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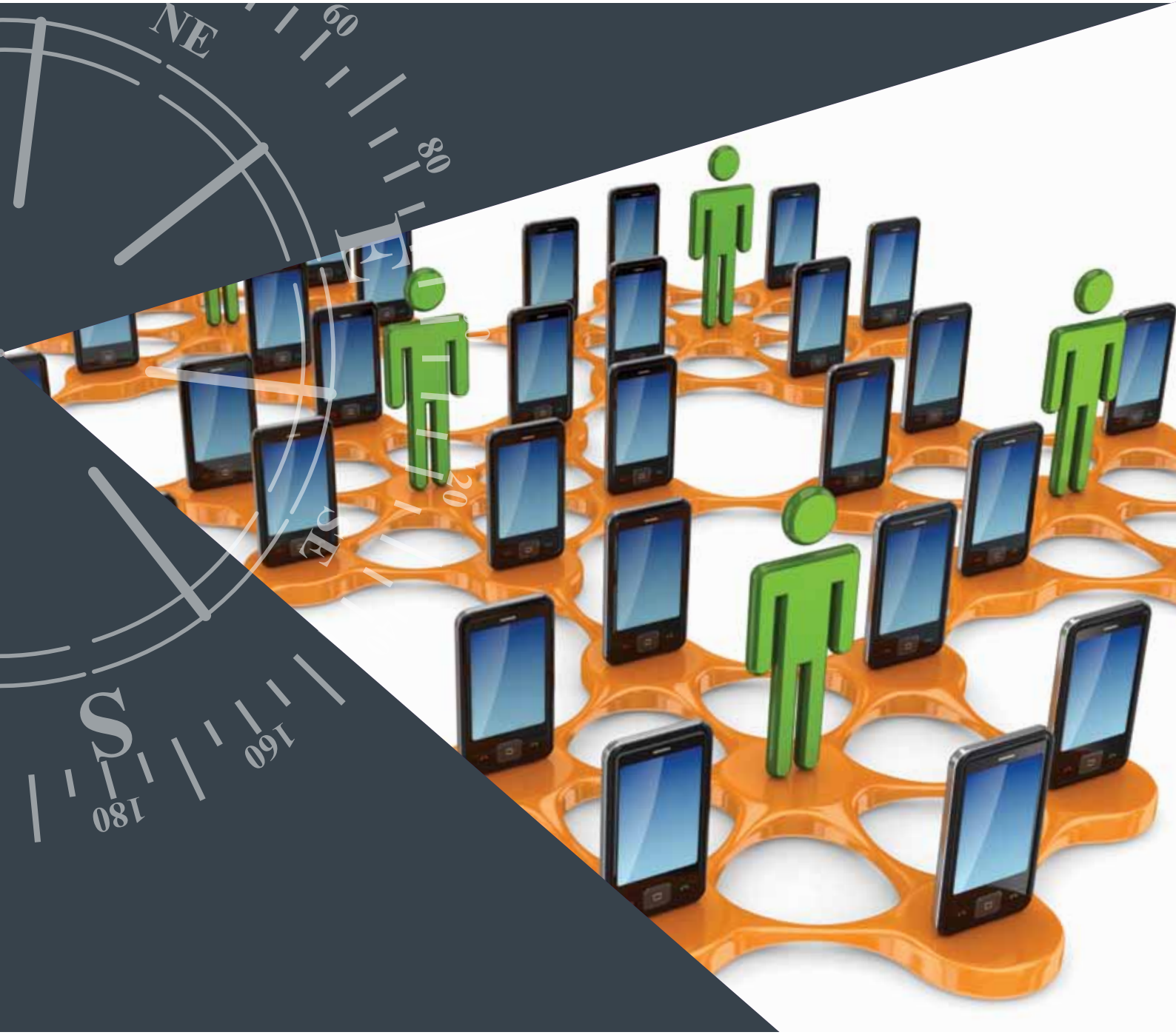
Crowdsourcing Support of Land Administration

A new, collaborative partnership between citizens and land professionals



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Crowdsourcing Support of Land Administration

A new, collaborative partnership between citizens and land professionals

Report for Royal Institution of Chartered Surveyors

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1.0 Executive Summary

Land Administration Systems (LAS) provide the formal governance structures within a nation that define and protect rights in land, including non-formal or customary institutions. Their benefits range from guarantee of ownership and security of tenure through support for environmental monitoring to improved urban planning, infrastructure development and property tax collection. Successful land markets depend on them.

Despite this pivotal support of economic development, effective and comprehensive LAS exist in only 50 mostly OECD countries and only 25 percent of the world's estimated 6 billion land parcels are formally registered in LAS. This leaves a large section of the world's population with reduced levels of security of tenure, trapping many in poverty. Missing and dysfunctional LAS can precipitate problems such as conflicts over ownership, land grabs, environmental degradation, reduced food security and social unrest. Rapid global urbanisation is exacerbating these discrepancies.

This security of tenure gap cannot be quickly filled using the current model for registering properties that is dominated by land professionals. There are simply not enough land professionals world-wide, even with access to new technologies. To quickly reduce this inequality we need new, innovative and scalable approaches to solve this deep-seated problem. This is one of our fundamental global challenges.

This paper explores one potential solution to the security of tenure gap: 'crowdsourcing'. Crowdsourcing uses the Internet and on-line tools to get work done by obtaining input and stimulating action from citizen volunteers[1]. It is currently used to support scientific evidence gathering and record events in disaster management, as witnessed in the recent Haiti and Libya crises, for example. These applications are emerging because society is increasingly spatially enabled. Establishing such a partnership between land professionals and citizens would encourage and support citizens to involve themselves in directly capturing and maintaining information about their land rights.

Although citizens could use many devices to capture their land rights information, this paper advocates the use of mobile phone technology. Due to high ownership levels (5 billion licenses world-wide) and widespread geographic coverage (90 percent of the world's population can obtain a signal), especially in developing countries, mobile phones are an excellent channel for obtaining crowdsourced land administration information. Frugal innovation is making them affordable for all, especially in developing countries where a new generation of information services in health and agriculture, for example, is turning the mobile phone into a global development tool.

Mobile phones are progressively integrating satellite positioning, digital cameras and video capabilities. They provide citizens with the opportunity to directly participate in the full range of land administration processes from videoing property boundaries to secure payment of land administration fees using 'mobile' banking. But even today's simpler phones offer opportunities to participate in crowdsourcing.

A key challenge in this innovative approach is how to ensure authenticity of the crowdsourced land rights information. The paper explores applicability of the approaches adopted by wikis[2], e-commerce and other mobile information services and recommends the initial use of trusted intermediaries within communities, who have been trained and have worked with local land professionals. This approach has the potential to provide a good level of authenticity and trust in the crowdsourced information and would allow a significant network of 'experts' to be built across communities. To optimise the scarce resources, these intermediaries could be involved in a range of other information services, such as health, water management and agriculture.

Crowdsourcing provides an opportunity for land professionals to forge a new relationship with citizens to jointly solve the global challenge of security of tenure. This citizen collaboration model encourages land professionals to rethink how land administration services are designed and delivered resulting in the more inclusive and 21st century aim of supporting land administration by the people, for the people.

1 www.crowdsourcing.org 2 Wiki is a piece of server software that allows users to freely create and edit Web page content using any Web browser.

2.0 Aims of Paper

Citizens are increasingly volunteering their knowledge, personal time and energy using the Internet and on-line tools to get work done, to obtain input and to stimulate action. Current applications include counting birds, checking water quality and creating new base mapping for developing countries. Crowdsourcing has never been directly applied to the capture and management of land rights within the land administration sector. Is it feasible and can it help to rapidly shrink the security of tenure chasm? This paper explores how we could engage citizens through crowdsourcing within a new citizen collaborative model for land administration that would be much more inclusive for the disadvantaged and vulnerable, increase access to land markets and help support poverty reduction. It is primarily a challenge to land professionals to radically rethink how land administration services are managed and delivered.

3.0 What is Crowdsourcing?

Before science became the preserve of the professional scientist, almost all science was citizen science albeit mostly by affluent members of society. Famously, Charles Darwin joined the Beagle voyage, not as a professional naturalist, but as an unpaid companion to Captain Fitzroy (Haklay, 2011). However, even with the rise of the professional scientist, the role of volunteers remains significant, especially in archaeology, astronomy and natural history. People sign up to support archaeological excavations, others collect and send samples and observations to national repositories. For example, the Christmas Bird Watch started around 1900 counted a total of 63 million birds in 2009 using tens of thousands of observers (Silvertown, 2009). More recently, communities have been gathering scientific evidence to fight environmental issues, for example, the approach of the Global Community Monitor to support citizens in gathering air samples in buckets (Scott and Barnett, 2009). Tapping into 'crowds' of people using the Internet and on-line tools to get work done, to obtain input and to stimulate action is called 'crowdsourcing' and is part of the wider societal change towards participatory democracy. A good example of citizens influencing government policy is 'FixMyTransport'[3]; a site specially built for public transport users who want to make public transport better for all in the UK.

Traditionally governments have had their own formal channels for collecting public sector geospatial information through National Mapping Agencies and Land Administration Agencies, for example. Originally internal resources were used, but increasingly over the past 30 years, the private sector has been involved in the collection and maintenance of data through outsourcing and partnership agreements. However, a dramatic shift in how geospatial data are sourced is unfolding through the direct involvement of citizens in crowdsourcing. Its roots lie in the increasing convergence of three phenomena: the widespread use of Global Navigation Satellite Systems (GNSS) and image-based mapping technologies by professionals and expert amateurs; the emerging role of Web 2.0, which allows more user involvement and interaction; and the growth of social networking tools, practices, and culture. This crowdsourcing approach is also known as "Citizen Cyberscience" (Haklay, 2011), Volunteered Geographic Information (Goodchild, 2007) and "neogeography" (Turner, 2006).

The highest profile mapping based crowdsourcing initiative is OpenStreetMap[4] which has spearheaded the democratisation of mapping. In August 2011, this world-wide initiative involved over 400,000 citizens and 2,480,072,760 GPS points had been uploaded in mapping covering most countries of the world[5]. State governments in Victoria, Australia and North-Rhine Westphalia, Germany employ volunteers to input to their mapping programs (Coleman et al., 2010). In the commercial domain, firms like Tele Atlas, NAVTEQ and TomTom use Web-based customer input to locate and qualify mapping errors and/or feature updates required in their road network databases. Google Map Maker now provides citizens in 188 jurisdictions with the ability to help populate and update Google Maps' graphical and attribute data (Google, 2011). Further examples are included as case studies in the annex.

Not all capture of crowdsourced information is active. We are increasingly carrying devices that can sense and can be sensed. Ubiquitous sensing has entered the back pocket and handbag. In the case of mobile phones, a significant amount of information is captured passively (usually with the authority of the user). Mobile phones are progressively being spatially enabled through integration with GNSS technology, cell phone triangulation or Wi-Fi positioning. The location of mobile phones can therefore be regularly sampled to determine traffic flows (Cheng, 2008) and to measure signal strengths[6] to create coverage maps, for example. The mobile phone is generating a move to distributed citizen/participatory sensing and supporting Mobile (M)-government as an extension or supplement to e-government and providing information and services through mobile devices (Trimi and Sheng, 2008).

But what persuades citizens to use their spare time and give up their weekends for mapping parties to make contributions to web content? Recent research by Coleman (2010) has indicated a wide range of motivations both constructive and negative. Some involve themselves because of professional or personal interest, enhanced personal reputation and pride of place whilst others for mischief, malice and/or criminal intent. Also there is an ageing population of skilled retirees capable of contributing high quality information: research in the USA has shown that citizen scientists identified crab types correctly 95% of the time (Cohn, 2008). However, with so many crowdsourced sites contending for the attention of the citizen, will fatigue and lack of interest over time make citizen contributions a scarce resource?

By tapping the knowledge, personal time and energy of volunteer contributors, crowdsourcing has the potential to relocate and redistribute selected government service activities from government agencies to networks of non-state volunteer actors. This paper looks at the potential of crowdsourcing supporting Land Administration activities.

3 www.fixmytransport.com 4 www.openstreetmap.org 5 http://www.openstreetmap.org/stats/data_stats.html 6 www.OpenSignalStrength.org

4.0 Reasons Why Land Administration Systems are Important

This section highlights the benefits of land administration systems, but also indicates that the current solutions are not scalable to solve the global problem.

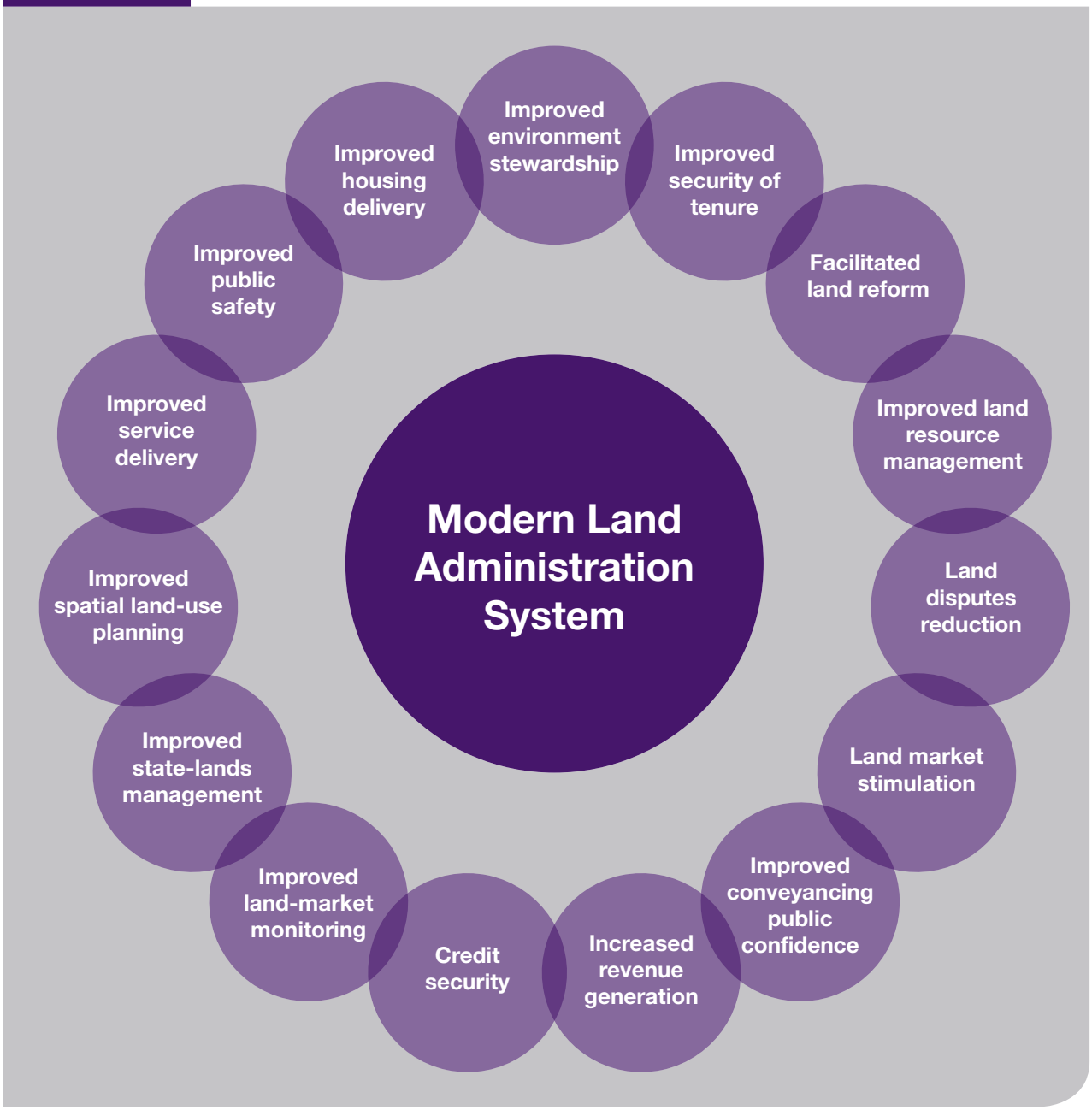
4.1 What are Land Administration Systems?

"Land administration" has been defined by the United Nations Economic Commission for Europe as "the process of determining, recording, and disseminating information about ownership, value, and use of land, when implementing land management policies" (UNECE 1996). Land Administration Systems (LAS) provide the infrastructure for implementing land policies and land management strategies in support of sustainable development. Typically, it is the formal governance structures within a nation that define and protect rights in land. Recognition is growing, however, that non-formal or customary institutions can and should play a role in defining and protecting land rights and that they need to be included in the on-going development of land administration. There is an urgent need for land law and policy reform concerning the recognition of customary land rights, partial interest (secondary rights) on state land and resource rights. Uganda, Kenya, Ghana and Mozambique are developing along this line, but too many countries are not. Without an improved policy and legal framework, people will just register informalities.

Figure 1 illustrates examples of the benefits of good land administration (UNECE, 2005), ranging from guarantee of ownership and security of tenure through support for environmental monitoring to improved urban planning, infrastructure development, and property tax collection.

Good land administration creates accurate, accessible, interoperable, timely, secure, and complete information about land and property in an affordable and efficient way that promotes confidence in the public, its commercial enterprises, and government. The records commonly held for land administration are also the bedrock for integrated spatial information systems that link multiple users in the provision of government services by electronic means (e-government). They often provide the key data needed by all local and central government organizations and, to a lesser extent, by the public (McLaren and Stanley, 2011). Land Administration services are delivered by land professionals: licensed cadastral surveyors, notaries, lawyers, planners, property valuers, to name a few.

Figure 1 Benefits of Modern Land Administration Systems (McLaren and Stanley, 2011)



Where countries lack robust and tested LAS, significant dysfunctions can occur. Examples include:

- Weak land markets, conflicts over ownership, land grabs, and social disharmony
- Diminishing food security, negative impacts on the environment, and civil unrest
- Lack of an essential policy tool that can assist governments in creating a civil society with democratic norms
- Cannot participate in the Reducing Emissions from Deforestation and Degradation Plus (REDD+) incentive system that can offer developing countries substantial financial benefits for protecting their forests
- Reduced potential for economic growth as the large amount of capital typically invested in real property is never formalised and integrated into the financial system.

4.2 Are current Land Administration Systems delivering the benefits?

Despite the clear link between effective LAS and efficient land markets (Al-Omari, 2011), sustainable development and the other benefits highlighted in Figure 1, their current adoption and effective implementation are limited to about 50 countries and found mainly in OECD countries and in countries in transition in central Asia (Enemark et al., 2010). A number of factors limit their scope of implementation:

- Costs are significant and national solutions can take from five to over 20 years to implement
- Overly complex procedures lead to high service delivery costs and end user charges, excluding the poor and the vulnerable
- Lack of a supporting land policy framework ensures that the LAS do not deliver against the main drivers of land tenure, land markets and socially desirable land use
- Insufficient support for social and customary tenure systems excludes large proportions of the population
- Lack of transparency encourages corruption in the land sector, lowering participation through lack of trust
- Communication channels to customers are either office or Internet based and lead to geographic discrimination or exclusion through the 'digital divide'
- A mortgage requires a bank account and credit rating, which is difficult for the poor and those remote from financial services to obtain
- Cadastral surveys using professional surveyors are normally mandatory and generate higher fee rates, e.g. in the USA, a typical residential land parcel costs $300 -$1,000[7] to survey depending on local rates and the size and type of parcel.

It is estimated that there are around 6 billion land parcels or ownership units world-wide, but currently only 1.5 billion parcels are formally registered and have security of tenure (Zimmerman, 2011). Within many of the 4.5 billion unregistered parcels[8], 1.1 billion people live in the squalor of slums. With urbanisation predicted to increase from the current 50% to 60% in 2030 and a further 1 billion being added to the world's population in this timeframe, the security of tenure gap will become a chasm. This will be impossible to fill in the foreseeable future using the currently available land administration capacity. The International Federation of Surveyors (FIG) currently represents 350,000 land professionals world-wide. The current LAS paradigm cannot be scaled up quickly enough to meet the demand.

The lack of effective, affordable and scalable LAS solutions conspires to limit access to land administration services by large sections of society, especially the most vulnerable, leaving them trapped in poverty. There is a pressing need to radically rethink LAS: simplify procedures, reduce the cost of transactions, and open new channels for participation. Crowdsourcing through ubiquitous mobile phones, for example, offers the opportunity for land professionals to form a partnership with citizens to create a far-reaching new collaborative model and generate a set of LAS services that will reach the world's poor. The rest of this paper explores how citizens can be empowered to support the delivery of LAS services through crowdsourcing.

7 http://www.costhelper.com/cost/home-garden/land-surveyor.html 8 Including state land, individual land rights on public land and customary land right units.

5.0 A New Citizen Collaboration Model for Land Administration

This section provided a vision of how citizens armed with mobile phones, with the help of land professionals, could effectively capture and manage their land rights.

5.1 The Increasingly Pervasive Mobile Phone

Although citizens can provide their crowdsourced data through a number of traditional channels, including paper, mobile phones are progressively proving to be the device of choice. Mobile phones have made a bigger difference to the lives of more people, more quickly, than any previous communications technology. They have spread the fastest and proved the easiest and cheapest to adopt (see Figure 2). In the 10 years before 2009, mobile phone penetration rose from 12 percent of the global population to nearly 76 percent. It is estimated that around 5 billion people currently have mobile phones and 6 billion will have them in 2013[9].

Recently, the fastest growth has been in developing countries, which had 73 percent of the world's mobile phones in 2010, according to estimates from the International Telecommunications Union[10]. In 1998, there were fewer than four million mobiles on the African continent. Today, there are more than 500 million. In Uganda alone, 10 million people, or about 30 percent of the population, own a mobile phone, and that number is growing rapidly every year. For Ugandans, these ubiquitous devices are more than just a handy way of communicating: they are a way of life (Fox, 2011). Not all phones in the developing world are in individual use, but are actually used as a communal asset of the household or village.

A series of innovations drove this adoption and continue to drive this expansion. Regulatory design has improved in recent decades, boosting competition among telecommunications companies. Also competition has spurred significant innovation in business models. For example, in most of the developing world, in contrast to practices in some wealthy countries, only the person making the phone call pays. Moreover, mobile phone airtime is available in prepaid bundles, allowing poor customers to avoid lengthy contracts and manage their expenditure in a granular manner. For those at the bottom of the pyramid, where income is indeterminate and managing finances is very important, this model is a key driver of access and use (Donovan, 2011). This has been possible through the innovative, dynamic tariff model and the outsourced infrastructure sharing network model devised originally by the Indians. These supply-side improvements have met strong demand from customers around the globe. Like all networked technologies, mobile phones exhibit network effects, making them more valuable as more devices are in use.

9 http://www.itu.int/ITU-D/ict/statistics/. 10 http://www.itu.int/ITU-D/ict/statistics/.

What this proliferation means is that mobiles are often the only form of connectivity. While mobiles may be a substitute or complement for landlines in rich countries, they are more frequently the first form of telephony and access to the Internet for many of the world's poor. For example, Telecom Regulatory Authority of India reported that at the end of March 2011, the country had just 8.8 million broadband connections. By contrast, it boasts some 812 million mobile subscribers. Worldwide, only 10 percent of the world's population does not have a mobile phone signal[11].

Originally used for communication, then education and entertainment, now a whole new generation of information services are being provided to users in developing countries through mobile phones: providing agricultural information services for prices, weather and farming tips; gathering health information in the field to help manage drug stocks and verifying the authenticity of drugs. However, the mobile service that is delivering the most obvious economic benefits is money transfer, better known as 'mobile banking'. This has grown out of using pre-paid calling credit as informal currency and is well placed to bring financial services within the reach of billions of 'unbanked' people across the developing world. An increase of 10 percentage points in mobile-phone adoption in a developing country leads to an increase in GDP per person of 0.8 percentage points (The Economist, 2009). The former luxury item has become a basic tool of global development.

Box 1 **Mobile Banking in Uganda**

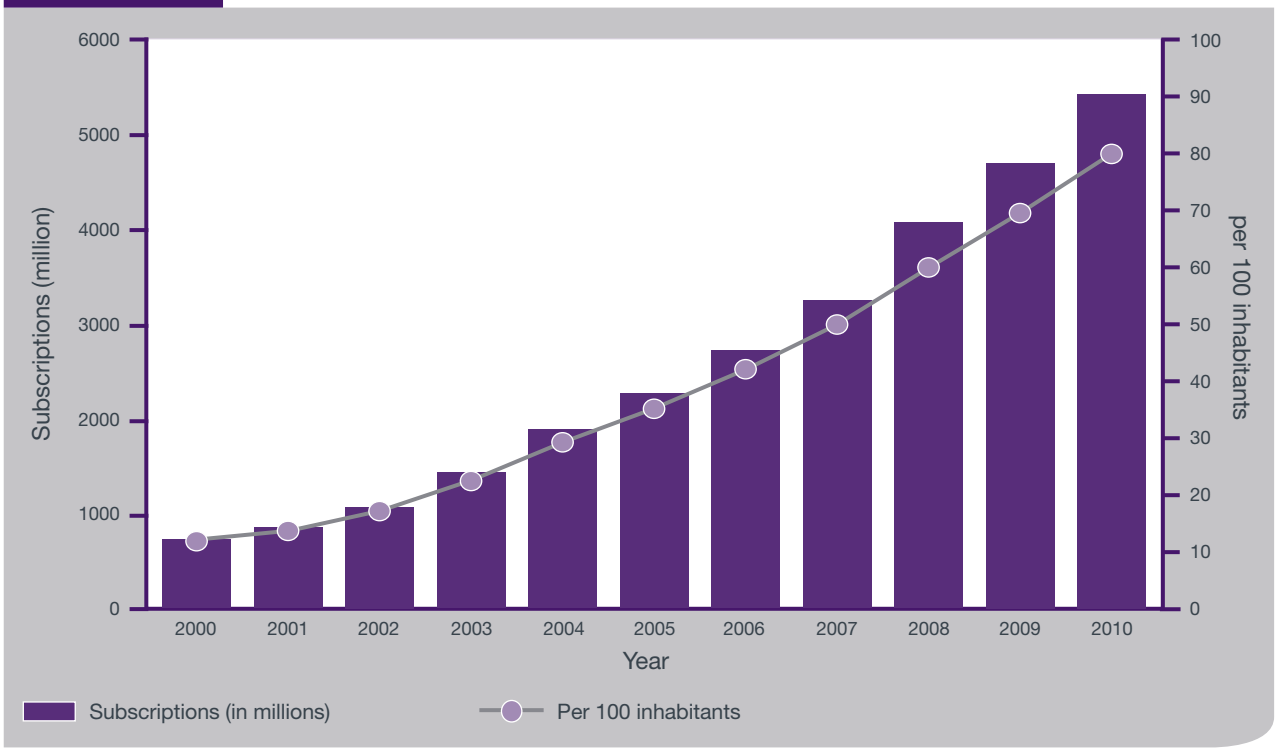
The mobile banking phenomenon spread quickly in the developing world. Uganda's largest telecom company, MTN Uganda, created its own version, MobileMoney, in March 2009. Within a year, 600,000 Ugandans had signed up. Now, thanks to aggressive recruitment drives to win more subscribers – MTN agents trolling the streets for new customers are known as "foot soldiers" – the service has more than 1.6 million users.

MobileMoney outlets are everywhere in 2011: the distinctive canary-yellow buildings and kiosks that house them are dotted around not just Kampala, but the greater part of the country. The MTN network reaches 85% of Uganda, and MobileMoney is available everywhere MTN has coverage. Many of the villages, however minor or remote, have at least one tell-tale splash of yellow.

Source: (Fox, 2011)

Due to their high ownership levels and widespread geographic coverage, especially in developing countries, mobile phones are therefore an excellent channel for obtaining crowdsourced land administration information. But are they affordable and do they have the necessary functionality? The next section explores the smart phone.

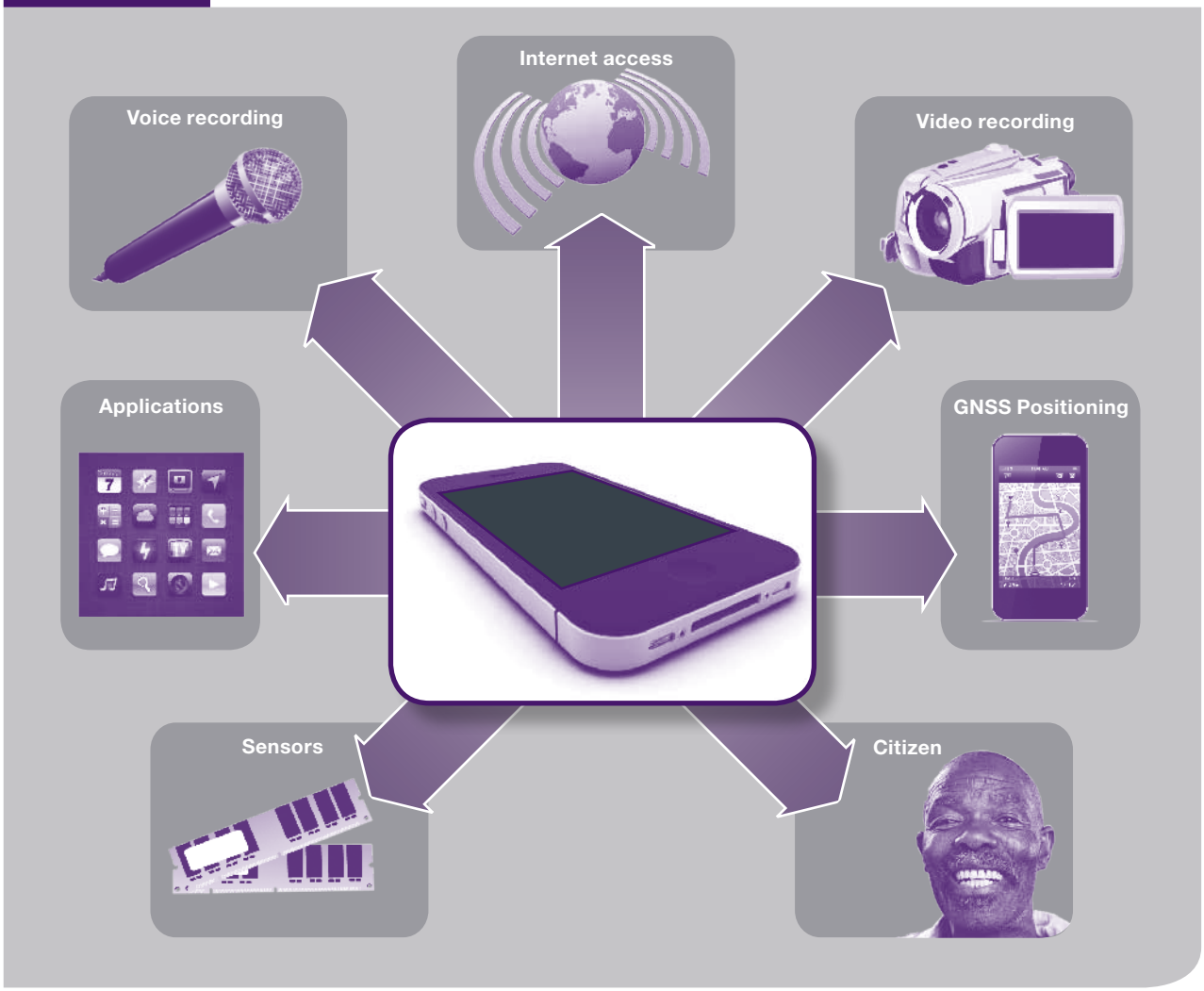
Figure 2 **Global Mobile Cellular Subscriptions, total and per 100 inhabitants, 2000-2010**



Source: ITU World Telecommunication /ICT Indicators database

11 ITU World Telecommunication /ICT Indicators database

Figure 3 **Smart Mobile Phone Cyborg Functionality**



5.2 The rise of smart phones and tablets

Telecommunications has developed exponentially. Phones have changed: there is a big shift from holding a phone to your ear to holding it in your hand. Smart phones have emerged that are able to browse the web, send and receive email, and run applications - as well as storing contacts and calendars, sending text messages and (occasionally) making phone calls. See Figure 3 for the range of Cyborg (an organism that has enhanced capabilities due to technology) functionality provided by smart phones. Smart phones represented 24 percent of all mobiles sold worldwide in the first quarter 2011 – up from 15 percent a year before. The tipping point when they make up 50% may only be a year or so away. Although smart phones may cost around US$600 today, volume of sales and frugal innovation will drive the cost down to an estimated US$75 in 2015. A US$100 smartphone has already arrived on the streets of Nairobi. Before the end of the decade, every phone sold will be what we would now call a smartphone and cost US$25 (Arthur, 2011).

Although smart phones have combined an array of technologies onto the mobile phone platform to significantly increase its functionality and its applicability in a wide range of new applications, regular mobile phones can still be used to support information services and gather crowdsourced information, through text messaging services (SMS) for example.

The emergence of tablets is also providing an opportunity for effectively supporting crowdsourced information, especially graphical information. This technology will play a significant role in the future of crowdsourcing.

5.3 Vision of an effective crowdsourced Land Administration solution

This increase in functionality of the mobile phone, its migration to lower cost devices through frugal innovation, its increasing pervasiveness across developing countries and its connection to Internet and information services is opening up significant opportunities for its use in delivering more effective and accessible land administration services. The possibilities are explored below:

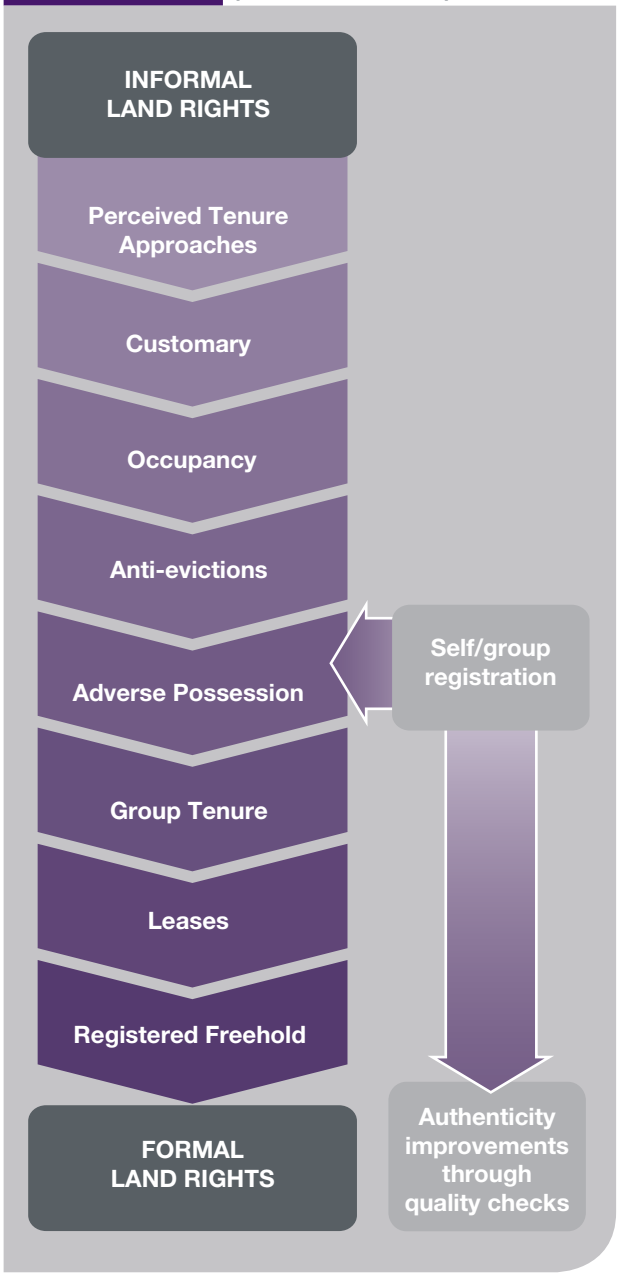
Accessing Customer Information Services – A whole new generation of innovative information services, such as agricultural and health, are being provided to users of mobile phones in developing countries. A good example is the use of mobile phones to record and transfer water quality or water source inspection data from the field to a central database where water sector professionals can then view the data collected and identify hazardous water sources[12]. A similar set of land administration services for users could provide explanations of procedures, electronic forms for completion, standard applications and best practice for land registration and cadastre, for example. This remote guidance and support will be essential when there is more significant citizen participation in land administration services and could be provided by tiers of citizen intermediaries with guidance by land professionals.

Recording Land Rights – The mobile phone will allow citizens to directly record the boundaries of their land rights. This can be achieved in several ways:

- marked up paper maps digitally photographed with the phone
- a textual description of the boundaries recorded on the phone
- a verbal description recorded on the phone
- geotagged digital photographs of the land parcel recorded on the phone
- a video and commentary recorded on the phone – this could include contributions from neighbours as a form of verification (mobile phone numbers of neighbours could be provided)
- the positions of the boundary points identified and recorded on imagery using products such as Google Maps and Bing, for example
- the co-ordinates of the boundary points recorded directly using the GNSS capability of the phone.

In all cases, the authenticity of the captured information would be enhanced by passively recording the network timestamp at time of capture. This information is not something that most (99.999%) of users can tamper with.

Figure 4 Continuum of Tenure Types (UN-HABITAT, 2008)



12 www.bristol.ac.uk/aquatest/about-project/workplan/ma6/

Box 2 **Community Knowledge Workers as Intermediaries in Uganda**

Despite the proliferation of phones in Uganda, however, a digital divide persists. How can information be understood and properly implemented when more than a third of the country's adult population cannot read or write? And can complex and detailed information be managed by anything less than a smartphone, which is currently beyond the means of most Ugandans?

One intriguing solution to these problems is being tried out by the microfinance organisation Grameen Foundation. Seeking to establish a reliable means of interacting with farming communities in the Ugandan countryside, Grameen has started to lease smartphones to local literate farmers so that they can receive information – seasonal weather reports, planting advice, disease diagnostics, and market prices – and pass it on to their neighbours. They also gather information from the farmers they register and feed it back to Grameen in Kampala, which passes it on to agricultural organisations and food programmes.

These intermediaries, known as community knowledge workers (or CKWs), are chosen for their command of English, community standing and entrepreneurial spirit as well as their technological know-how. After training CKWs to use smartphones, Grameen pays them a performance-based wage averaging at about US$20 per month – via MobileMoney, obviously. Deductions are made to cover the lease arrangement and high-performing farmers can expect to fully own their phone, and the charging solution that comes with it, within two years.

So far, Grameen has trained 500 CKWs in 32 Ugandan districts, reaching more than 20,000 households, or 100,000 people. "We're aiming for a million," says Sean Krepp, Grameen's Uganda director, "and we're looking at scaling this to several other countries." In addition to interacting with farmers, the community knowledge workers have formed a strong peer-to-peer network, minimizing the need for external expertise.

Sources: (Fox, 2011; Donovan, 2011)

The results of this crowdsourced or self-service information could then be submitted electronically to either the land registration and cadastral authority or open data initiative for registration. Although there are limitations in the quality and authenticity of the ownership rights information provided, it could form the starting point in the continuum of rights being proposed by UN-HABITAT (2008) – see Figure 4. This recognises that rights to land and resources can have many different forms and levels.

To increase the authenticity and quality of the registration application, the concept of the 'Community Knowledge Worker' created by the Grameen Foundation (Donovan, 2011) could be adopted. The 'Community Knowledge Workers' are trained members of communities supporting agricultural and health information services who act as trusted information intermediaries to those who have limited skills and access to information. A similar model could be used for crowdsourced land administration services to record or check land rights prior to their submission. In fact, the 'Community Knowledge Workers' model could be extended to also support land administration information services. This model is similar to the administrative roles of the Patwari in India and the Lurah in Indonesia.

This engagement of local communities is also being highlighted as a key success factor by crisis mapping projects. They realise that without community buy-in, the valuable crisis mapping tools will not be used. Communities must be engaged at all stages of the project and technical design to ensure that crisis mapping efforts are in line with local incentives and capacities. For example, this community led approach brought fourteen organisations into a network in Liberia contributing data to a multi-layered map that served as a central nervous system for early warning signs of conflict in the run up to the national elections in 2011 (Heinzelman et al., 2010).

When the captured land rights are submitted to the property register (see section 6 for a discussion on an alternative shadow property register based on an open data initiative) a variety of quality checks could be applied to the submitted information, including: random checks in the field; comparisons with other applications submitted in the same proximity; checks on ownership of the mobile phone; review evidence for the location of its owner through the log showing that the phone is frequently used within a location; network time stamping of captured information; societal evidence from the community; discussions on social media; and contact the client and their neighbours on their mobile phones to ask for clarification. Further details of approaches to managing the authenticity risk are contained in section 8 'Managing the Risks'.

Obtaining Title – The submission of an application for registration usually involves the payment of a fee. This is normally paid as cash over the counter or a financial transaction through a bank or post office. However, in the context of mobile phones, the payment could be made by the client through 'mobile banking' on the mobile phone.

Mobile phones are currently being used to manage identification information. In Finland, chip ID cards for government employees are being adopted throughout Finnish central government. It is therefore feasible that encrypted forms of land title could be incorporated into clients' mobile phones and used as proof of ownership. In addition, biometrics could be associated with the captured land rights through fingerprint scanning and recognition.

Accessing Land Information – Effective LAS are supported by Land Information Systems. These are initially developed to support the internal operations of the land registration and cadastral authority. However, the next development stage is to make them outward facing and accessible by customers either by Extranet or Internet. However, with mobile phones directly supporting Internet access, these information services can now be accessed by mobile phones. This new channel, which will be the only access to the Internet for many countries, creates much more accessibility for the citizen, bringing land administration services to a wider range of society, many of whom are currently excluded. Social media channels can also be used to support help desks, manage complaints and provide updates on the status of applications.

Paying Mortgage Instalments – Securing a mortgage normally requires the property owner to have a bank account to support the mortgage payments transactions. However, the mobile phone offers opportunities to provide secure payment of land administration fees with the increasing use of 'Mobile Banking,' simplifying the procedures and again potentially opening up the means of wider property ownership.

Participating in Development Control / Planning – Within the context of land use control services, mobile phones have the potential to increase citizen participation. Mobile phone alerts could provide citizens with details and location maps of new development proposals within the citizen's specified area of interest. This will let citizens understand what developments are parts of the formal development process.

5.4 Technology standards and tools to support land administration crowdsourcing

A number of crowdsourcing initiatives are providing technology toolkits to support their easy and widespread adoption. For example, Ushahidi[13] has helped human rights workers and others from Kenya to Libya to Japan to document and make sense of fast-moving crises with a web-reporting platform. The free and open source software platform allows crowdsourced reports from cell phones and web-connected devices to be collected and simultaneously displayed on Web-based maps – see Figure 5. The organisation uses the concept of crowdsourcing for social activism and public accountability, serving as an initial model for what has been coined as 'activist mapping'.

Another crowdsourcing toolkit initiative has been developed at the University of Washington (Open Data Kit, 2010) using Android, the open-source mobile operating system championed by Google, to develop an Open Data Kit to turn a mobile phone into a versatile data-collection device. It is being used by organisations around the world that need inexpensive ways to gather information in areas with little infrastructure. For example, members of the Surui tribe in Brazil have tested the Open Data Kit as a tool to raise awareness of illegal logging on their lands and plan to use the tool to take an inventory of its forests so it can participate in global carbon markets. In another application, children have been mapping their home slum of Rishi Aurobindo Colony in eastern Kolkata, India with the support of UNICEF and will upload much of the information onto Google Earth[14].

The EpiCollect.net[15] toolkit provides a web application for the generation of forms and freely hosted project websites for many kinds of mobile data collection projects. Data can be collected using multiple mobile phones and all data can be synchronised from the phones and viewed centrally (using Google Maps) via the project website or directly on the phones. This toolkit has been used in the Congo to support communities protect significant areas from logging (see Box 3).

Similar open source toolkits to support crowdsourcing in land administration are starting to emerge. An initiative in setting data model standards is the Social Tenure Domain Model under the wider Land Administration Domain Model developed by UN-HABITAT and FIG (Lemmen et al. 2007), which provides a standard model for social/customary tenure that ISO is ratifying and adopting. The Land Administration Domain Model is being used to support Solutions for Open Land Administration (SOLA) Project[16]. Open toolkits for mobile phone platforms will emerge from initiatives like this.

13 www.ushahidi.com a non-profit software company. 14 http://opendatakit.org/about/deployments/ 15 http://www.epicollect.net/
16 http://www.flossola.org

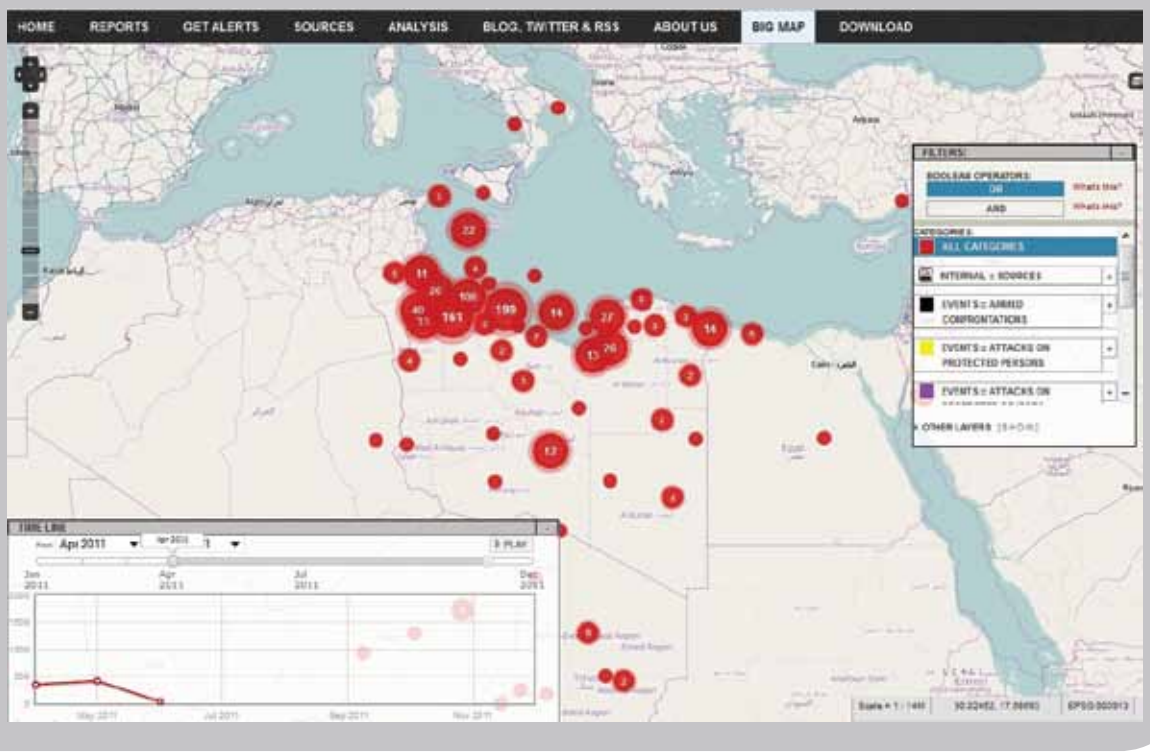
Box 3 **Safeguarding Places of Community Importance in Congo**

The Mbendjele people of Congo-Brazzaville are using the latest satellite mapping technology to stake claim to a rainforest, two-thirds of which may be gone in 50 years. The Mbendjele take hand-held satellite technology devices into the forest to create maps showing places of community importance. A specially designed touch-screen allows them to easily record the locations of these features, such as areas for hunting, cemeteries, and sacred trees. The Mbendjele do not need the maps themselves, but for the first time they have a record of how they use the land that can help them discuss their land rights with companies and the government.

Source: (Lewis, 2007)

Crowdsourcing initiatives in land administration may coalesce into a much wider open data phenomenon similar to the global OpenStreetMap initiative. If this happened then a free and open source software solution to store and manage the crowdsourced land administration information would be created and populated by volunteers. It is not difficult to imagine a LAS App (application) for a smartphone that is designed for non-literate users and allows them to collect land rights information in a structured way.

Figure 5 **Example of Ushahidi Crisis Mapping of the Libyan Conflict in 2011 (The Ushahidi Blog, 2011)**



6.0 Impact of New Citizen Collaboration Model on the existing Land Administration Sector

The introduction of this new LAS model will likely be perceived by most land professionals working in the land administration sector as radical and by some as a serious threat. However, the current generation of mobile phones and other devices are increasing the potential range of participants in land administration. We are seeing the rise of the 'proamateur', somewhere between the professional and the amateur, caused by this easy to use and accessible technology. Disruptive technology has caused professional realignments in the past: total stations allowed surveying technicians to perform more tasks, more accurately than before. Crowdsourcing by 'proamateurs' is not a risk to land professionals, but allows a wider range of participants to be involved in land administration and more quickly address and solve our global challenges.

Land professionals' attitudes towards this new model will determine how land administration is shaped in the future. Here are three scenarios of the potential impact of the new model on the land administration sector.

Rejection by Land Professionals: Shadow Property Register – In countries where there is little citizen trust in poorly performing or corrupt land administration services provided by the government, an alternative property register may be created through crowdsourcing. This 'shadow' property register would be similar to the OpenStreetMap crowdsourced model that has successfully provided an alternative source of mapping for many countries. An 'OpenCadastralMap' (Laarakker and de Vries, 2011) or 'OpenLandOwnership' open data initiative would emerge. Despite not having the usual endorsement and guarantee from government, its legitimacy may progress over time as quality and trust evolve. It may even be embraced by the informal market as a trusted repository to support transactions more affordably and effectively than the formal property register. The real test will be if financial services use it to judge risk in the mortgage market. Ultimately, it may either replace the government land administration service, reinforcing the informal land market, or be adopted by government once it has reached a critical mass and quality.

Acceptance by Land Professionals: Supplement to the Formal Property Register – Other countries may embrace this new model as an opportunity to accelerate the number of properties being registered across the country and support a much more inclusive solution to land administration. If land professionals work in partnership with citizens and communities and grow a network of trusted citizens to record and register land rights then this source of land information could be managed directly by the formal property registers. Initially, these crowdsourced records could have a provisional status that would be formalised following checks on authenticity. This could be performed directly by land administration staff or accepted directly from trusted community experts or quality checks achieved through crowdsourcing. The approach to and judgement of authenticity would evolve and improve over time, just as has happened with the maintenance of all wikis. This would involve a changing role for land professionals, working with citizens rather than for citizens. Consequently, the new role of land surveyors will be for capacity building, enabling technology and land information flow and quality control, but not primarily for field work where daily allowance and transport to and in the field normally account for over 50 percent of the cost for land registration.

Countries are also experiencing a professional divide in land matters. There are emerging countries, such as India, Kenya and Ghana, with a long tradition of training surveyors. However, there are other countries with just one land surveyor per one million inhabitants and no qualified educational facility. In countries where there are insufficient land surveyors or land surveyors do not wish to embrace a crowdsourced approach, the lawyers, assessors or even bankers may eventually try to remove or at least reduce the need for land surveyors in the property transaction by either resorting to direct crowdsourcing or identifying another type of intermediary to facilitate crowdsourcing in different communities in exchange for some cash or in-kind consideration. Crowdsourced land rights information could also be considered as a prerequisite for receipt of a service, rather than having the recording of land rights as the sole task for which you are rewarded. Banks could use crowdsourced land rights information to register the property as an integral part of a loan application and a connection to the grid would require the coordinates of your house.

Reluctance by Land Professionals: Awaiting Impact on the Formal Property Register in Terms of Quality Assurance – The most likely initial outcome is that land professionals will be pragmatic and delay their acceptance of this crowdsourcing approach until the issues surrounding data quality and authenticity are fully understood and managed effectively.

16 http://www.flossola.org

7.0 The Benefits

The adoption of this new model provides benefits to a wide range of stakeholders across the land administration sector and beyond:

Citizens

- Access to affordable land administration services, especially for the poor and vulnerable
- Direct involvement in the land registration process that strengthens the relationship between the citizen and the land, leading to greater trust and legitimacy in the land administration process
- Recognition of a level of land rights that at worst would lead to fewer evictions and at best would lead to formal land rights
- Fully open and transparent access to land information services that will help to reduce levels of corruption associated with public and private land. Citizens could crowdsource the extents of public land to publicise and safeguard these public assets
- Sufficient security of tenure for citizens to start investing in their land and property.

Land Administration Agencies

- More inclusive set of land administration services, directly involving the citizens that leads to a stronger and more trusting relationship with citizens
- Potential outreach of services to remote rural regions and slums within urban environments
- More comprehensive coverage of land rights with fewer professional resources
- Greater number of transactions in the formal land market that leads to higher revenues to increase the sustainability of land administration service and lower the cost of transactions.

Land Professionals

- Land professionals would continue to deliver current services in engineering surveying applications and cadastral surveys in high value urban areas
- New opportunities to provide guidance / services to local community experts and citizens
- New and enhanced role of land professionals in partnership with citizens that will strengthen the profession.

8.0 Managing the Risks

As with all radical changes to long standing approaches, vested interests will be jeopardised and entrenched opposition will inevitably be encountered. Here are some of the risks that will most likely be raised to attempt to keep the status quo.

8.1 Can crowdsourced land rights information be sufficiently authenticated?

One of the most contentious issues surrounding crowdsourced information is the authenticity or validity of the information provided. Without the rigors and safeguards associated with formal professional and legal based processes, crowdsourced information is of variable quality and open to potential abuse. Crowdsourced information has provided input to wikis, feedback of quality of services and counting birds, for example, but is not normally used to capture information as critical and legally binding as property rights in an authoritative register. So what techniques could be used to quality assure the authenticity of the information to a level that would be acceptable for inclusion in a property register? Some alternatives, including lessons learned from leading wikis and e-commerce, are discussed below. However, the most appropriate crowdsourcing approaches to authenticity assessment will only be identified through testing in the field.

Grameen Community Knowledge Workers as Intermediaries (see Box 2)

This approach would avoid open, direct crowdsourcing at the outset and only allow information to be provided by trusted intermediaries within communities who have been trained and have worked with local land professionals. Initially, there would be comprehensive quality assurance of the crowdsourced information, but over time as trust is established with the intermediaries the level of quality assurance sampling could significantly decrease. These initial intermediaries could then train further experts to build a significant network of 'experts' across communities. Each expert would be continually checked and appraised to determine the level of expertise and trust in the associated crowdsourced information. To optimise the scarce resources, the intermediaries could be shared with a range of information services, such as health and agriculture.

Community based Quality Assurance

Quality assurance could be directly provided by members of the local communities who take direct responsibility for authenticity. The crowdsourced land right claims could be posted for communities to review and comment on. Some form of local or regional land tribunal could be established to arbitrate on conflicting claims. Once a critical mass of land rights information is obtained, it is then easier to identify anomalies and conflicting claims. Levels of trust and accuracy of the land rights would be upgraded over time as more evidence and cross checking validates the claims. The local public display of the results combined with the witness function of the local land committee and the citizens will provide societal evidence of land rights.

The driving forces for land registration will originate more and more from local communities, producer association, for example, coffee producer cooperatives in Uganda for facilitating access to credit market, housing cooperatives and traditional communities / leaders. This is compatible with systematic registration campaigns - district by district or commune or cooperative - rather than sporadic or unsystematic registration. This also fits well with a district-based crowdsourcing approach. Experience in Lao, Cambodia and Azerbaijan (Zimmermann, 2011) with the German Development cooperation (GIZ and KfW) in speeding up the process of land registration, training local land technicians and involving local citizens indicates that the registration costs in rural areas could come down to US$3 per parcel.

In Croatia, the government placed the old land registration and cadastral records on the web with open access to the public and asked for feedback to improve the records. They received an astonishing 40 million responses to the cadastral records and 120 million to the land registration records (Adlington, 2011).

Wiki and e-Commerce Solutions

Beyond local involvement in quality assurance, a centralised user reputation system based on feedback from crowdsourced registrations, similar to the buyers' ratings of the sellers used in eBay, could be used to assess the credibility of contributors and the reliability of their contributions (Coleman, 2010). Leading wikis, such as Wikipedia.org, originally relied solely upon the "wisdom of the crowds" to evaluate, assess and, if necessary, improve upon entries from individual contributors, usually with great success. However, recent contributions of deliberate misinformation to specific entries have caused Wikipedia to re-assess its approach. Beginning in December 2009, it has relied on teams of editors to adjudicate certain "flagged entries" before deciding whether or not to incorporate a volunteered revision (Beaumont, 2009). See Box 4 for how TomTom assesses their volunteered contributions.

Although the data that are contributed to Volunteered Geographic Information (VGI) projects do not comply with standard spatial data quality assurance procedures and the contributors operate without central co-ordination and strict data collection frameworks, research of VGI is starting to provide methods and techniques to validate quality and also the needed evidence to show that this data can be of high quality. Recent research by Haklay et al. (2010) supports the assumption that as the number of contributors increases so does the quality; this is known as 'Linus' Law' within the Open Source community. Studies were carried out using the OpenStreetMap dataset showing that this rule indeed applies in the case of positional accuracy.

Crowdsourcing Quality Assurance

Some elements of the quality assurance process do not require local knowledge of the land rights claim and could be crowdsourced to a network of informed consumers and world-wide professionals or could even be automated.

Passive Crowdsourcing Quality Assurance

Mobile phones can also be used passively to collect evidence that supports validation of user entered information. For example, the use of a mobile phone is continually logged and this log can be analysed to show where the phone is frequently used, inferring the location of the owner. The network timestamp is another robust piece of evidence that could be associated with collected land rights data, such as images or videos. This is not something that most (99.999%) of users can tamper with.

The extent to which control is held by the contributor, by the institution, or by "the crowd" of contributors assessing each other's contributions may be different across different implementations of crowdsourcing.

Box 4 **TomTom's Approach to Assessing Volunteered Contributions**

TomTom's online MapShare™ Service is one of the best operational examples of how one large commercial data supplier manages risk in terms of assessing volunteered contributions and disseminating such non-certified updates to its customers. The company employs a graduated approach to sharing, assessing, and using the volunteer-provided updates. First, MapShare contributors have a choice of only using their updates themselves, within their own group, or with the general TomTom community. Second, TomTom itself assigns a progressively higher level of credibility through independent confirmation of a given update by: more than two independent contributors; many independent contributors; a "trusted partner" or corporate user; and its own crews or contractors in the field. Finally, it allows its customers to interactively select the "level of trust" they desire for the data used on their navigation unit. Customers may elect what level of updates to use. According to TomTom, the MapShare service has been very successful. In the first 8 months of 2010 TomTom indicated that the top twenty countries, in terms of the volume of reports, had reported over two million change notices. Over the same time period, there had been a marked decrease in map-related questions to TomTom's Customer Support Unit. MapShare is also an exceptional tool for identifying change detection, especially for map updates that are hard to discover otherwise.

TomTom also has passive community input. This involves the user of a TomTom navigation platform agreeing to allow traces of the GPS positions and paths recorded by their TomTom PND to be anonymously uploaded through the TomTom Home software to the TomTom mother ship. This has now produced over two trillion GPS points that are being used to improve the quality of the map database. Aggregating a massive number of data points collected over time has helped them average out errors and create a database with an extremely high level of positional accuracy.

Source: (Coleman, 2010; Dobson, 2010)

8.2 Will openness lead to more corruption in the land sector?

Land administration is often perceived as one of the most corrupt sectors in government. Although individual amounts may be small, petty corruption on a wide scale can add up to large sums. In India, the total amount of bribes paid annually by users of land administration services is estimated at US$700 million (Transparency International India, 2005), equivalent to three-quarters of India's total public spending on science, technology, and the environment. However, one of the best means of reducing corruption within a good governance framework is through transparency of information and the ability to have two-way interaction with clients – see Box 5.

Data collected by the public must be validated in some way, otherwise the crowdsourced information is open to abuse, and in the case of land rights, corruption through false claims. However, transparency, which is at the heart of the crowdsourced philosophy and the increasing use of the mobile phone to check authentication, should support the fight against corruption.

8.3 Will Land Professionals form a new partnership with citizens?

This new partnership model implies that land professionals will have a different relationship with citizens or 'proamateurs'. The increased collaboration with citizens opens up the opportunity for new services to train citizens and community intermediaries and to quality assure their crowdsourced information. It should therefore not be perceived as a threat to their livelihoods and profession. But will land professionals accept this new role and will sufficient citizen entrepreneurs provide land rights capture services and become trusted intermediaries? Disruptive technologies have and will continue to challenge the relationship between 'proamateurs' and land professionals, but these drivers of change also present significant opportunities for all stakeholders.

8.4 Will crowdsourcing just reinforce the informal land market?

There is a danger that the emergence and acceptance of crowdsourced land rights information by citizens will just reinforce the informal land markets in countries where there is ineffective land governance, poorly performing land administration systems and weak formal land markets. Lack of trust in the formal land administration system will persuade citizens to try crowdsourcing alternatives that are attractive due to their transparency and citizen involvement. The final outcome of the informal or formal market will depend on the Land Administration agencies' reaction to crowdsourcing and whether they reject or embrace it.

8.5 Who will provide the ICT infrastructure to support this initiative?

The implementation of crowdsourcing in land administration requires technical infrastructure to support the uploading, management and maintenance of the land rights information. The implementation could mirror the voluntary support model of OpenStreetMap. OpenStreetMap's hosting, for example, is supported by University College London's VR Centre for the Built Environment, Imperial College London and Bytemark Hosting, and a wide range of supporters[17] provide finance, open source tools or time to support the initiative.

Box 5 **Reducing Corruption with Mobile Phones**

The mobile phone can play an important role in reducing corruption associated with financial transactions in the land sector. For example, in Pakistan's Jhang District, all clerks were asked to submit a list of their daily transactions, giving the amount paid and the mobile numbers of the buyers and sellers. Supervisors then called buyers and sellers at random to find out whether they had been asked to pay any extra bribes or commissions. After charges were brought against one clerk who had asked for a bribe, service improved markedly. This two-way interaction with clients opens opportunities for essential feedback and quality checks.

Source: "A Special Report on Telecoms in Emerging Markets," (The Economist, 2009)

9.0 Lessons learned from citizen science experiences

This is new territory and we are still in the early stages of understanding citizens' engagement in citizen science and how they can best support science. Some guidelines for good practice in citizen science have begun to be formulated but, at the moment, most engaged in this activity are probably learning by doing, if only because the technological possibilities are advancing so fast. Some basic principles guiding citizen science are (Silverton, 2011):

- data collected by the public must be validated in some way
- methods of data collection must be well designed and standardised
- as many assumptions as possible must be made explicit
- it is desirable to have a hypothesis in mind, even if it is only a question like: 'how is X changing?' or 'how is Y distributed?'
- volunteers must receive feedback on their contribution as a reward for participation.

The majority of these principles apply directly to crowdsourcing in land administration and land professionals need to incorporate these lessons learned into their new approaches.

10.0 Conclusions

Crowdsourcing within the emerging spatially enabled society is opening up opportunities to fundamentally rethink how professionals and citizens collaborate to solve today's global challenges. This paper has identified land administration as an area where this crowdsourced supported partnership could make a significant difference to levels of security of tenure around the world. Mobile phones and personal positioning technologies, satellite imagery, the open data movement, web mapping and wikis are all converging to provide the 'perfect storm' of change for land professionals. The challenge for land professionals is not just to replicate elements of their current services using crowdsourcing, but to radically rethink how land administration services are managed and delivered in partnership with citizens. Land administration by the people for the people can become a distinctly 21st century phenomenon. If social media can topple governments, crowdsourcing must be able to improve land administration.

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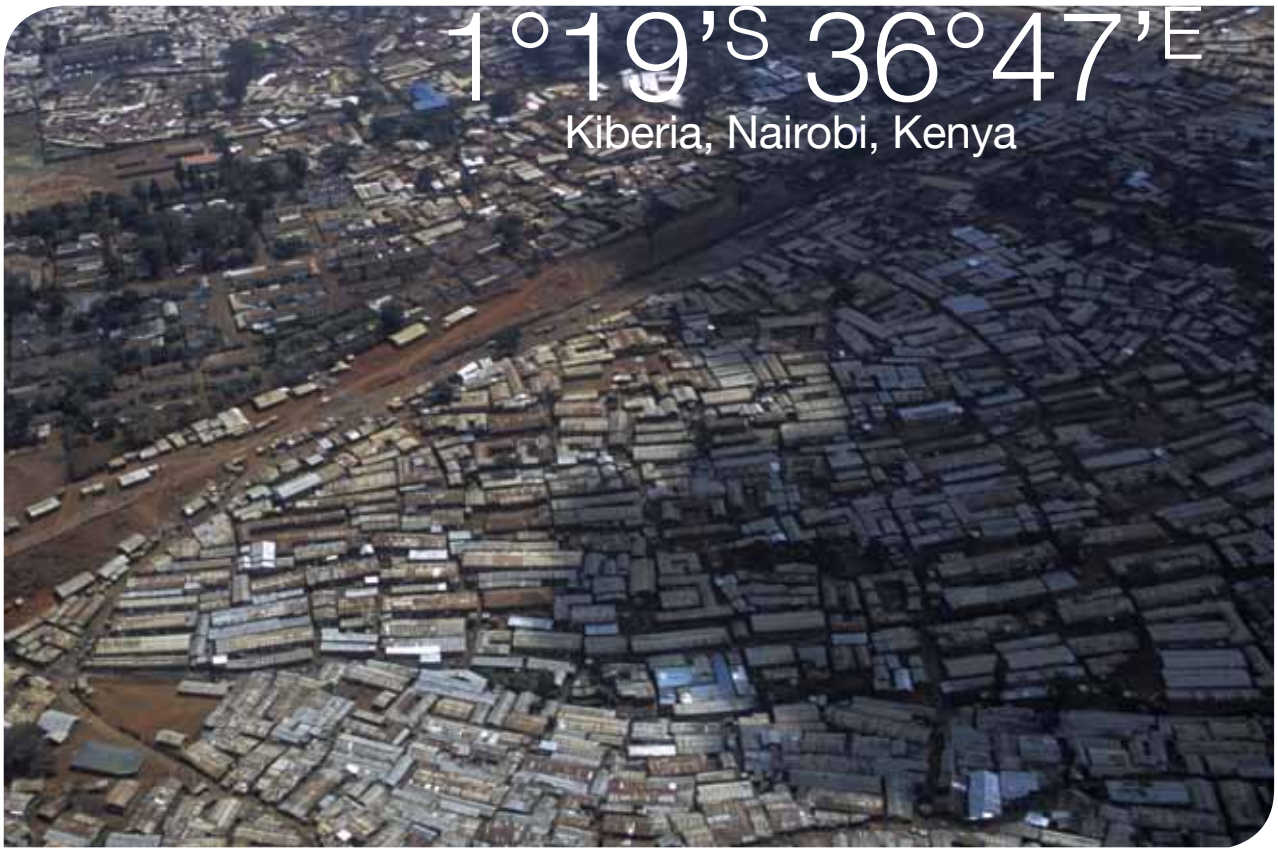
Annexes Case Study 1

A1 Kenya – Crowdsourced mapping of Kibera in Nairobi – Africa's largest slum



OpenStreetMap (OSM) is a free editable map of the whole world. The OSM project was originally created because most maps that were considered "free" did in fact have legal or technical restrictions on their use. These restrictions stopped user from being creative, productive or using the maps in innovative ways. The open source nature of the map means it can be downloaded, repackaged and used offline as well as online[18].

Currently more than 400,000 contributors to OpenStreetMap create and correct geographic data in a number of ways. Contributors use GPS, cameras and their own observations to record the precise locations of roads, buildings, utilities and amenities and often create maps entirely from scratch. Contributors also correct data in areas where existing open licensed map data has been imported into OpenStreetMap, but may be inaccurate or out of date. Contributors use local knowledge and aerial images to correct and refine the accuracy of this data. OSM provides online map-editing tools for uploading data to OSM's database.

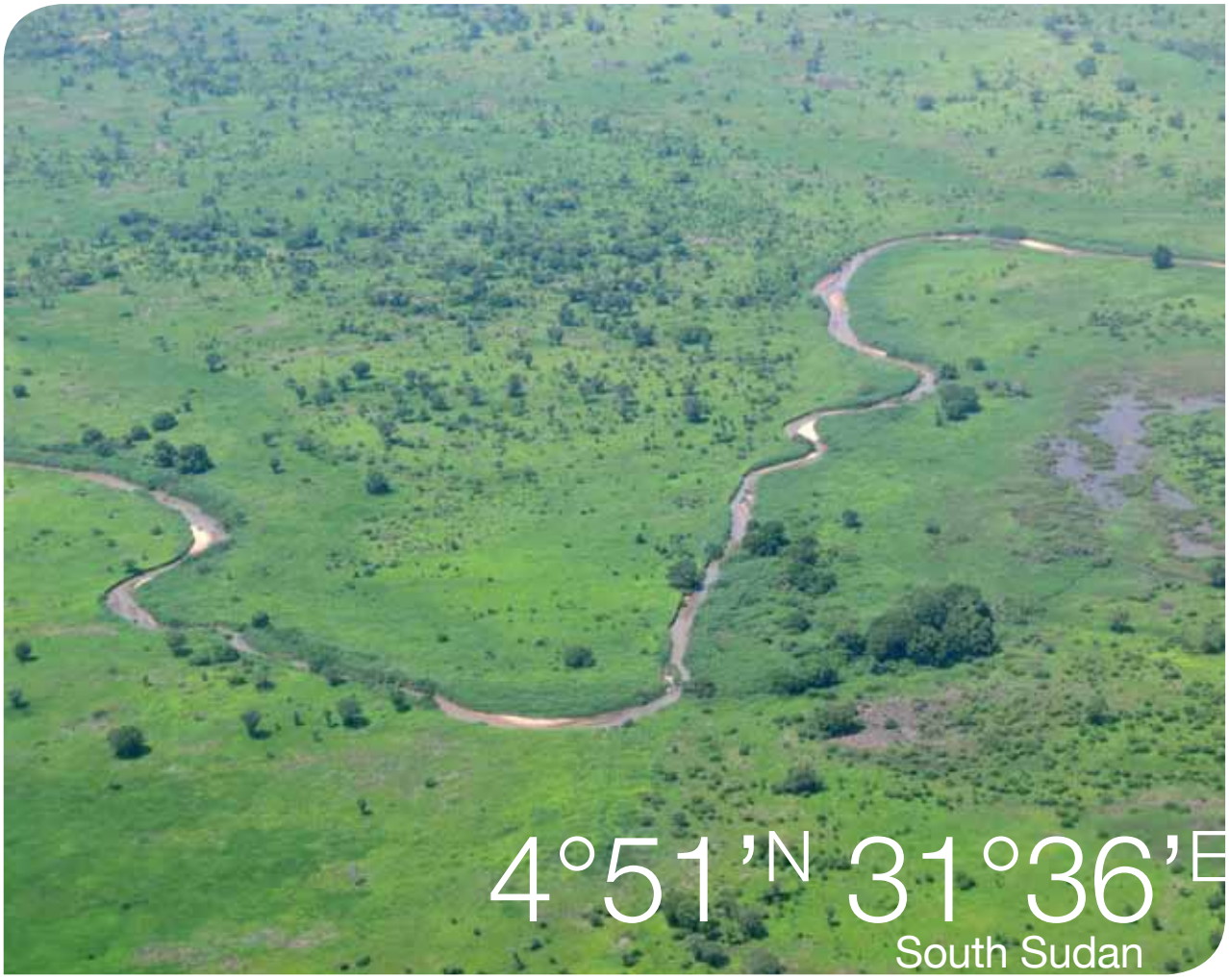
The OSM initiative is not just limited to mapping developed countries and formal settlements. Until recently, what is often billed as one of Africa's largest slums – Kibera, in the Kenyan capital Nairobi – was a blank spot on official maps. A group of volunteers has been training young people living there to create their own digital map of the area using GPS and OpenStreetMap map editing tools. They also engaged the broader community through participatory GIS workshops to create paper maps of local issues such as security, health, water, sanitation and education. The result is the first complete map of Kibera, which it is hoped can form the basis of plans to improve the area and the lives of its residents. It is impossible to plan a brighter future for Kibera residents without this basic geospatial information.

18 www.openstreetmap.org

Annexes Case Study 2

A2 South Sudan – Navigating their path to independence with crowdsourced mapping

Following the historic referendum in South Sudan, Google and the World Bank co-hosted an event in Nairobi to demonstrate the power of mapping to support the building of the world's newest independent nation. South Sudan is a huge region that is poorly mapped today. Without basic geospatial information, it is difficult for the government, civil society, development partners, and all stakeholders to evaluate risks and current needs, target their efforts and mobilise proper resources. At times like these, it is critical to have good maps of roads, settlements, buildings and other services, with both local and official names. The training session was designed to train NGOs and the Sudanese diaspora community to use Google Map Maker[19] technology to help create comprehensive maps of the region; over 100 attended, mostly Sudanese university students, humanitarian workers, journalists, developers, donors and citizens.



19 http://www.google.com/mapmaker

Annexes Case Study 3

A3 Canada – Inuit provide evidence on impact of climate change (Siku Atlas, 2011)

Sea ice is a fundamental feature of the polar environment; it is also one of the most tangible indicators of change in the Arctic. During the last two decades, and in the past several years in particular, both polar scientists and local Inuit residents have detected important shifts in the extent, timing, dynamics and other key parameters of arctic sea ice. Conventional maps show terrestrial variations and features in great detail, while water bodies are outlined and left "blank." Therefore, the Inuit Sea Ice Use and Occupancy Project, carried out by the Geomatics and Cartographic Research Centre (GCRC) at Carleton University, has undertaken collaborative investigations to document and map sea ice knowledge and use around several Inuit communities, including: characterisation of seasonal sea ice conditions; extent and areas of sea ice use; nature and location of notable sea ice hazards; key harvesting areas; traditional and current ice routes; and shifts in patterns of sea ice use due to social and/or climatic change.

Inuit elders and hunters are the local experts on sea ice. Through long term observation and experience with the sea ice, they have developed deep and rich understandings of the marine environment. They had to learn about the relationships between winds, weather, tides, currents, and sea ice in order to travel safely on the sea ice, understand animal habitat and behaviour, hunt successfully and survive.

Much of this detailed Inuit knowledge is not written down. It has been passed on orally over generations, and through long term use and experience in this environment. However, today, elders and experienced hunters recognize that youth are not travelling on the ice as much. Young Inuit have less experience on the ice as they travel faster with snowmobiles, and they rely more on technology for navigation. Elders want to make sure that youth have the survival and navigational skills needed if their snowmobiles break down, or their GPS runs out of batteries. They are also concerned about changes being observed in seasonal sea ice conditions, and want to be sure that youth are aware of these changes, and know how to identify signs of danger as they travel in more unpredictable times.

Methods used to facilitate the capture of this information from the Inuit have ranged from traditional interviews and focus groups, through participatory mapping, community-based monitoring and multi-media recording of ice trips, to cutting edge technology. New technology was designed that combined a hand-held computer with a GPS receiver and mobile weather station that could be mounted on a snow machine or dog sled. Hunters tested the new technology and documented their observations as part of their regular activities. The information and maps created have allowed individuals to: record their travels and harvests; collectively evaluate patterns in hunting success, animal populations, and links to weather or hazardous conditions; municipal land use planning or land use negotiations; school materials to study hunting, local geography, and weather; and real-time tracking of snow machines for search and rescue activities.

The rich local knowledge base and oral history has been collated into an online interactive sea ice atlas as a means of sharing stories in the form of maps, audio, video, pictures and text, in a way that encourages different types of interactive learning. Making this material available online, also means it can be shared across Nunavut (and even Canada) and it can be updated more easily. Eventually, the goal is that it can be directly modified and updated by Nunavut community members and Inuit experts themselves. With the development of a user-friendly interface, contributors will not require advanced technical skills, so communities will be able to input information in their own language and in a variety of forms, e.g. voice input, storytelling, video, photographs, documents, GPS data, and text. This represents an important advance in open source geospatial software as well as in community mapping.

Annexes Case Study 4

A4 Haiti – Crowdsourcing support of disaster management and recovery (Caley et al., 2010)

In January 2010, a 7.0 magnitude earthquake occurred in southern Haiti, about 15 miles from the capital Port-au-Prince. The earthquake caused catastrophic damage across wide area including the whole urban area of Port-au-Prince and several other major towns to the south and west. Estimates suggest that the incident affected 3 million people and killed about 300,000 making it one of the most damaging events in the past century. The collapse of key public infrastructure, including UN offices and Haitian mapping agency offices, made access to map based information difficult for the first responders.

The contribution of Volunteered Geographic Information (VGI) to the relief effort was far greater than anything seen in the past. This increase in activity was partly due to the maturity of new tools which allow for remote geospatial data gathering and analysis being applied to this humanitarian response. High resolution satellite imagery was rapidly disseminated by private organisations via software packages such as Google Earth. The data was then processed by a remarkable number of agencies which, despite initial duplication of efforts, were able to create products such as the Post Disaster Needs Assessment (PDNA) that identified and classified over 30,000 damaged structures. The contributions to the PDNA analysis included over 600 engineers and scientists from 23 different countries, 18 organisations, and over 50 private companies. Other VGI efforts included mapping efforts such as OpenStreetMap and Google´s MapMaker. Coordinating communities such as CrisisMappers, which focuses on communication, and GeoCommons, which is an online GI repository, were used to coordinate VGI efforts and identify priorities, provide easy access to datasets and delivered forums for discussion and planning.

Mapping efforts also provided support for situational awareness of Search and Rescue (SAR) teams and other US Government agencies. A key example of this is the OpenStreetMap (OSM) initiative. The Humanitarian OSM Team (H.O.T) remotely coordinated volunteers to download satellite imagery and digitise features such as streets and buildings. This data was then extracted and uploaded to a public site in easy to use format that allowed direct upload to GPS receivers or a graphic file that could be sent directly to a printer. This OSM data provided a reasonably reliable base map for organisations such as MapAction to overlay analysis, data layers and further points of interest relevant for relief operations. These initial datasets were produced rapidly.

In addition to the use of VGI data produced by digitising remotely sensed images, Ushahidi provided a system which allowed citizens to send SMS messages about the situation on the ground to a particular mobile number. These messages were then translated (via crowdsourcing), geocoded and plotted on the OSM base map. This SMS sourced VGI was used by search and rescue teams and other responders. This novel approach proved valuable in terms of providing an additional form of two way conversation between citizens and NGOs.

There has been considerable fanfare regarding the contribution of GI to the humanitarian response following the Haiti earthquake. Even with the availability of such novel GI products, interviews with actors on the ground in Haiti indicate that despite an abundance of data, GI remains underutilised and is not yet integrated into norms of response by the majority of organisations. This is the next challenge to consider how information that is processed outside the impacted zone can reach the first responders while taking into account the bandwidth, skills and equipment limitations.

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