therefore, the mere introduction of information technology will not lead to reforms and good governance if the overall environment is not conducive.

**Information Management, Development, and Governance: The Role of ICT**

New technologies have dramatically changed the way this information is collected and applied in the forest sector. For example, World Bank experiences from Eastern Europe and South Asia demonstrated the importance of appropriate management and generation of information and the need for information on financial and operational issues, as well as performance assessment of state agencies. Public access to this information is a prerequisite for greater accountability (World Bank 2008, 2005).

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*4 Personal communication, project team.*
in the narrow sense and lacked cross-sectoral linkages. Information system development has also been integrated into wider forest sector reform programs, as described in the following section and box 15.2.

**Experience of World Bank Support to Forest Management Information Systems**

Implementation completion reports for a sample of recent World Bank forestry projects show that the introduction of computerized information management systems to facilitate institutional reform had limited success.

For three forestry projects in India, the report notes that the project objectives for FMIS implementation were not achieved or were limited in their success due to delays in assigning the consultancy contracts and lack of technical capacity. More positive outcomes have been noted in projects in Romania and Bosnia and Herzegovina. In Romania, the report found that “the full system has been installed and tested in headquarter and field office.” The project in Bosnia has had a positive outcome, and the reason for this seems to be a phased approach. The initial focus was on developing overall IT capacity, followed by the introduction of more specialized capabilities such as geographical information systems (GIS) mapping tools.

While forestry administrations seem to have welcomed computers, the link between technology, information management, and institutional reform was not always maintained. The most important reason often was the lack of clarity in how to get the best from the technology. There was inadequate analysis on how technology could be used to improve information management to improve core business processes. Technology was seen as a means to spruce up the “front office” while “back office” processes largely remained unaltered. Based on these findings, it would be easy to assume that forestry departments did not need information technology to improve their functions. However, it would be more appropriate to conclude that information management needs were insufficiently assessed before executing such a large-scale introduction of new technologies. Other important reasons these projects were not as effective include the following:

- FMIS components were too big and complex.
- Government staff were less familiar with the technical side of information management and thus drawing up specifications for consultants to develop the systems was difficult.
- Delays in award of contracts meant that the systems could not be tested by the client till the end of the project period.
- Insufficient attention to “change management” to generate “buy in” from staff at all levels.

**BOX 15.2: Vietnam—Management Information System for the Forestry Sector**

The Management Information System for the Forestry Sector (FORMIS) aims to introduce modern approaches to information management in the Vietnamese forest sector. This includes technological solutions for information integration, remote-sensing technologies, and mobile technologies. FORMIS will contain a number of subsystems and modules to provide information for steering and managing the forestry sector toward sustainable forest management. The FORMIS information strategy will also guide the Ministry of Agriculture and Rural Development in aligning IT investment in other development projects to obtain a harmonized, cost-effective system.

FORMIS is expected to reduce the fragmentation of information by harmonizing standards within the agriculture ministry. The project will come up with consistent data structures, standardized and consistent data collection methodologies, and centralized coding systems. The fragmented nature of existing forestry information is partially caused by a case-by-case approach when planning and building information systems, without having a strategic overview. The project pays particular attention to the initial planning of the information strategy and the information system architecture of the systems to be built.

ICTs in Forest Governance: Experience from Three Countries

Three detailed country reports were prepared to analyze what lessons could be drawn from the experiences of countries with different forest governance challenges and different stages of advancement in the application of ICTs in development. The country reports are from Finland, Ghana, and Uganda.

Finland is one of the world’s leading countries in applying ICT across all levels of society and different economic sectors. Forests have held a remarkable role in Finnish society for over a century. Alongside the rapid overall development of ICT, forest sector actors have actively developed and applied different ICT solutions to improve efficiency. Conventional ICT applications have been developed to support decision making and to improve the efficiency of the wood supply. During the past decades, the importance of communication between forest actors and the general public has become an emerging requirement, and new solutions have been introduced in response. ICT solutions in Finland are currently in a transition period to second-generation solutions, with a large proportion of solutions and e-services being revised and improved. The major drivers for this are the changes in the operating environment and the rapid development of hardware and communication possibilities.

In general, the readiness for ICT solutions in the Finnish forest sector is very high, which reduces the need for capacity building and technical support in introducing new solutions. The key success factors for ICT solution development and application processes are the involvement of the stakeholders, adequate capacity, and a high level of trust between the government and the private forest owners. For developing countries, the Finnish model presents two important lessons: (1) good outcomes from ICT solutions can be expected only through a good communication strategy and upfront involvement of stakeholders and (2) piloting with a smaller user group is beneficial for the final product quality.

The Uganda report shows that the country has put in place the legal and policy architecture for expanding the role of ICTs in all spheres of development. However, in general, the forest sector has been lagging behind in adopting these technologies. The high cost and specialized technical skills needed for traditional remote sensing and GIS applications have been a limiting factor. However, corruption, illegal logging, and other forest crimes are notable governance problems in the country. The lack of avenues for citizens to hold their public office bearers accountable has been cited as one of the governance challenges in the sector. On the other hand, the growth of mobile phone connectivity in the country is being exploited by illegal loggers and poachers.

The experience from Uganda also demonstrates how linking ICT and e-readiness assessment with extensive governance diagnostics provides a good basis for reform.

The important example from Uganda is the spontaneous development of ICT applications through radio and SMS in response to governance challenges (see box 15.5). Other initiatives led by the private sector are using technologies to optimize plantation management and processing. Thus, Uganda is an example where the government has created the space for ICT applications to be widely used, but has not really provided direct support. It is an environment where low-cost, innovative applications would thrive and where radio is still the most influential technology to reach the rural population.

In the case of Ghana, while the country has made a lot of progress with Internet and mobile connectivity in general, applications in the forest sector are lacking. The National Wood Tracking System, which aims to establish a system for tracing the chain of custody, is a notable exception. The system is still being piloted and when complete will enable the forest department to trace timber slated for exports all the way back to the stump, thus meeting its requirements to certify legal timber under the Voluntary Partnership Agreement with the European Union. However, it is a donor-driven system, which does raise questions regarding its sustainability after external funding ends.

Developing a More Integrated Approach

The three main interlinked drivers of change toward a more integrated approach in forest sector information management are as follows:

1. Technological change and convergence: Enables exploring data from anywhere in the world and collaborating with others.

2. Increased openness, transparency, and participation: The forest sector can no longer work in isolation and needs to share information with other stakeholders.

3. National e-strategies and e-development programs: Forest sector information systems development needs to have a whole-government approach.

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ICT experiences in the forest sector have not been systematically studied, but new applications are being piloted in various countries, and there is a wealth of experience from the field. Experience with ICTs in other sectors such as banking, agriculture, fisheries, and public-sector governance has also generated lessons on how ICTs can be effectively used to improve governance and service delivery. This module explores the range of ICT applications available and relevant for forest governance, using a sample of field experiences. While most of the cases are directly from the forest sector, non-forestry cases have been included for their relevance to the forest sector. The discussion is focused on understanding what works under real-world conditions, the potential for replication and scaling up, and what can be learned from other sectors.

To understand how ICTs can best serve forest governance needs, this module uses the World Bank framework for forest governance (see box 15.1) to classify the selected examples. Information is a key cross-cutting requirement for all the pillars of forest governance. The role of ICTs in improving information management under each pillar is explored with the help of field examples through the subsequent Topic Notes (each Topic Note represents a pillar). Table 15.1 summarizes the relationship of ICTs to the five pillars. The only pillar in the World Bank framework that has not been specifically addressed is “Stability of Forest Institutions and Conflict Management.” This is closely related to the other pillars. If issues such as transparency, quality of administration, and economic efficiency are ensured, conflicts in the sector can be reduced.

### KEY CHALLENGES AND ENABLERS

Though there is great potential for using ICT to improve forest governance, there are no ready-made or easy solutions. This section looks at the operational challenges that confront national forest agencies and practitioners when using ICT for forest governance. It also reviews the key enablers that can help to overcome these challenges. Some of the following discussions address issues generic to all agricultural ICT and e-government initiatives, while others deal with issues specific to forestry.

**Be familiar with national ICT policies and e-readiness. Projects can be developed in countries with low readiness, but they must be designed accordingly.** E-readiness is an essential factor ensuring that e-services can be used.

### TABLE 15.1: Pillars of Forest Governance and ICT

<table>
<thead>
<tr>
<th>PILLAR OF GOVERNANCE</th>
<th>WHAT IS THE INFORMATION MANAGEMENT PROBLEM?</th>
<th>WHICH ICT APPLICATIONS CAN HELP?</th>
</tr>
</thead>
</table>
| I. Transparency, Accountability, and Public Participation | • Insufficient access to key information on forest management, land tenure, concessions, etc.  
• No forums for public to share ideas, alert forest managers, or register complaints.  
• Lack of information or public consultations on planned development projects and major land use changes. | • E-government and open government applications  
• Advocacy and awareness campaigns through text messaging and Internet social networking sites  
• Community radio  
• Crowdsourcing to increase public participation  
• Collaborative and participatory mapping |
| II. Stability of Forest Institutions and Conflict Management | (Applications presented under other pillars.)                                                               |                                                                                                  |
| III. Quality of Forest Administration             | • Costly and difficult to gather detailed information for forest inventories and carbon estimation.  
• Extensive damage from forest fires and insufficient advance information for forest managers to take action.  
• Conflicts between humans and wildlife; wildlife poaching. | • Forest cover and carbon stock assessment with CLASlite and airborne LiDAR  
• Real-time fire alerts  
• Wildlife tracking and conflict management |
| IV. Coherence of Forest Legislation and Rule of Law | • Difficult to monitor movement of logs from forest areas.  
• Information for legality verification is easily tampered with.  
• Lack of awareness of forest laws.  
• Surveillance of all critical areas for illegal activities is expensive. | • Technologies for surveillance and deterrence—computerized check posts and GPS  
• Technologies for tracking timber—chain of custody systems  
• Legal information management systems: Global Legal Information Network  
• Mobile and online crime reporting services |
| V. Economic Efficiency, Equity, and Incentives     | • Lack of transparency in auctions, sales and allocations of licenses for planting.  
• Accurate information on distance and time needed to optimize timber transportation and increase cost efficiency. | • Online timber sales, licenses, and auctions  
• Logistics  
• Mobile phone or PDAs for carbon estimation and receipt of payments |

Source: Authors.
and that investments in new systems provide the desired outcomes. The existing and potential capacity needs to be assessed and mapped, and applications need to match the capacity. Development programs may also have components to strengthen the e-readiness in partner forest organizations; this needs to happen in full alignment with national e-government development strategies. Particularly in environments with weak capacity, there is a risk of systems being developed independent of each other, adding to the difficulties associated with building e-government systems across sectors.

**Define the problem clearly, assess the information needs, and compare possible solutions.** Defining the problem to be addressed is a fundamental requirement for any project, and ICT projects are no exception. ICTs are tools or enablers, and having good devices alone is no assurance that forestry management will be improved. Therefore, it is essential to properly identify the underlying causes and effects before looking for a technological solution. The objective is also to find the most cost-efficient and feasible solution. Mobile and Internet applications provide many benefits, but traditional communication channels may also be appropriate. Particularly in environments where access to information networks and electricity is limited, lower-tech solutions may be needed. If no systematic feedback systems are required or the information is not time sensitive, conventional strategies like public posters, community meetings, or radio can also help disseminate important information.

**Determine the best entry points and the appropriate technology.** In ICT, the gradual introduction of new services based on existing ones can be also beneficial. In particular, systems that are aimed at the public and where extensive end-user training cannot be provided should be based on familiar user interfaces. Another decision that needs to be made when selecting entry points is the type of technology to be used. Technology choice depends heavily on the existing capacity: mobile phones and even smartphones are much more common in poorer developing countries than Internet-connected computers.

**Design culturally appropriate and relevant content.** Services provided have to be locally adapted and relevant and meet the requirements of the target audience. The key element is to ensure that applications do not require language skills that are not widely available. Particularly in areas with low literacy rates, it is essential that e-applications form part of a more extensive service package where illiterate users can also access the information through various agents that help them with the applications. This can be arranged through public agencies or voluntary nongovernmental organizations (NGOs). Working at the local level ensures that applications are responsive to local needs and that there is uptake of the models being developed.

**Information and communication technologies can improve forest governance, but operation, maintenance, and project design issues must be addressed.** All cases show that if planned properly, both mobile and Internet applications can be developed to improve various aspects of governance. Moreover, these systems can be combined with others to provide a full range of services to public and forest professionals. But having appropriate technology alone is not adequate. One needs to consider two issues crucial to the long-term sustainability of the applications: (1) Project design has to be appropriate and focused on meeting demand and (2) operational and maintenance issues must be addressed. Recurrent issues like power supply (for recharging laptops, mobile phones, and PDAs), spare parts (such as replacement batteries), and service also need to be addressed.

**Some services are consumer driven and can become financially self-sustaining, while others are public goods and need to be financed from public sources.** In designing projects, consider costs, long-term financial sustainability, and scalability. Many pilot studies and applications are funded and subsidized by international donors, NGOs, or national governments. However, particularly for commercial services, the long-term sustainability of an application depends mainly on end-user participation and out-of-pocket expenditures. These costs arise from the purchase of various information technology services, such as sending responses to text messages, in which cases the total cost depends on the cost of a text message. Very few pilot projects have focused on the financial sustainability of the models, including how much investment is required. To be sustainable, programs need to consider scaling up and replication. This is exceptionally important to forestry because the sector is inherently public-service oriented. For example, law enforcement is a public good and should be financed from public resources. Well-functioning business models and reliable revenue streams are critical to public forest management (image 15.2).

**Address data security and privacy issues, and develop risk mitigation to prevent misuse of technology and inaccurate data.** Having access to ICTs to track illegal activities facilitates better law enforcement; the converse could also be true. Loggers and wildlife poachers may intercept communications between forest authorities and voluntary informers, and text messages can be used to mislead law enforcement agencies. Consequently, law enforcement...
bodies need to be prepared to counter disinformation, have at least comparable resources, and be capable of investigating criminal activities. If ICT applications are developed to encourage public participation on forest law enforcement—for example, by opening hotlines for reporting corruption, illegal logging, poaching, or other forest sector crimes—it is critical that the identities of sources not be disclosed, as this could jeopardize their personal safety.

Ensure that there is adequate information on the resource (for example, forest inventories and resource assessments) or readiness to improve data collection. Having adequate data to be processed in the system is a precondition for transparent information sharing. The lack of data cannot be overcome by any investment in technology. Nevertheless, these investments do not need to be sequential. In most cases it is possible to collect inventory information while developing ICT applications.

Identify the right stakeholders and ensure their participation and avoid local elite capture; include indigenous peoples, women, and rural poor. The forest sector, by its nature, has diverse stakeholders with varying levels of competence. Large enterprises, senior management, and technical specialists in forest administrations and international NGOs have better knowledge than rural and indigenous communities, who may have little formal knowledge of the sector and poor or no access to information networks. Also, within the communities, access may be unequal and women or poor may be excluded even if local elites have some access and knowledge. To avoid any potential unintended exclusion of key stakeholders, it is essential that any information system development plan include a comprehensive stakeholder or client mapping. This needs to assess what the information needs are and how to provide the required information services, including training.

Ensure buy-in from forest authorities at all levels. Ensuring adoption of an e-governance agenda in forest agencies may also happen through other means. It may require strong normative guidance from national e-government programs and agencies and may also require the provision of financial incentives. Often, increased use of new technology is driven by efficiency gains and cost savings. If these can be clearly analyzed and demonstrated, agencies have incentives to stay engaged and expand the use of ICT. Even if many NGOs and international organizations have been developing innovative models, if the right authorities are not involved, the new systems have limited value if their operators do not have access to relevant information and data. Frequently, donor-funded projects have been able to equip the project implementation units with modern hardware and software while other departments remained much more poorly equipped. If wide-scale ICT reforms are expected to happen, it is essential that relevant agencies be upgraded in a way that allows for their participation. This requires adequate investment funding for upgrading hardware, system development, and human capacity building.

Users are able and willing to use new technologies but they need to be aware of the service and motivated to use it. Even models that are fully functional from a technical perspective may fail to deliver or perform below expectations if users are not aware of them or do not have the right incentives. It is essential for clients to be able to provide feedback
and to be genuinely involved. Making information available by the forest authorities serves several purposes: information is a basis for public consultations and inclusive decision making. However, even limited dissemination is beneficial; if authorities disseminate information through websites, for example, the information is available to the media and NGOs for scrutiny, even if the public only has limited access to the information.

Applications using mobile phones, radio, and the Internet can be deployed quickly with minimal technological support. In many cases, the underlying technology already exists and only applications need to be developed. The examples discussed in the Topic Notes clearly demonstrate that many of the forest applications have been developed on existing platforms based on a demand-driven innovation. These have been used in a number of ways to increase public participation and surveillance of forest areas, to monitor fires, and to reduce human-wildlife conflicts around protected areas.

Additional observations and practical implications from the field examples in the Topic Notes are summarized in table 15.2.

### TABLE 15.2: Summary of Field Examples

<table>
<thead>
<tr>
<th>PILLAR OF GOVERNANCE</th>
<th>SUITABLE ICT APPLICATIONS</th>
<th>ISSUES TO BE CONSIDERED</th>
</tr>
</thead>
</table>
| Transparency, Accountability, and Public Participation | • E-government and open data initiatives  
• Advocacy and awareness campaigns through text messaging and internet social networking sites  
• Community radio  
• Crowdsourcing to increase public participation  
• Collaborative and participatory mapping | • Applications are mostly Internet and mobile phone based, technologically less challenging, and cheaper to deploy. Cell phone applications would be more useful in forested areas.  
• Legal and political support is necessary for e-government and open data initiatives, and these applications are best led by government agencies.  
• NGOs and civil society can establish and manage mobile phone applications, community radio, and participatory mapping.  
• Costs to users/communities need to be offset through funding from donors/private sector. Community radio (FM) stations can be set up for US$ 5,000–US$ 15,000 and managed by community members; SMS can be purchased at bulk rates from cell phone companies.  
• For mapping applications, GPS capability is necessary; PDAs (US$ 800–US$ 1200) or smartphones (US$ 150–US$ 200) can be used, depending on how rugged the device needs to be. |
| Quality of Forest Administration | • Forest cover and carbon stock assessment with CLASlite and airborne LiDAR  
• Real-time fire alerts through MODIS  
• Wildlife tracking and conflict management through mobile phone applications | • These applications are for government agencies.  
• Satellite imagery is now available at lower or no cost; recent developments have simplified software for interpretation. However, technical training is essential to interpret images and generate maps.  
• The LiDAR approach for carbon assessment is still in the early stages, and costs are estimated at US$ 0.10/ha. Currently, the Carnegie Institution for Science (Department of Global Ecology) is the main provider of the LiDAR technology for forest cover and carbon assessment.  
• CyberTracker software is free to download onto PDAs and can be tailored for different uses: tracking wildlife, movement of logs, location of specific tree species, etc. It is a good technology for working in collaboration with communities.  
• Fire alerts from MODIS and through Fire Alert system are free text and e-mail services. |
| Coherence of Forest Legislation and Rule of Law | • Technologies for surveillance and deterrence: computerized checkpoints and GPS tracking of vehicles  
• Technologies for tracking timber—chain of custody systems  
• Legal information management systems: Global Legal Information Network  
• Mobile and online crime reporting services | • Comprehensive chain of custody systems are expensive operations. They are useful where the benefits of legality assurance outweigh the costs, such as in timber exporting countries. Costs of these systems could be shared between industry and government as benefits accrue to both.  
• Less expensive crime reporting hotlines could be set up to work through voice and text messages. All crime reporting systems need to assure citizens anonymity and safety. |
| Economic Efficiency, Equity, and Incentives | • Online timber sales, licenses, and auctions  
• Logistics | • These applications would work well in situations where the forest sector is fairly advanced in the use of information technology. While the government agency may need to set up and maintain the applications initially, some services such as online auctions and inventory data, which are used by the industry can have a user fee to offset the cost to the public sector. |
Topic Note 15.1: PILLAR 1—TRANSPARENCY, ACCOUNTABILITY, AND PUBLIC PARTICIPATION

TRENDS AND ISSUES

Information availability is a precondition for transparency, accountability, and efficient public participation. Enhancing the accountability of the government and its institutions, including forestry institutions, is a key issue in all countries. Transparency and access to information are essential if public-sector forest institutions are to be held accountable for their performance. Making the public aware of forest sector policies, laws, and the rights and responsibilities of citizens and the state is the first step in increasing transparency and accountability. Public participation and support for forest activities can be increased by actively seeking public opinion and suggestions on government actions through easily accessible avenues. Approaches to increasing transparency, accountability, and public participation through ICTs include the following:

- e-government services and open government applications
- advocacy campaigns through text messaging and Internet social networking sites
- community radio
- crowdsourcing—mapping for the people, by the people
- collaborative and participatory mapping.

E-Government and Open Government/Open Data Applications

Open government, open data, and e-government initiatives are meant to increase access to government-owned information and increase transparency and accountability in general. Open government and open data initiatives are giving more access to information that would otherwise be out of bounds. On the other hand, e-government solutions are designed from the perspective of increased efficiency, reduced corruption, and better service delivery. While open government/data may not strictly be the same as e-government, all of these approaches use ICTs to make governments more transparent and efficient.

Websites are the first and simplest point of communication with the public in the digital world. Several ministries of forests and the environment have websites with information on key policies, programs, and organizational responsibilities; however, only a few have interactive features that allow them to receive information from the site’s users. A very advanced example is the website of the Forestry Commission of the United Kingdom. This site provides users with information, access to relevant policies and procedures, and links to wider e-government applications in the country (see box 15.3).

BOX 15.3: Website of the Forestry Commission, United Kingdom

The Forestry Commission of the United Kingdom is one of the best examples of e-government in action in the forest sector. The commission’s website (http://www.forestry.gov.uk/) not only disseminates information on the forests under its jurisdiction, but also serves as a platform for interaction with citizens, including e-commerce services. The site is user friendly and, from a governance perspective, has a number of features:

- Information on all aspects of forestry (educational, recreational, scientific, and industrial).
- Up-to-date statistics on timber production, sales, inventory.
- Information search feature through the land information search, which is a map-based tool giving information about land designations.
- Information on grants and licenses for planting and felling, with a feature for online comments on individual applications.
- Environment Impact Assessment register shows details of the decisions that the commission makes after assessing the potential environmental impact of work to carry out afforestation or deforestation or to build forest roads or quarries.
- Online auctions through the e-timber sales portal.

In addition to these interactive features, the site provides the commission’s policies and standards for sustainable forest management, the government’s policies on freedom of information and the rights of citizens to information held by state agencies, and the process of consultation the commission follows before planting or felling in any woodland. The commission also carries out an annual survey where public opinion on forestry is gathered and posted on its site.

Source: http://www.forestry.gov.uk.
Australia, New Zealand, and the United Kingdom have open government or open data policies to share information with the public. There are numerous benefits of having access to such large volumes of public data. For example, budget information for the forest sector could be used to monitor performance of the state agencies’ projects; data on harvesting volumes and area could be used by interested civil society organizations to monitor whether harvest levels are sustainable and whether critical ecosystems are being protected.

While open data policies are primarily initiated by government agencies, the Open Budget Initiative demonstrates that it is possible for civil society organizations to generate demand for open data policies. The Open Budget Initiative is a global advocacy program to promote public access to budget information and the adoption of accountable budget systems. It is anchored in a biennial Open Budget Survey that evaluates whether governments give the public access to budget information and opportunities to participate in the budget process at the national level. To measure the overall commitment of the countries surveyed for transparency and for comparisons among countries, the Open Budget Index (OBI) was developed, which is a score assigned to each country based on the information it makes available to the public throughout the budget process. The OBI was initiated by the NGO International Budget Partnership. The OBI could also be applied in the forest sector, and NGOs could initiate an OBI for the forest sector in their country. The role of ICTs in this case could be to increase access to information through websites or mobile phones.9 The Central Vigilance Commission of India is another example of a “partial” open government initiative.

E-government services have been high on the agenda of many countries for over a decade. The primary motive for launching e-government services from the perspective of the government is often to improve the efficiency and cost-effectiveness of operations; reducing corruption is often not stated as one of the objectives. However, studies have shown that e-government programs have a great impact on user perception of corruption and transparency. For example, the World Bank (2009a) found that in India, users’ perception of corruption in the electronic land registration and records services called Bhoomi, CARD, and Kaveri was lower when compared to the older manual systems. (For discussion of ICT in land management, see Module 14.)

BOX 15.4: Advocacy and Awareness Tools

FrontlineSMS is free, open-source software that turns a laptop and a mobile phone into a central communications hub. Once installed, the program enables users to send and receive text messages with groups of people through mobile phones. Its features include the following:

- No Internet connection is required.
- A phone and SIM card can be attached and the local mobile phone service operator paid per SMS as usual.
- All phone numbers and records of all incoming and outgoing messages are stored.
- Data are stored on the user’s computer, not on external servers.
- Messages can be sent to individuals or large groups and can be replied to individually, which is useful for fieldwork or during surveys.
- Easy to install and requires little or no training to use.
- Developers can freely take the source code and add their own features.
- It can be used anywhere in the world by switching the SIM card.

Source: http://www.frontlinesms.com/

Advocacy and Awareness Campaigns through Text Messaging and Social Networking Sites

The large number of mobile phone subscribers in developing and developed countries and the relatively simple technology for setting up mass text messaging systems (see box 15.4) are helping NGOs and advocacy groups reach out to greater numbers than is possible through traditional mass media. NGOs have used text messages effectively in their campaign for a new forest law in Argentina and to generate public pressure on a food company to stop it from sourcing palm oil from companies that cut down primary rain forests to make room for oil palm plantations. Sites such as http://www.mobileactive.org connect NGOs and advocacy groups using mobile technologies for social change and help them with information on the latest trends, do-it-yourself guides, and reviews of mobile applications.

The growth of text messages in advocacy campaigns could be attributed to the following:

Mobile phones are carried everywhere as a personal accessory and are kept switched on almost 24 hours each day, so the target audience is almost always accessible.

Messages targeted at individuals are more likely to generate a response than those broadcast to a mass audience.

Responding to a text message is easier and quicker than making phone calls or sending letters, especially when the responder does not have to pay for sending the message.

Mobile phones allow two-way interaction, and feedback can be received almost instantly.

NGO campaigns have started using Internet social networks such as Facebook and Twitter to target the youth, who are the primary users of these networks. For example, an international NGO carried out a two-month campaign through Twitter, Reddit, Facebook, and online video against an international food company during 2010 for its use of palm oil from suppliers linked to rainforest destruction. As a result of the campaign, the food company announced in May 2010 that it will partner with the Forest Trust, an international nonprofit organization, to rid its supply chain of any sources involved in the destruction of rain forests.10 This approach may be more feasible in medium- and high-income countries where there is more access to the Internet than in low-income countries (see more on how civil society and NGOs can participate in e-government in Module 13). In many developing countries, text messaging is still the primary means of data collection and dissemination. A combination of media can be used successfully, as the example from Uganda demonstrates (see box 15.5).

**Community Radio**

The use of radio to broadcast development issues is not new. However, community radio is relatively new, and over the past decade several community radio stations have been established around the world to help women and marginalized groups to build networks and gain access to information on health, livelihoods, farming, weather, and markets, as well as to educate communities on democracy, citizen rights, and gender issues.

Radios are relatively cheap and easily repaired and widely available, even in the poorest regions. In several African countries, radio broadcasts are the primary medium for communicating political and religious messages. In the poorest areas of the globe, radio is the medium of choice, far outstripping other mass media in terms of audience numbers. For instance, in West Africa, radio ownership dwarfs that of all other communication equipment, including TV and mobile phones. In Africa in general, between 80 and 90 percent of households have access to radio.11

Radio programs can be combined with other media as well. Radio browsing of the Internet is a more recent format that

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**BOX 15.5: Uganda—Environment Alert: Civil Society Organizations Use ICTs in Advocacy Campaigns**

In 2007, the government of Uganda wanted to give away a third of the Mabira Central Forest Reserves to a sugar company after the government was asked to remove the reserve status of the forest and allocate the land to the company. At the same time, sensitivity to environmental matters had been heightened in Uganda by the campaigns about the impact of the loss of forests on floods, unpredictable weather, and rising food prices.

As a result, civil society organizations used ICTs to alert individuals about official actions that would affect them adversely and to mobilize them to save the Mabira Forest. Environmentalists took their fight to discussion groups on FM radio stations and used text messages to campaign against buying the company’s sugar until the plan to grab part of Mabira Forest was dropped.

The text messages were particularly effective. The company saw a decline in sales, and some retail businesses withdrew their products from store shelves entirely. Environmentalists argued that apportioning part of the Mabira Forest would bring more adverse effects than the sugar shortage. Opposition politicians also picked up the slack and started criticizing the government for the lack of concern. In this particular example, text messages helped in alerting people what would happen next if they did not join the movement to stop the forest giveaway. The campaign of the civil society organizations was complemented by other actions in the country and strong reaction from the international development partners. Eventually, the plan was withdrawn.


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11 Statistics for 11 countries for which consistent data were available, Myers (2010).
combines the power of the Internet with the reach of the radio. During the program, the presenter browses the Internet with a local expert (for example, a forestry or agriculture extension official or a community development expert) and together they describe, explain, and discuss the information in the languages used by the community. This has been successfully demonstrated by the community media centers piloted by UNESCO in Sri Lanka, Bhutan, and Nepal, among others. Similarly, mobile technology is being combined with radio programming, where listeners can call or text message the program.

With the availability of bandwidth on WorldSpace satellite radio subscription through First Voice International or RANET, community radio stations in remote locations can access news and entertainment programs on other stations. However, the main benefits of community radio are in programming that is in local languages, in formats that communities relate to, and on issues of local importance. For example, in Papua New Guinea, a mix of community radio and digital audio programming has been used to convey messages on forest management and sustainable land management. The programs were presented in the form of drama in several local dialects and were listened to in community meetings, where the questions raised by the key characters were discussed by the gathering. This technology could serve forest communities in other countries as well, to keep them aware of policy changes and developments that can affect their resources and their lives. Box 15.6 summarizes how community radio can help promote better forest governance. (See IPS “Farm Radio International Involves Men and Women Farmers” in Module 6 for more on participatory radio.)

Crowdsourcing to Increase Public Participation

Combining a web-based platform with inputs from text messages increases the versatility of information gathered. Information can be instantly geo-referenced and provide an overview to a decision maker on where activities should be prioritized. In addition to increasing transparency and public


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**BOX 15.6: How Can Community Radio Benefit Forest Governance?**

**Fighting corruption and increase awareness of citizens’ rights:** In Malawi, the Development Communications Trust broadcasts “village voice” recordings from a network of radio clubs around the country. These programs report (among other things) on local-level delays, corruption, malpractice, and mismanagement by service providers, including international NGOs and local authorities and politicians. These problems are then broadcast on national radio, and the ministry, individual, or organization responsible is invited to reply on air in a context of a mediated dialogue with the community in question. The Development Communications Trust says that 70 percent of radio club problems are resolved satisfactorily after they have been aired nationally. It is currently supported by UNDP, Oxfam, and the Malawi national AIDS body.

**Reporting on corruption and governance:** In Sierra Leone, KISS-FM in Bo and SKY-FM started a series called “Mr. Owl” to report on local police corruption. This resulted in increased pay for the police and the establishment of a community affairs department. A voter education program, “Democracy Now,” resulted in higher voter turnout in the station’s listening area compared to other parts of the country.

**Increasing women’s empowerment:** USAID’s Women in Governance pilot program in Mali distributed more than 500 Freeplay radios to women’s listening groups in April 2004. The radios were designed for rural African conditions and can function without batteries. Instead, batteries can be charged manually by winding or through solar power.

**Increasing awareness of environmental issues and public participation in policy development:** In September 2009, Developing Radio Partners (DRP), a U.S. NGO, launched a year-long pilot project called “Our Environment, Our Future” that brings residents the information they need in the way they can best use it. DRP is working with 99.6 Breeze-FM, a community-oriented private station in Chipata, Zambia, to help six radio stations in rural Zambia and Malawi create and broadcast local environmental programming. It also encourages innovative use of mobile phones to expand the stations’ interaction with listeners, using the text messaging software FrontlineSMS (box 15.4). The project is helping build skills in environmental reporting and in developing relevant content on topics such as the impact of deforestation on local agriculture, sustainable farming methods, and many others.

participation, it can also serve as a means to track accountability of civil servants. This application gained popularity after Ushahidi became a success story in the aftermath of the Kenyan riots in 2008, as a means of keeping citizens informed on safety and security through information reports from individuals. The success of Ushahidi has led to its replication in other countries for other purposes (see box 15.7).

A similar application by the Blue Link Information Network in Bulgaria was initiated to gather information on illegal logging, which was simultaneously posted on the website, to show authorities where the illegal activities were concentrated. The project “Expose and Improve—The Power of Information Technologies (IT) in Combating Illegal Logging” was started in 2008 by developing a broad network of active citizens and NGOs to support the integration of a web-based platform for information alerts about instances of illegal logging into the work of Bulgaria’s forestry administration.

Crowdsourcing can be used for many different purposes. While it is a useful and cost-efficient way of collecting information, there needs to be a way to ensure that the data entered are valid and have not been fabricated. The managers of the urban forest map in San Francisco, California, have built in some specific algorithms to raise red flags in case of dubious data inputs. They also propose carrying out random verifications in the field (box 15.8). Alerta Miraflores in the municipality of Miraflores in Peru is an expansive system for tracking and reporting incidences of crime.

BOX 15.7: Public Participation and Crowdsourcing of Data

**Ushahidi**, which means “testimony” in Swahili, is a platform designed to take input from hundreds of people by mobile phone or e-mail. It uses free software called FrontlineSMS that turns a laptop and a mobile phone into a text-broadcasting hub. As an SMS is sent from a hot zone, the message syncs with the Ushahidi software and shows up in a web administrator’s inbox. The web administrator can decide to send a text message back to the sender to verify the information, send out a blast alert to large numbers of people, or post the information onto a web page with location information from Google Maps (or do all three). Ushahidi is free, and although it was primarily developed as a quick information-gathering and broadcasting tool during the riots in Kenya in 2008, it has quickly been adapted for uses other than crisis response. The following programs use the Ushahidi platform to gather information from people and then show on a map where the events are happening and how large an area is affected:

- **Wildlife Trackers** is a citizen science project in Kenya.
- **Stop Stockouts** is an initiative to track near-real-time stockouts of medical supplies at pharmacies (in a medical store or health facility) in Kenya, Uganda, Malawi, and Zambia.

The Ushahidi platform combines the benefits of the Internet and mobile phones and could be used to generate near-real-time information on forest crimes, fire, wildlife sightings, and so on. The advantage of mobile SMS-based data inputs is immense in remote and rural areas.

**Source:** [http://www.ushahidi.com/](http://www.ushahidi.com/).

BOX 15.8: Citizen-Powered Urban Forest Map of San Francisco

An example of crowdsourcing, this project is a collaboration of the government and nonprofits and businesses and citizens of San Francisco to map every tree in the city. Citizens can create an account and upload a tree’s location, its diameter, and a photo of the tree following instructions on the website. There is a link to an online guide called “Urban Tree Key” to help in identification of the trees. The project is the first of its kind, and there has been concern regarding the quality and authenticity of the data entered by the public. The collaborators intend to overcome this challenge by carrying out field verification of random samples of data.

**Sources:** [http://www.urbantreekey.org](http://www.urbantreekey.org); [http://www.urbansan.com](http://www.urbansan.com); Friends of the Urban Forest ([http://www.fuf.net](http://www.fuf.net)).

Collaborative and Participatory Mapping

Maps are vital for decision making in forestry. While public-sector forestry institutions prepare maps to record changes in cover with data from satellites, day-to-day changes at a smaller scale are often not recorded or not available in easily accessible formats to a wider audience. Mapping devices and software have been out of reach for nonspecialists until recently. However, new software makes it possible to put the power of creating and updating spatial information in the hands of field staff and local communities (see image 15.3). Open-source programs make this more affordable for application developers. Communities can partner with forest agencies to help create and update information on forest maps. Information
on boundaries, use rights and planned developments, and small-scale logging or clearing for agriculture have implications for land-use management and governance. Information presented on maps is a powerful visual tool for decision making. It also increases transparency, which is essential when the interests of several stakeholders are involved.

Collaborative mapping is a tool to facilitate spatial data collection and analysis. This tool is more appropriate for the forest sector than basic crowdsourcing, as it allows mapping of points of interest and other geo-referenced information such as specific routes and areas. It can be useful for the staff of forest departments, NGOs, and national-level planning and policy-making bodies.

With the availability of open-source and simpler software for desktop computers, even nonspecialists can view and upload data to maps. Greater accessibility to data is expected as a result of high-speed Internet services around the world, and data on forest cover, deforestation rates, density, and so on are now accessed by a wide range of audiences. Collaborative mapping has the potential to increase and widen the scope of stakeholder participation in project design and management and to facilitate the viewing and updating of project data. Three applications relevant for forestry are discussed:

- PoiMapper
- World Wildlife Fund’s Moabi
- CI Earth’s Participatory Mapping

Moabi is a collaborative mapping system that enables groups and individuals to build a large database for sharing, viewing, editing, and discussing spatial information relevant to REDD+. The system has been developed by the World Wildlife Fund (USA) and is currently being applied in Democratic Republic of Congo. Moabi allows policy makers, research institutions, and carbon project developers to view, download, and edit relevant spatial data. It will facilitate on-the-ground monitoring of activities such as illegal logging, mining, and the bush-meat trade. By using mobile mapping devices, data can be collected and directly uploaded to the system either through the Internet or mobile phones. To compensate for slow Internet connectivity, data can be sent to proxies who will upload the data, making it available to global users. The site is built on open-source, widely used free software such as Google Maps and Drupal, which is a web content management system. This helps ensure that the design is flexible, easily customizable, and functional on a wide variety of computers and web browsers.

Any registered user in Moabi can post data to the website, but the data can only be approved by a peer review member. Users will be able to view both approved and unapproved data in the system and provide ratings on comments on any material posted. The system provides users with incentives to contribute information by recognizing regular contributors through elevated status or promotion to the peer review panel. For mobile phone contributors, incentives may be offered through phone credit awards. Moabi is being developed with funding from a donor. However, once the first pilot is successfully tested in the Democratic Republic of Congo, it is thought that subsequent replications can be developed with a smaller budget of US$ 30,000 to US$ 50,000.13

Moabi has a high level of utility in forest governance, to increase transparency and public interest and participation in development activities that could lead to deforestation and illegal logging and to promote law enforcement. This application

13 WWF (USA), pers. comm.
will be more useful when it allows data collection and uploads via mobile phones to offset the lack of Internet connectivity in rural areas. However, the peer review process for information displayed on the portal may become a point of contention between different stakeholder groups, and it would be important to ensure the integrity of the peer review process.

Participatory mapping is used extensively by development agencies and NGOs around the world. However, customizing a handheld PDA with icons and images and training members of local and indigenous communities in its use are important advances in this area. Helveta Ltd., an international corporation that develops and deploys supply chain and asset management software for timber and agrocommodities has pioneered the use of its Control Intelligence (CI) Earth software to create maps of forest inventory in an online environment accessible by all registered users.

This innovative project is not without its share of problems. An interim review pointed out a number of concerns, mainly with project management and coordination between project partners and improvements in technology, such as more appropriate methods of recharging the GPS batteries, for which the communities currently travel long distances, and to improve the icon designs.14

The use of handheld computers by local communities shows that technology can be customized for all needs, and that it need not be a barrier for illiterate members of the community. However, the handheld devices currently used in the project cost between US$ 800 and US$ 1200, putting them out of reach for most forestry departments. The need for such expensive devices may be justified by the nature of the task—extensive data collection in remote locations necessitating the need for rugged devices—but the appropriate technology has to be selected on a case-by-case basis.

**INNOVATIVE PRACTICE SUMMARY**

*Participatory Mapping in Cameroon*

This project has been implemented in a partnership among local and indigenous forest communities across the southern forest zone of Cameroon and the Forest Peoples Programme, University College London, Centre pour l’Environnement et le Développement, and Helveta Ltd. Local forest-dependent communities were trained in using GPS-enabled handheld computers with the specially developed icon-driven software CI Earth, which requires no literacy skills, to create forest inventory maps. Data are captured using CI Mobile and GPS reader technology. CI Mobile combines handheld data entry with data from GPS, RFID, and barcode readers to gather accurate records of how assets are being managed and processed in the forest or factory. CI Earth uses a CI Mobile interface configured to record data types that are relevant to the particular user or region. CI Earth data are synchronized with CI World through any locally available means of Internet connection, ranging from satellite to dial-up modem. GPS-referenced data are then made available within CI World in chart form and through GIS applications such as Google Earth and ESRI’s ArcView.

The communities are meant to use the devices during their daily expeditions to the forest, recording their use of the resources and their observations of illegal logging activities. These data are then transferred to a secure website via satellite to a data center in the United Kingdom and can be accessed by authorized users and translated into maps. Accurate manipulation of these devices will thus create reliable data and maps that can define resource use, document customary areas, and expose illegal logging practices.

So far, data have been collected south of Dimako in eastern Cameroon. Logging activities were monitored both in and outside communal forest areas where Baka Pygmies currently reside or hunt. Forest communities in the Mbalmayo region recorded bulldozer tracks that indicated industrial logging activities near illegally felled trees found outside of the legal commercial logging boundaries. Data gathered by local communities assisted a logging company operating in the area in identifying which communities it should consult over management plans for local forest areas as part of their Forest Stewardship Council certification process.

The CI Earth software with handheld computers has also been used in Nigeria to monitor biodiversity in the Afi Mountain Wildlife Sanctuary, which is home to a subpopulation of the critically endangered Cross River gorilla.15

**INNOVATIVE PRACTICE SUMMARY**

*The Central Vigilance Commission Website—India*

The Central Vigilance Commission (CVC) was designed to be India’s top vigilance institution, free of control from any...
executive authority. It monitors all vigilance activity under the central government and advises various authorities in central government organizations in planning, executing, reviewing, and reforming their vigilance work. The CVC is a statutory body, and its website (http://cvc.nic.in/) contains the following sections and features:

- Information on its role, responsibilities, and strategies to combat corruption.
- Communication directly with the public through messages and speeches to bolster confidence in the institution.
- Instructions for how any citizen can lodge a complaint against corruption, without fear of disclosure or reprisal.
- Central Vigilance Officer’s List: Each organization is expected to nominate a senior officer to whom an employee can take a complaint on corruption.
- Statistical reporting of the achievements of the CVC and its annual report.
- Details of convictions of public servants by the courts, along with information on officers against whom an inquiry has been initiated or a penalty imposed.
- This section also highlights the performance of various departments responsible for conducting investigations.

A decade ago, publishing names of officers undergoing inquiries on charges of corruption on the CVC website created a stir in the media, but it quickly caught the public’s attention. Despite the low level of access to computers and the Internet, the information has been widely disseminated by radio and print media throughout the country. Thus, the site has had a wider impact than what could be expected based on India’s computer density alone.

Given the explosion in mobile phone ownership and widespread use of the Internet, the CVC has stepped up its use of ICTs. The “Blow Your Whistle” site is a technology-supported anticorruption initiative of the CVC. The site allows citizens to report through mobile phones and the Internet by uploading text, audio, and video files. Known as Project Vigeye, the system requires registration, and once a complaint is filed, the complainant can log in and check the status of the complaint. The “Blow Your Whistle” site also has discussion forums and podcasts on corruption in the country, videos, and links to other resources.16

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**INNOVATIVE PRACTICE SUMMARY**

**PoiMapper in Kenya**

The PoiMapper (“Poi” stands for “point of interest”) is being piloted by Plan in Kenya to develop a geospatial database for project planning and management. Plan Kenya field staff upload answers to preloaded questionnaires on mobile phones and take photos to record the status and use of development infrastructure such as schools, drinking water sources, and clinics. Information collected includes the number of school-age children and population without access to sanitation facilities; each point of interest, such as a school, is tagged with GPS referencing. This information is uploaded to the PoiMapper portal, where it is overlaid on a digital map to provide the agency with a spatial overview of its projects. This database provides the management of Plan Kenya a comprehensive overview of its projects in the field, and facilitates better planning for available resources. One feature of this application is that it allows organizations to share their data, especially when working in the same region.

PoiMapper, as a mobile geomapping, data management, visualization, and sharing solution that can be integrated with open-source portal tools such as Drupal or Vaadin and map engines such as Google Maps or Geoserver. It runs on standard low-end GPS-enabled phones as well as on smartphones. It enables mapping of

- **places**, such as location of schools and water points;
- **routes**, such as roads and water pipes;
- **areas**, such as community boundaries, forests, fields;
- **structured survey data**, such as numbers, text, exclusive, and multiple choice; and
- **multimedia**.

PoiMapper can be used in offline mode for work in locations where connectivity is unavailable and allows viewing of data on digital maps on a web browser. It eliminates the need for expensive hardware and license investments or the need for software licenses. The application allows open access of the stored data and the possibility to integrate open-source analytics tools such as Pentaho for data mining (image 15.4).

The system requires a subscription fee and registration for users to download the software and upload their data to the portal. It will be tested for use in the forest sector through a pilot in Vietnam. Having offline and online capabilities is an advantage in the forest sector, where access to the Internet or cellular networks is often erratic. The cost of the application as a software-as-a-service is a monthly fee per active user. The

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16 The source of information within this section is http://blowyourwhistle.in/pages/about-us/.

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**ECONOMIC AND SECTOR WORK**
price depends on volume, whether a project is associated with it, and in which country it is used. The current default pricing is US$ 15 for NGOs and local users in developing countries and US$ 30 for commercial organizations and users in developed countries. The developer currently requires a minimum monthly engagement of US$ 750 (25 users) to set up a new database and support agreement. The price of mobile phones on which the system works starts from US$ 50 if GPS is not required and US$ 150 with embedded GPS, making them affordable for certain project-specific applications. Field staff already use mobile phones, and the application, if useful for project management, is no more complicated than text messaging.

Multiple users can browse and update the same information, and previous versions of data are maintained for tracking purposes. Data are accessible via a web browser, with appropriate authorization. Once an organization registers on the PoiMapper website and creates its account, the software can be downloaded to the mobile phone. Questionnaires relevant to the organization’s work can be created and downloaded to the mobile phones. Existing data from a particular location on the portal can be downloaded, and only new fields can be updated, which makes the system fast and efficient. The application is available for a monthly subscription fee per user, which allows the organization to store its data and edit them on the PoiMapper portal. At this stage, PoiMapper does not have options for data input through icons, which can be developed if needed, but this would restrict the type of data that could be collected or monitored.17

**IMAGE 15.4: POI Mapping in Kenya**

![POIMapping in Kenya](image)

Source: Plan Kenya.

**Topic Note 15.2: PILLAR 2—QUALITY OF FOREST ADMINISTRATION**

**TRENDS AND ISSUES**

High-quality professionals and good information management are key requirements for effective forest management. Distance learning programs are now available on the Internet from a wide range of universities around the world. In addition, some public-sector forest service websites host customized training packages online. For example the U.S. Forest Service has several online training programs on a number of technical tasks, ranging from basic statistics to cruising and scaling. One application on this site is the “Timber Theft Program,” which uses regression analysis to estimate standing tree volumes from stumps. Demonstrations include how to input data, how to perform regression analysis, and how to generate reports in the program.18

Not all online training courses have been sustainable. For example, in Chile, the Catholic University of Chile developed extensive online professional development courses and modules for forestry professionals called UC Virtual. After some time, these had to be discontinued due to lack of user demand.19

17 The source of information within this section is [http://www.pajatman.com](http://www.pajatman.com).
19 Gurovich (2006) and pers. comm.
Information management, and more specifically, spatial information management is the second key requirement for forest administration. In Finland, MESTA is a free, Internet-based software application that is used to prepare and discuss forest management plans with communities (see Box 15.9). Similarly in the United Kingdom, the Forestry Commission found that discussions over management plans with communities were more productive when the commission was able to present digital plans with three-dimensional maps and images that make the presentations more appealing and make it easier for nonspecialists to comprehend the long-term outcomes of the proposed management actions.

The quality of forest administration also depends on good policy and administration, financial and human resource management, law enforcement and land tenure, and timber sales and revenue management—all of which require unhindered information flows both within the forestry department and with other parts of the government, as well as with the private sector and citizens. Comprehensive forest management information systems have been seen as the ideal solution to enhance the capacity of public-sector forestry institutions to manage these information flows. However, it is possible to deploy smaller-scale ICT solutions to manage information requirements in key areas, such as management of fires, inventories, and wildlife tracking, without investing thousands of dollars in hardware and software. Four such applications are discussed below:

- **Real-time fire alerts**
- **Forest cover and carbon stock assessment with CLASlite and airborne LiDAR**
- **Google Earth Engine**
- **Wildlife tracking**

**Real-Time Fire Alerts**

One innovation in forest management is the near-real-time fire alert system that has been developed by combining NASA’s Moderate Resolution Imaging Spectro-radiometer (MODIS) data with GIS. The Fire Information for Resource Management System (FIRMS) by the University of Maryland analyzes the data from MODIS and presents it in a form that is easy to use by field personnel. The system can deliver e-mail alerts to subscribers with information on likely fires in their area of interest.

A more focused alert system is being developed by Conservation International. The Fire Alert System has been developed for use in specific biodiversity hot spots around the world and is currently piloted in Madagascar, Bolivia, Peru, and Indonesia. This system delivers alerts on fires within a few hours after the NASA satellites sweep the earth. The Fire Alert System is a fully automated analysis and alert system that delivers a range of products tailored to a user’s specific needs.

There are some other highly advanced fire management systems such as the one used by the New South Wales Rural Fire Service in Australia, which received a Meridian Award.

**BOX 15.9: MESTA—Participatory Forest Management Application**

MESTA is open-access Internet software developed and funded by Metsla (a Finnish forest research institute). It was first developed to serve as a tool for Metsähallitus (a state entity that manages state forests and most protected areas) for participatory forest management, but it has become available to private forest owners for evaluating different management strategies. Developed for holistically evaluating different decision alternatives, it is based on the definition of so-called acceptance borders for decision criteria (for example, the minimum income from the forest cuttings).

The strength of the software is that it can facilitate the illustration of the effects of different strategy alternatives at stakeholder meetings. A better understanding of the different alternatives and corresponding results can help one stakeholder group in accepting the needs of another stakeholder group. Through the evaluating process, the stakeholders will get information concerning potential costs and benefits.

MESTA has been used in participatory forest management by Metsähallitus in eastern and western Lapland, where decision making often requires difficult compromising on different objectives and needs, such as combining logging with nature-based tourism.

Compared to other methodologies of evaluating different management alternatives, MESTA allows the study of alternatives with less input information and knowledge on the subject. Therefore, it is considered to be efficient, especially when used in communicating with stakeholder groups that have less direct contact with forestry.

in 2007 (http://www.meridianawards.com). HeliFIRE turns MapInfo Professional into a purpose-built application for the airborne mapping of fires. Using a GPS connection, HeliFIRE becomes a moving map application, showing the user’s current position. Fire features such as active/non-active fire edge, fire trails, threatened properties, water sources, and firefighter locations can be recorded accurately as the aircraft flies over the features. This information is transmitted immediately via the Internet to users on the ground who make the response decisions.

A second application, MapDesk, turns this information into updated fire maps. This custom application from MapInfo Professional has several features that have been standardized to allow the quick generation of maps with minimal training. Information derived from these applications is delivered to all 70,000 personnel, many of whom are volunteers, as well as to other agencies and the broader community.

These custom systems are expensive to build and maintain. But the e-mail and text message updates such as the ones sent by FIRMS are free.

Forest Cover and Carbon Stock Assessment with CLASlite and Airborne LiDAR

The Carnegie Institution for Science’s CLASlite (Carnegie Landsat Analysis System-lite) is a software package designed for highly automated identification of deforestation and forest degradation from satellite imagery. Outputs from CLASlite include maps of the percentage of live and dead vegetation cover, bare soils, and other substrates, along with quantitative measures of uncertainty in each image pixel (see image 15.5).

CLASlite converts satellite imagery from its original (raw) format, through calibration, preprocessing, atmospheric correction, and cloud-masking steps, and then performs a Monte Carlo Spectral Mixture Analysis to derive high-resolution output images. Its algorithms easily identify and accentuate areas where clearing, logging, and other forest disturbances have recently occurred. CLASlite does not provide a final “map” but rather a set of ecologically meaningful images identifying forest cover, deforestation, and forest degradation that can be readily analyzed, processed, and presented by the user.

The new approach involves four steps undertaken in concert to produce a rapid high-resolution assessment of forest carbon:

1. Mapping of vegetation type and forest condition using freely available satellite data and CLASlite.
2. Large-area mapping of forest canopy three-dimensional structure using airborne LiDAR.
3. Conversion of LiDAR structural data to aboveground carbon density estimates using LiDAR-carbon metrics along with a tactical use of field calibration plots.
4. Integration of the satellite map with the airborne LiDAR data to set a regional, high-resolution baseline carbon estimate.

CLASlite runs on standard Windows-based computers and can map more than 10,000 km² (at 30 m spatial resolution) of forest area per hour of processing time. While CLASlite is highly automated, its user guide recommends a level of training corresponding to the complexity of the forest area.

IMAGE 15.5: Satellite Imagery Can Map Levels of Vegetation, Forest Cover, and Forest Degradation

Source: CIFOR.
According to the developers of the system, the cost using a combination of commercial and free data sources is approximately US$ 0.10 per hectare and is likely to fall further. Free licensing of CLASlite is granted to nonprofit/noncommercial organizations in Latin America following completion of technical training. The CLASlite website reports that as of June 2010, more than 150 governmental institutions, NGOs (non-commercial), and academic or research institutions have been trained in the use of CLASlite.

The developers of CLASlite have also tested airborne Light Detection and Ranging (LiDAR) in conjunction with remote sensing and ground mapping to carry out carbon stock assessments, to establish it as a low-cost and efficient method of assessing carbon in different types of tropical forests (see Module 5 on productivity for more on LiDAR).  

Mapping in the Cloud: Google Earth Engine

Google Earth Engine is a technology platform that puts an unprecedented amount of satellite imagery and data—current and historical—online for the first time. It enables global-scale monitoring and measurement of changes in Earth’s environment. The platform will enable scientists to use Google’s extensive computing infrastructure to analyze this imagery. The images of Earth from space contain a wealth of information. Scientific analysis can transform these images into useful information—such as the locations and extent of global forests, detecting how forests are changing over time, directing resources for disaster response, or mapping water resources. The challenge has been to cope with the massive scale of satellite imagery archives and the computational resources required for their analysis. As a result, many of these images have never been seen or analyzed. Now scientists will be able to build applications to use these data on Google Earth Engine and will be able to take advantage of the following features and benefits:

- Landsat satellite data archives over the last 25 years for most of the developing world available online, ready to be used together with other data sets, including MODIS. A complete global archive of Landsat is expected to be available soon.
- Reduced time to do analyses, using Google’s computing infrastructure. By running analyses across thousands of computers, for example, unthinkable tasks are now possible for the first time.
- New features that will make analysis easier, such as tools that preprocess the images to remove clouds and haze.
- Collaboration and standardization by creating a common platform for global data analysis.

Google Earth Engine can be used for a wide range of applications—from mapping water resources to ecosystem services to deforestation. Initial use of Google Earth Engine is most likely to support development of systems to monitor, report, and verify efforts to stop global deforestation.

During the United Nations Framework Convention on Climate Change, COP 16, in Cancun in December 2010, it was announced that 10 million CPU-hours a year over the next two years would be donated on the Google Earth Engine platform to strengthen the capacity of developing world nations to track the state of their forests, in preparation for REDD. The Earth Engine was developed in collaboration with the Gordon and Betty Moore Foundation, the U.S. Geological Survey, Mexico’s state forest agency (CONAFOR), scientists of the Carnegie Institution for Science, the Geographic Information Science Center at South Dakota State University, and Imazon to develop and integrate their desktop software to work online with the data available in Google Earth Engine.

Wildlife Tracking and Management

Conflicts between humans and wildlife are common where communities live in or near wildlife sanctuaries and parks. The following applications prove that ICTs can be used for wildlife tracking and management with the assistance of communities. Even simple mobile text messages sent on a regular basis to communities to keep them updated on the movement of wild animals can go a long way in helping people stay safe and in turn not harm the wildlife. “Push to talk” is a rather infrequently used feature of mobile phone networks in developing countries. However, there is an interesting example of its use to alleviate conflicts between humans and elephants in the Laikipia District of Kenya. This case demonstrates that park management, communities, and the private sector can, assisted by the innovative use of mobile phones, come together to find a viable solution for management of wild elephants and crops.
Another example of ICTs being employed to track wildlife is CyberTracker, a free software application that was developed to enable indigenous communities with little or no literacy to track wildlife in game parks. The software uses icons and pictures to guide data inputs and works on handheld computers with GPS capability. One of the longest ongoing uses of CyberTracker is at Kruger National Park in South Africa, where rangers collect vast amounts of data on, among other things, the movements and behaviors of key species, fires, availability of water, illegal presence and activities of humans, and the presence of new or invasive species of plants. CyberTracker has been piloted in several countries in Africa, mainly for recording and monitoring wildlife and biodiversity data to aid research and management (CyberTracker Conservation 2007).

### INNOVATIVE PRACTICE SUMMARY
**Fire Alert Systems Integrating Remote Sensing and GIS**

Remote sensing and GIS are now being integrated to provide timely information on large-scale fires in the tropics. The Moderate Resolution Imaging Spectro-radiometer (MODIS) that flies on NASA’s Aqua and Terra satellites as part of the NASA-centered international Earth Observing System provides the data. Both satellites orbit Earth from pole to pole, seeing most of the globe every day.24

### The Fire Information for Resource Management System

While NASA’s MODIS Rapid Response system provides near-real-time images and data on global fires in the public domain on the Internet, forest managers in the field would be unable to find the time and technical skills to analyze the data quickly. The University of Maryland developed the Fire Information for Resource Management System (FIRMS) to serve MODIS fire observations to this community. FIRMS displays active fires detected in near-real time using thermal and mid-infrared data from the MODIS instruments; this means the data are processed and available on the web four to six hours after the satellite passes over. Subscribers can sign up for e-mail alerts on fires in their area of interest. The Web Fire Mapper of FIRMS is an open-source, Internet-based mapping tool that delivers locations of hot spots and fires. These can be viewed on an interactive world map showing hot spots or fires for a specified time, combined with a selection of GIS layers and satellite imagery. Each hot spot/active fire location represents the center of a 1 km (approx.) pixel flagged as containing one or more hot spots or fires within that pixel. FIRMS is currently being transitioned to an operational system at the United Nations Food and Agriculture Organization.

### Conservation International’s Fire Alert System

The Center for Applied Biodiversity Science at Conservation International, International Resources Group, Madagascar’s Ministère de l’Environnement, des Forêts et du Tourisme, and USAID have teamed up with the MODIS Rapid Response System and FIRMS to develop an e-mail alert system for fires in or around protected areas and areas of high biological importance. This system currently focuses on some biodiversity hot spots: Madagascar, Bolivia, Peru, and Indonesia. The Fire Alert System is a fully automated analysis and alert system that delivers a range of products tailored to a user’s specific needs. These include simple text-based e-mails containing the coordinates of active fires within protected areas, areas of high biodiversity, different vegetation and land cover types, administrative units, or user-defined regions. The e-mails can include JPEG attachments showing a satellite image of a protected area with the active fire depicted as red squares, ESRI shape files for importing into GIS software, and KML files for importing data into Google Earth. Each e-mail alert also provides information on the time and date of satellite observations and a confidence value for each fire detected. Subscribers may select from a range of background images and maps. The next phase of this system will include multivariate/multicriteria analysis, which enables more flexible user customization, and an advanced report generator.

In addition to fire response and management, the Fire Alert System is now being extensively used to monitor and inform enforcement officials of suspected illegal activity such as illegal logging and encroachment taking place in protected areas.

### INNOVATIVE PRACTICE SUMMARY
**Kenya: Solving Human-Elephant Conflicts with Mobile Technology**

The Laikipia District is home to the second-largest population of wild elephants in Kenya. There is competition for land between the wealthy farmers who own large ranches and private conservancies, small agriculturists, and the elephant herds whose natural habitat and corridors have been made inaccessible by human activity. The frequent encounters between people and elephants have caused human and elephant deaths.

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24 Information within this section is drawn from Davies et al. 2009 and https://firealerts.conservation.org/fas/home.do.
To find a viable solution to this situation, the GSMA Development Fund in collaboration with the University of Cambridge Laikipia Elephant Project, the Laikipia Nature Conservancy, Laikipia Wildlife Forum, Safaricom, Wireless ZT, Nokia, and Nokia Siemens Networks devised a closed-group communication network between the park staff, ranch owners, and farmers in the district with special push-to-talk mobiles. This technology combines the functionality of a walkie-talkie or two-way radio with a mobile phone and enables communication between two individuals or a group of people, as needed, with the push of a single button. With stakeholder consultations and training, the pilot project initiated communication between the Kenya Wildlife Service staff, ranch owners, farmers, and NGOs that normally would not take place in a systematic way. The pilot was meant to reduce human-elephant conflict, by facilitating early communication between the stakeholders regarding elephant movement and seeking the help of wildlife rangers when needed.

The results of this pilot proved that improved communication between the various stakeholders significantly reduced human-elephant conflict: 73 percent of the users in the pilot said that the technology provided early warning of elephant raids and allowed the farmers to take preventative actions. Sixty-five percent of the users also reported that the system helped prevent theft of livestock and recover stolen livestock. Twenty-one percent also reported that management response improved, especially by the Wildlife Service staff. An important observation by one user was that group communication increased pressure on the government staff, because several members listen in to a request for intervention. Thus, accountability of the Wildlife Service staff seems to have increased.

The use of this technology was also appreciated by the Wildlife Service, which reported that receiving reliable information over a larger area helped it to be more effective in the job.

While the results of this pilot were very encouraging, the service was not rolled out on a larger scale. Cellular operators did not find this technology commercially attractive in Kenya. Nevertheless, the pilot proves that “push to talk on cellular” has benefits in specific situations and could be used in other locations where similar challenges in wildlife management exist.25

**Topic Note 15.3: PILLAR 3—COHERENCE OF FOREST LEGISLATION AND RULE OF LAW**

**TRENDS AND ISSUES**

In the forest sector, various types of resource use, both commercial and noncommercial, are governed by various laws. At the same time, forests have several characteristics that make them prone to timber theft and other illegal activities:26

- owner absent
- potential witnesses indifferent or hostile to owner
- easy to bribe way out of trouble
- asset unsupervised/unguarded
- loot easy to sell
- owner/manager unaware of inventory and value
- police untrained, underequipped, uninterested
- staff untrained and underpaid
- lax business practices/procedures

Many of these vulnerabilities can be addressed through ICTs. Effective law enforcement systems in the forest sector usually follow the steps of prevention, detection, and suppression. Technology has an important part to play in each of these steps in the efforts to curb illegal logging, transportation, and processing of timber and illegal trade in wildlife. A variety of ICT applications can be used to improve deterrence and response measures, and these have been discussed in detail in previous World Bank reports.27 A few innovative ones are reviewed here:

- **prevention**—e.g., crime mapping, corruption hotlines
- **detection**—e.g., timber tracking, chain of custody systems, checkpoints, satellite images, GPS surveillance
- **suppression**—e.g., crime databases, case management systems

**Mobile and Online Crime Reporting Services**

Governments around the world are increasingly involving citizens in crime reporting through e-government services to

25 Information within this section is drawn from Graham et al. 2009.
27 See, for example, Magrath et al. 2007, Asia–Pacific Forestry Commission 2010, and Dykstra et al. 2003.
report incidences of corruption and crime. Members of the public can send text messages, leave a voice message or send e-mails to report incidences of corruption and crime. Allowing citizens to report crime to the authorities is a cost-effective and reliable way of preventing crime. The website of India’s Central Vigilance Commission has a similar system where anonymous callers can report corrupt officials of state agencies. The example from a crime prevention project in Peru shows how citizens can effectively contribute to law enforcement and crime reduction in a municipality. The municipality of Miraflores in Peru and has developed a system called Alerta Miraflores to manage crime, using an Internet and phone-based system that does the following:

- gives citizens a way to report incidents to local security officials to record and take action
- captures data electronically and displays the information on reports and maps to let public safety officials pinpoint the areas from which citizens are calling, define priorities, and dispatch the closest officers
- allows municipal officials to manage citizen security proactively, respond more rapidly, and analyze results

By improving its ability to rapidly respond to reported incidents, providing timely feedback to citizens, and capturing detailed crime information, the municipality was better able to prevent crime and increase citizen security. Alerta Miraflores has reported a 68 percent drop in robberies since 2003, and a 30 percent reduction in assaults and a significant reduction in overall crime.

The tools and methods used in this project have a lot to offer to the forest sector. One application was used by the Blue Link Information Network’s project in Bulgaria called “Expose and Improve—The Power of Information Technologies (IT) in Combating Illegal Logging.” Individuals participate by registering alerts (30 alerts have been logged in the system since its launch in July 2009) and by supporting NGO experts in the preliminary checks on the registered alerts. Alerts are checked against a checklist of indicators to verify the criminal character of the case before submitting it to the authorities. Established environmental NGOs in Bulgaria have demonstrated their genuine interest and active support of the project by providing expert advice on forestry issues, participating in preliminary checks, and lobbying for the integration of the online platform into the work of the Bulgarian forestry administration. While this project was developed and executed by an NGO, it could be easily undertaken by forest law enforcement agencies. The system could enlist the services of interested NGOs and citizens to report suspicious activities that can trigger additional investigation by the forest agency. The ability to receive information via mobile text messages or voice messages helps the system to be used by anyone.

A key issue to be solved is the confidentiality of information and safety of the informants. It is essential that all information is dealt with very carefully both to ensure the safety of the individuals who report crimes and to ensure that the reporting system is not used for spreading unfounded allegations.

Tracking and suppressing illegal logging and trade in endangered wildlife often needs information beyond the borders of a single country. The United Nations Office on Drugs and Crime has developed a series of software applications to help countries collect, analyze, and share intelligence and information on international crime (see box 15.10).

**Technologies for Surveillance and Deterrence**

While there are several sophisticated technologies available for crime detection, only some are specific to the forest sector. One application was used by the Blue Link Information Network’s project in Bulgaria called “Expose and Improve—The Power of Information Technologies (IT) in Combating Illegal Logging.” Individuals participate by registering alerts (30 alerts have been logged in the system since its launch in July 2009) and by supporting NGO experts in the preliminary checks on the registered alerts. Alerts are checked against a checklist of indicators to verify the criminal character of the case before submitting it to the authorities. Established environmental NGOs in Bulgaria have demonstrated their genuine interest and active support of the project by providing expert advice on forestry issues, participating in preliminary checks, and lobbying for the integration of the online platform into the work of the Bulgarian forestry administration. While this project was developed and executed by an NGO, it could be easily undertaken by forest law enforcement agencies. The system could enlist the services of interested NGOs and citizens to report suspicious activities that can trigger additional investigation by the forest agency. The ability to receive information via mobile text messages or voice messages helps the system to be used by anyone.

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**BOX 15.10: UNODC’s “Go” Family of Products**

The Information Technology Service of the United Nations Office on Drugs and Crime (UNODC) specializes in the development, deployment, and support of software applications for use by member states in a range of UNODC’s program areas. The Government Office (“go”) family of products are part of UNODC’s strategic response to crime, particularly serious and organized crime. The “go” family includes integrated investigative case management and intelligence analysis tools for financial intelligence units, law enforcement, investigative, intelligence, regulatory, prosecution, and asset recovery agencies, and for courts and other government agencies involved in the criminal justice process. All the software products include multifaceted integration and can function as stand-alone applications or together to form one global system, depending on the needs of the country. The application of systems able to interface with each other encourages interagency and cross-border cooperation and information sharing at the national, regional, and international levels.

BOX 15.10: continued

The computerization of checkpoints in Gujarat, India, is a good example of how technology can lead to better law enforcement and increased revenues for the state.

A slightly different approach for surveillance—with the help of GPS—has been tried with success in fisheries in West Africa under the Sustainable Fisheries Livelihoods Program, sponsored by FAO and the UK Department for International Development. Community surveillance of fishing grounds in Guinea has succeeded in reducing illegal incursions by industrial trawlers by 59 percent. Members of the fishing community on Guinea’s northern coast use GPS technology to track poachers. The fishermen can calculate the exact location of a poaching trawler using a handheld GPS receiver and radio the information to the nearest coast guard station. The GPS coordinates generate an alert if the trawler is in within the prohibited zones. The fisheries example has a lot of relevance for the forest sector; while communities may not be in a position to monitor vehicle movement inside forests, forest authorities could use similar means to track vehicle movement in unauthorized locations.

Technologies for Timber Tracking and Chain of Custody Systems

Radio frequency identification (RFID) holds considerable promise for use in systems tracking the timber supply chain. RFID uses radio waves to exchange data between a reader and an electronic tag attached to an object, for the purpose of identification and tracking. Some tags can be read from several meters away and beyond the line of sight of the reader.

On average, an appropriate RFID chip costs from US$ 0.07 to US$ 0.15. An important advantage of RFID systems for log tracking is that signals can be read rapidly, remotely, and under difficult conditions. RFID labels can potentially store a large amount of data with a high level of security. The labels can be difficult to counterfeit or tamper with and can provide a high level of covert security. These devices can significantly facilitate data capture, data processing, and security audits. It is possible to encode RFID labels at all stages of the wood
supply chain from the field to the end user. RFID labels can enhance logistics and inventory functions.

Microtaggant tracers are microscopic particles composed of distinct layers of different colored plastics that can be combined to form a unique code. Millions of permutations are possible by combining several colors in different sequences. Codes can be read in the field with 100-power pocket microscopes. These tracers can be used together with other labels to provide additional security and to aid investigations of log theft or log laundering. They do not represent a stand-alone labeling technology.

Chemical and genetic fingerprinting offer promise for the future but are currently too expensive and have not been fully developed for routine use in wood supply chain tracking systems. They are likely to prove most useful in proving the origin of wood in investigations of log theft or log laundering.

GPS tracking devices for vehicles can be used to track movement of vehicles and can quickly point to vehicles in unauthorized locations. The GPS vehicle tracking unit can have a wireless modem that is able to communicate with global tracking systems (image 15.6).

More technologies and two examples of timber tracking are discussed in IPS “Ghana National Wood Tracking System” and IPS “Liberia: LiberFor Chain of Custody.”

**Legal Information Management Systems: Global Legal Information Network**

The Global Legal Information Network (GLIN) is an electronic online tool that gives access to authentic and updated official legal information at a low maintenance cost. The system has been developed by the U.S. Library of Congress to improve access to original legal texts. In Gabon, GLIN has been used by the government to publish the primary sources of the law and all environmental legal information. The government chose to become a member of GLIN to provide the stakeholders (forest administrations, private sector, donors, civil society, NGOs, and so on) with a modern legal archiving system. The system helps to strengthen the rule of law and to start a discussion among stakeholders. Experience from courts and government institutions has shown that the Internet was their only source of access to reliable, up-to-date legal information.

**INNOVATIVE PRACTICE SUMMARY**

**Ghana National Wood Tracking System**

The Ghana National Wood Tracking System (WTS), developed by Helveta Ltd., provides a timber legality assurance system that is an important tool in reducing illegal logging—a key initiative under the EU–Ghana Voluntary Partnership Agreement. The system addresses the traceability of wood in on-reserve areas destined for export. However, a chain-of-custody system should track all wood and wood products in circulation in a given market. Otherwise the system makes it easy to “launder” illegal wood—that is, mix it with legitimate sources. The system uses handheld computers in remote forest areas in conjunction with plastic barcoded tree and log tags to capture data such as species, diameter, length, and geospatial location. WTS is based on an existing


system from Helveta Ltd. called CI World. It consists of four main components:

- identification and tagging of individual products or consignments using barcoded labels or RFIDs
- incorporation of these tag numbers onto the statutory forms used for declarations, inspections, and other relevant records and reports
- use of electronic technology for data collection and transmission
- development of a database to receive, analyze, and report all wood production and movements

WTS allows Ghana to demonstrate compliance and control across their timber supply chains and secure access to premium markets in the European Union and United States. Trees are numbered (engraved on the tree), and next to the numbering is a white tag that has a barcode with the corresponding number.

A PDA equipped with GPS, scanner, camera, and data input is handed out to the enumerators who venture into the reserve with the field rangers and supervisors. The stock enumeration involves numbering and tagging the yet-to-be harvested timber with a barcode near the base of the tree. When harvested, the timber would also have a replica number and barcode, allowing tracking of the timber through the process to export. Information collected includes the following:

- Allocation of reserves, compartments, and lots
- Consortium holding
- Consortium harvesting schedule and by whom
- Plant species and how harvest is done
- Where to mill
- Due diligence on taxes
- GPS position of trees

The timber flows monitored and verified are standing trees in the lots or compartments in the forest reserves; the system has not yet proceeded to tracking the timber through logging and processing, import to processing, and local sales or export. WTS will enable the tracking of individual logs and consignments of processed products. It will include product labeling, physical inspections, and documentation checks electronically. The use of ICT in this case allows a more comprehensive review of all wood movements than paper-based systems alone can provide, which is the current method.32

The system has tagged and located approximately 440,000 trees, verified approximately 180,000 trees in the system, and invoiced more than US$ 11 million in revenue, mainly from areas fees.

With the new system, the Liberian Forest Development Authority will be able to do the following:

- Manage the supply chain for all wood products from the point of origin to the export gate or domestic markets.
- Manage the conditions for release of timber export permits.
- Ensure that taxes and fees related to timber production and trade are collected.
- Invoice and monitor payments by logging companies to the government through an information system involving the forest administration, Ministry of Forestry and Central Bank.
- Strengthen the capacity of the Liberian Forest Development Authority.
- Help both the Forest Development Authority and private concession holders to better know the resource base in the forest, which is a precondition for sustainable forest management.

The LiberFor chain-of-custody system is being operated on a build-operate-transfer basis by SGS Liberia. While the system is technically functioning and able to meet the requirements of law enforcement and revenue collection, there are severe concerns regarding the sustainability and feasibility of the system. Both public and private sector stakeholders have raised concerns that the system is extremely complicated, has increased transaction costs unnecessarily, and is inappropriate for the Liberian context. The main concerns were based on the need to have a 100 percent inventory (above a threshold size) of the logging sites (as opposed to only collection information on commercial species), inappropriate design of the tags, and dependence on LiberFor inspectors. One issue of concern is that the system runs on Helveta servers in the United Kingdom rather than in Liberia. Long distances and limited international bandwidth may lead to reliability issues.33

**Topic Note 15.4: PILLAR 4—ECONOMIC EFFICIENCY, EQUITY, AND INCENTIVES**

**TRENDS AND ISSUES**

Timber sales and auctions and concession-allocation processes are prone to unfair practices, collusion, and nontransparent decision making. This ultimately has an impact on both state revenues and private sector competitiveness. In general, participatory design and proper enforcement of the law should result in more equity and economic efficiency. Thus, technologies aiding law enforcement could be considered tools for enhancing equity and efficiency as well.

**Online Timber Sales, Licenses, and Auctions**

There are examples of ICT applications that are designed to promote business transactions with the private sector. One such example is the online auction of public timber, or e-auction. Most forest agencies in developing countries do not have integrated and well-functioning forest management and information systems that would enable e-auctions. Even in developed countries there are only a few instances of fully online systems.

The Forestry Commission of the United Kingdom has an advanced online auction system (image 15.7). The auction process is fully online and integrated into the e-government service of the United Kingdom. This site is simple to use and has a help feature that tackles most of the common problems faced by users. The site explains the different types of auctions and allows bidders and nonbidders to view sales events, which increases transparency. All terms and conditions are posted, so that bidders are fully informed before bidding. In addition, there are links and phone numbers to provide help. As a truly online auction, the sale closes automatically when the bid closes and the winner is informed, with no further need for paperwork. Bidders cannot see other bidders’ quotations, and losing bidders are only given the name of the winning bidder on request. The system has been operational since 2004, and about one-third of the Forestry Commission’s annual production of about 6 million m³ is sold on the open market, indicating that electronic sales are an effective model. Cost-benefit analyses carried out by the commission reveal that approximately £100,000 are being saved annually as a result of electronic sales.34

The commission also operates an online grants and licences system that provides private forest and farmland owners an opportunity to apply for grants to plant trees or seek permission to fell trees on their lands. The system enhances transparency by displaying all applications on the website,

33 Information within this section was provided by the LiberFor team.
34 Pers. comm.
linking each application by a case number to the map, which shows the location of the proposed activity.

Logistics
Two examples from Finland demonstrate the use of tracking devices to improve efficiency and productivity. One project, called Indisputable Key, used RFID to reduce waste and increase the usable volume of wood from the harvest, while the Metka project was aimed at reducing transportation costs to increase productivity. Transportation costs are optimized when only those piles of bioenergy wood that have dried to the right moisture content are transported by the company. Both examples could be adapted to any wood-processing unit around the world.

INNOVATIVE PRACTICE SUMMARY
RFID Chips for Efficient Wood Processing

The multinational development project Indisputable Key was a three-year EU-funded endeavor with a total budget of €12 million. It was launched in 2006 and held its final seminar in March 2010. The primary objective of the project was to decrease the proportion of timber that is wasted or used for lower-value end products than the initial timber quality would have warranted. The data management is based on Individual Associated Data methodology. According to this methodology, each felled tree has a unique code through an embedded microchip connected to a database. The chip or tag can also include information about the log parameters, felling location, and time of felling. This information is used in subsequent stages of the production chain to optimize process exploitation. Within the project, a new type of RFID tag was developed. By using new, pulping-compatible raw material, the tag does not affect any of the processing options. The project also resulted in the development of transponders that could read and modify tag data in harvesters and in tools such as large metallic saws, which had been problematic with the old transponders. The system was designed to be usable in all possible field conditions within the European Union, from the northern icy conditions to the southern warm and dry conditions.

The increased efficiency of the timber supply is achieved through the ability to source the raw material from the harvesting point all the way to the most profitable producing unit. Currently, the forest industry consumes timber in bulk without taking full advantage of the different characteristics of wood harvested from different origins. By being able to identify different sources, manufacturers can take into account the differences in timber quality in the processes. The quality aspect is noticed in market transactions through premiums for better timber quality. The methodology and technology behind the system are fully transferable to any geographical area.

IMAGE 15.7: Online Timber Sales in the UK

Source: UK Forest Commission.

ECONOMIC AND SECTOR WORK
Metka

Metka is a development project that uses an RFID tracking system. The project’s objective is to develop an operational tracking system for local bioenergy supplier Vattenfall; the client benefits from increased profitability of wood-based bioenergy production. The software developer Protacon built the information database, basing the system on existing Oracle-based stock management software. The tracking system is built on RFID tags attached to the bioenergy wood piles when harvested. The cost efficiency of the system is achieved by using cheap, low-capacity bulk tags. This makes it possible to track low-value items as well. The tag allows the company to follow the chain of custody more carefully and to optimize the processes to reduce the transportation costs. Another benefit from the information in the tags is the ability to optimize the drying time of harvested wood in order to minimize the transportation costs and maximize the caloric value per transported units. This has a remarkable effect on the chain profitability. The system has been taken into operational use by Vattenfall. At the moment, the system is in use in the areas of two forest management associations and by two operators. The total number of vehicles and forest tractors using the system is about 10.36

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(When the source is a personal communication, website, or unpublished report, it is mentioned in the footnotes and not listed in the references.)


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ICT IN AGRICULTURE