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Research Report

Digitalisation of property taxation in developing countries: Recent advances and remaining challenges

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Report

Digitalisation of property taxation in developing countries

Recent advances and remaining challenges

Justine Knebelmann

June 2022





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Acronyms

ATI	African Tax Institute
CAMA	Computer Assisted Mass Appraisal
COTS	commercial off-the-shelf
DRC	Democratic Republic of Congo
GDP	gross domestic product
GIS	geographic information system
GV2000	General Valuation Project 2000
ICTD	International Centre for Tax and Development
IT	information technology
LiDAR	light detection and ranging
OECD	Organisation for Economic Co-operation and Development
TaxDev	Centre for Tax Analysis in Developing Countries
UK	United Kingdom
UN	United Nations
UN-Habitat	United Nations Human Settlements Programme
UNU	United Nations University
US	United States
WIDER	World Institute for Development Economics Research

Executive summary

Governments in low- and middle-income countries lag behind more advanced economies in terms of local tax collection.

There is a growing need for such revenues to address the challenges posed by rapid urbanisation. This report focuses on recurrent taxes on built property, for which the scope for improvement is large. In the years 2010–2018, the ratio of property tax revenue to total taxes was on average 0.4% in low-income countries, compared with 5.6% in high-income countries (UNU-WIDER Government Revenue Dataset, 2020).

Many of the hurdles that governments face in improving their property tax systems are common across different countries and contexts. Key challenges include: incomplete and outdated property tax rolls; limited staff and resources to carry out updates; ambiguity in land rights; imprecise addressing systems; and thin property markets, making it difficult to leverage information from transactions and contracts.

Digitalisation has the potential to address some of these barriers: it can provide specific benefits for property tax systems because satellite imagery tools and geolocalised data systems can help in detecting, registering, characterising and valuing properties. In other words, they can help in creating and managing the property tax roll.

This report draws on experiences from over 15 property tax digitalisation projects in countries in Africa, Latin America, the Caribbean and Asia. It takes stock of the main features of these projects and their results where available, and provides an overview of the lessons learnt and the main challenges encountered. While these projects provide useful insights and emerging

evidence for policy-makers embarking on similar projects, most are ongoing or very recent, limiting the ability to draw conclusions about the extent of their success or failure, or whether they can be sustained.

Recent and ongoing developments in the digitalisation of property tax reform processes

The integration of aerial imagery and GIS data linked to the property tax register is the main feature of recent property tax digitalisation reforms in low- or middle-income countries. GIS-enhanced property tax registers allow each plot to be georeferenced, enabling the administration to easily locate it irrespective of the quality of the addressing system. In addition, the use of tablets and smartphones can streamline and strengthen the collection of information about taxpayers, properties and occupancy, to create digitalised property tax registers. Land and property ownership registers and property tax registers are often separate, and in many contexts they are managed by different government agencies (Franzsen and McCluskey, 2017). There are a number of examples in this report of modernisation programmes that have targeted one without the other. Thinking ahead about the potential to link information between these different data sources is important.

The systematic use of computers, mobile devices and aerial imagery can also play an important role in the property valuation process, which is key to determining the tax base. These tools make it possible to envisage the adoption of Computer Assisted Mass Appraisal (CAMA) methods in these contexts.

A CAMA system is one in which property values are estimated based on some objective characteristics, with an underlying formula calibrated using statistical methods. The number and sophistication of the variables used in the CAMA formulas may vary, and the overall cost and complexity of using this approach may similarly vary. CAMA methods have the potential to substantially reduce the resources required for valuation compared to expert valuations, and are particularly appealing in contexts where sourcing information on sales prices or actual rental values is challenging. In sub-Saharan Africa, for example, a number of projects are experimenting with using newly available data from digital field surveys and satellite imagery, using lower-complexity formula and property characteristics that are easy to recover during fieldwork.

The introduction of digital platforms also creates opportunities for the tax administration to systematically assign tasks, monitor the activities of its staff and oversee overall project progress. While this may be relevant to other tax instruments too, it is particularly useful for property tax, which can require lengthy and intensive door-to-door field operations.

Finally, digitalisation may occur at the point of interaction between taxpayers and the administration, through, for example, enabling taxpayers to register their properties, make appeals or make payments online.

Lessons learnt from digitalisation reform processes

In line with previous in-depth reviews of tax property reform processes in Africa, Eastern Europe and elsewhere (Franzsen and McCluskey, 2017; Bahl et al., 2008),

the emerging lessons from the diverse projects featured in this report suggest that, while there are opportunities in increased digitalisation, the transition is often costly, lengthy and complex. In most contexts, different institutional actors will need to work together over a long time and mobilise extensive and diverse human and technical resources for the reform to be successful. A number of these challenges are outlined in further detail below.

First, an important obstacle to the development of digitalised property tax systems are the upfront costs associated with the purchase of software and hardware, and the ongoing troubleshooting, updating and broader maintenance costs required to sustain the system over time. Whether administrations opt to use commercial off-the-shelf solutions (COTS) or embark upon tailored internal or external software development processes, these costs may be high relative to the resources of the administration – even more so if they fall on subnational governments. For this reason, many digitalisation projects are currently funded by international donors. Other important technological dimensions that need to be considered include the feasibility of integrating and migrating pre-existing data, and practical technical challenges such as internet connectivity, speed and ensuring sufficient storage.

Second, transitioning to a sustainable digitalised system requires buy-in from managers and users, as well as substantial human resources. The software development process involves intense engagement with users: regular testing is required over long periods of time, and acceptance of the new tool by the relevant staff in the administration or local government is a precondition for success. Data collection operations that typically accompany

property tax modernisation projects are extremely labour intensive; in some instances, administrations rely on hundreds of additional short-term employees. Furthermore, after the initial expansion of the tax base is complete, periodic updates of the valuation roll will still be needed. Finally, it is necessary to ensure that the administration has sufficient capacity to implement the associated collection and enforcement actions if a large-scale project leads to a steep increase in the number of taxpayers over a short period of time.

Third, while digitalisation projects for property taxation may improve property detection, registration and billing processes, they can also co-exist with low levels of compliance, as in some of the country studies we draw from. Research has started to explore the role of taxpayers' intrinsic motivation and public service preferences; other research has highlighted that liquidity constraints could be a structural obstacle to property tax payments by the poorest households.

Fourth, digitalisation alone cannot overcome the political challenges associated with strengthening property taxation systems. Property tax is very salient to taxpayers, and in low-income countries it may well be the only direct tax which some individuals are subject to, or at least the only one for which they have to undergo a proactive declaration and payment process.

Finally, shifting to a new system for property tax management often requires effective coordination between different government agencies and levels of government. In some contexts, it may also require modifications to the legal or regulatory framework, which can take time.

For all of these reasons, modernising the property tax system is far from just a technical endeavour, and requires strong and lasting leadership and political will.

Potential policy implications

Based on lessons learnt from the projects covered in this review, a number of potential policy implications emerge. Importantly, the legal, institutional and socioeconomic context in which property taxation occurs may vary widely both within and across countries. As such, these recommendations are of a general order and need to be tailored to context.

The successful development of the digital solution itself requires constant interactions between developers, users and project managers. Allocating sufficient staff time to the process is key early on, even before the development starts, to prepare the needs assessment and terms of reference. It may be useful for the administration to appoint a full-time product owner, to streamline the development and testing processes. Whether the optimal choice is a local vendor or an international software company depends on the context, funds and needs. More importantly, the guiding principles when choosing the software developer should include the ability of the vendor to deliver the product in a reasonable time span, at a price that is affordable relative to project funds, and, as importantly, the potential for the administration to conduct maintenance and future modifications to the application as well as ensure long-term data storage.

There are three main challenges to address when creating and maintaining an up-to-date valuation roll. The first is the selection of a valuation method that can be deployed at a large

scale while enabling tax equity. The second is the update of property values in future years. The third relates to the recovery of information on the identity of property owners, for enforcement actions and updates when needed. A common suggestion is to adjust the number and complexity of property characteristics used in the valuation process to the administrative environment: in low-income settings, simpler valuation methods such as banding approaches or formulas based on a small number of variables may be more desirable than complex valuation formulas relying on a large number of characteristics (McCluskey et al., 2002; McCluskey, 2021). Furthermore, because of the cost and logistics involved, it is not feasible or desirable to conduct comprehensive property listings on a yearly basis, even though the market value of properties might evolve. The frequency with which revaluations should occur depends on the resources available and on the expected benefits in terms of tax revenues. A fruitful area for future innovation involves thinking about ways through which revaluations might be less costly than the initial fieldwork – for example through increased use of aerial imagery, such as change detection technology, or through increased interactions with owners and tenants once their contact details are in the valuation roll.

Finally, the political economy environment strongly affects the extent to which a digitalisation project will succeed in raising more revenue over the long term. Local governments in low- and middle-income countries are particularly resource-constrained, and decision-makers may not find it optimal to invest in property tax capacity, either because they are wary of the political consequences or because they consider that the costs will not be recovered. For this reason, an increasing number of property tax modernisation programmes seek to set up financial incentives for municipalities

to put in sufficient effort for the success of the field operations to enlarge the tax net. Recent empirical evidence has highlighted the importance of increasing taxpayers' voluntary compliance for an effective property taxation process. Institutional settings that seek to make the channels through which taxpayers can engage with the administration or the local government more salient and convey their level of satisfaction or their expectations in terms of public services have shown some promising results – although the effects are not large enough to fully close the compliance gap (Khwaja et al., 2020; Krause, 2020; Weigel, 2020).

1 Introduction

1.1 Background: the state of property taxation in low- and middle-income countries

Property tax revenues are significantly lower in low- and middle-income countries compared with higher-income countries. As Table 1 shows, for the 2010–2018 period, property tax revenues amounted to 0.06% of gross domestic product (GDP) and 0.40% of tax revenues in low-income countries, against 1.30% of GDP and 5.62% of tax in high-income countries. Furthermore, comparing 2000–2009 and 2010–2018 period averages reveals that the contribution of property taxes to total taxes increased significantly in high-income countries and progressed slightly in upper-middle-income countries but stagnated in low-income and lower-middle-income countries between the two periods. There are strong heterogeneities in the performance of property taxes within income groups, and even within countries across cities. Relying on data for 40 cities over the 2009–2017

period, Kelly et al. (2020) estimate the median value of property tax revenue per capita in US dollars for certain sub-regions: \$79 in Latin America and the Caribbean; \$15 in Southeast Asia; \$7 in India; and \$6 in sub-Saharan Africa.

Yet, as low- and middle-income countries continue to urbanise rapidly, property tax revenues are increasingly crucial for local public service provision. Africa is currently the fastest urbanising region in the world: in 2015, over 50% of Africans lived in urban agglomerations compared with 13% in 1950, suggesting a pace of urbanisation that is unprecedented; the African population is projected to double by 2050, and two-thirds of this increase will occur in urban areas (OECD, 2020). Asia is also continuing to urbanise at a high pace: its urbanisation rate in 2020 exceeded 50%, up from 37.5% in 2000 (UN-Habitat, 2020). Current levels of urbanisation are higher in Latin America, at 81% on average (United Nations Population Division, 2018).

Table 1 Property tax revenues by income group in 2000–2009 and 2010–2018

	2000–2009			2010–2018		
	Property tax as % of GDP	Property tax as % of tax	Number of countries	Property tax as % of GDP	Property tax as % of tax	Number of countries
Low-income	0.12	1.07	25	0.06	0.40	14
Lower-middle income	0.17	1.16	43	0.19	1.04	34
Upper-middle income	0.34	2.01	47	0.42	2.16	44
High-income	1.00	4.61	53	1.30	5.62	53

Note: The property tax variable includes taxes on recurrent property but excludes taxes on property transactions. Total tax is total taxes excluding grants and social contributions. The figures are period averages for each subset of countries.

Source: UNU-WIDER Government Revenue Dataset, 2020.

Importantly, a significant share of the growth in urban populations in Africa, Latin America, South and South East Asia is accounted for by informal urbanisation, with inadequate planning. More generally, there is a shortage of well-functioning public services and infrastructure, resulting notably in high levels of congestion and insufficient networks for roads, transportation, sanitation and waste management. This is a profound challenge that can be addressed in part through increased local tax revenues.

These urbanisation trends also suggest that the tax base for property taxes is increasing, as more properties are being built and their values are increasing (Fjeldstad et al., 2017). However, limited information on property ownership and construction means that precisely estimating the full potential of property taxation is often a challenge for administrations in settings of low state capacity.

Improving property taxation is a prerequisite to strengthening the capabilities of subnational governments. As such, the issue of property taxation is intricately connected to questions around decentralisation and the roles and responsibilities of different levels of government. Property taxes often represent one of the main instruments for levying taxes to finance local spending, together with local business taxes, market fees, user charges, some forms of income or capitation tax, or royalties from natural resources (Fjeldstad et al., 2014). The literature agrees that it is reasonable and worthwhile to invest in strengthening property taxation but that improvements come with administrative and political challenges: ‘Property taxes offer perhaps the single greatest opportunity for strengthening local revenue systems – but they also pose plenty of political and institutional obstacles’ (Moore et al., 2018: 152); ‘Countries that want to have

local governments that are both responsive and responsible must follow this hard road’ (Bird, 2010: 31).

Even though property tax revenues accrue almost universally to local governments, the taxation process can be managed either at the central level – revenues are then transferred to local governments after collection – or directly at the local level. The responsibilities may also be shared between the two levels of government, for instance with central government setting the rates and local governments collecting the revenues. In Africa, Francophone countries tend to be more centralised compared with Anglophone countries. Latin America also displays a mix of systems: in a 2012 study, the Lincoln Institute reports that the central government is involved in the assessment process in 7 out of 12 countries while it is involved in the collection process in 6 out of 12 countries (De Cesare, 2012). A wave of fiscal decentralisation in the 1990s led to an increase in the number of countries where property taxation is managed locally.

The literature converges on the idea that property taxes will be more likely to reach their full potential if they are managed at the local level, or at least if local governments have some leeway regarding some of the policy choices (Bird, 2010; Goodfellow, 2017; Moore et al., 2018). Bird (2010) offers a review of the theoretical arguments behind these reflections, notably the principle stemming from second-generation fiscal federalism suggesting that tax responsibilities should be aligned with expenditure responsibilities. In this sense, whether or not property tax management should be assigned to local governments depends on the extent of services these levels of governments are mandated to deliver. More pragmatically, some advantages in the local management of property

taxes, in addition to consistency between the taxation and service delivery functions, are higher quality of local information (on properties and owners) and a better alignment of incentives. Conversely, the advantages of property tax management by the central government are that the government is likely to have greater administrative capacity, to be able to link property and owner details with other information, to be more able to take on the political challenges associated with tax enforcement and, finally, to have higher ability to monitor corruption (Goodfellow, 2017).

1.2 Taking stock of lessons learnt from recent empirical research

Recent studies relying on micro-level data in a given context generate rigorous measures of the property tax gap. By contrasting property tax registers with cadastral information, aerial imagery or results from property surveys in the field, researchers have been able to produce recent estimates of the registration gap – a first important margin of underperformance. The share of properties that are registered for the property tax is estimated to be around 15% in Dakar, Senegal (Knebelmann, 2021), around 5–10% in Monrovia, Liberia (Okunogbe, 2021), 40% in Kigali, Rwanda (Ali et al., 2018) and around 50% in Carrefour, Haiti (Krause, 2020). Recent expansion efforts have increased the rate to 80% in Kampala, Uganda (Ahabwe et al., 2020), and from 52% to a register deemed complete in Freetown, Sierra Leone (Prichard et al., 2020).

Recent studies also enable quantification of the compliance rate – whether or not a tax payment is made for a given property.

Among registered owners in Mexico, 60% pay the property tax (Brockmeyer et al., 2021), in Mendoza, Argentina, around 20% of billed taxpayers are in

arrears (Eguino Lijerón and Schächtele, 2020) and in districts of Lima province in Peru, only 66% of billed taxpayers pay the tax (Del Carpio, 2014). Turning to amounts of revenue, recent estimates find that 27% of assessments are being collected in Senegal (Knebelmann, 2021), 34% in Kampala, Uganda (Ahabwe et al., 2020), 29% in Kigali, Rwanda (Ali et al., 2018), 10% in Carrefour, Haiti (Krause, 2020), 40% in Junin, Argentina (Castro and Scartascini, 2015) and 85% in Punjab province in Pakistan (Khan et al., 2016). Knebelmann (2021) estimates that 9% of *total tax potential* is being collected in Dakar, Senegal; Krause (2020) estimates this figure at 5% in Carrefour, Haiti. Importantly, we do not necessarily expect that in such contexts where the administration is substantially resource-constrained it is always optimal that the property tax gap be zero – it could be that efforts would pay off better in other areas of revenue collection. This question is open for future research.

Recent experimental evidence helps fill the knowledge gap on what might strengthen property tax capacity in a given context. A first set of experimental studies evaluates the impact on registration of enforcement through increased interactions between the administration and property owners.

In Kananga in Democratic Republic of Congo (DRC), Weigel (2020) documents that a randomised door-to-door property tax campaign with on-the-spot registration and appeal for payment by agents of the provincial government increased the payment rate from 0.1% to 11.6% in the treated areas. In Monrovia, Liberia, Okunogbe (2021) documents that a letter sent to randomly selected owners informing them that their unregistered property had been detected, combined with information on penalties,

quadruples the likelihood of tax payment, with a 7.6 percentage point increase from 2.2% in the control group.

A second set of experimental studies considers the effect on compliance of campaigns targeted at already registered taxpayers. In Lima province in Peru, Del Carpio (2014) finds that a social norm treatment consisting of informing owners about the level of property tax compliance in their area increases tax compliance by 20% (8 percentage points from 43%), while a reminder letter has an effect that is also positive but smaller (10%). Results are different in Junin, Argentina, where Castro and Scartascini (2015) find that the social norm treatment has no significant effect, nor does a message informing owners of the public services funded by property taxes. However, a deterrence message listing penalties has a significant impact on tax compliance, shifting it from 40% to 44.7%. In Mendoza, Argentina, Eguino and Schächtele (2020) test the effect of adding specific messages directly to the tax bill. An improved design of the tax bill combined with a public service message raises the baseline 77% compliance rate by 3 to 4 percentage points. In Mexico, Brockmeyer et al. (2021) detect a positive and significant effect of two types of messages mailed by the administration to delinquent property owners: the penalty message (which triples the probability of making a payment); and the public service message (which has half of the effect size compared with the penalty message).

A third strand of experimental (or quasi-experimental) studies sheds light on the causal effect on property tax revenues of changes in tax policy or administration. In Colombia, Martinez (2020) finds that a cadastral update in a given municipality leads to a 34% increase in property tax revenue in the subsequent years (the sample includes over 900 municipalities,

throughout 2006–2010). In Mexico, Brockmeyer et al. (2021) study the effect of increases in the tax rate caused by the removal of abatements for residential properties within specific cadastral value bands. A set of reforms that occurred between 2008 and 2012 led to a 36% increase in property tax revenue in Mexico City. The hikes in tax rates in particular had positive revenue effects, although less than the expected mechanical effects, since tax compliance fell at the same time. For a 1% increase in the tax rate, revenues grew between 0.3% and 0.7%. In a purely experimental setting, Bergeron et al. (2021) find that, in Kananga, DRC, the status quo tax rate is above the revenue maximising tax rate: owners receiving a reduction in the tax rate actually increase their property tax payment – 13% of taxpayers (respectively, 9.9% and 6.7%) complied among those subject to a 50% lower tax liability (respectively, 33% and 17% reductions) compared with 5.6% of taxpayers among those subject to the status quo tax rate.

The type of staff involved, their incentives and the information they have significant importance for property tax performance. In Punjab province, Pakistan, Khan et al. (2016) find that, when agents from the provincial government are compensated under a performance pay mechanism, revenue growth is 46% higher than with a standard pay scheme. The downside is that a higher number of taxpayers report paying bribes to the agents in the field. In a follow-up study with the same provincial administration, the authors find that an alternative way of incentivising staff is to set up a performance-based geographical posting system. Revenue increases by 30–41% when agents know that higher performance will increase their probability of being posted in a place for which they expressed a preference. In Kananga in DRC, Balan et al. (2021) compare property tax revenues raised by city chiefs with those raised by agents of the provincial

government, relying on the random allocation of this responsibility across areas of the city. They find that chiefs raise 43% more revenue, which they explain by the fact that chiefs have better local knowledge about property owners.

Appendix 1 provides a summary table of these recent experimental studies on property taxation in Africa, Latin America and the Caribbean and Southeast Asia. It is important to note that these results rely on a subset of property owners, and on sectors within a metropolitan area, region or country. They need to be interpreted within the specific context in which they occur. A given intervention does not necessarily have the same effects in one setting as it will in another. This reinforces the need for in-depth background work and needs assessments before designing reform programmes.

1.3 Objective of this report: investigating the potential offered by digitalisation

Many of the hurdles property taxation faces are common to various contexts. These include incomplete and outdated property registries and valuation rolls; ambiguity in property and land rights; imprecise or absent addressing systems; limited staff and resources of the administration to conduct the field and office work necessary to update the valuation roll; and thin property markets, making it difficult to leverage information from transactions and rental contracts to improve the valuation roll. Digitalisation can play an important role on all of these fronts through: improved data and information systems and, importantly, through geolocalisation and GIS systems; by providing assistance for valuation purposes; and by lowering the costs of collecting information and communicating with taxpayers.

However, levels of tax education and voluntary tax compliance among taxpayers are often low. Furthermore, reforming property taxation is politically challenging, first because elites tend to be reluctant to reinforce this tax instrument to which they are very likely to be subject, and second because it is a tax that is extremely visible to taxpayers (Bahl et al., 2008; Bird, 2010; Moore et al., 2018). As Bird mentions, ‘it is little surprise that academics generally tend to be much fonder of the property tax than are the politicians who actually have to impose it’ (2010: 29). Digitalisation may pave the way for stronger property tax systems, if accompanied by political will, preparedness for reform and sufficient human and financial resources.

The objective of this report is to bring together the latest insights from recent, or ongoing, property tax modernisation programmes in low- and middle-income countries, to pull together lessons learnt that are otherwise scattered across multiple sources. Although the digitalisation process has been slower for local taxes than for national taxes (income, corporate and trade taxes, for example), over very recent years there has been increased attention from governments and the international community to the need to modernise local taxes and property taxes in particular. This has allowed us to review cases from over 15 countries. We build on previous reviews of property taxation, augmenting them with the latest available illustrations (Bahl et al., 2008, review property tax reforms in transitional countries in Eastern Europe; Franzsen and McCluskey, 2017, review digitalisation projects in African countries).

The methodological approach for this report has consisted of reviewing different types of literature: academic research, grey literature from government agencies and international

organisations, specialised blogs and articles from news outlets. This has been combined with insights from experts shared in thematic international conferences on local taxation in low- and middle-income countries in 2020 and 2021. Finally, the report has also benefited from the author's direct contacts with some of the administrations involved in property tax digitalisation projects. Appendix 2 provides a useful overview of each of the property tax digitalisation projects reviewed for the report, with the corresponding references.

This report is organised as follows. Section 2 sketches out the various dimensions of property taxation that benefit from digitalisation, and also reviews a wide array of recent and ongoing digitalisation projects. Section 3 outlines the challenges and limitations that government bodies may encounter throughout the life cycle of property tax modernisation programmes. Finally, Section 4 provides policy recommendations for the development of digitalised property tax systems.

2 The advantages of digitalisation in the property taxation process

This section reviews recent or ongoing property tax digitalisation projects in cities in low- and middle-income countries. Digitalisation offers opportunities for improving the management of property taxation at different stages in the fiscal process.

As outlined in Kelly et al. (2020), the amount of revenue collected from property taxes is the result of a combination of policy variables and administration variables. The policy variables are:

- the definition of the tax base
- the rules determining the tax liability.

The administration variables are:

- the coverage ratio – the share of taxable properties that are registered
- the valuation ratio – the share of total real estate market value that is captured on the valuation roll
- the tax liability assessment ratio – the share of tax liability as defined by the legal framework that is actually being collected on any given property
- the collection ratio – the share of assessed liabilities that are being collected.

All of these administration variables can directly benefit from digitalisation.

The existence of basic computerised systems to manage property tax assessment datasets and

produce tax notifications is relatively widespread, and they have similar benefits to those they offer for other tax instruments.¹ Their advantages are, for instance, a significant gain in information management and processing time, the ability to easily compute summary statistics, the more timely production of tax notifications and the potential to link property tax information with other administrative data.

However, a computerised register is in itself only a small step towards fully reaping the fruits of digitalisation for property taxation. First, many substantial problems may continue to exist even if a computerised property tax register is established (see Knebelmann, 2021 in the case of Senegal, for example). Second, the specificity of the property tax leads to additional advantages of switching to digitalised processes, precisely because satellite imagery tools and geolocalised data systems can help detect, register, characterise and value properties – in other words the tax base.

This report focuses on cases where administrations are turning to systems that integrate more steps of the taxation process within the same system, and, above all, include precise geolocalised information on properties, which are key in settings where there is no comprehensive and unique addressing system.

This section is organised according to the different dimensions through which digitalisation can boost property tax mobilisation. Section

¹ Some illustrations in low administrative capacity contexts include its introduction in Dar es Salaam (Tanzania) as early as 1995 (Kelly, 2004), in Senegal in 2015, in Haiti starting 2011, in municipalities in The Gambia, etc.

2.1 focuses on the integration of GIS-enhanced information and aerial imagery. Section 2.2 looks at property valuation methods. Section 2.3 discusses the way in which digitalisation can change the monitoring and management of tax agents. Finally, Section 2.4 presents features pertaining to the taxpayer's experience. For an overview, please refer to Appendix 1, which recapitulates all digitalisation projects listed in this section with the associated references.

2.1 Aerial imagery, GIS systems and data collection tools for property taxation

The main feature of recent digitalisation reforms for property taxation in low- or middle-income countries is the integration of GIS data linked to the property tax register. Furthermore, technological progress has led to a strong reduction in the price and complexity of using information retrieved from high-resolution satellite and drone images, which are increasingly integrated in digitalised property tax systems. The main objective of the digitalisation projects presented in this section is to combine fieldwork, office work and information collection from satellite or drone images to create a modernised property tax valuation roll and dematerialise the different steps of the taxation process.

Indeed, the tax base for the property tax is visible and tangible, whereas it is less straightforward to use imagery and localisation technologies to detect incomes and profits, for example. Generating information on the property's precise location, area and characteristics makes it possible to fully exploit this specific nature of the property tax. It is interesting to note, however, that in high-income countries where property tax enforcement is significantly higher, property tax registers are not systematically associated

with GIS information. This is because, in most of those countries, long-standing cadastral registers and addressing systems are reliable and comprehensive enough to fully identify all property units and their location.

GIS-enhanced property tax registers allow for the georeferencing of each plot, thanks to its coordinates, meaning that the administration can easily locate it irrespective of the quality of the addressing system. The boundaries of plots and even of built properties can also be georeferenced, meaning that the system includes information on the exact demarcation and area of properties. In some systems, each georeferenced plot is additionally associated with a unique administrative number.

Remote sensing technologies used for property tax purposes include: exploiting orthophotos (aerial images that are corrected to account for perspective and that are georeferenced) to generate digital maps; exploiting 2D satellite or drone images to measure the area of plots or of buildings; more sophisticated technologies allowing for the recovery of 3D data on the height and characteristics of constructions; and aerial imagery analysis, making it possible to detect changes in constructions between two periods in time. In this realm, technological changes in the 2000s, having made drones cheaper and easier to utilise, have generated substantial opportunities (Wihbey, 2017).

Finally, in addition to relying on these technologies, the creation of digitalised property tax registers (also called digital fiscal cadastres) requires a phase of data collection or enumeration work in the field, to collect additional information on taxpayers, properties, occupancy and usage for each plot. Digitalisation has considerably strengthened the efficiency of data collection

in the field, due to the increased affordability of smartphones and tablets. These data collection tools allow information to be automatically stored into a dataset, even processed, instead of manually copied or digitalised back in the office, which is still the case in numerous localities for the administration of subnational taxes. Digital tools for data collection also make the enumeration process easier to monitor, with the possibility of generating high-frequency advancement statistics, or even geolocalisation or time measurement at the individual level. Finally, encountering agents equipped with tablets or smartphones may increase taxpayers' perception of the state's capacity to assess tax liabilities and enforce taxation.

It is important to note that land and property ownership registers and property tax registers are two different tools of the administration, which may or may not be combined. Importantly, in many contexts, they are not managed by the same administration or the same departments within the administration (Franzsen and McCluskey, 2017). As such, there are examples of modernisation programmes that have targeted one without necessarily targeting the other. Thinking ahead about the possibility to link information between the different information sources is crucial. For example, in Kigali, Rwanda, it is estimated that only 40% of properties are in the property tax net (Ali et al., 2018), even though all properties are registered on the land and property cadastre.

The adoption of technologies to create digital property tax registers varies widely across the

globe. The remainder of this section presents illustrative cases from around the world. Some of these projects are currently being rolled out.

In Latin America, the majority of municipalities use digital systems incorporating GIS information for cadastral purposes, and the connection with taxation information (also referred to as multi-purpose cadastres) is increasing although not universal (De Cesare, 2012). An example is Bogota, Colombia. The cadastral updating project initiated in 2008 included an essential digitalisation component: data collection on properties in the field including GIS coordinates started being conducted on mobile devices, and a web-based application allowed the cadastre to monitor the fieldwork and also allowed professional valuers to intervene in the process. Property owners could review the information regarding their property. The project is generally seen as a success: it led to a vast increase in the share of properties registered on the tax roll and was accompanied by steep increases in municipal revenue (Ruiz and Vallejo 2010; Bahl et al., 2013).

In India, two subsequent national programmes for urban reform spanning 2005–2014 and 2015–2022 paved the way for property tax modernisation by inciting and supporting local governments to adopt new technologies for property tax management. An additional World Bank-supported project ran from 2012 to 2018 with similar objectives. Hundreds of participating cities are required to implement GIS-based fiscal cadastre and e-governance solutions for property taxation. Some prominent examples include the cities of Bengaluru, Raipur, Pune and Ranchi

² The Jawaharlal Nehru National Urban Reform Mission ran from 2005 to 2014; subsequently, the Atal Mission for Rejuvenation and Urban Transformation was established in 2015. An additional World Bank project was called the Capacity Building for Urban Development Project.

(Awasthi and Nagarajan, 2020). In Bengaluru, a GIS Enabled Property Tax Information System was introduced in 2008 and gradually achieved important coverage of the metropolitan area. The geolocalised properties in the system are associated with tax-related information such as identification of the owner and occupancy status (Bahl et al., 2013). While the digitalisation reform is seen as a success – over 1 million previously unassessed properties were brought into the tax net and revenues increased by 30–40% (Awasthi and Nagarajan, 2020) – it has still not reached its full potential. The 2016–2017 national India Economic Survey estimates, using satellite images, that Bengaluru collects only 12–23% of its potential property tax revenue (Ministry of Finance, Government of India, 2017).

In Raipur, a mobile application was developed to allow extensive door-to-door surveys of properties. Properties were assigned a unique identification number as well as GIS coordinates in the field, along with geotagged photos, videos and voice messages. Drone images were exploited to complement the fieldwork. The newly collected data was utilised to clean the valuation roll, and property tax assessments increased by 68% after the reform (Awasthi and Nagarajan, 2020). In Pune, a digital property database was created, enabling the registration of 18% more properties. In Ranchi, the modernisation programme triggered in 2014 allowed for the generation of a property database with unique property identification numbers and geolocalised information. The number of properties on the valuation roll grew by 67%. The World Bank evaluation report based on the six pilot cities (Haridwar, Nagpur, Dehradun, Puri, Cuttack and Chhindwara) notes that the project allowed ‘an average of 73 percent increase in the property tax base and an over 300 percent increase in the property demand’ (World Bank, 2018: 15).

In **Punjab, Pakistan**, the local government conducted a broad reform of the property tax (in the Punjab context, the Urban Immovable Property Tax), with support from the World Bank (Kelly et al., 2020). The project spanned 2012–2019, and its main features were: (1) to digitise pre-existing maps, ownership and taxation information; (2) to conduct field surveys on mobile devices to update information or add properties that were missing on the valuation roll; and (3) to establish a GIS-enhanced system for the administration of the property tax and revenue collection, incorporating data retrieved from satellite imagery and aerial orthophotographs. The digitalisation and extensive fieldwork led the number of properties on the tax roll to increase from 2.69 million in 2008 to 3.19 million by 2016.

Quezon City, in the Philippines, initiated a digitalisation reform as early as 2002. In that year, a private company was hired to digitise all records (property declarations, business registrations, construction permits and payment information for taxpayers already paying the property tax). Additionally, the city’s Assessor Department led a mapping exercise relying on GIS data and aerial photography. Properties were each assigned a unique identifier number, and their area and boundaries were included in the modernised property tax valuation roll (Kelly et al., 2020).

In sub-Saharan Africa, digital cadastres enabling property taxation are still very recent, and are far from having reached their potential. In **mainland Tanzania**, a first initiative was triggered in 2006, when a system that computerised assessment and billing was introduced in a few local government authorities across the country (McCluskey et al., 2018). A broader programme was introduced in 2014–2015 under the Local Government Revenue Collection and Information System project. First piloted

in nine localities, it was expanded country wide, although its effectiveness varied from one place to another. On the more successful side, Arusha conducted a city-wide field enumeration to update the valuation roll in 2015 (McCluskey and Huang, 2019). However, the GIS component of the system displayed important delays before being integrated with the computerised property tax roll. The approach taken in **Zanzibar** in its 2011–2016 modernisation project was slightly different: the aim was to establish a full fiscal cadastre, relying on drone images. As of 2020, half a million building footprints were mapped, and details for over 13,000 buildings were collected through fieldwork. However, the valuation and billing stages of the reform have not yet been conducted (Kelly et al., 2020; McCluskey, 2021; ATI and Lincoln Institute of Land Policy, 2021).³

In **Nigeria**, a first reform occurred in Lagos state starting 2001, following the Land Use Charge Act. A private firm was contracted to digitise and automate property tax management, with GIS features introduced in the system later on (Goodfellow and Owen, 2018). Enumeration work in the field using the new digital tools made it possible to enrol 750,000 properties in Lagos state by the end of 2010, up from 45,000 in 2007. Other Nigerian states have engaged in property tax digitalisation. An ongoing project in Ondo state, supported by the World Bank, relies on Google Maps to fully map properties and urban areas and to precisely monitor the advancement of the delivery of tax notifications (Awasthi, 2021).

In **Kampala, Uganda**, the city council (Kampala Capital City Authority) has benefited from the support of international donors to expand the property tax register, starting 2014, relying on fieldwork conducted using tablets and a new

IT tool that made the data collection work significantly more efficient than what could have been done on paper. As a result, over 300,000 properties have been registered and, importantly, the new dataset includes their GIS coordinates (Kopanyi, 2015; Kopanyi and Franzsen, 2018; McCluskey et al., 2018; Ahabwe et al., 2020).

In **Freetown, Sierra Leone**, the city council has utilised a new IT system to substantially expand and update the valuation roll, relying on a comprehensive geomapping of the city. The new system helps collect data in the field on mobile devices, and automatically manages the creation of tax notifications. Unique property identifiers are created for each property during the fieldwork and are entered into the dataset, associated with geolocation; the area of each property is recovered from a semi-automatised analysis of high-resolution aerial photographs. The enumeration in the field has made it possible to double the number of registered properties in 2020, from around 57,000 to around 120,000 (ICTD, 2021).

In **Senegal**, the national tax administration has contracted a local software company to develop an application that relies on existing GIS cadastral information and enables enumeration in the field, picking up information on properties, owners and photos, as well as the verification of information and production of computerised tax notifications in the office (Knebelmann and Pouliquen, 2021). Importantly, each property in the modernised property valuation roll is associated with a unique administrative identifier and is geotagged. The measurements of built area have been recovered from high-resolution satellite images. The project is currently being implemented as a randomised control trial: some neighbourhoods within the

3 Presentations by key informant Odd-Helge Fjeldstad.

region are being subject to the property tax fiscal census with the new digital tool, while another set will be taxed according to the usual process, based on the existing property valuation roll.

Collecting administrative data on payments and conducting taxpayer surveys will make it possible to precisely quantify the gains in terms of tax revenues from the introduction of the digital tool and the enumeration work. It will be insightful to put these gains into perspective with the cost of the modernisation programme. High-resolution satellite images combined with automatised imagery analysis also make it possible to detect changes in constructions over time. This feature has been explored by Airbus in Dakar, Senegal (Graham et al., 2018), but is not yet integrated in the administration's system.

In **Ghana**, 17% of the 216 districts have a geospatial registry of properties, often alongside software that links property information and revenue collection (Dzansi et al, 2022). In Madina, in the greater Accra region, property-level information was added to the geospatial database through field work conducted in the 2021 tax campaign. Furthermore, tax collectors were equipped with tablets that provided navigational information to locate properties – this feature was estimated to increase the number of bills delivered by 27% and revenue collected by 103% (Dzansi et al., 2022).

Digitalisation can lead to localised improvements even in extremely low state capacity settings. In **Somalia**, the United Nations Human Settlement Programme (UN-Habitat) partnered with municipalities in Somaliland and Puntland to capture georeferenced data on properties that has made property tax enforcement and compliance easier (UN-Habitat, 2006; Franzsen and McCluskey, 2017).

Three cases are worth mentioning to illustrate the separation between digital property titling and digital property taxation programmes.

In **Rwanda**, a vast land tenure regularisation process was initiated in 2008 and successfully completed, one of the main dimensions being the digitalisation of parcel-level information (location, area, boundaries, property title) for over 10 million parcels. However, property taxation itself relies on self-declarations by owners and is limited to owners with a freehold property title. Therefore, in spite of the impressive coverage of the digital land administration information system, property tax enforcement in Rwanda continues to underperform (Franzsen and McCluskey, 2017).

In **Mozambique**, an overarching land registration and administration programme was triggered in 2012 and further modernised in 2015 (Terra Segura), with support from the World Bank. A mobile application was introduced, which makes it possible to register plots and properties, identify their boundaries and integrate property titles. The application also relies on satellite images. Although interoperability with property taxation functions is also part of the objective of the project, this had not yet been realised by 2018; as such, the digitalised land registration programme has not yet yielded direct taxation benefits (Crispin et al., 2020; World Bank, 2021b).

In the case of **Quezon, in the Philippines**, described above, part of the computerised project specifically consisted in matching the digitalised property tax records with information from property transfers and property ownership from the Land Registration Authority. This is more likely to occur when proactive efforts are put into this activity, since identification details across

these different information systems rarely match in contexts where the cadastre and addressing systems are not robust.

2.2 Property valuation facilitated by digital tools

The systematic utilisation of computers, mobile devices and information extracted from aerial imagery plays a crucial role in the realm of property valuation, which is key in determining the tax base for property taxation.

Importantly, these tools can be extremely useful, whatever the legal basis for valuation, from the most basic valuation systems, based on area only, to the most sophisticated, when the administration aims to generate a precise estimate of the price or rental value for each property.

Computer Assisted Mass Appraisal (CAMA) methods refer to systems in which each property value is estimated based on a formula, the inputs of which are objective characteristics of the property (location, built area, type of wall, type of roof, number of rooms, etc.). The underlying formula is calibrated using statistical methods (multivariate regressions). The advantage is that, once the formula has been calibrated based on a learning sample of properties, for which both the characteristics and the corresponding property value are available, expansion of the tax base can occur only by picking up the characteristics of new properties, after which the system will yield the estimated value. This means a substantial reduction in cost and resources compared with those involved in having each property valued by experts, and is even more appealing in contexts where recovering information on sales prices or actual rental values from property records is challenging. CAMA systems are in place in the US, some European countries, Australia and Hong Kong. The details of the statistical methodology

may vary, and innovations are growing rapidly, notably with the development of the machine learning literature (McCluskey et al., 2012). The number and sophistication of the variables used in the formula may also vary, and with this the overall complexity and cost of conducting mass valuations using these methods.

In **Latin America**, the use of multiple regressions for property valuation exists in a certain number of municipalities (notably Colombia and Brazil) and continues to increase (De Cesare, 2012). In **Cape Town, South Africa**, a CAMA valuation system has existed since the early 2000s, in the context of the General Valuation Project 2000 (GV2000), and the process has subsequently been modernised, thanks to a new software module (Barlow, 2015). The software module covers, among others, records management, utilisation of satellite images and workflow management. The reform is generally regarded as a success: revenues have increased while valuation and management costs have decreased (Whittal and Barry, 2004; Barlow, 2015). According to a KPMG report, for each dollar invested in the new digital tool, the city had a return of \$97 (Barlow, 2015). Other low- or middle-income countries in which some localities have implemented CAMA systems include Mauritius, Egypt and Thailand (Awasthi, 2021).

One of the most sophisticated utilisations of aerial imagery for property valuation purposes in a middle-income country is the example of **Shenzhen, China**. Although there is no recurrent tax on property in China, there are taxes on real estate transactions, and Shenzhen has been selected since 2003 to pilot mass valuations. The Shenzhen municipal agency has tested a combination of CAMA methods with georeferenced imagery (Nunlist, 2017). More precisely, the LiDar (light detection and

ranging) remote sensing technology makes it possible to create three-dimensional cadastres, by incorporating the height of buildings and even information on construction materials. This enables the augmentation of CAMA models with variables such as number of windows and luminosity, adjusting values for each apartment even within the same building. By 2010, the municipality had provided building-level evaluations for 170,000 buildings, and by 2011 basic evaluations had been made for 1.5 million residential properties. An advantage in the process was that a great deal of real estate in Shenzhen is recent, meaning that digitalised maps of these constructions were available and could be integrated into the system.

In **India**, six cities designated as pilots in the World Bank Capacity Building for Urban Development Project (Haridwar, Nagpur, Dehradun, Puri, Cuttack and Chindwara) implemented two innovations in the realm of valuation made possible through digitalisation. First, the annual rental value approach to valuation was replaced by a formula-based, simplified assessment method: values are estimated based on objective valuation criteria integrated in a computerised system. Second, self-assessment of liabilities is enabled, since taxpayers are encouraged to log into the system and report information on their property and its characteristics (Kelly et al., 2020).

In **sub-Saharan Africa** (beyond South Africa), several ongoing projects are experimenting with the introduction of formula-based assessment methods, benefiting from newly available data from digital field surveys and satellite imagery.

Importantly, these projects tend to focus on lower-complexity formulas, and property characteristics that are easier to recover during fieldwork, compared with in full CAMA systems existing in richer countries and in South Africa.

In **Senegal**, a new technology introduced by the tax administration makes it possible to test a simplified formula-based valuation method (Knebelmann and Pouliquen, 2021). An important feature chosen to increase feasibility in this context is that all property characteristics used in the formula are either recovered from satellite or drone images or collected during fieldwork, but visible from the outside of the property. Indeed, the roll-out of valuations under the previous method, whereby expert valuers needed to visit the properties, was too often severely impeded by the reluctance of occupants to let the agents in. As a result, before digitalisation, valuations were made at the agents' discretion, and depended strongly on whether or not the agent had been let in. The formula-based valuation relies on property built area, location and 11 observable property characteristics.⁴ Importantly, this valuation method will be piloted in an experimental setting: among neighbourhoods where the administration is conducting a fiscal census with the digital tool, properties in half of the areas are being valued with the formula while properties in the other half are being valued according to the current (discretionary) method. The results will make it possible to quantify the differences in property values, in tax liabilities and in the distribution of tax burden under the two methods. The conclusions

4 These characteristics are property location, built area, number of floors, utilisation (residential, commercial or both), type and quality of fence, type and quality of wall, type and quality of cladding, presence of decorative tiles on wall, quality of doors and windows, landscape arrangement, architectural arrangement, garage and balcony.

will help the administration decide on the modalities for the scaling-up of the property tax census with the new digital tool.

In **Freetown, Sierra Leone**, the newly developed digital tool also integrates an innovative valuation method, relying on property area, location and a subset of property characteristics. The simplicity has made possible a very rapid expansion of the tax net, and has also increased transparency, since the components of the valuation formula are displayed on the tax notifications distributed to taxpayers. The actual calibration of the formula in this case relies on manual adjustments by an expert valuer for each factor, rather than on multivariate regressions, as in the case of Senegal or as in traditional CAMA methods. This method is referred to as the ‘points-based method’ (Fish, 2018; Grieco et al., 2019). As in the case of formulas relying on regressions, a learning sample, including observations of property values and the associated characteristics, is needed to calibrate the formula. The experimenting with this valuation method reached the actual tax payment stage in year 2020. The points-based method had been experimented with previously in **Muzuzu, Malawi**.

In **Kampala, Uganda**, similar approaches are being explored by Kampala City Council, although the resulting values have not yet been utilised for actual tax assessments (Manwaring and Regan, 2019).

An alternative to simplified valuation methods that yield a predicted nominal value for each property is the banding valuation method (McCluskey et al., 2002; Davis et al., 2004), similar to the council tax in the UK. In this case, each property is simply situated in a specific band, defined by an upper-bound and a lower-bound value, instead of being assigned a precise estimated value. Through its

simplicity, this methodology could be appealing in settings with low resources for the actual valuation and enumeration work.

In **Rwanda**, a pilot study has shown the feasibility and revenue potential of using mass valuation to value properties in Kigali, using data from high-resolution satellite images from the land registry, and survey and census data (Ali et al., 2018). This has not been adopted by the administration for taxation purposes as of today.

2.3 Monitoring and organising the work of tax agents

The introduction of digital platforms also creates opportunities to systematically monitor the activities of the administration’s staff. This is true for other tax instruments as well, but a specificity of the digitalisation of property taxation in low-income countries is the quasi-systematic necessity of intensive door-to-door field operations. This requires identifying mechanisms to maintain sufficient levels of motivation and effort of the agents conducting these lengthy operations, which can be facilitated by means of digital tools enabling geographical tracking of progress and the generation of performance statistics on data collection agents. During the cadastral upgrade in **Bogota, Colombia**, initiated in 2008, mobile devices used for data collection in the field allowed supervisors to measure the performance and task duration of the field staff and to improve monitoring (Uribe Sanchez, 2010). In the experimental project in **Dakar, Senegal**, performance indicators by area and by agent are computed every few days and shared with supervisors, thanks to the data generated by the digital tool. The set-up of the mobile devices aims to prevent agents from using the tool for leisure purposes and in areas that are outside of the project’s location. The

dashboard functions of the web component of the application make it possible to display progress statistics for the staff in office. Furthermore, the application allows the head of the tax office to assign tasks to each agent individually, depending on their status within the administration, and to follow the completion of the tasks.

Similarly, in **Punjab, Pakistan**, the new digital tools make it possible to track the delivery of tax bills in the field, and to identify who has made changes in a specific taxpayer information sheet in the database. The tool introduced in **Quezon, Philippines**, produces performance and statistical reports. In **Ranchi, India**, the new system includes web-based dashboards displaying tasks and results of the different members of the administration.

2.4 Digitalising the taxpayer's experience: voluntary declarations, tax payments, tax enforcement, appeals

Digitalisation may also occur at the point of interaction between taxpayers and the administration. Some of the property tax modernisation programmes we have presented in this section have introduced the possibility for taxpayers to register their properties, make appeals or make payments using computerised tools.

Many of the **Indian cities** that have introduced the aforementioned modernisation programmes offer a digital interface for taxpayers (Awasthi and Nagarajan, 2020). In Bengaluru, a web portal allows property owners to log in to report additional information about their properties and make their payments. In Raipur, a similar website additionally allows the management of grievances made by taxpayers. In Pune, the administration sends tax notifications electronically and sends

taxpayers reminders by text message and email. In Ranchi, the web platform also offers taxpayers a helpline. In some Indian cities that have gone even further with the digitalisation project, the web platform allows citizens, in addition to submitting grievances, to view the GIS-enabled property data (Kelly et al., 2020).

In **Bogota, Colombia**, the property tax modernisation programme has also set up an interface for taxpayers to log into. The new application introduced in **Senegal** makes it possible to make property declarations directly into the system, to be processed into the valuation roll more easily, although property owners must come to the office to do so for now.

An increasing number of administrations are introducing the possibility for taxpayers to pay taxes through mobile or bank payments, instead of face-to-face cash payments or payments restricted to one physical location. In **Lagos state, Nigeria**, tax bills can be received by email, and payments can be made through bank or mobile transfer (Lagos State, 2020). In multiple **cities in India**, it is possible to pay either at bank branches or through mobile money. The tax administrations of Raipur and Pune additionally allow for small digital payments to be made during door-to-door visits. The modernisation project in **Punjab, Pakistan**, also enabled electronic online payments.

The reform in **Quezon, Philippines**, actually focused first and foremost on the revenue collection side, while the expansion of the tax net using GIS technology was implemented only as a longer-term objective. Since 2013, payments can be made via mobile money (Kelly et al., 2020). Before that, it was already possible to pay through internet banking and ATMs and in bank branches, following a 2005 change in the legislation. For

taxpayers who still come to pay at the office, an electronic ticket system helps improve the experience, and official computerised receipts have been introduced to fight the issuance of fake receipts. For delinquent taxpayers, the new computerised system makes it possible to generate automatic delinquency letters. These digitalisation features have been introduced in addition to other improvements: improving the taxpayer experience at the office by offering free tea and coffee, air conditioning and tax rebates for early compliers.

The new system implemented by **Arusha City Council in Tanzania** also allows mobile money

or bank payments, and automatically generates receipts (McCluskey et al., 2018). Kiambu county in Kenya procured its own revenue management system in 2014–2015, which includes the possibility for taxpayers to pay using a government-owned payment card and recover receipts with easily verifiable QR codes.

In other contexts, taxpayers may not yet pay using mobile money or (online) banking but payments are recorded digitally and receipts are generated automatically. This is the case in the ongoing reforms in **Freetown, Sierra Leone** (taxpayers come to the office in person, where payments are recorded in the new IT system).

Box 1 Collaborative development of a national digital solution for property tax management in Senegal

In 2017, the Senegalese national tax administration⁵ partnered with a research team of economists to embark on an ambitious modernisation programme for property taxation.

The first stage of the collaboration led to the development of a new application by a local IT company. This enables the collection of GIS-enhanced property information in the field using tablets and the preparation of tax notifications in the office for the property and waste management taxes.

Collaborative development process

- The tax administration expressed the need to modernise property taxation, and staff within the cadastre department listed the main functionalities that this new tool should include, notably allowing property information to be directly connected to geocoordinates and cadastral identifiers.
- The research team conducted an in-depth needs assessment and prepared the terms of reference for the software based on observational work within the administration and discussions with key informants.
- A tripartite working group bringing together the IT company, the research team and officials from the tax administration met regularly to discuss the functionalities of the software.
- Intensive testing and piloting were key throughout the development process.

5 Direction générale des impôts et domaines du Sénégal.

Key features of the new digital tool: overarching and flexible

The new application includes all steps of the property taxation chain: data collection in the field, registration and valuation of new properties, production of tax notifications and registration of payments.

- Each user has their own profile and authorisations based on their hierarchical and geographical position within the administration.
- An administrator uploads cadastral maps of targeted neighbourhoods into the system and assigns the task of conducting the property census.
- The Android application on tablets allows the agents to carry out the fieldwork through which they collect information on properties and owners.
- A formula-based property valuation method can be selected; in this case, an estimated property value is computed based on observable characteristics and built area measurement from aerial imagery. The characteristics and their respective weights can be modified by the administrator of the software without the need for additional IT development work.
- The web application makes it possible to validate or edit the information and create tax notifications.
- The tax notifications include the built property tax, the garbage tax and the vacant land tax, and are adapted to the characteristics of each property based on the tax code (e.g. with an abatement for owner-occupied properties).
- A payment interface exists but will be improved in collaboration with the National Treasury.

Impact evaluation

- Utilisation of the digital tool to expand the tax net is currently being evaluated in an experimental setting in the region of Dakar.
- This will make it possible to quantify the tax revenue gains thanks to the new system and also to compare the results of the programme under two different valuation methods.
- The conclusions will help the administration finetune the programme before scaling it up nationally.

Source: Knebelmann and Pouliquen (2021); Knebelmann et al. (2021).

3 Challenges and limitations: what digitalisation alone cannot resolve

The projects mentioned in the previous section are often ambitious and complex. Most of them are still very recent, which means conclusions on the extent of their success or failure cannot yet be drawn. This section highlights why digitalisation alone is not an immediate solution for sustained improvements in property taxation, and what important pitfalls may exist.

3.1 Costs and logistics of creating a digitalised property tax system

A first important obstacle to the development of digitalised systems for property taxation in low- and middle-income countries is the cost of software solutions. Whether it be for COTS sold by IT companies, or for a tailored development process, the cost may be high when compared with the resources of the administration – even more so if acquiring these tools comes within the responsibilities of subnational governments, which are often more cash-strapped than central government bodies. For this reason, it is no coincidence that a vast majority of the digitalisation projects presented in this report have received support and funding from international donors. To the development costs must often be added the costs of acquiring the mobile devices used for data collection in the field, and the cost of satellite or drone images where relevant. Costs will ideally be recovered over time if the modernisation is effective and enables an increase in property tax revenue; however, this may occur in the medium-to-long term, with substantial upfront investments required to kick-start the project. In some instances, the design of the contract between

the government and the technology provider is such that the initial development cost is reduced but the private company is granted a share of collected tax revenues (for instance in the Lagos Land Use Charge modernisation programme, Prichard, 2014).

Different contracting models exist for implementation by the administration of a new digital solution. Some (local) governments choose to buy the software from international IT companies, having already worked on similar solutions in other contexts (COTS). In other cases, the administration chooses to contract a local company to develop a new application from scratch (this is the case in the examples of Freetown, Sierra Leone, Dakar, Senegal, and Haiti mentioned previously). Finally, a third possibility lies in working with staff in house who are qualified to lead the IT development process (this was the case for the first system implemented in Kampala, Uganda).

There are pros and cons to each approach (Prichard, 2014). Working with international IT companies may quickly turn out to be significantly more expensive than the other solutions; in addition, the development and maintenance processes may suffer from geographical distance and asymmetries in knowledge and experience (Prichard and Fish, 2017). Administrations in low-income countries may end up in a vendor ‘lock-in’ situation, whereby they do not have ownership of the system, and only have restricted or costly ways of maintaining and upgrading it and may be forced into keeping the same vendor. In Senegal, for instance, a first application for digitising

property valuation was abandoned because it had been developed by an international company with little flexibility and could be updated to integrate updated cadastral identifiers only at a high cost. On the other hand, international companies may have expertise that can help the project move forward faster and deliver more reliable end products.

Working with local development companies is often significantly cheaper, and also has the advantage of facilitating the frequent interactions that are necessary in the development process between the developers and the clients.

Furthermore, local companies are likely to value relationships with government entities in their country more highly, as a result of reputational effects and the prospect of further contracts, which can be a lever to uphold effort and goodwill throughout the process. Finally, local companies may be more willing to generate open-source solutions that avoid any type of lock-in problem. The availability of highly skilled developers, although rapidly expanding, is very heterogeneous across low- and middle-income countries, meaning that the choice of a local company with the capacity to take on such a project may in fact be limited.

Finally, in-house development is attractive for its advantages in terms of cost, ownership and flexibility. However, only a minority of (subnational) administrations employ developers with this level of skill, since as of today this is not one of the main tasks of a tax administration or local government. Furthermore, staff turnover may pose important challenges over the life cycle of the project. Whichever contracting option is chosen, investing in the staff's capacity to understand and contribute to digitalisation projects, as product owners, testers, supervisors

or data managers, seems like a valuable decision to enhance the sustainability of digitalisation programmes for local revenue mobilisation.

Assuming the funding issue is resolved, the software development process itself may bring its own challenges. First, defining the precise functionalities of the new digital system, and the exact functioning of each of the different steps of the taxation process that will be included in the application – in other words coming up with comprehensive terms of reference – is a crucial, but lengthy and potentially sensitive, process. Indeed, as seen with the different illustrative cases, digitalisation most often means that important existing aspects of the taxation protocol will need to change. The work needed to enable the different involved parties to agree on how exactly the new system should function should not be underestimated. This includes key decisions on how taxpayers are identified in the new database, what geolocation and address variables are used, what property or cadastral identifiers are used, if any, whether the calculation of the tax liability is done automatically or inserted manually, what information is displayed on tax bills, whether the system allows for different types of taxes, etc. For some dimensions, legal changes may even be a prerequisite (e.g. to authorise digital tax bills or mobile money tax payments, to enact changes in taxpayer identifiers). These decisions made, the actual development process requires intensive testing and back-and-forth between the clients and the developers. Challenges in this step of the process may include delays, difficulties in correcting some of the technical bugs that have been identified and lack of sufficiently detailed feedback from end-users of the application. The development time span between the terms of reference and the delivery of a ready-to-use application is often long, at around one to two years. Once the software solutions are developed,

the final phases require the administration to choose data storage and maintenance solutions. These may be managed in-house or outsourced but are in any case key to the success of the digitalisation process.

Another important dimension is whether or not the new digital solution can absorb the administration's pre-existing information on properties and taxpayers. This can be challenging when former valuation rolls have no clear property or taxpayer identifiers, and address information is not harmonised. Since the new digital system aims precisely at having clearly defined and well-coded variables for these different dimensions, it may not be straightforward to input previously existing data in the new database. Some officials may be reluctant to transit to the new system if they have the impression that previous work is being over-written. In the digitalisation projects of Dakar, Senegal, and Freetown, Sierra Leone, for instance, it has turned out to be too costly and nearly impossible to insert entries from the existing valuation rolls into the new system, because of a lack of clear identifiers in the former. In other instances, substantial financial and human resources have been invested in this aspect of the project: in six Indian cities that served as pilots for the World Bank-supported project (Haridwar, Nagpur, Dehradun, Puri, Cuttack and Chhindwara), previously existing property tax records were digitalised and linked to GIS coordinates. The same was done in Punjab province of Pakistan (Kelly et al., 2020).

Finally, technical challenges may occur once the system is in place, such as internet connectivity problems, difficulties with speed and accessibility of the platform by the staff or by taxpayers where relevant, issues with data storage or compatibility issues across different

components of the system. In Kiambu county in Kenya, for example, the main problem of the new property tax system reported in its evaluation by McCluskey et al. (2018) are internet connectivity, power shortages and compatibility difficulties between different modules. In Senegal, the tax administration's IT department did not have enough storage capacity to host the new application and all the data that the field operations would generate. Thus, a subscription to an online server had to be implemented, which was funded through a World Bank-supported programme, as the cost of data storage had not been included in the initial budget allocated to the creation of the new application.

3.2 Human resources: switching to a sustainable digitalised system requires a full and well-trained workforce

There is a common perception that digitalisation and the automation it generates leads to reduced employment and a lower need for a human workforce. However, it is important to stress that, in the case of property taxation, the transition to a digitalised process actually requires a great deal of staff working time. The human resource dimension is in fact crucial for the success of these projects. A reduced need for human labour may arise eventually but generally at much longer time horizons. None of the reforms mentioned in this report should be confused with automated digital processes for registration, assessment, billing and tax collection.

The development process itself requires very intense engagement by the users of the new system (the staff of the local government or the tax administration) to test and validate it. Acceptance of the new tools by the relevant staff is of course a necessary condition for the

success of the project. This acceptance may not be straightforward in instances where the new system completely overturns agents' working habits.

Furthermore, the important field operations that typically accompany property tax digitalisation projects are extremely labour intensive. As an example, the modernisation project in **Punjab, Pakistan**, led to the setting up of 400 survey teams and the hiring of 700 data entry agents (Kelly et al., 2020). In **Dakar, Senegal**, the lack of sufficient staff available for field operations was an important issue facing the tax administration. Progress was made only when funding from international donors was made available to recruit short-term enumerators. In **Freetown, Sierra Leone**, the door-to-door distribution of tax bills generated by the new system was outsourced to a private company. Importantly, after the first expansion of the tax base is completed using the new digital tool, updates of the valuation roll will typically be needed in the years to follow. The trade-off between the cost of conducting field operations on a regular basis and the problems caused by having an outdated valuation roll is a key concern for the sustainability of the new system (see Section 5 for further discussion).

Importantly, although a digital system makes it possible to automatically store data collected in the field, to integrate information automatically generated from aerial imagery and, in some cases, to automatically calculate tax liabilities, this may not always mean that these inputs are systematically transformed into tax notifications without any human intervention. It may be that tax officials in the office are in charge of verifying the information and validating it before issuing tax bills. In settings where this is the case, the creation

of significantly larger datasets compared with under the previous system may imply more work for some officials of the administration.

Finally, if the digitalisation programme manages to enrol more properties in the tax net, in situations where the tax bills are not electronic this will generate much more work on the distribution side of the fiscal chain. When this implies door-to-door distribution, it can result in important increases in terms of staff and working hours. Furthermore, it is very likely that the number of appeals will also increase. The (local) government entities in charge of managing appeals may need to be reinforced to be able to assume this increased workload. These changes can be quite sudden with respect to human resource capacity if vast digitalisation and field census programmes lead to a steep increase in the number of taxpayers over a short time period.

As a result, some digitalisation projects may stagnate precisely because of human resource issues. As an illustration, in **Zanzibar, Tanzania**, even though 500,000 buildings were identified using drone images, field operations collected additional data on ownership for 'only' 13,232 or 3% of the properties (Kelly et al., 2020). The ongoing registration of commercial properties is also going much slower than expected as a result of resource constraints (ATI and Lincoln Institute of Land Policy, 2021).⁶ Following the Land Use Charge modernisation project in **Lagos, Nigeria**, initiated in the early 2000s, less than 14% of the properties in Lagos had been enumerated by 2018 (Bolarinwa et al., 2018). In **Kiambu, Kenya**, in addition to the purely technical challenges, the insufficient time spent on training staff to fully familiarise them with the system was considered an important shortcoming of the reform

(McCluskey et al., 2018). This shows how crucial the human resource aspect is for the success of these digitalisation projects.

3.3 Does digitalisation suffice to make taxpayers pay? Enforcement and voluntary compliance

An important number of digitalisation projects for property taxation tackle the stages of property detection, registration and billing. These are indeed crucial steps, but in some instances they are not enough to actually make taxpayers pay. In **Kampala, Uganda**, the digitalisation project has successfully enrolled 300,000 properties on the valuation roll. However, as of 2020, the main challenge has been tax compliance: only 12% of billed property owners paid the tax, and only around a third of expected tax revenue was collected (Ahabwe et al., 2020). In **Carrefour, Haiti**, although a digital system was initiated in 2011, Krause (2020) notes that only around half of the city's properties are on the valuation roll, and among these around 10% pay the property tax. Okunogbe (2020) reports that, in **Monrovia, Liberia**, after properties were registered with their GIS coordinates and owners received a tax notification, the compliance rate increased but still remained very low, at below 10%.

As explored in the previous section, digitalisation can also help on the enforcement side of the taxation process. However, enforcement can be costly, and there may be a cap on its effects. Innovative property tax projects have thus also started to explore how taxpayers' intrinsic motivation to pay can be increased. Digitalisation could help in this realm as well, although it is rarely the central piece of the programme. Prichard et al. (2019) provide a conceptual framework of the

determinants of tax compliance with a specific focus on the role of taxpayers' trust in the tax system and in government.

3.4 Digitalisation as only one instrument of reform within a broader political context

Digitalisation cannot by itself overcome the political challenges associated with the strengthening of property taxation. Property tax is very salient to taxpayers, and in low-income countries it may well be the only direct tax to which individuals are subject, or at least the only one for which they have to undergo a proactive declaration and payment process. Hence, property tax is often labelled a 'hated tax' (Cabral and Hoxby, 2012; Rosengard, 2012). There may be important political consequences to property tax enforcement. For **Carrefour, Haiti**, Krause (2020) documents an increase in anti-government protests and barricades in areas where the tax campaign was more intense; similar political backlash has been observed in Brazil and Colombia (ATI and Lincoln Institute, 2021).⁷ On the other hand, in **Italy**, Casaburi and Troiano (2016) find that localities with a more rigorous programme targeting property tax delinquents display higher incumbent re-election rates. This is driven mostly by areas with a low tolerance for tax evasion (tax culture), and by areas where the locality is efficient at delivering public goods and where expenditures have increased thanks to the programme.

The existence of these potentially strong responses by taxpayers/voters may create incentives for politicians to invest or not in property tax capacity. In the context of **Brazilian municipalities**, Christensen and Garfias (2021) show that incumbents who will not be able to

⁷ Presentation by key informant Klaus Deininger.

run again (term-limited) are 15 percentage points more likely to update the cadastre, and hence reap higher property tax revenues, suggesting that, in general in the Brazilian context, fear of political backlash reduces investments in property tax capacity. On the other hand, the process for a thorough modernisation of property taxation is lengthy and costly, and the financial benefits in terms of increased tax revenue may take time to materialise. Therefore, political leaders will decide to embark on such an ambitious programme if they are at least in part incentivised to think about the medium-to-long term. Political leadership throughout the life cycle of the project is key. In **North Kivu province of DRC**, a digitalised property tax system was set up by a foreign company and proved quite effective, linking property tax records to utility fees. However, the governor of the province, who had spearheaded the reform, became a minister in the central government in Kinshasa, and his departure led to the collapse of the programme (ATI and Lincoln Institute, 2021).⁸

Finally, shifting to a new system for property tax management often requires coordination between different government bodies, for example between local and central government or between the entity regulating property titles and the entity in charge of taxation. **Tanzania** offers an interesting case study of how political intricacies might mitigate the effects of modernisation reforms. The digitalised property tax system first introduced in Arusha was expanded to other localities, with a total project duration of 10 years. Some of the main challenges encountered included, first, insufficient planning and resource allocation to ensure the sustainability of the new system (maintenance, monitoring and evaluation) and, second, excessive complexity given the local

resources of some cities that had inherited the digital tool from Arusha. But most importantly, there has been back-and-forth in the legal framework defining which level of government is responsible for assessment and collection of property taxes, which has prevented significant progress being made. The responsibility was shifted from local governments to the central government in 2008, back to local governments in 2014, to the central government again in 2016 and back to local governments in February 2021. These frequent radical changes in the authority to collect property tax make it difficult for long-term reforms to fully materialise (Fjeldstad et al., 2019).

Furthermore, in some contexts, a proper modernisation of the property tax system may require modifications in the legal or regulatory framework, which may take some time. In **India**, the computerisation project rolled out in the six pilot cities of the 2012–2018 World Bank Capacity Building for Urban Development Project initially included the technical dimensions without institutional and policy changes. As such, after an increase in the first year, property tax assessments stagnated, until a number of policy changes were carried out, including modifications in the rules pertaining to property valuation (Kelly et al., 2020). Other improvements also contributed to greater success, some on the technical side (cheaper GIS solutions, ability to pay through mobile money) and important ones on the institutional side (outsourcing of some functions, repeated fieldwork).

For all these reasons, modernising the property tax system is far from being just a technical issue, and requires strong and lasting political will. It is easy to understand why embarking on a wide-ranging property tax reform could be a risky

choice for politicians: their electoral mandate is likely to end before the system reaches its full potential, taxpayers may be reluctant to pay this highly visible tax and the progress needed for a complete modernisation of the system most often requires substantial financial and human resources as well as cooperation across various administrations.

4 Policy recommendations

Taking stock of the case studies analysed in the previous sections leads us to draw policy recommendations in three areas: (1) on the purely technical and software development side; (2) related to computer-assisted mass valuations; and (3) on the institutional set-up of a reform seeking to modernise property taxation. Importantly, the legal, institutional and socioeconomic context in which property taxation occurs varies greatly across countries (and even within a given country in some cases). As such, these recommendations are of a general order and obviously need to be tailored to context.

4.1 Policy recommendations for the development of digital solutions

The choice of software provider and the features of the contract between the developer and the (local) government have important implications for the success of a digitalisation programme and its sustainability. Lessons learnt from recent projects can be summarised as follows:

Terms of reference: The amount and quality of work required before the development process actually starts, to flesh out the detailed terms of reference and choose the exact specifications and functionalities of the new application, should not be underestimated. In some contexts, the new system will be utilised by different departments within a given administration, and/or by different administrations, given the nature of property taxation. This means that all these different actors must be brought on board, and that the terms of reference for the development of the new application should rely on insights from the processes of each of the different actors of the fiscal chain. This preparatory work will also make

it possible to determine whether any legal or regulatory changes are required in putting the modernised system in place.

Product owners: A successful development process also entails the strong implication of one or multiple ‘product owners’ working as intermediaries between the end-users and the developers. The ‘product owners’ may well be staff from the local government or the tax administration, and/or staff contracted for the purpose of the project, but their level of qualification, understanding of the overall modernisation programme and of the taxation modalities, familiarity with digital tools and, importantly, the work time they will be able to allocate to this reform must be sufficiently high. Their role is notably to provide detailed instructions to the developers on each and every aspect of the application, and to organise back-and-forth testing sessions between the users and the developers. As digitalisation projects within public administrations keep expanding, it could be useful for administrations and local governments to invest in training and retaining staff who display these skills.

Choosing a vendor: The guiding principle when choosing the software developer should be the ability of the vendor to deliver the product in a reasonable time span, at a price that is affordable relative to project funds; just as important, however, is the potential for the administration to conduct maintenance, updates and future modifications to the application where needed. For its success, the digitalisation project should not be considered a one-off effort. It is crucial to avoid getting locked in with a particular vendor, or more generally being unable to make future

adjustments that could prove necessary. There is no unique way to achieve these goals. An international software company may be fit to deliver a satisfactory product and, in cases where the administration has sufficient funds to contract technical support for maintenance and updates in the future, this solution may be desirable. A risk in this case is that, if the project funds are exhausted after the first implementation phase (e.g. if they originate from a donor project that comes to an end), it could be that contracting the same company again for maintenance or development updates will be too expensive for the government involved. Solutions where a smaller/local company has worked closely with the client, and where the source codes have been shared with the administration as part of a co-ownership agreement, and/or capacity has been built within the administration for maintenance and potentially coding updates, may offer higher sustainability (Prichard, 2014). However, this will depend on the availability of highly skilled and reliable private development companies and the level of technical capacity within the administration.

Testing and adoption: The development process will necessarily entail a great deal of testing at different stages of the process. Involving end-users in these testing sessions is a good way to obtain immediate feedback and better prepare for the adoption of the new tool by the administration. Some users may be reluctant to abandon the working methods they were used to. Incorporating the same language in the application as on the pre-existing paper forms, asking for comments and suggestions early in the testing sessions and allocating time to make users familiar with the basic functions of the mobile phones or tablets are elements that can help enable a smoother technology adoption process.

Data storage: The total cost of the digital solution will include not only the purchase of the software but also fees associated with data storage over the long run. Property tax censuses in the field are often data-intensive, even more so if stored data includes cadastral maps and images, photos of the properties, aerial imagery, etc. It is likely that the current data storage capacity of the local government or the tax administration will need to be expanded if comprehensive field operations are intended; this should be planned for in advance to avoid any bottlenecks when the digital tool is ready to be used.

4.2 Policy recommendations for maintaining an up-to-date valuation roll

There are three main challenges in addressing the crucial aspect of creating and maintaining an up-to-date valuation roll after the introduction of a digitalised system. The first is the selection of the valuation method that can be deployed at a large scale with the help of digitalisation. The second challenge is to be able to update property values and hence tax liabilities when relevant. The third pertains to the mechanisms put in place to recover information on the identity of property owners to be included in the valuation roll, in order to be able to enforce taxation and to update property owner details when changes occur.

Conducting field operations at a large scale is costly in terms of human resources, transport and monitoring activities, even when a digital tool is already in place. Detailed property inspections increase the duration and cost of these mass enumeration exercises. For this reason, a common suggestion is to adjust the number and complexity of property characteristics used in the valuation process to the administrative environment: in low-income settings, simpler valuation methods

such as banding approaches or formulas based on a small number of variables may be more desirable than complex valuation formulas relying on a large number of characteristics (McCluskey et al., 2002; McCluskey, 2021).

Furthermore, because of the cost and logistics involved, it is not feasible or desirable to conduct comprehensive property listings on a yearly basis, even though the market value of properties may evolve. The frequency with which revaluations should occur depends on the resources available and on the expected benefits in terms of tax compliance and tax revenues. A fruitful area for future innovations involves thinking about ways through which revaluations may be less costly than the initial fieldwork – for example through increased use of aerial imagery, such as change detection technology, or through increased interactions with owners and tenants once their information details are in the valuation roll. Another strategy is to target revaluations towards urban areas or specific types of properties for which changes in values have been the largest.

Finally, an up-to-date valuation roll should include relevant information details on property owners. Recovering this information can be costly, especially since, in a large fraction of visited properties, owners may be absent or reluctant to share information details. Policy recommendations for this sensitive area are twofold. First, communication and sensitisation activities should aim at increasing the acceptance of property taxation and the willingness of taxpayers to share the relevant details during field visits. This can also occur through additional channels put in place in the context of the property tax modernisation programme; for example, if the owner is not found during field visits, a letter of the administration might be delivered on the spot indicating that the owner

is expected to contact the administration or will be contacted by the administration to provide their identification information. To increase the willingness to share such information, the campaigns might highlight the private and collective benefits from having up-to-date records on property occupancy and ownership. In **Dakar, Senegal**, the tax administration and the municipalities mobilise neighbourhood delegates to participate in sensitisation activities before conducting the property tax census in a given area. Indeed, the delegates tend to be known to occupants and trusted, hence they play a role in inciting property owners to share their identification information. Second, the government body in charge of property tax operations may want to consider all other interaction points with property owners where additional identification information may be recovered. This could include cases when owners come to pay their tax bill or to declare a sale or property transaction. This could also include working towards integrating property census data with other data sources, for example from utility bills, when this is possible. Without these efforts, the property valuation roll could become obsolete, not so much because of outdated property values but because of outdated owner identification.

4.3 Policy recommendation to overcome the political economy challenges of reform

As highlighted in several instances in this report, projects aiming to fully digitalise the property tax fiscal chain are costly and lengthy, and may face obstacles at different stages. Long-lasting political will and strong leadership are prerequisites for such a project to succeed.

Local governments in low- and middle-income countries are particularly resource-constrained and, although increased property tax revenues benefit them in theory, they may be caught in a bad equilibrium. Indeed, the decision-makers may not find it optimal to invest in property tax capacity, either because they are wary of political consequences if their popularity is affected or if they benefit from their discretion in a weakly monitored taxation process, or because they consider that the costs will not be recovered. This can be aggravated in situations where the local government does not collect tax payments directly and there is a lack of transparency on the share actually accruing to each layer of government.

For this reason, there is an increasing number of property tax modernisation programmes that seek to set up financial incentives for municipalities to put in sufficient effort for the success of the field operations to enlarge the tax net. In **Nigeria**, a World Bank project launched in 2017 encourages the creation of digital property tax cadastres, and each state that signed the agreement will receive \$2.5 million if half of the urban structures that have an electric connection are on the valuation roll (World Bank, 2021a; Awasthi, 2021). A total of 34 out of the 36 states took on this challenge. The variables that must be collected for a given property using aerial imagery techniques and data enumeration in the field are geotagged location, name of owner or occupant, size of the parcel and of the building, usage, and a description or photo.

In **Ethiopia**, a similar set-up has been agreed upon between the government and the World Bank, at the level of municipalities (ATI and Lincoln Institute, 2021).⁹ This is also an important characteristic of the property tax modernisation programme in **Senegal**, which is enshrined in

a larger World Bank and French Agency for Development-supported project on strengthening the capacities of municipalities. At the end of every year, municipalities will receive pre-specified disbursement amounts, based on the expansion of the property tax valuation roll. This example is interesting since in Senegal the responsibility for maintaining the valuation roll lies with the national tax administration, and municipalities only have a role of supporting the work of the tax administration by conducting sensitisation activities and helping recover the identity of property owners. The results from these ongoing projects with financial incentives for municipalities will be insightful.

Furthermore, recent empirical evidence has highlighted the importance of increasing taxpayers' voluntary compliance for an effective property taxation process. Institutional settings that seek to make more salient the channels through which taxpayers can engage with the administration or the local government and convey their level of satisfaction or their expectations in terms of public services have shown some promising results, although the effects are not large enough to fully close the compliance gap (Khwaja et al., 2020; Krause, 2020; Weigel, 2020).

9 Presentation by key informant Chyi Yun Huang.

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Appendix 1 Recent empirical evidence on property taxation

Country (locality)	Description	References
Argentina (Junin)	Randomised letter intervention. A deterrence message listing penalties has a significant impact on tax compliance, shifting it from 40% to 44.7%. Neither the social norm treatment nor the reciprocity message has effects.	Castro and Scartascini (2015)
Argentina (Mendoza)	An improved design of the tax bill and a public service message raise the baseline 77% compliance rate by 3–4%. The impact is stronger if the taxpayer was delinquent, and even stronger if the delivery occurred in person.	Eguino Lijerón and Schächtele (2020)
Argentina	Randomised letter intervention with reminders about e-payment of the property tax. The results show both direct positive effects on the payment rate and indirect spillover effects in the neighbourhood.	Cruces et al. (2021)
Colombia	A cadastral update in a given municipality by the responsible national agency leads to a 34% increase in property tax revenue in the subsequent years. The sample includes over 900 municipalities, throughout 2006–2010.	Martinez (2020)
DRC (Kananga)	A randomised door-to-door campaign increased the payment rate from 0.1% to 11.6% in the treated areas. Treated citizens were more likely to engage with the provincial government.	Weigel (2020)
DRC (Kananga)	Owners receiving a reduction in the tax rate actually increase their property tax payment. 13% of taxpayers (respectively, 9.9% and 6.7%) complied among those subject to a 50% lower tax liability (respectively, 33% and 17% reductions) compared with 5.6% of taxpayers among those subject to the status quo tax rate.	Bergeron et al. (2021)
DRC (Kananga)	Randomised door-to-door tax campaign. Chiefs raise 43% more revenue than administration officials. This is explained by the fact that chiefs have better local knowledge about which property owners have a higher propensity to pay.	Balan et al. (2021)
Ghana (Madina)	Randomised utilisation of tablets with navigational information for tax collectors. Increases the distribution of tax bills by 27% and collected revenues by 103%.	Dzansi et al. (2022)

Country (locality)	Description	References
Haiti (Carrefour)	Randomised enforcement letter intervention, and randomised provision of waste management services. The enforcement treatment reduces compliance and increases political unrest. However, these effects are mitigated in areas with the higher public service provision.	Krause (2020)
Liberia (Monrovia)	Two randomised letter interventions. In the first, a letter sent to unregistered owners informing them that their property had been detected, combined with information on penalties, quadruples the likelihood of tax payment. In the second, informing delinquent owners of a higher enforcement risk increases the payment rate by 35%.	Okunogbe (2021)
Mexico (Mexico City)	This study combines a randomised message experiment and results on the effects of policy changes in tax brackets. There is a positive and significant effect of two types of messages mailed by the administration to delinquent property owners: the penalty message (triples the probability to make a payment) and the public service message (half of the effect size compared to the penalty message). The hikes in tax rates had positive revenue effects, although less than the expected mechanical effects, since tax compliance fell at the same time.	Brockmeyer et al. (2021)
Pakistan (Punjab province)	Randomisation of the remuneration scheme, for field agents in a door-to-door tax enforcement campaign. For agents compensated under a performance pay mechanism, revenue growth is 46% higher than with a standard pay scheme. While this is driven by a small number of properties that were correctly reassessed, the downside is that a higher number of taxpayers report paying bribes to the agents in the field.	Khan et al. (2016)
Pakistan (Punjab province)	Randomised evaluation of performance-based geographical posting system, for agents in charge of door-to-door tax enforcement campaigns. When agents learn that their performance will allow them to be posted in places for which they expressed their preference, revenue increases by 30–41%.	Khan et al. (2019)
Peru (Lima)	A social norm treatment – informing owners about the level of property tax compliance in their area – increases tax compliance by 20% (8 percentage points from 43%), while a reminder letter has an effect that is also positive but smaller (10%).	Del Carpio (2014)
Rwanda (Kigali)	Estimates theoretical gains if property valuation was done using satellite images.	Ali et al. (2018)

Country (locality)	Description	References
Senegal (Dakar)	Measuring the property tax gap and the distribution of the tax burden in Dakar. 9% of tax potential is collected, 16% is foregone on the intensive margin and 75% is foregone on the extensive margin. The tax in practice is more regressive than on paper.	Knebelmann (2021)
Cross-country study	Panel of 64 countries between 1990 and 2010, finds positive relationship between property tax as a share of GDP and GDP per capita and degree of urbanisation. Openness to trade and legal origin play only a minor role.	Norregaard (2013)
Cross-country study	Panel of OECD countries between 2006 and 2016. GDP, population size, lower federal transfers and smaller household size have a positive relationship with property tax revenues. No significant relationship with governance or corruption indicators.	Awasthi et al. (2020)

Note: This list refers to recent empirical studies on property taxation in low- and middle-income countries that were reviewed in the preparation of this report.

Source: Author

Appendix 2 Property tax digitalisation projects referenced in the report

Country (locality)	Key features	Start year	Report sections	References
China (Shenzhen)	Piloting CAMA models with the inclusion of sophisticated data from remote sensing technologies.	2003	2.3	Nunlist (2017)
Colombia (Bogota)	Cadastral upgrade with mobile devices for data collection and georeferenced entries, a CAMA model and an interface for taxpayers.	2008	2.4, 2.5	Bahl et al. (2013), Ruiz and Vallejo (2010), Uribe Sanchez (2010)
DRC (North Kivu province)	Digitalised property tax system linked to utilities records, set up by a foreign company.		3.4	Key informant Fjeldstad, in ATI and Lincoln Institute, (2021)
Ghana (Madina)	Digital database of properties with GIS information, revenue management software, and navigational functionalities available on tablets for distribution and collection activities.		2.1	Dzansi et al. (2022)
Haiti (Carrefour)	Computerised property tax system at the municipality level developed by a local company.	2011	2.1, 3.1, 3.3, 3.4	Krause (2020)
India (multiple cities including but not restricted to the six pilot cities of Haridwar, Nagpur, Dehradun, Puri, Cuttack and Chhindwara)	Two subsequent national programmes for urban reform with a property tax component, with support from the World Bank. Includes GIS coordinates, door-to-door data collection, computerised valuation. In some cities, taxpayer interface and digital payments.	2005 and 2015	2.2, 2.3, 2.4, 2.5, 3.1, 3.4	Awasthi and Nagarajan (2020), Bahl et al. (2013), Kelly et al. (2020), World Bank (2018)
Kenya (Kiambu county)	County-level revenue management system. Includes possibility to pay via a pay card and generate verifiable receipts.	2014	2.5, 3.1, 3.2	McCluskey et al. (2018)
Liberia (Monrovia)	GIS enhanced property listing and creation of tax notifications in the context of an academic project.	2014	2.1, 2.2, 3.3	Okunogbe (2021)

Country (locality)	Key features	Start year	Report sections	References
Nigeria (Lagos state, Ondo state)	Lagos Land Use Charge Act: a private firm was contracted to digitise property tax management, the system was GIS-enhanced subsequently; taxpayers can comply with their obligations electronically. Ondo state, other states: ongoing digitalisation efforts, incentive-based objectives for state governments in the context of a World Bank project.	2001 (Lagos), 2017 (multiple states)	2.2, 2.5, 3.2, 4.3	Awasthi (2021), Bolarinwa et al. (2018), Goodfellow and Owen (2018), World Bank (2021a)
Pakistan (Punjab province)	Reform of the Urban Immovable Property Tax at the local government level with support from the World Bank. Digitalisation of pre-existing ownership and tax data, and extensive GIS-enhanced field work. Possibility of electronic payments.	2012	2.2, 2.4, 2.5, 3.1, 3.2	Kelly et al. (2020)
Philippines (Quezon)	A private company was hired for a reform programme that focused first on the revenue collection side, by digitising existing taxpayer information and facilitating payments. Subsequently, field operations with mobile devices aimed at expanding the tax net.	2002	2.2, 2.4, 2.5	Kelly et al. (2020)
Senegal (Dakar region)	A local company was contracted by the national tax administration (with funding from international donors) to develop a GIS-enhanced digitalised property tax management system, including a mobile component for property census in the field, that allows for simple or formula-based property valuation, and a web component for tax notification management.	2017	2.2, 2.4, 2.5, 3.1, 3.2, 4.2	Knebelmann et al. (2021), Knebelmann and Pouliquen, (2021)
Sierra Leone (Freetown)	The municipality has launched field operations to expand the tax net using a newly developed mobile application for property registration and valuation. A points-based valuation method is being rolled out.	2020	2.2, 2.3, 2.5, 3.1, 3.2	Fish (2018), Grieco et al. (2019), ICTD (2021), Prichard et al. (2020)
Somalia (Somaliland, Puntland)	The states of Somaliland and Puntland partnered with UN-Habitat to implement a georeferenced property listing to facilitate tax enforcement.	2004	2.2	UN Habitat (2006), Franzsen and McCluskey (2017)

Country (locality)	Key features	Start year	Report sections	References
South Africa (Cape Town)	First implementation of CAMA system in an African city.	2000	2.3	Barlow (2015)
Tanzania (mainland: Arusha, Zanzibar)	A digital property tax system was first established in Arusha, with a city-wide property survey. Expanded to nine pilot cities. In Zanzibar, the starting point is the elaboration of a cadastral-based on drone images. The responsibility for property taxation has been shifted from central to local government several times over the past years.	2006 (Arusha), 2014 (other localities), 2011 (Zanzibar)	2.1, 2.2, 2.5, 3.2, 3.4	Key informant Fjeldstad, in ATI and Lincoln Institute (2021), Kelly (2004), Kelly et al. (2020), McCluskey et al. (2018)
Uganda (Kampala)	Kampala City Council Authority triggered a city-wide GIS-enhanced property listing relying on an application developed in house. Formula-based valuation is envisaged. The project has been supported by international donors.	2014	2.2, 2.3, 3.1, 3.3	Ahabwe et al. (2020), Kopanyi (2015), Kopanyi and Franzsen (2018), McCluskey et al. (2018)

Note: This list refers to property tax digitalisation projects in low- and middle-income countries that were reviewed in the preparation of this report.

Source: Author