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# An Innovative Approach to Land Registration in the Developing World

## Using Technology to Bypass the Bureaucracy

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### EXECUTIVE SUMMARY

Informal land tenure continues to be the norm in developing countries despite billions spent on land administration and reform programs in the last 20 years. The problem goes deeper than insufficient funding or poorly executed projects. By strengthening public land registry institutions that work on behalf of authoritarian or predatory governments, reform programs, often financed by Western aid agencies and intended to improve property protections for smallholders, may have actually enhanced the ability of elites to capture informal property or delay formalization for their own political or financial benefit.

An effective process of creating new formal rights can occur when smallholders take the initiative to collect and certify land claims, demanding that their property be officially removed from the public domain and they be granted private rights. This process of public "claim-staking," even if it does not result in any positive action by the state, creates clear and precise evidence of use and occupation, which can allow smallholders to negotiate more effectively with authorities, reduces the risk of expropriation, and generates lower costs of credit.

This paper explains how inexpensive handheld devices, satellite imagery, and informal online land registries can be used by communities to identify and settle property claims through mutual verification of rights among neighbors. Such documentation of land claims is not costly or complex and is thus accessible even to the poorest communities around the globe. Neither would such a process be controversial for those involved. The vast majority of informal land claims are well established and undisputed within the communities, and an informal mapping and registration process would simply make a record of existing property patterns.

Such informal communities and support organizations can and should engage in self-registration of property and transactions, in essence bypassing incompetent, inefficient, or hostile land registry bureaucracies, until they reach the critical mass necessary to achieve formal recognition of their land rights.


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## INTRODUCTION

Economic development typically involves a process of land-use change. Existing activities are intensified, assets are transferred or subdivided, new structures and equipment are installed. Forests become farms, farms become settlements, and settlements become cities, which now are home to more than half the world's people.

In all nation states, governments claim the right to control and regulate land use and to allocate land rights within their sovereign territory. However, the process of land-use change often occurs outside existing legal frameworks and is a matter of market-driven evolution. In most poor countries, the actual practices on the ground differ substantially from the government's records and rules. In many of these situations, access to land becomes difficult, informal owners are subject to extortion or expropriation, economic activities must be concealed or camouflaged, and open conflict can erupt.

Ultimately, the government asserts its physical control over land through the use of force, for example via bulldozers, which have been used to impose the state-sponsored allocation of land rights.[1] The human suffering and loss of productive wealth associated with inefficient slum economies and with sporadic "slum clearing" and relocation programs, has been enormous. For modern economies to emerge in today's poor countries, it is imperative that a peaceful and constructive way of dealing with changing patterns of land use is found and put into practice. Even in the absence of violence or displacement, a simple lack of government recognition can impose enormous costs on informal landholders. Valuable assets are frozen in legal limbo, and globally trillions of dollars in savings are rendered illiquid.[2]

Today, billions of people informally occupy—or squat—on land that is nominally owned by public and private entities. It is impossible to generalize about how competing claims might be settled in different political environments since each situation is different. Nevertheless, no matter who originally owned the raw land—and in most cases it is marginal public land—the *political* reality in most poor countries is that most villages and neighborhoods that have been built up over time are not going to be bulldozed back to raw land. If you find a few families in your backyard, you have a legal problem that can likely be settled in your favor. But if you find a hundred families, then you have a political problem that will not be easily resolved. (Those difficult situations, fortunately, do not represent the vast majority of cases of informally occupied land, and so should not become an obstacle to the formalization of land rights for the majority of informal occupants).

So if mass removal isn't a realistic option, governments have only two choices: formalize tenure or ignore the informal settlements. All too often governments choose the latter because there is another political reality. Enormous political and economic power is derived from the power to make arbitrary political decisions concerning land rights instead of relying on legal decisions made according to the rule of law.

As a result, government-sponsored property rights projects often ignore the needs of smallholders and only end up reinforcing the property claims of elites. This is because property rights projects usually begin by digitizing paper land registries that are inaccurate or outdated rather than verifying actual occupancy on the ground.

The literature of urban development is increasingly filled with discussions of bottom-up "redevelopment" or "slum upgrading" that often encourages direct investment by owners in their existing structures. However because the residents do not have full title they are being asked to make insecure investments, necessarily relying on the goodwill of a government that is unwilling to formalize their tenure.

By having the community collect social and physical details of its informal settlement, however, the residents stake a claim on their property, increasing their security and enhancing their prospects for eventual titling. As a result of their common actions, they are better able to obtain *formal* authority from the local government approving these self-financed projects, as well as opening up the possibility of publicly financed projects whose main ob-

jective is to provide these informal communities with municipal services. A limited number of pilot projects of "enumeration and participatory mapping" have been used to document community claims and begin a concrete discussion with authorities about where infrastructure is most needed.

This process seems to have been first used by an Indian non-government organization (NGO) called Shelter Associates for slums in the cities of Pune and Sangli in the late 1990s. This approach was then adopted by other NGOs, like Kenya's Spatial Collective, supported by Slum Dwellers International, for the Mathare and Kisumu slums in Nairobi. There they have developed a system of self mapping, recordation, and then community approval that makes use of various mapping techniques, such as satellite imagery and GPS, as well as traditional maps when useful.[3] In Mathare, a similar program was useful in the acquisition of public services and the installation of infrastructure (in this case water pipes) without displacing the inhabitants.[4]

The World Bank, which calls this process "interactive community mapping," or ICM, has only begun studying the idea in the last few months.[5] But the primary focus of these programs is "enumeration," or social mapping, which aims to collect demographic data while physical mapping, when it is even done, is more interested in the shelters than in the actual property lines.

And for the last year in Nokia's *Here* program and Google's *Mapathon* effort, both in India, are trying to do what they call community mapping using their proprietary spatial recordation technology. However they are focused on public objects such as roads, bridges, and points-of-interest (POIs), not private property.[6] But precise property lines are necessary to get meaningful titles, obtain mortgages, and reduce the risk of social conflict among neighbors.

The tactics and techniques may vary according to the available information and local customs, but the basic process has evolved in a manner that is consistent over time and distance. Claims are made by individuals, verified by those affected, aggregated by their community, and finally presented to authorities. The more precise the claims, the more valuable the data is to the community, to lenders, and to governments. This process of community mapping is quick, inexpensive, and effective. It contrasts favorably to existing alternatives, under which billions of dollars have been spent to improve land management and update records, while billions of people still live in poverty and informality without the documents to prove their property rights for their homes, farms, or businesses. In Latin America, over $2.8 billion was spent on land management programs between 1994 and 2004, yet the Inter-American Development Bank estimates that "92% of businesses, 76% of rural properties and 65% of dwellings" in 12 surveyed countries in the region were extralegal or informal.[7]

In the absence of a reliable state system for enforcing ownership claims and handling transactions, communities pursue diverse strategies to protect themselves and their assets. Kinship networks, criminal organizations, and religious groups are often important in enforcing contracts and property claims, and in some places, sophisticated parallel governments have emerged to deal with dispute resolution and facilitate voluntary changes in land use.

Researchers Claudia Williamson and Carrie Kerekes have shown that, following a formal titling program in Peru, "individuals prefer private enforcement methods of securing property to public means."[8] Private enforcement mechanisms arise "where the enforcement of property rights is not achieved through public institutions."[9] According to them, the Peruvian experience "suggests that government land titling is not always a channel through which countries can achieve secure property rights institutions."[10] Peru's property rights program was supported at the highest levels of government and is regarded by the World Bank as a major success,[11] but it still could not replace locally effective property systems.

Similarly, on the African continent, where states are often predatory, incompetent, or both, local elders are the default arbiters of land rights in many communities.

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> In most traditional African societies . . . disputes over property were resolved . . . by arbitration by moot courts, family elders, or by village elders. In more organized societies, property claims and rights were settled and upheld in native courts. In each case, settlement was reached by consensus in order to preserve social harmony within the community.[12]

Around the developing world, these private, local systems of dispute resolution may be quite robust, but they do not generally adopt the record-keeping and surveying practices that would allow their decisions to be upheld in the case of disputes with outsiders or that would allow landholders to petition the state for formal recognition. In order for local informal land allocations to be defensible, their claims must be translated into a form that is transparent, legible, authoritative, and, ideally, digital. That is to say, communities must move to create their own autonomous land registries based on the existing social consensus.

The following sections will detail why existing approaches are inadequate and provide a technical framework for low-cost cadastral mapping and transaction registration by and for informal communities.

## IS FORMALIZATION POSSIBLE?

Having accepted the idea that property rights are important for development, aid agencies and governments have sponsored property rights programs across the developing world. These programs generally involve legal and regulatory reforms, capacity building, and technology transfers. Their main objective is the creation of computerized land administration bureaucracies that function according to rules set by outside experts and local interest groups including—indeed especially—political interests.

These top-down projects have, with few exceptions, failed to address the needs of informals—the urban "squatters," rural smallholders, or tribal villagers who represent the impoverished majority in most developing countries. Jamaica's Land Administration and Management Program (LAMP), for instance, was funded by the Inter-American Development Bank and has installed new computer systems at the National Land Agency, but it has not significantly reduced the large number of informal properties in the country.[13] A June 2014 report shows that St. Elizabeth Parish has nearly the same level of informality in 2014 (32%) as it had when the LAMP program started in 2000.[14]

Program design generally reflects the priorities of existing large landholders, foreign investors, the legal community, and the professional surveyors and career bureaucrats who carry out mapping and registration. The resulting systems are often cumbersome and expensive, with no clear process for establishing first titles to informally held land. In cases where formal titles are finally provided to smallholders, they are often encumbered by transaction restrictions[15] that all but guarantee a rapid return to informality.[16]

With few exceptions, the goal of these programs in the developing world appears to be to maintain top-down control of land use rather than to support efficient land markets or to defend smallholders from expropriation. The history of the developed world saw similar projects aimed at orderly and government-controlled settlement. Yet these were almost invariably abandoned in favor of laws that ratified smallholder claims.

History provides examples of land titles that were first created by landholders and only later recognized formally by the government. On the American frontier—as in many informal settlements around the world today—it was common practice for communities to adjudicate their own land disputes and to create rudimentary registries based on the emerging social consensus. These registries were not initially enforced by law, but as these informal occupations became more permanent and communities demanded government recognition, they often became the basis of "official" property distributions.

In the Distributive Preemption Act of 1841, for example, the 27th U.S. Congress gave squatters the preemptive right to purchase,

for a nominal fee, the lands they already held before those lands were opened to public sale. Nearly 40 preemption acts were eventually passed, covering vast tracts of the United States. These ad hoc laws were largely aimed at validating existing settlement patterns, not at preparing the way for settlement. As economists Terry Anderson and Peter Hill write:

> Farmers on the frontier of Ohio, Indiana, and Illinois confronted the problem of creating property rights in the absence of formal legal institutions. To limit entry onto the land, they formed land-claims clubs or associations that registered the settlers' claims to land and ensured that those claims would be honored when the land was formally opened for settlement under the various federal land laws. These clubs established their own constitutions and bylaws, developed rules for adjudicating disputes, and devised procedures for registering claims.[17]

During this period, the American West was being squatted, and the government at all levels had no choice but to accommodate this fact. Hernando de Soto notes:

> In California . . . there were some 800 separate property jurisdictions, each with its own records and individual regulations established by local consensus. It took more that 100 years . . . to pass special statutes that integrated and formalized US assets [and so] managed to integrate into one system the informal property rules created by millions of immigrants and squatters. The result was an integrated property market that fueled the US's explosive economic growth.[18]

Around 1880—ten years before the American frontier officially closed—the U.S. economy had become the largest economy in the world and was fueled by capital investments in housing, industry, railroads, and ranching, all of which depend on secure property rights.

We believe that effective property formalization is only possible when the central government accepts the decisions of legitimate *local* authorities—formal or informal—and adopts their property allocations as the basis for titling. Other ways have not worked well because attempts to "redraw the map" by moving settled populations, restricting existing informal rights (for example, the right to gather forest products or graze animals), or imposing complicated registry procedures are met with resistance, avoidance, or even violence.

Under pessimistic assumptions about the benevolence and capacity of the government in many developing countries, it is necessary for communities to negotiate for recognition and protection of their rights. They are only able to do this effectively if their demands are in a format that is recognizable and legible to the wider society. In the case of land, this means translating community norms and agreements into a concise set of rules (analogous to homeowners association bylaws, municipal articles of incorporation, or zoning restrictions) and translating informal rights into delineated parcels of land, the precise boundaries of which can be accessed by everyone.

New technology and emerging participatory mapping techniques greatly reduce the cost of this process, enabling even the poorest communities to produce accurate reflections of their land ownership claims. Even in the absence of state intervention and titling, the delineation of rights and restrictions can improve the efficiency of land markets and increase tenure security. When communities face pressure from outside groups competing for land or other natural resources, it is doubly important that the community consensus over land rights be recorded.

The initial goal of participatory cadastral mapping is to record the extent of all actual land rights, making note of any disputes, and providing a resolution system that creates the incentive for equitable agreements. We all understand that the process of staking a land claim is the mutual verification of rights among neighbors. This process of establishing occupancy was the foundation of the jury system in medieval Eng-

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land,[19] and it provides a useful model for understanding the implications of participatory mapping. If someone makes an ownership claim and a dozen of his neighbors unanimously agree that it is correct and accurate, there is a good chance that the claimant is the owner. If a boundary is disputed or ownership of a piece of land is unclear, it affects the quality of all the claims in the area, and all landholders have an incentive to eliminate the ambiguity.

Our observation is that in areas of significant human settlement, the basic boundary negotiations have already taken place. The goal should not be to overrule such negotiations but to make a systematic registry of their outcomes. To this end, software systems can be used for data collection in the field, and then for public validation of property, as well as for the recording of transactions.

Early efforts to collect parcel data for community mapping have relied on NGO intermediaries, who can play an important role, especially in training community groups. But we believe that in the future, it will be quite possible for communities and landowners to carry out the mapping activities for themselves, and will be necessary for the community itself to maintain the accuracy of registries over time.

In addition to the Kisumu and Mathare registry programs in Kenya, there have been other projects throughout Africa that have adapted modern mapping techniques to the process of setting boundaries, creating maps, and maintaining registries. The use of GPS for the creation of community registries began in India more than a decade ago. In 2000 in Sangli and Pune, India, slum dwellers began a self-mapping program.[20] And while 130,000 citizens of Pune have had their properties mapped, the current political authorities have reneged on an agreement to recognize the registries.[21] Recently in India, tribes in the forest areas of Gujarat adapted this mapping system to their tribal lands, although only 10 percent of the villages had been mapped by the summer of 2013. However, the acceptance rate of land claims by the bureaucracy has gone from 30 percent to 90 percent.[22]

Self-registration without the use of costly outside experts is possible, but it will require the development of simple local-language tutorials to help "barefoot surveyors," informal landholders, and community organizations to prepare parcel data for submission. There are many ways to capture geographic information, but current data collection techniques include:

- The digitization of parcel boundaries from high-resolution satellite or aerial imagery. With this method, it is possible to achieve spatial resolutions of 0.5 m, and it is therefore appropriate for medium to large rural land parcels.
- The capture of parcel corners using high-accuracy GPS devices, capable of 10 cm accuracy using "post-processing." This technique is most appropriate for small, high-value rural and peri-urban parcels.
- Traditional "line of sight" surveying, capable of centimeter accuracy, appropriate for dense urban settlements where multi-story buildings will be built.
- The capture of rough parcel boundaries or point locations using consumer grade GPS devices with 10 m accuracy is suitable for low-value rural land.
- Online recording of parcel boundaries or point locations produced directly from user mouse clicks on a digital map. This method can be quite accurate for all land types if recent imagery is available.

At the present time, when intermediaries create parcel records, they are generally submitted for public scrutiny in person during a community meeting, and landholders are provided with documentation of their claims that correspond to the information recorded in the database. In the future, an online registry could be used to validate new records as they are submitted, track changes over time, and even submit claims for government approval if the legal system offers a mechanism for the titling of informal property.

Participating communities would then have permanent access to land information, including satellite photos showing the territory with overlaid parcel boundaries and a searchable database of owners, of ongoing and settled disputes, and of transactions.[23] It would also be useful in these individual property records to link to information about the community, its use restrictions, and any common property to which landowners have user-rights, such as hunting, fishing, watering, grazing, and the collection of natural products such as deadfall.

It is important to emphasize that a community cadastre that has been entered into an online registry will be accessible by anyone with an Internet connection anywhere in the world. It is also possible to provide a data and a transaction interface by SMS (text message) so that a computer is not even necessary to interact with the registry; interactions can take place by cell phone. This is a significant advantage over government land registry systems, which often restrict data access and force users to travel long distances for service.

The cost and level of expertise required to create a basic community cadastre is minimal. Barun Mitra of the Liberty Institute in New Delhi, India, estimates that a cost of $1 per parcel is possible in an efficiently run self-mapping program in the forest areas of India.[24] Currently, the largest costs come from designing and configuring the data infrastructure and user interfaces, but ideally a single open data repository would eliminate the need for communities around the world to operate their own independent systems.

Some training—both technical and social—is required to help occupants create accurate maps. But the use of a GPS device to create the data is relatively simple and comes quite naturally to anyone who has operated a cellular phone.

The cost of creating a community cadastre and registry, even in the poorest and most remote parts of the world, should be low because the technology now permits participants in the informal economy themselves to carry out the bulk of the work.[25]

## IMPACTS AND BENEFITS

By occupying a visible public space and making expropriation obvious, the collection of community registries should offer real protection against uncompensated takings.

When a community achieves a critical mass of registered users, it will be very difficult for their governments to ignore the claims that have been recorded. As noted above, the records from California's private land clubs were ultimately entered into the state's cadastre, and dozens of preemption acts validated and formalized landholding in much of the American West. Over time, an accepted registry that records ownership, land transfers through sales or inheritance, rentals, and liens will be a true living document recording the chain of ownership, and the fact that it reflects the social consensus will provide it with a quasi-legal status that will protect the property from capture by both public and private interests.

For those who are earning their living directly from land, few issues are more important than protecting their possession of the land. As a result, it is common practice throughout the world for informal landholders to accumulate indirect proof of occupancy. They will, for instance, collect utility bills or seek membership in community institutions that may provide indirect certification of residency. These practices demonstrate that there is demand for, and value in, a system that can create evidence of ownership, even if it does not immediately result in formal title. Even better if they represent the first step toward formalization.

It is far more appealing for the state to offer formal titles to landholders after a community consensus over land division has been established, after a cadastre has been created, and after a registry has been compiled. Instead of being an expensive and protracted process, formalization will appear to be a low-cost course of action that could have huge political and fiscal benefits.

As a community cadastre increases in size and reliability, investors seeking to exploit land through real estate development, mining, agriculture, or logging will be under increasing

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pressure to acknowledge the community's consensus even if the government does not. Normally, large investors seeking a land concession will negotiate directly with the government in private, and then present the government concession to landholders as a fait accompli.[26] This nearly always creates intense and sometimes violent reactions from the inhabitants.[27] However, if a community cadastre existed, both governments and outside investors would be able to contact one another and negotiate directly with landowners for access or development rights. This could help eliminate "land grabs," which are a major source of conflict and uncertainty.

Under present systems, foreign investors are often unaware of existing informal claims, and land made available for development is presented as belonging to the state. It is often only after the fees are paid and the contracts signed that investors are met by disenfranchised landowners who protest that they have been relocated against their will or evicted without compensation. An accurate and complete registry system would instead allow owners to advertise land for sale or lease, or provide a way for interested buyers to contact landowners. There is great value to any investor who wishes to acquire land in knowing who, in addition to the government, may have a claim on property. Under this system all parties should be able to benefit.

The proposed system could also prove valuable in a number of ways that are not directly related to tenure security or land transactions. Squatter communities rarely have officially named streets and so lack address systems that make navigation or the delivery of mail possible. In the absence of a recognized local system, a community registry's parcel identifiers can become *de facto* addresses. Communities accessing the online system could also see whether thoroughfares in their area have been mapped and named. If not, residents could name streets and assign address numbers in much the same way that parcels are created.

Often public utility companies are reluctant or even unwilling to provide services such as power and water, because the company not only doesn't have an official address but they do not have an owner of record, and so they cannot identify their customer. Having a customer's name and address is a critical first step in defining and servicing an enormously underserved market for basic utilities.[28]

In addition to filling an important economic role, community-based land protection organizations may have powerful effects on the development of democratic political institutions. In a number of well-documented cases, such land claims networks became the foundation of local civil society and formal institutions such as courts and local governments.

For example, during the large-scale formalization program in postwar Japan, local commissions that were formed initially to implement land reforms were quickly transformed by the people into grassroots political organizations. Over time, they became the conservative backbone of Japan's main political party for more than half a century up until the present day. Although in the case of Japan this transformation was based on the actions of the central government, it was implemented through a process of direct citizen involvement.[29]

A key feature of an online land registry system is its ability to link geographically separate communities together in a single project of self-government, development, and pursuit of land rights. It is likely that network-level effects will be at least as important as the local-level improvement in transparency and security of individual land rights. Network effects might include the sharing of innovations and strategies, the creation of a mutual aid insurance fund to compensate evicted landholders, the rise of more active land and credit markets, and the ability to carry out complex negotiations and legal contests over recognition and compensation for transferring both individual and collective rights.

Integrating an online land registry system with existing social networking platforms in order to provide identity and claim verification could ease the process of setup considerably as well as making the system more robust. With the marginal cost of registration rapidly

approaching zero thanks to the dissemination of Internet access and wireless devices, it is possible that in a relatively short time a decentralized network could achieve what decades of state-administered land registry projects have failed to accomplish.

Creating a credit market that supplies affordable long-term credit for capital investment—not simply enhancing tenure security—should be the ultimate objective of property formalization. Bottom-up formalization might be accomplished quickly in some countries, but it could take years in others. Credit is an important incentive to participate in property registration, and affordable long-term credit might be made available even before the state agrees to formalize the community cadastres.

As community cadastres become more widely used and registrations become accepted as reliable, the system should allow banks to offer secured credit at reduced interest rates approaching those of traditional mortgage loans. Working with title insurance companies, "title" insurance products for informal properties that are registered in a community cadastre can be created, and these insurance-backed claims might be as good or better than state-backed titles with poor enforcement.[30]

Although informal landholders are often poor, in 2000 De Soto estimated that the *replacement* value of informal property held globally was $9.3 trillion, a value that surely has grown since then. So making these assets liquid could have an enormous impact on the global economy. If even a fraction of registered users were able to get loans based on their property as collateral, their investments could dwarf foreign aid spending.

As the Western economies demonstrated during the recent years of recession brought on by a credit crisis, long-term credit is essential to self-sustaining economic growth and the rise of a modern economy. But credit can only be made widely available and affordable if the risk is minimized. The most secure and so the most affordable credit comes through loans that are backed by collateral, not personal guarantees or expectations of future business revenues.

## COMMUNITY REGISTRATION OF FORMAL PROPERTY

It is uncommon to find settlements that are completely formal or informal. It is more common that they are a mix of both. Logically this intertwining of formal and informal property possession should complicate the process of self-mapping and so the creation of a community registry. However, having both formal and informal property integrated into a community registry could be a valuable tool to protect all property holders against land fraud and improper seizure.

Extensive informality is the result of having bad property laws and regulations, and an imperfect legal and regulator environment creates risks and costs to all property holders. However, if formal property owners also have their property lines validated by a community consensus that is reflected in a public community registry, they not only help protect themselves against fraud by criminals who exploit poor records and weak enforcement, but also against encroachment by their informal neighbors, or in the case of large formal landholders, by squatter invasions. By sharing validation by the community registry, their informal neighbors actually become the defenders of the status quo that includes a mix of informal and formal property lines.

Major property line disputes, whether formal or informal, are unlikely to be settled through the self-mapping process, but more minor disagreements can be managed through a process of negotiation among neighbors. It may seem that there is little incentive for a formal property owner to settle a dispute with an informal neighbor, since the formal owner has title validated by the law. But it is often the situation that the formal registry is not up-to-date and can be abused through the political process, which in poor countries often improperly influences the legal process. Thus, having property lines defined by a public, community-owned, community-controlled, and community-validated registry has the potential to provide an additional—perhaps even higher—level of security to whole communities made up of both formal and informal occupants.

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## CONCLUSION

Because property rights, secure tenure, and access to low-cost secured credit is crucial for self-sustained, long-term economic development, it seems sensible that billions of aid dollars have been spent over the last decade trying to help governments carry out a process of formalization. However, in practice these projects have been unable to incorporate significant numbers of urban squatters and traditional landholders into the global market economy. Although there have been several national registry programs that operated on a large scale, there are inherent limitations to state-led efforts.

State-run registry programs increase bureaucratization of the process and are vulnerable to capture by politicians and rent-seekers. Moreover, they often focus on "cherry-picking" the well established properties or politically favored occupants. The more recent squatters are often specifically excluded. At times, large areas of the country are simply ignored, as with the northern third of El Salvador, where an insurgency had been active. These facts make it unlikely that the current top-down formalization programs will produce the huge economic benefits predicted by De Soto and others.

Although the transformation of informal tenure into formal property rights is ultimately a sovereign act, that does not mean that the process begins from the top. To the contrary, history repeatedly shows that with rare exceptions the modern property systems in rich countries emerged from a process of informal occupation of territory followed by government action to recognize existing tenure patterns.

In contrast to the conventional notion that land registration needs investment into government administrative capacity, the bureaucratic nature of the government is typically the *cause of*, *not the solution to,* informality. It is essential that we stop making the problem worse by funding and upgrading these bureaucracies, and instead redirect our efforts toward automated, participatory, public-focused systems, simple data standards, low-cost mapping techniques, and a political strategy that confronts the entrenched interest groups such as politicians, large land owners, lawyers, surveyors, and bureaucrats who profit from the current dysfunction. Furthermore, a bottom-up approach has the advantage of being voluntary in nature—as opposed to centralized land titling schemes. There may be reasons—such as the threat of government predation, or the existence of well-governed commons[31]—for which individuals or whole communities may choose not to register their property claims.

Using inexpensive hand-held devices and satellite imagery, informal communities can now take the first step by self-mapping their property claims. Creating a global system of extra-governmental property rights based on open access and community participation—a system that can hold governments accountable when they violate the rights of their own citizens—could be the first step in a process that leads to secure and legally recognized land tenure, active real estate markets, and affordable secured credit.

## NOTES

Clayton Schaefer, a specialist who designed Globaland Group's self-registry pilot software, and who consults on land tenure issues, spatial data management, and low-cost cadastral mapping, presented some of the ideas expressed in this paper at the TEDx conference in Brussels in November 2009, http://www.youtube.com/watch?v=buY_iB-eNpA.

1. Governments in many developing countries, ranging from China to Nigeria, still bulldoze slums, while Brazil and India have begun to move away from that approach. See, for example, "No Place to Call Home," *The Economist,* June 7, 2007, http://www.economist.com/node/9302841, or Amnesty International, "Nigeria: Bulldozer Day," December 2011, http://www.slumstories.org/episode/nigeria-bulldozer-day.

2. Hernando de Soto, *The Mystery of Capital: Why Capitalism Triumphs in the West and Fails Everywhere Else* (New York: Basic Books, 2000), table 2.1, p. 36.

3. Irene Karanja, "An Enumeration and Mapping of Informal Settlements in Kisumu, Kenya, Implemented by their Inhabitants," *Environment and Urbanization*, International Institute for Environment and Development, April 2010.

4. This was discussed by NPR: http://www.npr.org/blogs/parallels/2013/07/17/202656235/in-kenya-using-tech-to-put-an-invisible-slum-on-the-map.

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11. World Bank, *Implementation Completion Report (SCL-43840) on a Loan in the Amount of US$36.12 Million to the Republic of Peru for an Urban Property Rights Project*, December 27, 2004, http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2005/01/12/000012009_20050112101614/Rendered/PDF/29298.pdf.

12. George B. N. Ayittey, *Indigenous African Institutions* (Leiden, NL: Brill, 2006), pp. 87–88.

13. An Inter-American Development Bank report stated that "[LAMP] also met with only limited success as just 40% of the targeted 30,000 parcels are in some stage of the regularization process and just 570 of the targeted 6,400 persons were granted legal titles." See Jesse W. Wright, "Feasibility Study of Jamaican Low-Income Housing," Inter-American Development Bank, June 2007, p. 11. In 2010, it was "estimated that there are more than 800,000 parcels of land in Jamaica, of which only about half is registered and titled." See Garfield Myers, "LAMP Faster, Cheaper Means of Getting Titles," *Jamaica Observer,* July 25, 2010, http://www.jamaicaobserver.com/LAMP-faster--cheaper-means-of-getting-titles_7825659.

14. Munsung Koh and Garfield Knight, "LAMP II: A Land Registration Project in Jamaica," paper presented at the International Federation of Surveyors Congress, Kuala Lumpur, Malaysia, June 2014, http://www.fig.net/pub/fig2014/papers/ts01c/TS01C_koh_7075.pdf.

15. India's *Recognition of Forest Rights Act* (2006) is a recent example of this phenomenon. Landholders are given use rights, but do not have the right to alienate or mortgage their properties.

16. Restrictions on sale or transfer also make it difficult for owners to access credit since banks cannot foreclose. This is in contrast with the historical experience in the United States, where people could get loans under the homesteading acts. If a farmer did not repay, the bank would seize the property. To avoid straw purchases and registrations, developing countries put a time limit on any transfer. To be fair, this does appear to follow the logic of English common law for adverse possession ("flagrant" or open possession for 7–10 years), yet makes land formalization schemes of little avail to prospective entrepreneurs in developing countries who need access to credit.

17. Terry L. Anderson and Peter J. Hill, *The Not So Wild, Wild West: Property Rights on the Frontier* (Redwood City, CA: Stanford University Press, 2004), p. 160.

18. De Soto, p. 53.

19. The first use of juries in medieval England was for a panel of 12 neighbors (peers) to verify that a person claiming a property right was indeed the proper claimant. See Joseph Strayer, *On The Medieval Origins of the Modern State*, 2nd ed. (Princeton, NJ: Princeton University Press, 2005).

20. Pratima Joshi, Srinanda Sen, Jane Hobson, "Experiences with Surveying and Mapping Pune and Sangli Slums on a Geographic Information System," *Environment and Urbanization* 14, no. 2 (2002): 226.

21. Ibid., p. 235.

22. Swaminathan Aiyar, "Tribals Finally Get Land Rights Using GPS Technology," *Times of India*, July 21, 2013, http://blogs.timesofindia.indiatimes.com/Swaminomics/tribals-finally-get-land-rights-using-gps-technology/.

23. Creating consensus within the community may require a paper map to be posted in a public place and marked by citizens assembled in public meetings. This technique is intended to identify and settle disputes before data enters the registry. It has been used successfully in several countries, including Afghanistan.

24. Righttoproperty.org, "A Property Rights Revolution Is Taking Root in Gujarat," February 13, 2014, http://righttoproperty.org/blog/?p=342.

25. Our company, the Globaland Group, has already tested prototype online registries, but further work is required, particularly in the areas of language support and SMS (texting) registration.

26. In 2013 the government of Myanmar evicted farmers from land so that a Japanese consortium could build a factory. See also the NPR coverage thereof: http://www.pbs.org/newshour/bb/world/july-dec13/myanmar_07-17.html.

27. The Ok Tedi Mine in Papua New Guinea displaced 50,000 people, and both legal and illegal development of the Amazon Basin often generates violence. Clearing land in both China and Brazil for the Olympics has been a problem for these countries' governments.

28. Stealing electricity is common practice in many Latin American countries, where denizens of informal dwellings find it extremely difficult to contract formally with power providers. See Kevin Sullivan, "Electricity Pirates Zapping Mexico's Power Grid," *San Francisco Gate*, January 27, 2002, http://www.sfgate.com/news/article/Electricity-pirates-zapping-Mexico-s-power-grid-2878668.php.

29. Peter F. Schaefer and P. Clayton Shaefer, "Planning for Reconstruction and Transformation of Japan After WWII," *Case Studies I*, Project on National Security Reform, 2008, p. 549.

30. We have established a mechanism to create such "title" insurance.

31. Elinor Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action* (New York: Cambridge University Press, 2000).

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