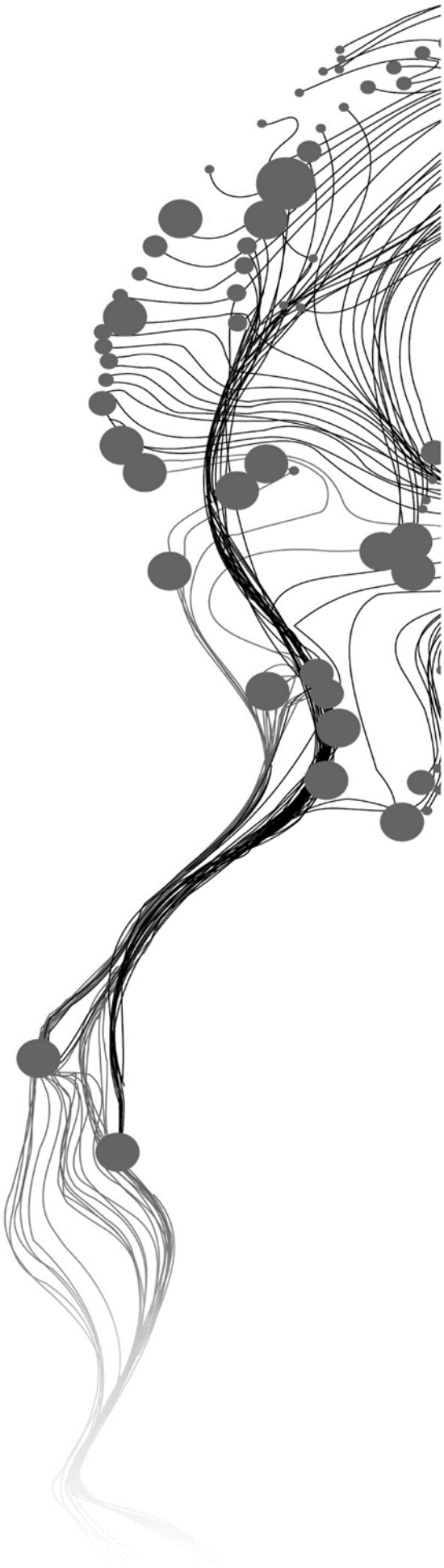
INVESTIGATING THE SUITABILITY OF THE USE OF INNOVATIVE LAND TOOL TOWARDS COMPLETING THE JAMAICAN CADASTRE

SHAUNTELLE OLIVA RICKETTS

March, 2018

SUPERVISORS:
Dr. M. N. Lengoiboni
Prof. Dr. Ing. P.Y. Georgiadou



INVESTIGATING THE SUITABILITY OF THE USE OF INNOVATIVE LAND TOOL TOWARDS COMPLETING THE JAMAICAN CADASTRE

SHAUNTELLE OLIVIA RICKETTS
Enschede, The Netherlands, March, 2018

Thesis submitted to the Faculty of Geo-Information Science and Earth Observation of the University of Twente in partial fulfilment of the requirements for the degree of Master of Science in Geo-information Science and Earth Observation.

Specialization: Land Administration

SUPERVISORS:

Dr. M. N. Lengoiboni
Prof. Dr. Ing. P.Y. Georgiadou

THESIS ASSESSMENT BOARD:

Prof. Dr. K. Pfeffer (Chair)
Dr. M. N. Lengoiboni
Prof. Dr. Ing. P.Y. Georgiadou
Dr. R. McLaren (External Examiner, The University of Edinburgh)

ABSTRACT

Land administration systems facilitate well-functioning land markets and promote good governance rooted in informed decision making. At the core of land administration systems are cadastres, containing records of land information that support land management activities. However, not many countries are successful at developing or maintaining cadastres, hence lacking significant land information that is required for development due to complex, costly and rigid systems causing stagnant progress of their registration systems through which the cadastre is compiled. The codification of land rights created an inflexible system that could not record the various tenure types that existed. The fit for purpose land administration agenda was developed to provide an easier, less costly and attainable way for less developed countries to be able to capture and manage their land information. Innovative land tools provide the platform for this.

The objective of this study is to investigate the suitability of using innovative land tools to document extra-legal tenure in an effort to complete the Jamaican cadastre. Innovative land tools have been used in other countries in various local projects, however little is known of its applicability in Jamaica and its suitability to update the cadastre.

The study involved getting an overview of the challenges that prevent complete cadastral coverage in Jamaica from the perspective of land professionals associated with the cadastre's use. The views of stakeholders on the use of innovative land tools were ascertained based on the elements and principles founded in the fit for purpose land administration agenda. The suitability of its application for updating the cadastre is explored based on the legal, spatial and institutional requirements.

The study was qualitative in nature and was carried out through the use of interviews with land professionals and extra-legal tenure land holders. A small experiment was done using an on-screen mapping land tool to introduce the concept to land holders.

The findings of the study show that innovative land tools can potentially support the completion of the Jamaican cadastre as it can provide a solution to the lack of spatial information faced and the lack of resources required to maintain the cadastre, however, the research presented barriers that would affect its use inclusive of the disparity of the acceptance of the use of the tools between land holders and land professionals, where professionals were more apprehensive towards it. Also, the challenges inhibiting cadastral coverage included the lack of prioritization of the cadastre and fragmentation of cadastral stakeholders would require institutional reform in the face of a new approach.

Innovative land tools provide an opportunity to be used to update the current cadastral index but is subject to a change in legislation, particularly in the use of general boundaries. Further investigation is needed to explore the usefulness of these land tools on small islands and whether the size of a country affects the suitability of these land tools.

Keywords: *Innovative land tools, Cadastre, Fit for Purpose land administration, Cadastral coverage*

ACKNOWLEDGEMENTS

First and foremost, I acknowledge and give praises and thanks to the Creator for guidance, strength and endurance to embark on this ITC journey and for seeing me through to the end of the thesis process. Without Him none of this would be possible.

I must say thanks to my support system in Jamaica, inclusive of my family and extended family. To my parents and siblings for their unwavering support, though far away. Special thanks to my sister, Kaydian, for keeping me sane and being a light. To my extended family- aunts, uncles and cousins- who have kept me in their prayers and who encourages me daily, thank you. I would also like to thank my circle of friends who keep me laughing and never fail to believe in me.

Great appreciation is extended to my supervisors, Dr. Monica Lengoiboni and Prof. Dr. Yola Georgiadou for their patience and guiding expertise throughout the writing of my thesis. I must also thank the Land Administration faculty for their assistance, not only through the thesis process but also throughout the master's course for their instructions and cultivating knowledge. To my land administration classmates and ITC friends, thank you all for sharing yourselves with me and for the teamwork and your countless support over the 18 months we were together.

My deepest gratitude goes out to all who have helped me during the data collection process of this thesis. Thank you to the members of the Canaan Heights community for freely speaking to me. I must also thank all the organizations that opened up to me for interviews and so willingly provided me with invaluable data.

Finally, to everyone who has been on this journey with me and seen my highs and lows and have been my inspiration, sounding board and kept me in their prayers, thank you.

TABLE OF CONTENTS

Abstract iii
Acknowledgements iv
Table of Contents v
List of Figures vii
List of Tables viii
List of Abbreviations ix
1. Introduction 1
1.1 Background and Justification 1
1.2 Research Problem 3
1.3 Research Objective 3
1.3.1 General Objective 3
1.3.2 Sub Objectives 3
1.4 Research Questions 4
1.5 Research Operationalization 4
1.6 Conceptual Framework 6
1.7 Thesis Structure 7
2. Literature Review 8
2.1 Introduction 8
2.2 Cadastres 8
2.2.1 Role of Cadastres 8
2.2.2 Performance of Cadastres 9
2.2.3 Challenges that affect cadastral completeness 9
2.3 Land Tenure and Tenure Documentation 10
2.3.1 Priority Areas for Tenure Documentation 11
2.4 Concept behind land tools 11
2.4.1 Framework for Implementation of a fit for purpose land administration 13
3. Research Design and Methodology 15
3.1 Introduction 15
3.2 Research Design 15
3.3 Study Area 15
3.4 Data Collection Methods 17
3.5 Sampling and Sample Size 18
3.6 Data Analysis 18
3.7 Data Reliability and Validity 20
3.8 Ethical Considerations 20

3.9 Limitations to the Study 20
3.10 Research Design Matrix 21
4. Results 22
4.1 What has prevented the completion of the Jamaican cadastre? 22
4.1.1 Challenges that prevent the completion of the cadastre 22
4.1.2 Intervention strategies implemented to address cadastral coverage 25
4.1.3 Impact of the Intervention Strategies 28
4.1.4 Factors that prevent access to intervention strategies 32
4.2 Perspectives on Innovative land tools 36
4.2.1 Stakeholder perspectives on documenting extra-legal tenure 36
4.2.2 Stakeholder awareness of land tools 37
4.2.3 Stakeholder perspectives on the land tools 37
4.3 Suitability of Innovative land tools 42
4.3.1 Required changes to the spatial framework 42
4.3.2 Required changes to the institutional framework 42
4.3.3 Required changes to the legal framework 43
4.3.4 Barriers and Opportunities towards Implementation 44
5. Discussion 46
5.1 Implications of the current practices of the Jamaican cadastre on its completeness 46
5.2 Perspectives on innovative land tools 47
5.3 Spatial, Legal and Institutional Framework 48
6. Conclusion and Recommendations 50
6.1 Conclusion 50
6.1.1 To explore the factors that prevent the completion of the cadastre. 50
6.1.2 To ascertain the perspectives of innovative lands tools to record extra-legal tenure in Jamaica by stakeholders. 50
6.1.3 To determine the suitability of using innovative land tools towards completion of the national cadastre. 50
6.2 Recommendations 51
7. References 52
8. Appendices 56
8.1 Appendix 1 Interview Guide for Land Professionals 56
8.2 Appendix 2 Structured Interview for Community Respondents 60
8.3 Appendix 3 Work plan of thesis 65
8.4 Appendix 4 Registered Parcels in Canaan Heights 66

LIST OF FIGURES

Figure 1 Conceptual Framework 6
Figure 2 Fit for Purpose Land Administration Components ((Stig Enemark et al., 2015) 13
Figure 3 Research Study Area - Canaan Heights 16
Figure 4 Screenshot of on-screen mapping using STDM software 19
Figure 5 Digital Globe Satellite imagery of 19
Figure 6 Percentage of registered parcels by Parish in 2010 27
Figure 7 Registered Parcels by parish in 2012 31
Figure 8 Registered Parcels by parish in 2017 31
Figure 9 Awareness of land registration process 34
Figure 10 Awareness of intervention strategies 34
Figure 11 Reasons for not accessing programmes 35
Figure 12 Community responses on perspective on participation 38
Figure 13 Community response on the representation of party, parcel and rights using the land tools 39
Figure 14 Community response on who should be responsible for the data collected using land tools 40

LIST OF TABLES

Table 1 Operationalization of the research 5
Table 2 Respondents for primary data collection 18
Table 3 Research Design Matrix 21
Table 4 Summary of the reasons for an incomplete cadastre categorized based on its impact on the spatial, legal and institutional framework on the cadastre. 23
Table 5 Cadastral mapping projects prior to NLA 25
Table 6 Cadastral mapping and land registration projects after NLA 26
Table 7 Summary of the responses from both key informants and community respondents of the reasons that prevent citizens from accessing the various intervention strategies made available. 32

LIST OF ABBREVIATIONS

COC	Certificate of Compliance
CORS	Continuously Operating Reference System
FFP-LA	Fit for Purpose Land Administration
GPS	Global Positioning System
LAMP	Land Administration and Management Programme
LAND	Land Access for National Development
NHT	National Housing Trust
NLA	National Land Agency
SDC	Social Development Commission
STDM	Social Tenure Domain Model

1. INTRODUCTION

1.1 Background and Justification

A spatially enabled society is the goal for many countries as the evolution of societal needs increasingly demands spatial information about their resources to effectively, sustainably and efficiently manage, monitor and plan them. This concept of spatial enablement adds a geographical location component to existing information thereby yielding a wealth of knowledge allowing societies to understand and address the challenges they face regarding its legal, economic, social and environmental affairs (Steudler & Rajabifard, 2012). Spatially enabled societies lead to the realization of sustainable cities, smarter delivery of housing, improved risk management, governance and decision making (Rajabifard, Williamson, Wallace, & Bennett, 2011). One of the essential elements of realizing a spatially enabled society is a land administration system. Complete and well-functioning land administration systems support the development of land markets through, property transactions and investment in land, as well as good governance based on informed decision making, influencing the national economy (Apostolopoulos, Geli, Petrelli, Potsiou, & Ioannidis, 2016; Mourafetis, Apostolopoulos, Potsiou, & Ioannidis, 2015; UN-ECE, 2005). According to Williamson, Enemark, Wallace and Rajabifard (2010), a cadastre, which is a spatial representation of land parcels, is at the core of land administration systems. Cadastres are defined by records of land ownership, accompanied by rights, responsibilities and restrictions, on the taxable area of the land, on the use of the land or on all combined (UN-ECE, 1996) and contains spatial information about land parcels combined with textual records describing attributes of said parcels, as described previously .

Not many countries have been successful at developing and maintaining a completed cadastre, with only 25% of the world's land parcels being documented (UN-HABITAT, 2008). In many developing countries, less than 10% of the land is included. The most common cause of incomplete cadastres across countries is the complexities involved in formal land registration services. Land registration is an element of land administration systems that provides the recordation of people to land relationships, containing ownership information of land parcels as well as related rights, responsibilities and restrictions that accompany it. The increasing transaction costs, distance to registries and complexity of procedures involved with the process (Williamson et al., 2010), excludes and discourages the most vulnerable in society from accessing this service, especially when there is no clear or immediate personal benefit. The colonial legacy left behind in many countries contributed to the stagnant progress of their registration systems through which the cadastre is compiled. Strict legal rules and regulations applied to the formal system, often promoting privatization of land ownership, fragmented the customary tenure systems being practiced in reality by communities. Thereby the codification of land rights created an inflexible system that could not record the various tenure types that existed (Zevenbergen, Augustinus, Antonio, & Bennett, 2013). In St. Lucia, after an island wide land tenure regularization programme in the 1980s, the implemented system eroded over time resulting in deformalization of the property titles (Barnes & Griffith-Charles, 2007). Expensive infrastructure and unsustainable procedures, highly accurate cadastral surveys, have resulted in Land agencies being unable to update and maintain their systems, for countries that do have cadastral systems. "The existence of formal nation-wide property registration systems is vital for the market, the national and the global prosperity; therefore, the establishment of such systems is urgent" (Mourafetis et al., 2015). Cadastres become important in supporting initiatives that strengthen governance activities that address societal challenges such as climate change, rapid urbanization, poverty reduction and food security, however when not properly implemented its

benefits would be lost (Alemie, Bennett, & Zevenbergen, 2015). Many developed countries, such as Germany and the Netherlands, have complete up-to-date tenure information systems that support functional land markets and land planning systems resulting in predictability and precision in land policy implementations (Griffith-Charles, Mohammed, Lalloo, & Browne, 2015; Williamson et al., 2010). Developing countries land administration systems' capacities cannot keep up with the rapidly expanding need for land management (Griffith-Charles et al., 2015) due to the increased urban challenges, where urbanization creates a need and demand for proper management of land information to support the growing need for housing delivery and the subsequent large scale investment that will be required to support its cities (Clarissa Augustinus, 2010).

The pro-poor land administration global agenda has fueled international research and development of methods and tools for cadastral data collection that is accessible in terms of costs and simplified procedures in an effort to support countries that have yet developed complete cadastres (Apostolopoulos et al., 2016; Mourafetis et al., 2015). The pro-poor land administration approach was realized through the development of the Social Tenure Domain Model (STDM), as a concept, created to bridge the disparities, making it applicable to capture the diversity of tenure forms existing in the developing world by creating a continuum of property rights and a continuum of land recording giving more people access to the property ladder (Zevenbergen et al., 2013). An influx of innovative land tools has risen based on the principles of this pro poor land administration, such as the Social Tenure Domain Model (STDM) tool, LandMapp, OpenTenure, OpenTitle and others. They provide the technical requirements needed for tenure documentation, be it from the use of satellite imagery to capture boundary information or the use of mobile devices by members of the community. The flexibility in their land recordation techniques promotes low costs, adaptability to country context and transparency through the participation of the community.

In Jamaica, freehold tenure is the only codified and legally recognized tenure form under the Registration of Titles Act, 1989. Apart from the high costs related to formal property registration, (DaCosta, 2003), the exclusion of existing informal land tenures perpetuates the existing gap in cadastral coverage of the country. These include non-formal tenure, squatting and a communal form of tenure known as Family Lands, these can be combinedly termed, extra-legal land tenure. The documentation of these informal tenure forms is an essential part to the creation of a complete Cadastre leading to better land management and planning, and therefore needs to be addressed through reform of the technical, legal and social frameworks governing land (Meinzen-Dick & Mwangi, 2009). Approximately 40% of the land parcels in the island remain unregistered, therefore resulting in a myriad of challenges including high lack of tenure security, ad hoc land use planning and development and the poor support for the country's property valuation system which remains out of date resulting in subpar tax collection and stunted land market (Government of Jamaica, 1997; Mantel, de Vries, & Kirk, 2017). Land registration in Jamaica is done voluntarily and sporadically and therefore parcel information is only recorded and added to the cadastre when an individual decides to bring their property under the Registration of Titles Act or to legally participate in land transactions such as land transfers or land subdivisions. Apart from the high costs in transaction fees and related taxes associated with tenure documentation in the conventional land registration system, the process requires high precision surveys carried out by land surveying professionals which attribute to a large portion of the costs and hence acts as a deterrent towards individuals seeking to register property or carry out any other land transaction.

While the literature (Griffith-Charles, 2011; UN-HABITAT, 2008; Zevenbergen et al., 2013; Zevenbergen, De Vries, & Bennett, 2015) promotes pro poor land administration for tenure documentation, for these to be applicable in a country context, then stakeholder buy in is necessary. The view of various stakeholders towards the use of tools for tenure documentation is not known. Griffith-Charles, Mohammed, Lalloo and

Browne (2015), highlighted the key challenges faced in St. Lucia after a pilot study on the use of STDM for Family Land tenure documentation. It presented the issue of the need for appropriate institutional frameworks and hence provided the motivation for this research. A challenge faced there was the resistance from external stakeholders, land professionals and freehold owners, as well as community members towards the concept of documenting informality. The author proposed further research based on how the various stakeholders, land owners and land professionals, view this concept of innovative land tools. The success of the use of these innovative land tools lies not only in the recordation of tenure, but the benefits that are provided thus, which cannot be realized without the buy in from all stakeholders and the existence of a land governance framework that protects these rights and subsequently establishes institutions that recognize such.

1.2 Research Problem

The high costs and complex processes within the land registration process, along with the failure of the government to recognize and document tenure forms outside of freehold tenure, has resulted in fragmented, out-of-date documentation or recordation of land rights across the island of Jamaica. Land registration provides critical information that is used to develop its cadastral map. The issue of having complete cadastral coverage is important to Jamaica as the cadastre is used as the base for property taxation and for the land market, incomplete data hinders their functions and performance. The use of innovative land tools for tenure documentation is assumed to be a possible solution towards this lack of land information as it has been used to document complex tenure information in other parts of the world at low costs. However, it has not been applied in a Jamaican context and it therefore not known if this type of technology will be accepted by land holders and land professionals.

This study aims to investigate the feasibility of using innovative land tools for tenure documentation towards updating the cadastre. The research will look at the challenges that inhibit the increase of cadastral coverage in Jamaica as well as to investigate the use of innovative land tools for documenting extra-legal tenure types from the perspective of land holders and land professionals. The applicability of using innovative tools towards addressing the gaps identified will be assessed based on these stakeholder perspectives and be used to determine the changes that would be required to be made to the current spatial, legal and institutional framework of the formal Jamaican cadastre for such an application.

1.3 Research Objective

1.3.1 General Objective

The main objective of this research is to investigate the suitability of the use of Innovative Land Tools for Extra-legal Tenure documentation towards the completion of the Jamaican Cadastre.

1.3.2 Sub Objectives

1. To explore the factors that prevent the completion of the cadastre.
2. To ascertain the perspectives of innovative lands tools to record extra-legal tenure in Jamaica by stakeholders.
3. To determine the suitability of using innovative land tools towards completion of the national cadastre.

1.4 Research Questions

1. Sub-Objective 1: To explore the factors that prevent the completion of the cadastre.
    - What do land professionals view as the reasons for an incomplete cadastre?
    - What is the nature of intervention strategies implemented to address the issue of an incomplete cadastre?
    - How are these intervention strategies addressing the issue of an incomplete cadastre?
    - What factors prevent land holders from accessing these intervention strategies?

2. Sub-Objective 2: To ascertain the perspectives of innovative lands tools to record extra-legal tenure in Jamaica by stakeholders.
    - What are stakeholder perspectives on documenting extra-legal tenure?
    - Are stakeholders aware of innovative land tools being used for tenure documentation?
    - How do stakeholders view the quality and use of the data collected using innovative land tools?

3. Sub-Objective 3: To determine the suitability of using innovative land tools towards completion of the national cadastre.
    - What changes are required to the legal framework to include this application?
    - What changes are required to the institutional framework to include this application?
    - What changes are required to the spatial framework to include this application?
    - What are the possible opportunities and barriers to accepting innovative land tools?

1.5 Research Operationalization

To achieve the main objective of the research, table 1, shows how each sub-objective is operationalized and how each of the sub-objectives and subsequent research questions is answered. Each sub-objective is broken down into concepts, indicators and variables. The matrix provides specific factors that allows each sub-objective to be measured qualitatively in order to collectively attain the main objective.

Sub Objectives	Research Questions	Concept	Indicator	Variables	Interview Questions
To explore the factors that prevent the completion of the cadastre.	What do land professionals view as the reasons for an incomplete cadastre?	Cadastral Coverage	Types of challenges	Identification of gaps in the cadastral system	What are the challenges that have prevented the cadastre from being complete?
	What is the nature of intervention strategies implemented to address the issue of an incomplete cadastre?		Types of intervention strategies	Location of intervention strategies Differences between intervention strategies and conventional methods	What strategies have been adopted or implemented to increase the parcel coverage of the cadastre?
	How are these intervention strategies addressing the issue of an incomplete cadastre?		Cadastral coverage status	Number of parcels registered under intervention strategies	How many parcels have been projected to be registered under this programme? How many parcels have been registered since implementation?
	What factors prevent land holders from accessing these intervention strategies?		Barriers to intervention strategies	Typology of internal and external factors	Are you aware of the programmes to register your property? Why have you not accessed it?
To ascertain the perspectives of innovative lands tools to record extra-legal tenure in Jamaica by stakeholders	What are stakeholder perspectives on documenting extra-legal tenure?	View on land tools	Views of extra-legal tenure	Variation in acceptance of tenure types between stakeholders	Do you think that family land holders should have documented proof of land right?
	Are stakeholders aware of innovative land tools being used for tenure documentation?		Awareness of land tools	Awareness of land tools	What do you know about alternative methods of collecting parcel data?
	How do stakeholders view the quality and use of the data collected using innovative land tools?		Participation; Inclusivity; Quality; Speed; Dependability; Flexibility; Cost	Variations in perspectives based on indicators	What do you think about the community being involved in collecting data about your land parcel?
To determine the suitability of using innovative land tools towards completion of the national cadastre	What changes are required to the spatial framework to include this application?	Suitability of Innovative Land Tools	Land tools legal requirements	Legal framework	What is the current legal framework for land tenure?
	What changes are required to the institutional framework to include this application?		Land tools institutional requirements	Institutional framework	What is the current institutional framework for obtaining parcel data to update the cadastre?
	What changes are required to the legal framework to include this application?		Land tools spatial requirements	Spatial framework	What are the current spatial requirements for parcel data?
	What are the possible opportunities and barriers to accepting innovative land tools towards completion of the cadastre?		Barriers and opportunities	Perspectives from stakeholders	

Table 1 Operationalization of the research

1.6 Conceptual Framework

The conceptual framework shown below, figure 1, describes the concepts that are addressed in the research. Achieving full cadastral coverage in a country that has multiple tenure types depends on the recognition of these tenure types that exists outside of the formal tenure. Innovative land tools were designed to be flexible enough to document varied tenure types. However, its implementation in a country to be used to fill the gap in the formal cadastre depends on the acceptance from stakeholders in that country, inclusive of both land professionals (technocrats and legislators) as well as landholders. Their views towards this new approach can gauge the level of acceptance towards these innovative land tools towards completion of the cadastre.

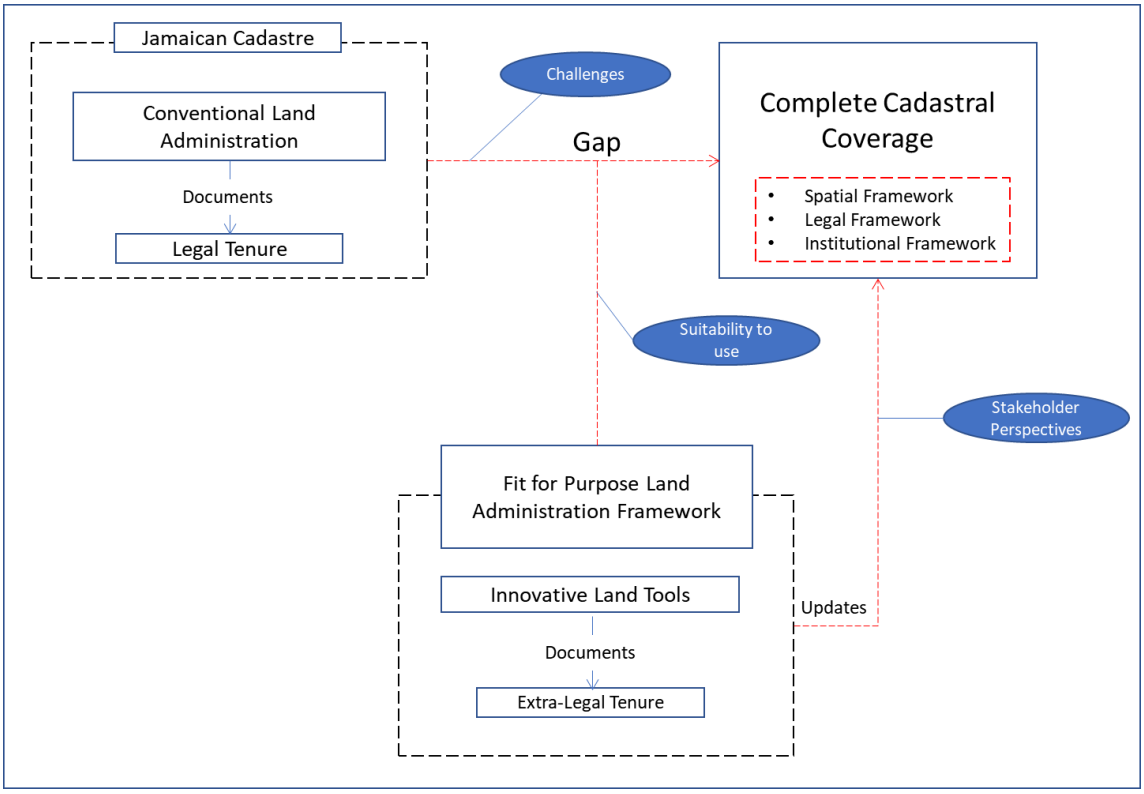


Figure 1 Conceptual Framework

1.7 Thesis Structure

The research was conducted over a period of six months, see work plan in appendix 3, and is organized in seven chapters, outlined as follows.

Chapter 1 – Introduction

This chapter contains the background and justification to support the purpose of the research. It defines the research problem and why it is important to Jamaica. The main research objective is presented. The sub-objectives and research questions for each that will together meet the general objective is identified in this section.

Chapter 2 – Literature Review

This chapter presents existing literature on the concepts that are covered in the research. It describes cadastres, their role in society and identifies different ways to assess its performance and also the challenges faced in having cadastral coverage. The literature review describes land tenure, the different types of land tenure and the documentation of such. The concept of innovative land tools and its governing principles are identified. The literature presents the various practice in use of innovative land tools in various countries and the impact that these have had.

Chapter 3 – Research Design and Methodology

This chapter presents the approach that was taken to collect and analyze data to answer the research questions. It presents the data collection methods, in-depth and structured interviews, chosen and the justification of such. The chapter also discusses the study area, sample size and sampling method that will be used. The analysis method, content analysis, is discussed.

Chapter 4 – Results

This chapter presents the findings from the fieldwork based on the research questions established for each sub-objective.

Chapter 5 - Discussion

The results are discussed based on the similarities or variations from the literature review and other relevant scientific literature.

Chapter 6 – Conclusions and Recommendations

This chapter establishes conclusions based on the findings and discussions. Suggestions for further research are identified and recommendations are presented.

Chapter 7 – References

This chapter lists all the references of existing literature that was used during the research.

2. LITERATURE REVIEW

2.1 Introduction

This literature review will present the concepts that are related to each of the research objectives presented in the previous chapter. The chapter will provide a review of existing literature that has emerged on the concepts as well as giving definitions of the context that these concepts will be used throughout this research. More information will be provided on innovative land tools, tenure documentation, cadastres and their role in society.

2.2 Cadastres

At the core of a land administration system is the Cadastre, which is a register containing parcel-based land information linked with other information such as the interests in land (proprietor rights, restrictions and responsibilities), the value of land (for taxation purposes) and/or the use of land (International Federation Of Surveyors, 1995; UN-ECE, 2005). A cadastre may be developed for fiscal, legal, planning purposes, or all three in the case of multi-purpose cadastres. The cadastre consists of a series of maps or plans, showing their spatial location and size, combined with textual records that describe the parcels' attributes (UN-ECE, 2005). Land administration systems provide the regulatory framework and institutional arrangements that realizes the implementation of land policies through the adjudication of rights and registration, the recording of land transactions, estimation of land value and the management of land use and land allocation (Tuladhar, Ali, & Zevenbergen, 2010).

The cadastre can be considered as the entry point of land registration as it contains the input documents from land registration in registers or maps or more recently in geographic databases. In some countries cadastres and land registration are either combined in one organization, separated or linked together, made possible by automation (Bogaerts & Zevenbergen, 2001). For this research, the context of cadastres is described as a geographical database containing land tenure information combined as one database or separated with an automated link.

2.2.1 Role of Cadastres

Adequate and up-to-date land information, linking the natural and built environment, in the form of cadastral and topographic datasets are required to facilitate the operational component of land policy objectives and land management strategies, supported by sound land governance towards achieving sustainable development (Stig Enemark, Mclaren, & Lemmen, 2016). This is important to the development of a society as good land administration systems are said to provide societal benefits inclusive of security of tenure for all land users, alleviation of poverty, create efficient and accessible land markets, provide equitable valuation for property taxation, protect state lands, reduce land conflicts through management of land disputes and to improve land use planning and implementation (Stig Enemark et al., 2016; Tuladhar et al., 2010). Land administration infrastructure allows for complex range of rights, responsibilities and restrictions in land to be identified, mapped and managed which is needed to implement policies related to forest management, coastal zone management, environmental and urban sustainability. As such there is an increase in the focus towards establishing and maintaining such infrastructures (Williamson, 2001).

Land Administration systems simplify land transactions and standardize procedures so that they are stable, predictable and as such creates trust among citizens, businesses and governments, hence stimulating the land market (Potsiou & Ioannidis, 2003). Where this does not exist, there is a lack of confidence in the system

where investment will be minimal, wealth creation limited and stunting economic or social benefit as the effort to participate in land activities requires too much effort and maximum risk. This is evident in developed countries as their spatial infrastructure supports their land markets, the use and creation of capital, land taxation systems and the management of their natural resources (Williamson, 2001). Developing countries tend to emulate the systems of the developed world to realize said benefits. Expensive infrastructure, unsustainable procedures and highly accurate cadastral surveys resulting in increased transaction costs, have resulted in Land agencies being unable to update and maintain their systems, for countries that do have cadastral systems. This led to ad hoc and incomplete cadastral systems. Approximately 30% of the world's parcels is documented, with many countries having only 10% of their lands being captured under the formal system. The traditional processes being used in the formal land administration is too complicated, slow and expensive therefore only accessible to elitists and non-accessible or beneficial to the poor and most vulnerable in society.

2.2.2 Performance of Cadastres

There is no general standard for cadastres since the social, cultural, economic, legal and institutional needs of countries vary. Improvements to cadastres or reform to land administration systems require detailed understanding of existing conditions for solutions to be recommended for its improvement or for changes to be introduced (Z. Ali & Nasir, 2010). To know if cadastral systems meet the societal requirements of a country, the purpose of the cadastre for the country should be determined. Several frameworks have been developed over the years to assess the performance of cadastral systems (International Federation Of Surveyors, 1995; Mitchell, Clarke, & Baxter, 2008; Shibeshi, Fuchs, & Mansberger, 2015; Tuladhar et al., 2010; Zhang & Tang, 2017). They provide indicators which are used to measure the success of the cadastral system. Williamson (2000), denoted the trust by the general society of a system and its extensiveness of its use by land stakeholders as desirable indicators for cadastral performance that cover the technical, economic, legal and institutional aspects. Performance indicators are evaluated to identify gaps where the cadastre does not meet optimal societal requirements. Food security, tenure security and climate change adaption are among the societal needs identified by (Asiama, Bennett, & Zevenbergen, 2017) that the cadastre needs to serve. The societal requirements should be determined by the key operators of the cadastral system (Zhang & Tang, 2017), such as the technocrats, land surveyors, land administrators and lawyers. However, these technocrats often focus on putting in advanced legal and technical infrastructures rather than determining the infrastructures that would be required to meet societal needs and the human to land relationships that exist (UN-HABITAT, 2002).

2.2.3 Challenges that affect cadastral completeness

It is estimated that only 25% of the world's land parcels are registered. Those countries that have complete or near complete cadastral coverage boast highly embedded systems. This is usually a characteristic of highly developed countries (de Vries, Bennett, & Zevenbergen, 2015). The lesser developed countries still struggle with developing their cadastral systems and at current rates, they may not reach full coverage status for decades or centuries (Zevenbergen et al., 2013). As they are at various stages of development, cadastral and land registration institutions are weaker and not able to achieve full coverage or support the growth of their cities (de Vries et al., 2015). Fekade (2000), attributes the institutional breakdown to poorly developed procedures (such as cadastral mapping and surveying) that are expensive, complex and cumbersome as well as to poor administration where the authorities are inept.

The collection of spatial data for land administration has been one of the key challenges faced and is yet one of the key tasks of cadastral systems. Conventionally, collecting data on the spatial extent of parcels and their relating rights, restrictions and responsibilities, has been expensive and requires highly accurate field surveys carried out by land surveyors. Hence, it has not been practical or economically viable especially at larger scales (Rahmatizadeh, Rajabifard, Kalantari, & Ho, 2018). As one of the issues the cadastre faces is maintaining its correctness, conventional data collection methods cannot keep up with this. Correctness can be defined as the relationship between the legal situation and what is in the cadastre (Bittner & Frank, 2002). The dynamic nature of the real world, where parcel information changes, especially in instances where informal land markets are actively conducting land transactions, it becomes difficult for the cadastre to reflect the reality of the land tenure relationships.

The failure to recognize non formal tenure types that exists and is practiced but not enshrined in the law is a common factor that prohibits cadastral coverage. Van der Eng (2016), highlights the situation in Indonesia where land tenure that is defined by customary rights is one of the reasons that has stunted the completion of their cadastre, as the existing legislation does not have provisions for such.

2.3 Land Tenure and Tenure Documentation

Land tenure is defined as the way in which rights to land are held (UN-ECE, 1996). Harvey (2006), argues that this is a narrow and misleading approach to defining land tenure as it implies that this 'right' is under the rule of law, which is not always the case. Land tenure, as defined by (FAO, 2002), is the people to land relationship which can be within legal or customary settings with people being individuals or groups. Land tenure is an institution that rules are defined by societies. It is multidimensional as land tenure relationships can be well defined and enforceable by law, formal or customary, or is can be ill defined and vulnerable (FAO, 2002; Harvey, 2006). Land tenure can be viewed as legal or extra-legal, formal or informal. Legal tenure is viewed as tenure described by the rule of law, while extra-legal tenure exists outside of the law. This may be legitimized where it is socially accepted or non-legitimate, where the relationship to the land is deemed criminal (Stig Enemark, Mclaren, & Lemmen, 2015).

USAID (2010), categorized tenure types existing in Jamaica as legal, customary and extra-legal. The legal tenure described freehold and leasehold, which are the only tenure types recognized by legislation. Freehold is the only documented tenure type, done through the land registration process. Family land is a customary tenure type that is dynamic and complex where land held by a family is passed down through generations, void of documentation and results in unsupervised fragmentation of land (E. Clarke, 1953; Stanfield, Barthel, & Williams, 2003). Extralegal tenure was identified as those existing in squatter settlements, where individuals encroach on private or state-owned land. For the scope of this research, we will refer to extra-legal tenure as tenure types existing outside of the formal tenure types.

Land tenure information and land registration are identified as areas in need of data that is up to date and maintained, a function of cadastral systems (Griffith-Charles, 2011). While cadastral systems contain information on land rights and land ownership, it usually does not include land tenure that exists outside of the formal system, which impacts how land is used and in a broader societal context, it influences the environment, economy and the society (Griffith-Charles, 2011). The absence of documentation showing people's rights to property gives way to varying perception of insecurity of tenure by current and potential property holders. Documentation of people's rights to land are especially important where land markets are active (Stanfield, Murtazashvili, Safar, & Salam, 2013). Clarification and documentation of land rights reduces

uncertainty over claims to land, especially in cases of inheritance (Ayalew, Deininger, & Goldstein, 2011). The legacy of colonization saw tensions arising from the attempts to accommodate western land tenure systems, where existing land tenure types were privatized, such as customary land tenure systems in developing countries (Williamson, 2001). The codification of these land rights created an inflexible system that could not record the various tenure types that existed (Zevenbergen et al., 2013). In St. Lucia, after an island wide land tenure regularization programme in the 1980s, the implemented system eroded over time resulting in deformalization of the property titles (Barnes & Griffith-Charles, 2007) as residents reverted to their former land tenure relationships with land.

Innovative land tools, such as STDM tool, were developed to record the varying interests that people have in land. The tools are targeted towards participation where the community is tasked with documenting their tenure relationships. The cooperation between the state in documenting land rights can help to reduce conflicts and strengthen governance in general (Stanfield et al., 2013). However, on the other hand, Griffith-Charles et al. (2015) presented a challenge of a STDM pilot project in St. Lucia as the resistance and concern of citizens and land professionals that documenting tenure rights outside of the formal system and legitimize this would pose a threat to the existing formal freehold and also result in increase of illegality in other areas. Tenure recording should reflect what exists in reality. Data documented on extra-legality can be used to make observations over time and inform interventions geared at reform and general decision making (Griffith-Charles, 2011).

2.3.1 Priority Areas for Tenure Documentation

A cadastre should be based on complete coverage of a country, especially when being used for taxation purposes. However, selected areas may be given priority for registration over other areas to maximize the use of resources (UN-ECE, 2005). Requirements or areas aimed at registration will differ for specific countries as it depends on the development strategies adopted by each country. Some common priority areas in developing countries are cities and urban areas occupied by informal settlements, high value agricultural lands, state lands, reserves and forests and lands subject to indigenous rights (Williamson, 2000). The stage of development of a country along with global drivers such as urbanization, globalization, environmental management and sustainable development will determine the land administration strategy that is selected. To achieve sustainable development a country should have all lands recorded, however this is not a short-term reality for developing countries. None the less, it should be noted that land registration is not only important for urban areas but addressing rural issues is just as important (Williamson, 2000).

2.4 Concept behind land tools

Conventional land administration systems are too complex, slow and expensive to meet the needs of all groups effectively and efficiently, therefore new approaches are needed to record, store and maintain land information. Advancement in geo-information technology and dynamic societal needs for land administration have created a demand for reliable systems that can cope with the current demands (Tuladhar et al., 2010). The pro-poor and fit for purpose land administration concept was borne as approaches to address these societal needs and provide strategies and access for developing countries (Stig. Enemark, Bell, Lemmen, & McLaren, 2014; Zevenbergen et al., 2013). The fit for purpose land administration can be described as a set of guiding principles that presents as approach for establishing land administration systems in less developed countries takes the focus away from top-down approaches focused on high accuracy surveys and technical solutions but rather on creating a sustainable way that countries can record legal and social tenure in a way that they can afford and sustain (Stig Enemark & Bell, 2014; Stig Enemark et al., 2016).

The principles include a system that is *flexible* in spatial data capture approaches; *participatory* to ensure community engagement; *affordable* so that the government can maintain it and the society can afford it; *reliable* so that the information is correct and authoritative; *inclusive* to support complex land tenure systems; *upgradeable* so that it can be improved over time and as needs be; and *attainable* so that the system can be established quickly (Stig Enemark & Bell, 2014). Its application is evident as governments, especially in Africa have restructured land policies, laws, surveying and mapping techniques to align with its principles. The Eastern African country of Rwanda has set the precedence for pro-poor, low cost, participative land administration, when it completed an aggressive Land Registration programme in 2012 that resulted in the mapping of all the land parcels in the country using the concept of general boundaries and making use of aerial photos to demarcate land parcels. Not only did the programme provide increased land rights to women, especially leading to an increase in the access to credit, but through linking the data with other government agencies data, there was improvement in the fairness and collection of property tax which supports the functioning of land and financial markets (D. A. Ali, Deininger, & Duponchel, 2017).

Out of this concept, came emerging ways of dealing with land tenure information, inclusive of new technology to record, manage and store this data. The STDM was realized as a refinement of the Land Administration Domain Model (LADM), which is a standard by the International Organization for Standardization (ISO) to logically structure the format for describing people to land relationship allowing for easy sharing and understanding of this data to support this global change in dealing with land. The STDM came after as a method of describing the resulting land tenure relationships in a more flexible and representative way than the generalized and individualized format of the LADM (Griffith-Charles, 2011).The Social Tenure Domain Model was also developed as a tool implemented by development agencies, Global Land Tool Network and UN HABITAT. It is described as the implementation of the LADM by (Antonio, Zevenbergen, & Augustinus, 2015). This tool can be described as an innovative land tool. STDM along with many others such as, LandMapp, Open Tenure, Open Title, were implemented to solve the discrepancies created by conventional land administration systems by adopting the concept within the design of their technology. Innovative land tools capture the diversity of tenure forms existing in the developing world by adopting the concept of the continuum of property rights, continuum of land recording and continuum of accuracies giving more people access to the property ladder (C Augustinus, Molendijk, Lemmen, & Plessis, 2015; Zevenbergen et al., 2013). These tools were created to enable easy use by the community who would be the driving force behind the data collection.

The use of innovative land tools to document land tenure information has emerged and been applied in several contexts. Ouma, Ochong, Antonio, Maina, & Trust (2017) describes the use of STDM in Kenya where the outcome was the use of the information to secure an informal settlement upgrade programme which saw to the government handing over land to the community. GROOTS Kenya was another project where the use of smart phones were used to document public lands from which a map was created where residents could then use this to monitor encroachment on state lands (Huggins & Frosina, 2017).

Asiama et al (2017) identifies a gap in knowledge in placing such emerging approaches as innovative land tools within a societal context other than to obtain tenure security and argues that so far, the underlying reasons for these approaches have been to secure tenure, therefore the need to support other areas such as taxation, land market and food security.

(Griffith-Charles, 2011) identified specific issues that would impact application of the STDM concept in Trinidad and Tobago. Among these, professional attitudes towards accepting imprecision in data captured by non-survey grade equipment would pose difficulty. Flexibility in the system, inclusive of spatial and attribute information needs to be accommodated. In a pilot project of STDM implementation barriers were presented

that would need to be addressed (Griffith-Charles, Mohammed, & Lalloo, 2016). Participants in the project were not receptive to other community members having access to their data.

2.4.1 Framework for Implementation of a fit for purpose land administration

The fit for purpose land administration approach has three components that serve as guiding principles for countries, see figure 2. It includes the spatial, legal and institutional framework that is favourable to facilitate adoption of the concept (Stig Enemark et al., 2015).

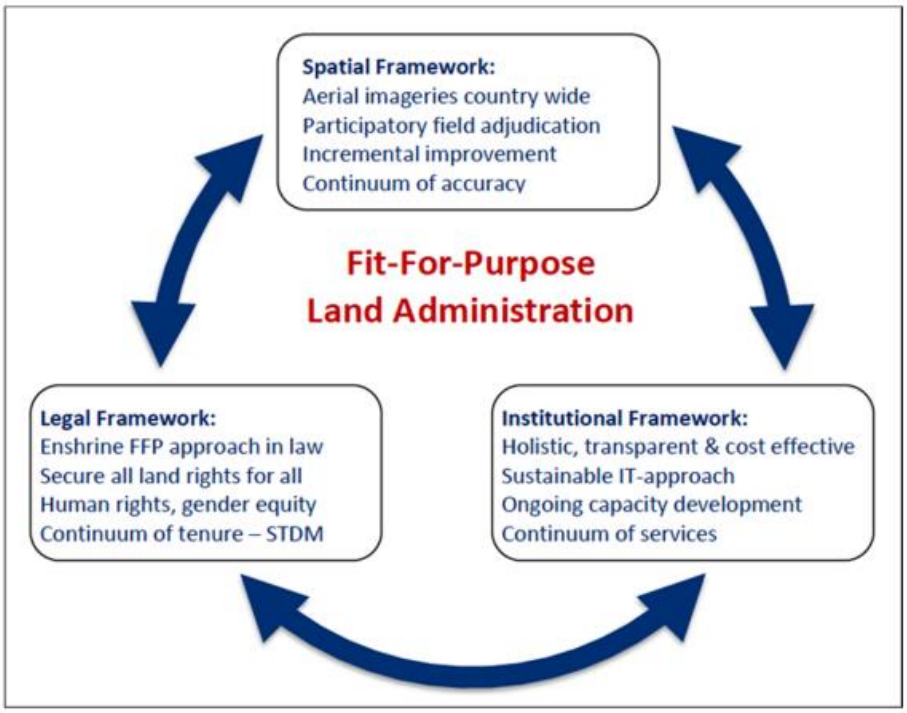


Figure 2 Fit for Purpose Land Administration Components ((Stig Enemark et al., 2015)

The spatial framework for conventional land administration systems usually consists of the carrying out of cadastral surveys or mapping of property boundaries having high accuracies, fixed boundaries and stringent regulations, standards and guidelines. While this has been maintained by more developed countries, maintaining or developing such technical standards of surveying and adjudication are not feasible for lesser developed countries as they lack the resources in time, finance and capacity (Stig Enemark & Bell, 2014). The spatial framework presented by the fit for purpose approach focuses on methods that are cheap, reliable and fast, where the advanced technical standards are seen as the end goal that can be upgraded to, but the entry point should focus on using techniques that the country can afford and maintain, but also provide reliable data. The spatial framework presented focuses on using satellite imagery for large scale mapping rather than field surveys, using general boundaries rather than fixed boundaries that require boundary monuments and taking the focus away from high accuracy for the purpose of technical standards but rather to focus on the purpose and need of the spatial data (Stig Enemark et al., 2016). The spatial framework is meant to be dynamic as the concept provides a platform where different levels of accuracy and tenure relationships can exist and can be improved and upgraded overtime and evolve as purposes evolve (Rahmatizadeh et al., 2018).

The legal framework presented by the fit for purpose land administration encourages flexibility and requires a reflection of the tenure systems that exist and are currently being practiced on the ground be enshrined in the law and recognized as legitimate tenure types by legislation and by the authoritative institutions (Stig Enemark

et al., 2016). Conventionally, the legal framework for land administration reflects systems adopted from colonial powers that do not recognize social tenures. The legislations often only recognizes legal tenure in the form of ownership and titling (Stig Enemark & Bell, 2014).

The institutional framework should be denoted by flexible ICT-infrastructure, such as those provided by land tools which allow for a co-management of land information where it does not have to be collected and managed only by formal institutions but by building on existing local and unconventional institutions. There is a collaborative effort of all stakeholders. It should be holistic, transparent and cost-effective where land information is easily accessible to not only government institutions but to citizens, and where the management of land information is not carried out in sectoral silos but by a coherent administration (Stig Enemark et al., 2016). Conventionally, land administration activities are carried out by different government departments that do not effectively share data, making the processes complex, cumbersome and expensive. LA processes have been underpinned by inadequate administration lacking in resources and capacity.

3. RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter describes the research design and methodology that answers the research questions posed under each sub objective. It indicates the study area, how the data was collected, sources of data and the analysis methods used to interpret the data. Ethical considerations will also be addressed. Steps that were taken to ensure data validity and reliability will be discussed.

3.2 Research Design

The research was conducted as a qualitative study. A qualitative research describes the variation and diversity in situations. It allows the flexibility to study various attitudes, values and perceptions related to a particular phenomenon and takes more of an inductive approach to exploring relationships between the theory and research (Bryman, 2012; Kumar, 2010). The research is classified as a combination of descriptive and exploratory. A descriptive study, according to Kumar (2010), systematically presents a situation or problem and provides information about it, such as attitudes towards an issue. Exploratory studies examines the feasibility of a study or explores a phenomenon in cases where little is known about it (Kumar, 2010). This approach to execute the research was chosen as the study explored the perspectives of various stakeholders towards the use of innovative land tools by describing their attitudes based on various indicators. Where a quantitative research measures and quantifies the magnitude of variations of a situation or phenomena, this research identifies and explores the nature of the cadastre in Jamaica and its performance, where not much research has been done in this area; and, determined the suitability of using innovative land tools, as this tool has not been implemented in the country of study. The views of stakeholders were explored and described. Rather than making an inference on the population, the research sought to ascertain an in depth understanding of the phenomenon to know the performance of the cadastre, what strategies have been implemented to increase its coverage, then looked at documenting extra-legal tenure using innovative land tools as a possible solution by obtaining the perspectives of various actors then using this to evaluate its possible application.

3.3 Study Area

Jamaica is a middle-income Caribbean island that occupies an area of 10991 sq. km with just under 3 million persons living there. The country comprises of 830, 000 land parcels, of which only 60% is currently registered (National Land Agency, 2017). However, this figure of 830,000 only accounts for the parcels that are currently on the valuation roll and is suspected to be in the range of 1, 000, 000 parcels as a result of undocumented subdivisions and failure to update the system (Koh & Knight, 2014). The National Land Agency, a centralized and autonomous state agency, is the sole institution that is mandated with land registration in the island which is used to update the national cadastre, also a mandate of the Land Agency. The Land Administration and Management Programme (LAMP II) is one of the strategies implemented in 2010 in the country to decrease the number of unregistered parcels in the country. This was implemented in four parishes as these were identified as having the lowest rates of registration of parcels. The parish of Clarendon was one of these 'special project areas' for implementation of the programme. To date, the parish has the second lowest rate of title registration in the country. This parish was chosen as the area of study as many of its communities have been involved in community mapping and community GIS projects. From this, one community was selected from which to provide a sample for the research. Only one community,

Canaan Heights, figure 3, was selected as it would not be feasible to study all the communities for this research. The tenure types in this community are not homogenous and have a mixture of legal and extra-legal tenure types, appendix 4. The Canaan Heights Community lies on the periphery of May Pen, which is the capital town of Clarendon and serves as its central business district. Canaan Heights is a residential community bordered by other communities such as Mineral Heights and Hazard. The community was established in 1970 by the government as a squatter settlement. It has a population of approximately 2000 residents.

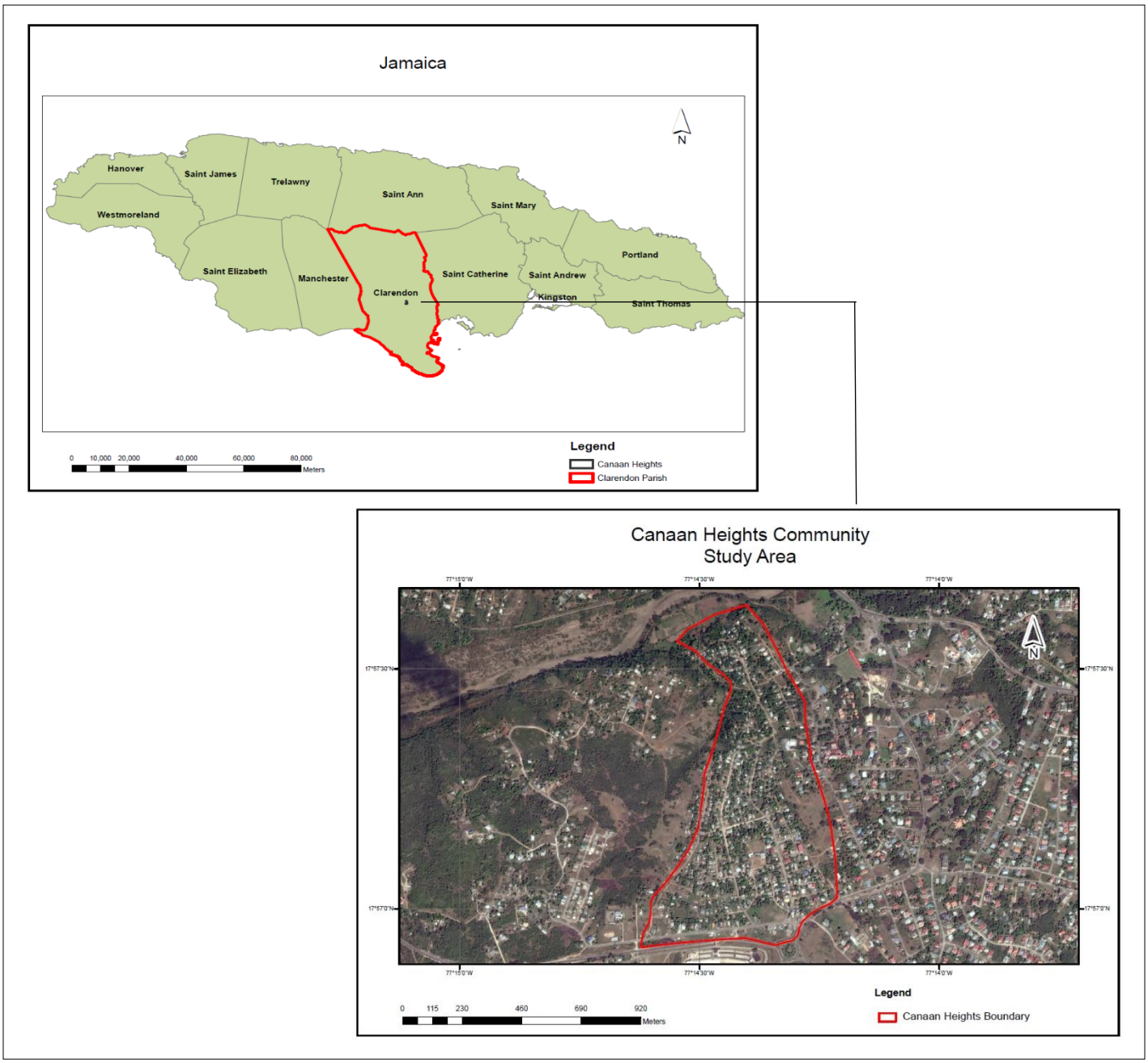


Figure 3 Research Study Area - Canaan Heights

3.4 Data Collection Methods

Data collected for this research was of mixed methods inclusive of in-depth interviews with key informants, structured interviews with land holders and land professionals and secondary data obtained from government records.

Primary Data Collection

In depth expert interviews, in a semi-structured format, was conducted with a range of stakeholders to determine the performance of the cadastre. These interviews were conducted with land related professionals, see table 2, who contribute to the collection of data to update the cadastre, are a part of the institutional framework of the cadastral system and also that are users of the cadastral information. The in-depth interview involved face to face interaction between the respondents and the researcher as this method is presumed to lead to in-depth and accurate information about experiences, situations and perspectives of the expert (Kumar, 2010). This data collection method was also used to determine the current spatial, legal and institutional framework of the Jamaican cadastre.

Structured Interviews were used to collect data about the perspectives of various stakeholders towards extra-legal tenure and innovative land tools. The structured interview was conducted based on a written list of questions and is done face to face, this method provides uniform information that enables comparability of the data obtained (Kumar, 2010). This method was chosen over a questionnaire, which is not done face to face, for 2 reasons, (1) the respondents required some explanation of the questions and (2) the interview consists of open ended questions which allows information to be extracted based on expounded answers given by respondents. The respondents were extra-legal land holders, as well as land professionals, see table 2. This was used to discuss and compare the differences and similarities of the attitudes of these categories of respondents.

Secondary Data Collection

Data was collected from governmental records, inclusive of published reports, legislation and government databases. Spatial data, the parcel statistics and maps, was obtained from the National Land Agency to deduce cadastral coverage. Legislation such as laws and policies were sourced as well as reports from the National Land Agency pertaining to intervention strategies.

Method	Respondents			
In-depth Interview	Key Informants	National Land Agency	Title Division	1
			Surveying & Mapping Division	2
			Estate Management	1
		Academia	Surveying & GIS Department – University of Technology	1
		Land Surveyor's Association	Commissioned Land Surveyor	1
		Ministry of Job Creation & Economic Growth	Squatter Management Unit	1
		External Project	BRACE Phase II	2
Structured Interview	Community Respondents	30 members		

Table 2 Respondents for primary data collection

3.5 Sampling and Sample Size

A mixture of sampling techniques was used in this research. Expert sampling was used to select the respondents for the in-depth interview with key informants. This sampling technique involves selecting known experts in the field of interest. For qualitative research the number of experts are dependent on the data saturation point (Kumar, 2010). Key informants were chosen based on their professional connection with the cadastral system in Jamaica and identified based on expert knowledge, see table 2. The sample used to conduct the structured interviews was extra-legal land holders. Land holders were selected based on the Criterion purposive sampling method. This method involves selecting individuals who meet a certain criterion based on their experiences (Palys, 2008) and its relevance to the research. This method allows for the selection of individuals who can provide critical and adequate information to answer the particular research question. The sample area is not homogenous and as such has a mixture of tenure types existing in the space; therefore, this sampling method was used to identify extra-legal land holders. They were identified based on an overlay of the parcel database and satellite imagery to see the areas which had unregistered parcels. Once this was done, persons were selected based on their willingness and availability to participate in the research. As this is a qualitative study and no inferences were made of the population from the selected sample, a sample size of 30 respondents was estimated to provide theoretical saturation. While it is difficult to quantify the number of respondents that will determine when no new themes will emerge (Fusch & Ness, 2015), the cost and resources available for the research was considered in the determination of the sample size. The data was analyzed as soon as was collected which allowed the researcher to identify when saturation was met.

3.6 Data Analysis

Content Analysis – This analysis technique was used to analyze the contents of the interviews to identify themes that emerge from the various respondents. These themes become the basis for analyzing the text (Kumar, 2010).

Spatial Analysis- ArcGIS software was used to visualize cadastral coverage and show the rate of increase in cadastral coverage since the implementation of intervention strategies by showing the changes in spatial parcel coverage since its implementation. An overlay of the parcel database on satellite imagery was done to visualize unregistered and registered parcels in the selected community.

Approach discussed by sub-objectives

Research Sub-Objective 1

In depth interviews, were undertaken with key land related experts, see table 2, to ascertain what they view as the challenges that prevent full cadastral coverage of the country as well as the strategies that were implemented to address this issue, appendix 1. Review of government reports and other documents of these strategies allowed for the identification of where these strategies were implemented and the nature of these interventions. Structured interviews were conducted with land holders in Canaan Heights that identified the reasons that prevent them from seeking access to identified intervention strategies. Content analysis was the chosen data analysis where the content was discussed based on the *spatial, legal and institutional* challenges that revealed the gaps in the cadastral system.

Research Sub-Objective 2

Structured interviews, appendix 2, were carried out, consisting of open ended questions. These interviews were conducted with land holders to get their views on extra-legal tenure documentation as well as on innovative land tools and their use. These questions were included in the semi-structured interviews conducted with land professionals to ascertain their perspectives as well, appendix 1. *Quality, Dependability, Flexibility, Cost, Participation and Inclusivity* were selected from the fit for purpose land administration assessment to be used as themes for the content analysis of the data collected. Land professionals were chosen based on expert knowledge, while land holders were identified based on a purposive type sampling.

Prior to conducting the interviews, an experiment was done to expose the respondents to the innovative land tool. The tool that was used is the Social Tenure Domain Model (STDM) tool, where respondents were introduced to it and allowed to plot their parcels using satellite imagery, figure 4. The satellite imagery was obtained from Google Earth Pro, where Digital Globe satellite imagery, figure 5, is available free of cost. This approach to carrying out an experiment in areas that have not used a tool prior and then conducting interviews was adopted from cases in Greece and Ghana (Asiama et al., 2017; Basiouka & Potsiou, 2012).

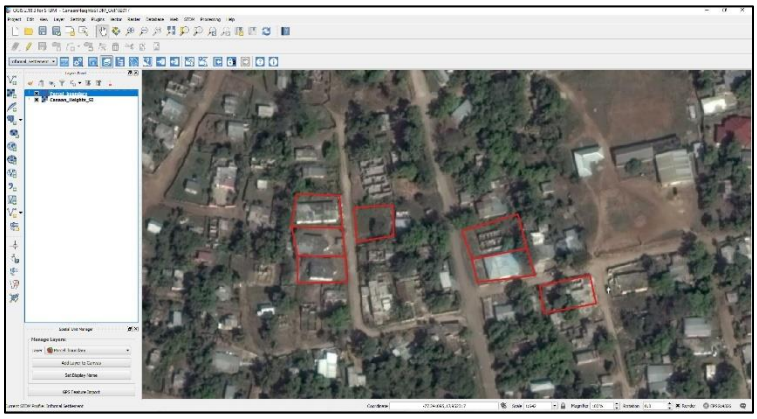


Figure 4 Screenshot of on-screen mapping using STDM software

Figure 5 Digital Globe Satellite imagery of Canaan Heights.
Obtained from Google Earth Pro.
Image Date: September 2017

Research Sub-Objective 3

A combination of in-depth interviews, document reviews and existing literature review was carried out to achieve research objective 3. A content analysis was done to present the environment that would be required in terms of spatial, legal and institutional framework for this implementation. Existing literature was used to identify barriers and challenges that were faced in other countries when implementing the use of innovative land tools. These experiences along with the results from sub-objective 2 was used to discuss the potential barriers and opportunities for implementation in Jamaica. The spatial, legal and institutional framework of countries that have implemented the use of these land tools identified in literature as well as the framework proposed by (Stig Enemark et al., 2015) were reviewed and used to inform that of Jamaica, based on similarities and differences.

3.7 Data Reliability and Validity

According to Kumar (2010), data reliability and validity speaks to the stableness and consistency of a research tool which will in effect produce accurate and predictable data. An attempt at data reliability and validity will be made through triangulation of data through interviews of more than one person to observe the consistency. The results from the research will be shared with the land professionals. It will be difficult to guarantee data reliability and validity when obtaining respondents perspectives.

3.8 Ethical Considerations

Informed consent was obtained from each respondent before any data is collected, both written and recorded data. Informed consent presumes that data collected is done so on the basis that the respondent is aware of the purpose of the data collection, what it will be used for and how it will be used (Kumar, 2010). The data collected was not and will not be used in the future beyond the purposes of the research and confidentiality and anonymity was maintained. No personal information that could be used to individually identify any respondent was collected. The data provided by respondents during the experiment using STDM, is only accessible by the researcher. Any answer provided by respondents will not allow for their individual identification. All data collected was used for educational purposes only and was not sold or used in a way not disclosed to the respondents by the researcher. This was conveyed to the researchers before each interview. The recordings that were made during the interviews are in the sole possession of the researcher and transcriptions were made from these recordings.

3.9 Limitations to the Study

As the use of innovative land tools for tenure documentation is an emerging approach, prior scientific research on the topic is limited and many of the available documentation of such is found in the form of reports from pilot projects. The lack of documented data and research on land tenure in the Caribbean and in Jamaica especially creates a limitation on the study. Innovative land tools have not been used in Jamaica, and as such limits the experiences of respondents. Rather than looking at perspectives based on practices, the research looks at perspectives based on the concept and limited time using the tools. There may exist a bias in the research as the responses obtained from the community was only done so in one community. Given more time and resources, the research would have benefitted from carrying out the research in different communities of varying typologies as political and socio-economic characteristics may influence the answers provided by community responses.

3.10 Research Design Matrix

The matrix, table 3, gives a summary of the data collection techniques, analysis and anticipated results of the research.

Research sub objective	Research questions	Techniques of data collection	Required source of data	Techniques of data analysis	Anticipated Result
To explore the factors that prevent the completion of the cadastre.	What do land professionals view as the reasons for an incomplete cadastre? What is the nature of intervention strategies implemented to address the issue of an incomplete cadastre? How are these intervention strategies addressing the issue of an incomplete cadastre? What factors prevent land holders from accessing these intervention strategies?	Semi - Structured Interview Government Documents and records review Structured Interview	Land Surveyor Association National Land Agency Land Policy Committee Academia Land holders Government Reports Government geo-database	Content Analysis Spatial Analysis	Identified challenges for completing cadastre (Unwillingness of land holders to pay for services; informal land market) List of intervention strategies; Actors involved in each intervention strategy Differences between intervention strategies and conventional land registration Maps showing increase in cadastral coverage Land holder's reasons for not participating in intervention strategies such as cost and distance
To ascertain the perspectives of innovative lands tools to record extra-legal tenure in Jamaica by stakeholders.	What are stakeholder perspectives on documenting extra-legal tenure? Are stakeholders aware of innovative land tools being used for tenure documentation? How do stakeholders view the quality and use of the data collected using innovative land tools?	Semi - Structured Interview Structured Interview	Extra-legal tenure holders Land Surveyor Association National Land Agency Land policy committee Academia	Content Analysis Descriptive Statistics	Variation in attitude towards documenting extra-legal tenure (resistance from land professionals and acceptance from land holders) Variation of stakeholder views on use of innovative land tools (Resistance from land professionals; acceptance from land holders)
To determine the suitability of using innovative land tools towards completion of the national cadastre	What changes are required to the spatial framework to include this application? What changes are required to the institutional framework to include this application? What changes are required to the legal framework to include this application? What are the possible opportunities and barriers to accepting innovative land tools towards completion of the cadastre?	Semi - Structured Interview Government Document review Existing Literature review	Land Surveyor Association National Land Agency Land policy committee Government Reports (Published reports, journals, books, conference papers)	Content Analysis	Fit for purpose framework for innovative land tool implementation in Jamaica to add to the cadastre Typology of barriers and opportunities based on stakeholder perspectives and experiences of other countries

Table 3 Research Design Matrix

4. RESULTS

This chapter presents the data that was obtained during the data collection process of this research. The data represents data collected from community respondents and key informants. Each research sub-objective is presented with the responses for each research question where the data collected with the use of structured and in-depth interview instruments.

4.1 What has prevented the completion of the Jamaican cadastre?

The first sub-objective addressed is to explores the factors that have affected the completion the Jamaican cadastre. In doing so, the research focused on cadastral coverage which is looked at in three aspects, firstly, the reasons why the cadastre has not been completed, from the perspective of the land professionals; secondly, a look at the projects/programmes (called intervention strategies) that have been implemented to address the increase in parcel coverage and land registration; and finally, looking at the reasons why these intervention strategies have not been accessed by the public. Together these three elements will provide insight on the performance of the cadastre by indicating its current status and the measures that have been taken and are currently being taken towards having complete cadastral coverage and how it relates to the overall spatial, legal and institutional framework of the cadastre.

4.1.1 Challenges that prevent the completion of the cadastre

Currently in Jamaica, there is the cadastral map and the cadastral index. The cadastral map is updated when a parcel is registered under the Registration of Titles Act and is accompanied with a cadastral survey of the property. The cadastral index is the most complete parcel representation of the island; however, it is not up to date or accurate as it was compiled from maps that pre-dates independence. As approximately 40% of the island remains unregistered, key informants identified reasons, from their perspective, that have contributed to the failure of the cadastre to have complete coverage, table 4.

	Reasons for incompleteness	Impact on the Cadastre
Spatial	- Adjudication of parcel boundaries and tenure - Importance of precise boundary delineation	The practice of using monuments and having highly accurate surveys exacerbates the issues that arises during adjudication and the disputes and conflict over parcel boundaries.
Legal	- Ad-hoc nature of land registration, which is not compulsory	First registration of land parcels should be the duty of the country, however, when this is not the case, it will be very difficult to get citizens to access a service on their own accord, that is costly and complex.
Institutional	- Lack of political will to make cadastre a priority - Failure on technocrats to lobby for cadastre - Insufficient skill set and human resources	There needs to be a comprehensive definition of the cadastre and its purpose that is agreed upon by all the stakeholders involved, such as land surveyors, NLA and politicians. This agreed upon ideology will generate the push towards the importance of the cadastre as an infrastructural goal, where the institutional elements required are realized.

	- Evolving uses for the cadastre	
Social	- Culture of kinship among Jamaicans	The social structure of a society is usually not included in cadastral discussions, but it can have an effect on the overall structure and attempts to completing the cadastre, as it requires the social structures to be reflected. Here it is seen where the informal generational transfer of land within families and several family members claiming their own space on a plot of land, and the cycle continues.

Table 4 Summary of the reasons for an incomplete cadastre categorized based on its impact on the spatial, legal and institutional framework on the cadastre.

The identified challenges that have inhibited cadastral coverage can be grouped based on spatial, legal, institutional or social characteristics, as summarized in table 4. The main challenges faced fall under five (5) main categories, the lack of resources, failure to prioritize, adjudication, ad-hoc land registration and the evolving use of the cadastre, as described below.

Lack of Resources

Key informants were asked to identify what they view as reasons for the failure of having a complete cadastre. A common and not surprising response that was identified by all respondents was the of lack of resources available to complete the cadastre. The lack of necessary funding allocated specifically towards the development of the cadastre coupled with insufficient skill set and staff availability to carry out such task have inhibited this focus. The National Land Agency is a centralized autonomous agency that is located within the capital city of Kingston and serves the entire population of the island, which is just under 3 million. The agency receives less than half of its funding from the government and therefore relies on its generated revenue for its operations. For a task, such as completing the cadastre for the country, "grand funding", as cited by one respondent, would be needed in the form that is usually provided by international donor and development agencies.

On the contrary, while acknowledging that financial constraints have impacted the completion of the cadastre, a respondent noted that this is not so much of a great challenge or impediment as that of the lack of priority that is placed on the completion of this infrastructure by those in authoritative positions.

Failure to prioritize cadastre

An even greater imposition on the completion of the cadastre is the lack of will on the part of those who are authorized to carry out this task and to lobby for its completion. This lack of will can be divided into two entities, one being the lack of political will, where if the choice was to seek funding between building a new highway or developing the cadastre, the cadastre would be the unpopular vote as it is much easier and more important, from the perspective of the politicians, to seek and secure funding for more visible infrastructure, such as road development, which also serves as a selling point to obtain votes. Therefore, it is not seen as a national priority.

The second part of the lack of will argument made by the respondent is on the part of the technocrats attached to the ministry responsible for the processes associated with the cadastre, The Ministry of Job Creation and Economic Growth including the National Land Agency, who is directly responsible, as they do

not place enough emphasis on having the cadastre completed. They are not willing or "brave enough" to challenge the directive of the Minister with the portfolio and the political directorate to have this seen as a priority.

Adjudication of boundaries

Adjudication of parcel boundaries as well as of tenure was identified as the biggest challenge inhibiting progression of the cadastre. A land titling project, Land Administration and Management Programme (L.A.M.P) that was carried out in 2002 was unable to be completed largely due to the disputes that arose over deciding the location of boundaries and who has the legal rights to a parcel. The National Land Agency stated adjudication as the main drawbacks that they face with building the cadastre. The culture of kinship in Jamaica and the informal way in which land is distributed among family members informally, especially in rural areas, was cited as the reason for the problems associated with adjudication. Precision in boundary delineations is deemed important to Jamaicans, where even an inch of land can be a contentious issue during the adjudication process which causes its delay, and often times a deliberate end to the land registration process as the issues cannot be resolved.

Ad-hoc land registration

Land registration in Jamaica is not compulsory and its system of land registered is closely modeled from the Torrens System, therefore land is registered when a parcel owner decides to bring property under the Registration of Titles Act or when a property transfer is done. This therefore gives way to an ad hoc development of the cadastre. The only time systematic land registration is carried out is when an area is declared for registration based on projects that may be carried out from time to time. However, when a map sheet is created for an area, this does not mean that persons will proceed to the end stages of title registration. This poses an additional problem, as when these persons do decide to obtain title, because of the dynamic nature of parcels, what was recorded on the map sheet differs from the interest that individuals now seek to register. This can either be due to the parcels initially not being demarcated properly, or the boundaries have changed due to informal subdivisions. The process would therefore need to be redone.

Evolving use of the cadastre

On the other hand, one respondent presented an unconventional reason while contradicting other respondents that there exists the will as well as the technical capabilities to carry out the task of creating the cadastre. However, the reason for not having a complete cadastre is due to the new and evolving purposes of a cadastre. There exists a cadastral index that was created from old plans that were created for the island pre-independence, during the 1940s and 1950s. Though, not completely accurate, it was created to be used for land valuation purposes and served as the spatial component of the valuation roll for property taxes. This was deemed good enough for this purpose. However, as time evolved it has outgrown this purpose as it is the only island wide coverage available, it was adopted by other agencies for other purposes, and hence the need now for more accurate, up to date and complete information by way of a complete cadastre. This bore way for the cadastral map, which is being created from survey plans obtained when a parcel is registered for title. As land registration is highly dependent on information from private surveyors, this poses a challenge for the NLA. In addition, the compilation process that is used to create the now cadastral map is deemed inefficient and hence the process is complex and detailed, which further inhibits the process.

4.1.2 Intervention strategies implemented to address cadastral coverage

The importance of cadastral coverage for the island was recognized from as early as 1956 when an all island cadastral map was produced. Up till now there have been several initiatives and projects implemented to promote cadastral mapping and increase land registration.

Prior to the National Land Agency

The first recorded cadastral mapping project dates to 1956. This was in the form of the Thomas Harrison map series that covered the entire island at a scale of 1:15,840 and produced a total of 126 map sheets. This forms the basis of the cadastral index that is used to date. Since then, a series of mapping projects done across selected areas, table 5, up to 2001, just before the amalgamation of the various departments that now form the National Land Agency. In 2001, the National Land Agency was formed into the autonomous state agency from the merger of four government offices, the Titles Office, Land Valuation Department, Lands Department, and the Surveys Department.

Map Description	Parish	Number of Sheets	Scale	Year
Thomas Harrison	All Island	126	1:15840	1956
Mid-Clarendon Plains	Clarendon	11	1:5000	1962
Outram Watershed	St. Mary	4	1:5000	1963
St. Dorothy Plains	St. Catherine	12	1:5000	1957 & 1963
East St. Catherine Plains	St. Catherine	29	1:5000	1964
Pedro Plains	St. Elizabeth	18	1:5000	1965
Rio Minho	Clarendon	7	1:5000	1966
Santa Cruz	St. Elizabeth	4	1:2500	1967
Highgate	St. Mary	15	1:5000	1968
Ocho Rios	St. Ann	8	1:2500	1969
Riversdale	St. Catherine	4	1:5000	1974
Brown's Town	St. Ann	9	1:2500	1974
Buff Bay	St. Thomas	5	1:2500	1974
Linstead and Environs	St. Catherine	26	1:2500	1978
Annotto Bay	St. Mary	3	1:2500	1985
UNDP	All Island	277	1:12500	2001

Table 5 Cadastral mapping projects prior to NLA

Table 5 shows the cadastral mapping projects that were carried out prior to the formation of the NLA. The table shows the map sheets generated from each project, the year it was done in and the scale at which the map sheets were produced. A total of 558 cadastral maps were produced during the pre NLA era, beginning in 1956 and ending in 2001.

The mapping projects embarked upon prior to 2001, were all project based, which can be indicated from the various scales used for mapping as well as the variations in targeted parishes. Most of the mapping projects were embarked upon in the years immediately after the country gained Independence in 1962. During this time, as seen from the table 5, the areas that the various mapping projects were done were those areas that were of most economic importance to the country at the time, as these were areas where sugar cane farming was being stimulated, such as in St. Catherine, Clarendon and St.Elizabeth. The mappings were embarked on

a needs basis and were carried out based on specific projects, hence the differences in scales, location and output.

Post the development of National Land Agency

After the formation of the NLA, there have been several projects and programmes implemented to carry out cadastral mapping and subsequently increase land title registration. The amalgamation of the four departments overlapping role in cadastral mapping, sought to more efficiency in the land registration process and a more collaborative approach to the intervention strategies that sought to increase cadastral coverage and land registration across the island. Table 6, shows a summary of various implemented projects.

Project	Year	Provisions to ease registration	Actors	Targeted parcels	Parcels delivered
LAMP I	2002 - 2005	The use of GPS to create digital cadastral map and installation of CORS	GoJ IADP* LMC	30000	18800
LAMP II	2010 - 2012	Special Provisions Act (waiver of certain fees)	KCSC* GoJ Geoland	15000	2585
Irrigation Area Land Regularization Programme	2012	Systematic registration	NIC	1000	1066
KOICA Cadastral Mapping and Land Registration Project	2013 - 2015	Provided titles to squatters	KCSC* LAMP	-	1008
National Land Agency Project	2013 - 2015	Special Provisions Act (Section 5 order removes need for Parish Council approval)	NLA	-	1018

Table 6 Cadastral mapping and land registration projects after NLA

Table 6 shows a summary of cadastral mapping and land registration that have been completed since the formation of the National Land Agency. The table shows the time period and the provisions that were implemented in each project to ease registration. The projects are each discussed in detail below.

*International actors in the respective projects
- Unknown targeted parcels were due to target parcels not being set at the initial onset of the projects.

LAMP I (Land Administration and Management Programme Phase 1)

The Land Administration and Management Programme (LAMP) was a joint funded programme between the Government of Jamaica and the Inter-American Development Bank (IADP) with the Land Management Consortium (LMC) as the contractor. It was a pilot project carried out in the parish of St. Catherine, with the aim of developing an affordable and innovative method for mass cadastral mapping and titling as well as regularizing informal parcels and updating already titled parcels (S. Clarke & Allen, 2006). The project consisted of four segments inclusive of a Land Registration Component, using modern technology such as GPS to update the cadastral index and create a digital cadastral map, a Public Land Management Component, to develop a digital inventory of state lands, a Land Use and Development Component and a Land Information Management Component (Ministry of Land and Environment, 2002). The LAMP was originally slated as a 2-year project delivering a total of 30,000 parcels, where LMC would deliver 25,000 parcels and NLA delivering 5000. However, the project ran from 2002 to 2005, with NLA and LMC submitted 548 and 21686 parcels respectively. Of the submitted parcels, only 18800 were approved. The project had anticipated a 60 – 70% participation rate from the community but only experienced less than half of that with only 31% of the persons in the community accessing the project. Clarke & Allen (2006), posed that lack of awareness of the project and its benefits contributed to the poor participation as well as the fact that "landowners were unappreciative of the value of holding registered title, relying on established and customary methods of land tenure accepted at the community level". This project involved the installation of continuously operating reference stations across the island, that facilitated more efficient surveying using GPS. The project also led to the realization of the Special Provisions Act, 2005 to supplement the existing Registration of Titles Act.

LAMP II (Land Administration and Management Programme Phase 2)

In 2010, a second phase of the LAMP project was commissioned, called LAMP II. This time, the project was a collaboration between the Korea Cadastral Survey Corporation (KCSC), which is a government organization under the Ministry of Land Transport of the Republic of Korea, the Government of Jamaica (GoJ) and Geoland Title Limited, which is a local private land management company in Jamaica. LAMP II was an initiative to improve upon LAMP I by improving the methods used in the first phase through systematic mapping and using a Network-RTK method to improve land tenure regularization. Under the Registration of Titles, Cadastral Mapping and Tenure Clarification (Special Provisions Act) of 2005, three parishes (St. Elizabeth, Manchester and Clarendon having the lowest rates of land registration, figure 6, were declared project areas, where the LAMP II project would be carried out. The Special Provisions Act facilitates the ease of registration by removing some of the regiments under the Registration of Titles Act and therefore lowers cost of the process through waivers on stamp duty, transfer tax and the processing fee paid. The LAMP II project ran its duration in 2012 and was ended. The project submitted 2740 parcels, of which 2585 parcels were certified. The proposed target for the project was 15000 parcels over a 2-year period. The low registration rate was said to be due to the actual cost of the project as opposed to the budgeted cost, which amounted to more than 100% as what was intended.

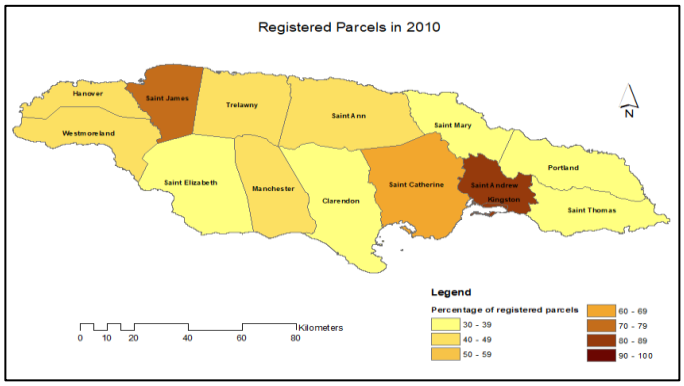


Figure 6 Percentage of registered parcels by Parish in 2010

Irrigation Area Land Regularization Programme

Under the Irrigation Area Land Regularization Programme, a cadastral mapping project was carried out by the National Irrigation Commission Limited in 2012, that delivered 1066 parcels for areas in New Forest, Manchester and Albion Estate and Phillipsfield in St. Thomas.

KOICA Cadastral Mapping and Land Registration Project

In 2013, the Korea International Cooperation Agency funded a project carried out by the KCSC and LAMP in St. Ann, St. Mary and Portland (northern Parishes) to provide titles to squatters in those areas. The project ended in 2015 and delivered 1008 parcels.

National Land Agency Project

In 2015, the National Land Agency, through the Cadastral Surveys Branch, delivered 1018 parcels that consisted of Government Land Settlements. They started surveying some of these government owned lands in 2013. The Special Provisions Act removes some of the bureaucracies involved in title registration such as the need for Parish Council approval for subdivisions, under the Section 5 order. Therefore, the NLA was now able to resurvey parcels that were done long ago, prior to LAMP, but never gotten the Parish Council approval it needed to continue with titling.

4.1.3 Impact of the Intervention Strategies

The intervention strategies implemented were all project based and carried out based on a needs basis. The LAMP I and LAMP II projects were carried out in parishes having lowest parcel registration rates. For example, the parishes targeted for both LAMP projects. These areas were also undergoing rapid development in terms of residential and infrastructural development, as with the case with the North-South leg of Highway 2000, that ran from St. Catherine to Clarendon. However, it can be noted as well that other projects were initiated based on special projects that were being undertaken, such as the Irrigation Area Land Regularization Programme, where the National Irrigation Commission carried out the mapping project to fulfil their mandate of providing parcels for farmers.

Each project, in particular the LAMP I and LAMP II projects, built on the lessons learnt from each and were dependent on the changes that needed to be made to the current spatial, legal and institutional framework of the cadastre. They provided the platform on which to improve upon the next projects or how land registration process progressed after.

Legally:

- There was the introduction of the Special Provisions Act, which supplemented the Registration of Titles Act, where the act allowed for the use of GPS to facilitate cadastral mapping. The Act also relaxed certain stringent conditions of the registration process, where it waived fees, such as the registration fees and stamp duty tax.
- In 2013, there was also an amendment to the Land Surveyors Regulations, where all cadastral surveys must be tied to the National Grid (JAD2001). This further facilitates the use of GPS in cadastral surveying.

Spatially:

- There was the use of GPS to produce cadastral maps and also the implementation of the CORS, which facilitated the systematic mapping of parcels using network-RTK in the second phase of the LAMP project.

Institutionally:

- The projects were dependent on collaborations with other agencies, notably international agencies that provided funding or expertise, such as the IADP and the KCSC.

However, though improvements were made on the conventional land registration processes during the projects, they still failed to deliver their targeted parcel coverage.

The awareness of the projects to the citizens was deemed as not adequate, where the LAMP project overestimated the interest and participation that they would have from the community. Though, the various projects reduced some of the procedures with the conventional registration system, it was still rigid and complex, as even the reduced fees were still costly, as surveying standards were rigid and precise, and the adjudication process was still very strict and a cause of contention.

Ongoing projects to increase land registration

The current projects that aim at increasing access to land ownership, have sought to address the issue of adjudication through the setting up of adjudication committees, but the process remains complex. They have also attempted to increase the awareness of the importance of land registration.

LAMP

The Land Administration and Management Programme is now a government initiative and serves as a central 'one stop shop' for obtaining land titles at a reduced cost. As with the previous LAMP projects, certain government taxes and fees are waived, and the Section 5 order to waiver Subdivision Approval is also applied. The initiative extended its services from just the special areas declared to access the benefits, to now being an island wide initiative, excluding Kingston and St. Andrew and parts of St. Catherine. The difference between accessing the LAMP and the conventional way of registering property, is as mentioned, the relaxing of stringent requirements under the Registration of Titles Act and the LAMP helps land owners with the process of registration at a lower cost. The survey that is required is just as rigorous, as stipulated under the Land Surveyors Regulations. This initiative saw to the establishment of adjudication committees that comprise of a group of persons appointed by the Minister under the Special Provisions Act who decide on the rights and interests concerning a parcel, in an attempt to alleviate the adjudication issue that often prolongs the process of registration. There is a total of 11 active adjudication committees across St. Catherine, Manchester, St. Elizabeth and Clarendon. In August 2016, 220 land titles were handed over. There are four LAMP offices that serve the country.

National Land Agency Awareness Campaigns

The National Land Agency embarks on road shows and promotional projects where they go to various communities, particularly in rural areas to create awareness of the benefits of land registration and to educate

on the processes involved in bringing property under the Registration of Titles Act. These awareness campaigns would also be done in collaboration between the Geoland and LAMP personnel.

LAND Project (Land Access for National Development)

The Land Access for National Development project is a collaboration between the government, KCSC, Geoland and the National People's Co-operative Bank (PC Bank). The programme was initiated in 2011 to provide land holders without certificate of titles to incrementally obtain one under the Facilities of Titles Act, 2005. They would obtain a Certificate of Compliance (CoC) which would allow them to access loans at the PC Bank (in the case of farmers) or at the National Housing Trust. This would be a stepping stone towards obtaining a title, as the CoC would be one step closer and aid in obtaining a Certificate of Title.

BRACE II Project

The BRACE project stands for Building Resilience and Capacity against Emerging Disasters. The phase 1 project of BRACE was carried out to reduce the risk and improve resilience to disasters to persons living in hazard-prone and vulnerable communities. They do so through retro-fitting housing or by providing upgrades. One of the issues encountered while carrying out phase 1 was that of land tenure and persons not having legal evidence of ownership or occupation of their dwellings. BRACE II was introduced in January 2017, where a Land Tenure and Community Redevelopment component was added to the project. The project is developed by Habitat International, where the Habitat for Humanity (HFHI) along with many local stakeholders and key informants, inclusive of the Portmore Municipality, Office of Disaster Preparedness and Emergency Management Community Councilors and Representatives. The project is funded through the United States Agency International Development (USAID). The project is carried out in the Naggo Head Community in Portmore, which was revealed as one of the most vulnerable areas to disaster in Jamaica. The project aims to target 500 households for its land tenure component. BRACE II has involved the community by creating a GIS land tenure database for the community. This is done through using satellite imagery printed on paper maps, where the community demarcates their parcels and collect parcel information such as proprietorship information, building information and tenure relationship. This is digitized and a map of the area is created. This information is handed over to a commissioned land surveyor to assist in carrying out surveys to then facilitate land registration, as only a cadastral map, under the Special Provisions Act, or a pre-checked plan, under the Land Surveyors' Regulations, are accepted for title registration.

Status of the Jamaican cadastre

Though various intervention strategies aimed at increasing land registration and cadastral mapping, there is still a slow increase in the number of parcels being registered and updated in the cadastral index, figure 7 and 8.

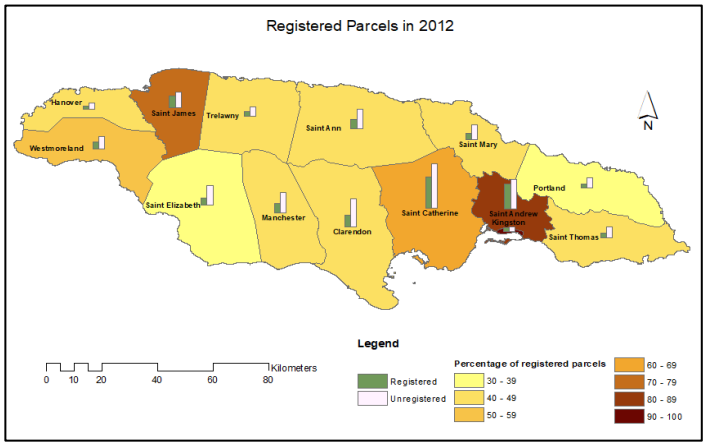


Figure 7 Registered Parcels by parish in 2012

Figure 7, shows the percentages of registered parcels by parish in 2012 after the completion of the LAMP II project. St. Elizabeth is still noted as having the lowest rate of land registered.

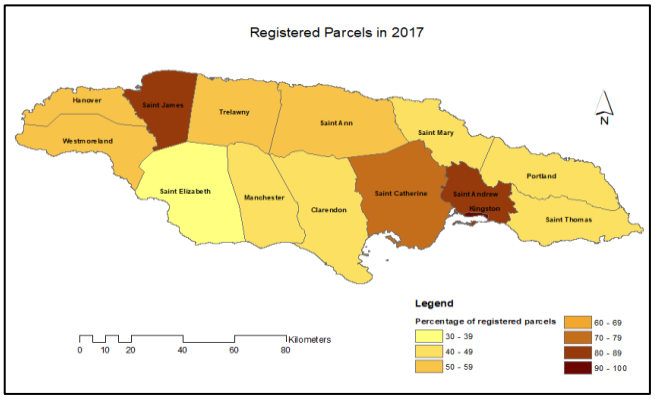


Figure 8 Registered Parcels by parish in 2017

Figure 8, shows the percentages of registered parcels per parish. This map represents the most current rates of lands registered, as at November 2017.

According to the slow rate of increase in the cadastral coverage, the estimated date that the cadastre would be complete, based on its rate of increase between 2012 and 2017, is 2058.

4.1.4 Factors that prevent access to intervention strategies

Respondents were asked, from both the technocrat view and community members, the factors that prevented persons from accessing the strategies implemented.

Table 7 below shows a summary of the reasons that act as a barrier of access to programmes. The responses between key informants and community respondents were similar. It does show that most of the reasons given on both ends reflect from an institutional barrier rather than on the part of the citizens, where the stakeholders involved serve as the bottleneck that prevents citizens accessing the intervention strategies as well as conventional land registration.

Key Informants	Community Respondents	Implications
• Lack of awareness of programmes • Lack of awareness of benefits of registration by citizens	• Lack of awareness of programmes • Lack of awareness of registration process	Citizens may be interested and wanting of their parcel to be registered but the disconnect comes where they are not aware of the steps to take.
• Failure of authority to bring the programmes to the community • Fragmented stakeholders in registration process	• Waiting on the programme to be brought in the community • Do not have required documents to access programmes	Citizens will access programmes that are targeted directly towards them and made easily accessible. The various stakeholders in the process of registration, further complicates the process
• Not a priority for citizens	• No interested at the moment • Too costly	The complexity and cost of the services act as a deterrent for citizens, especially those within the lower income bracket

Table 7 Summary of the responses from both key informants and community respondents of the reasons that prevent citizens from accessing the various intervention strategies made available.

The factors that prevent access to intervention strategies and the implications of the differing views between the key informants and community respondents are summarized in table 7. These are discussed further below.

Key informants' responses on factors that prevent access to intervention strategies

Lack of awareness of benefits of registration

A common theme that emerged across technocrats is that of a lack of awareness and education of the benefits of land registration and having a title for their property on the part of citizens. One respondent elaborated on this to point out that this also stemmed from a historical perspective, where after emancipation ex-slaves would squat on land away from the plantations or on the rugged parts of the plantations. Some were able to, through cash crop farming, save money and the purchase the land. However, many were deprived of this land. Older land owners, some who are descendants of slaves, are not keen on using land as collateral, with the fear of losing their land. This is evident in parishes such as St. Elizabeth, where persons would rather wait on the encashment of crops to gradually improve on the development on their land. Slowly this

perception is being changed, mostly by younger persons but also with benefits that persons can access with the National Housing Trust, where low income individuals can access loans for building homes. However, more awareness is needed, as indicated by a respondent.

Lack of awareness of programmes

The lack of awareness was also linked to the lack of personnel from the National Land Agency not doing more ground work. As the office to access land registration is located in Kingston, the capital city, "country folks" find it difficult to come into Kingston and hence this results in them not being proactive and not willing to put any effort in accessing this service. The respondent attributed the little success in land registration currently is attributed to programmes, in particular LAMP, that goes into the communities and bring the services to them on the ground. Another factor that prevents persons from accessing services is that the process is complex, which puts off persons from continuing with the process as they are intimidated, especially when they must go into the offices of technocrats to access the services.

Non-holistic approach

Respondents also cited the no holistic approach to land registration as a factor, where the professions involved in the process outside of the role of the government and government employees, need to play a larger role in creating awareness to the public and encouraging persons to continue the process to the end, where they obtain a title. There needs to be more buy-in for the goal of completing a National Cadastre from the other technocrats. When persons contract a surveyor to carry out a cadastral survey, often times when individuals obtain the survey diagram, they do not proceed to obtain a certificate of title. This is where, the surveyors can play a part by encouraging and creating awareness. This too can be said about lawyers, when their services are sought out for property related matters.

Registration not a priority

Social factors, other than the lack of education, was also mentioned as a prohibiting factor. This is in the form of prioritizing, on the part of the citizen. The option of going through the procedure of registering property is not as great a priority of other things, such as providing an education for their children or even in cases where providing food and shelter is a daily struggle.

Community respondents' responses on factors that prevent access to intervention strategies

Community Awareness of programmes

Respondents from the community were asked the reasons why they did not seek registration or access certain programmes. However, they were initially asked whether they knew the process for registering property, see figure 9. They were then asked if they knew of any of the programmes that aided in property registered, see figure 10. For the persons that knew of these, they were asked if they have ever tried to access these programmes, and if not, why not, see figure 11. The results are as follows.

Community Awareness of land registration process

Figure 9 shows that 90% of respondents were not aware of the processes that are involved in obtaining a certificate of title for their parcels.

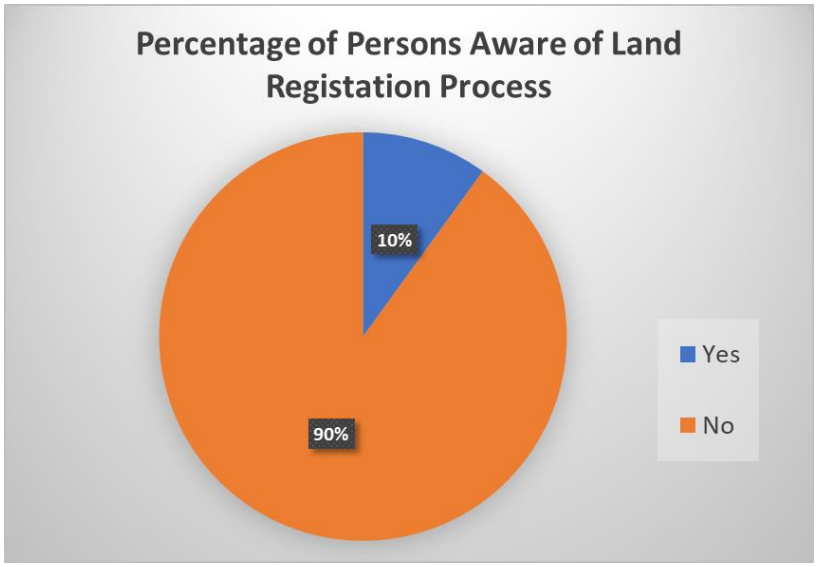


Figure 9 Awareness of land registration process

Contrary to the responses given by land professionals, all the respondents expressed interest in obtaining a certificate of title for their property, though not aware of the process, and cited the benefits they would obtain from it ranging from using it as a bond for bail from jail for relatives, using it as collateral to get a loan or just to simply to prove ownership of their property.

Community awareness of intervention strategies

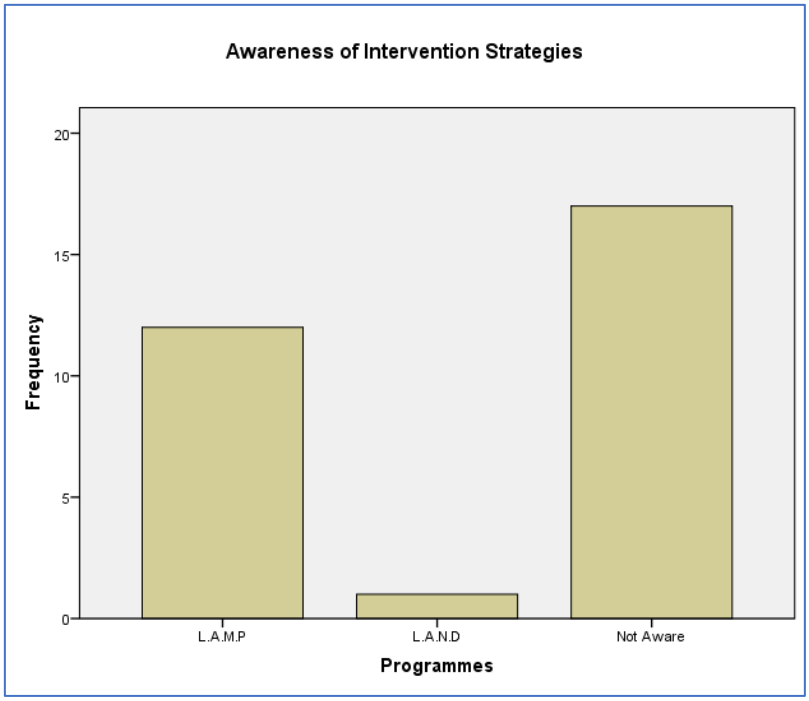


Figure 10 Awareness of intervention strategies

A total of 13 of the 30 community respondents were aware of either the LAMP or LAND programme. They knew about these programmes through television and radio advertisements. Among the responses for why respondents did not access the programmes to aid in obtaining their land titles, was that it was too costly or that they were waiting on personnel from the various programmes to come into the community and have a session with them and provide the service, as is the case with other services such as an electricity programme, where light is provided through a project by the Jamaica Public Service, facilitated by a mass community initiative.

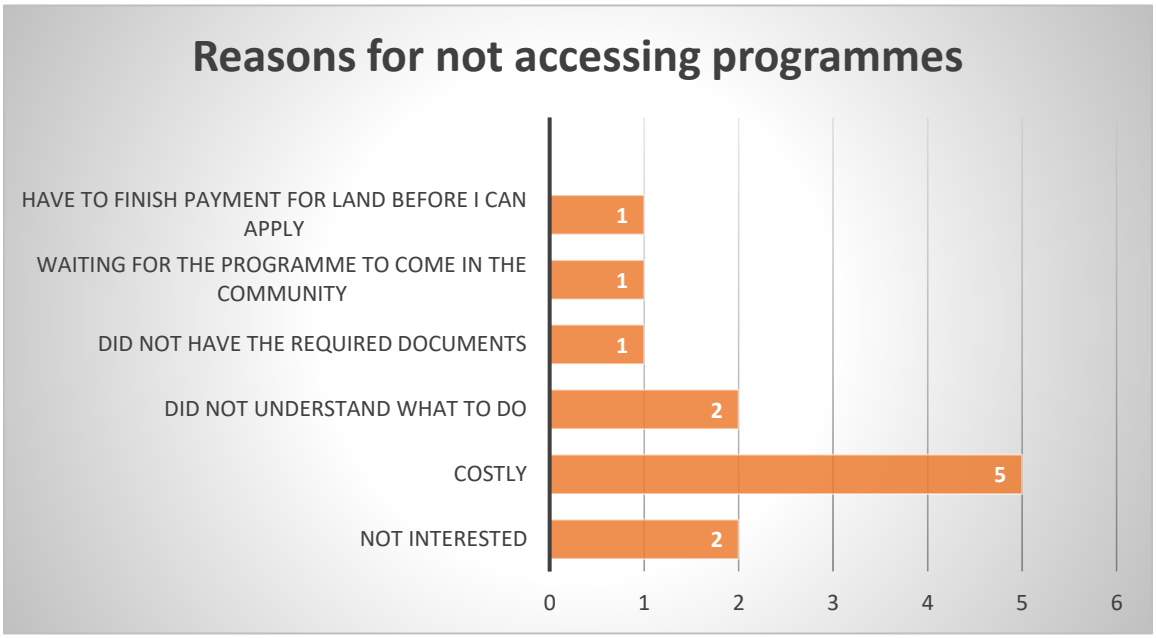


Figure 11 Reasons for not accessing programmes

It is therefore important that parcel registration or cadastral mapping initiatives be accessible to communities by going directly into the communities. The success of the current ongoing LAMP initiative to its involvement in the community where the services are presented to the citizens directly, especially with the involvement of the adjudication committees. The more decentralized the initiative is, the more comfortable citizens will be to access it.

Summary of Results for Sub-objective 1

Sub-objective 1 aimed at exploring the various challenges that have prevented the completion of the cadastre. From the finding, challenges were deduced from the perspectives of land professionals, from the perspective of community respondents as well as from the impact of projects that have been implemented. There are various challenges that were presented that can be grouped into challenges stemming from spatial, legal or institutional factors. Of the three categories, the institutional challenges posed as most common as the lack of assertiveness and prioritization of the cadastre has a domino effect on the other challenges.

4.2 Perspectives on Innovative land tools

The second sub-objective is to ascertain the perspectives on the use of land tools to record extra-legal tenure. This was obtained from key informants and respondents from the community. The use of land tools requires a buy-in from all stakeholders, both from land professionals and the community who play a role in the data collection when using these tools. It is important to ascertain whether they view the tools as a threat or as a possible solution to the challenges faced. This was done in three ways, firstly by ascertain how the respondents view the documenting of extra-legal tenure; secondly, their awareness of the land tools; and thirdly their view on the use of the tools and the data they provide.

4.2.1 Stakeholder perspectives on documenting extra-legal tenure

Stakeholders were asked to discuss their views on documenting extra-legal tenure. This could be manifested by either providing a document to land holders to show proprietorship or documentation in the form of a database where the government would have that information. This particular topic was discussed under various headings, which include a discussion on intermediate or starter titles, a discussion on the continuum of tenure and the implications these may have. Further, the following subjects were mentioned:

Proof of property status

All but one respondent was keen on providing some form of documentation for land holders that would give them some form of proof of their status with the property they occupy or own. This was likened by many respondents to two existing systems, one in Jamaica and one in Trinidad and Tobago. In Jamaica, there is what is called the Certificate of Compliance, which is issued under the Facilities of Titles Act, that can be obtained from several institutions- The PC Bank (farmer's bank), National Housing Trust (NHT) and Geoland. This document is a step before obtaining a Certificate of Title, where it can be used at select financial institutions to obtain loans, those being the PC Bank and the NHT. However, though this exists, it still has a high level of requirements such as proof of possession and ownership and at times a survey diagram. The Certificate of Comfort in Trinidad was introduced to afford squatters proof of possession that would protect them against evictions. One respondent suggested this approach in Jamaica would be recommended, but that it would only work with a commitment to have the necessary institutional arrangements put in place.

Prevalence of informality culture

The informality of the culture in Jamaica, where persons invest a significant amount of time and money on their land, without having documented proof of ownership or possession, was described by one respondent as a reason documentation outside of freehold would be important. It is very common where land is distributed among families informally, just by word of mouth, and it now becomes a part of the family's livelihood, where they build a house or carry out farming and are therefore dependent on it for the family's well-being. The main issue with family land and the reason why they remain undocumented is usually an internal family issue, where some persons in the family may not be willing to take on the responsibility of obtaining a title, and then this informal practice continues.

Encourages adverse possession

While respondents all agreed that having this information recorded would serve as a national good and having all parcel data island wide would be important towards development, most were also apprehensive of the usability of such documents on the part of the land holder. One respondent, speaking on issuing documentation for informal (squatter) settlements, was of the view point that it would dispossess the freehold title holder of the rights. Most squatter settlements are on large tracts of land, and these are usually the most difficult settlements to carry out regularization projects on. This is because it has been harder to obtain

adverse possession (12 years for private property; 60 years for government lands by law) from the courts for larger tracts of land than smaller ones. Therefore, the usability of having a document, such as an intermediate title, is a moot point as the freehold owner can petition for the land through the courts, hence putting the non-freehold holder would be at a disadvantage.

Incremental status of possession of property

Documenting tenure in terms of a continuum where a land holder can transition from one status to the next and move along the ladder of tenure would be useful. However, respondents posed implications that would have to be considered. There should be conditions on moving from one point to the next as well as the provision of adequate proof of possession or ownership. After proving that there is a legitimate claim on holding the land, only then can some form of documentation or recognition be provided. On the other hand, one respondent noted that one of the drawbacks with the conventional titling system was that of referees, who are the ones who approve or decide that there is indefeasible proof of a legitimate claim to the land by an applicant. Therefore, if the "starter titles" would provide a way to bypass or provide a more efficient way to work with the referee system, then this would be helpful. The respondent also noted that this may also cause additional problems, such as persons not moving from an intermediate documentation to a full title, as is the current case where land holders get survey diagrams but do not go on to register for Certificate of Titles. This would also pose a challenge to the survey profession as well. However, having limitations on the what this documentation can be used for would have to be instituted, where the document does not provide all the benefits of a full title.

Legitimacy of documentation

From the perspective of the land holder the process for obtaining this should be simple and not complex that would be a motivation for land holders to obtain it. However, as one respondent pointed out, it is also dependent on financial institutions as to what they will or will not accept, as they view a Certificate of Title accompanied by a survey diagram as the most concrete proof of ownership. This will also affect the motivation of land holders to use this alternative or transitional documentation.

4.2.2 Stakeholder awareness of land tools

Respondents were asked about their awareness of the various land tools that have been developed and whether they were aware of the fit for purpose land administration approach that is the concept behind the creation of these tools. It was not a surprise that all the members from the community were not aware of these alternative approaches. All but one of the key informants were aware of the land tools and the concept behind the tools through exposure from attending conferences and the experiences from other countries.

4.2.3 Stakeholder perspectives on the land tools

The land tools were discussed based on various themes that brought forth both similar and varying views among respondents. Based on the principles and concept presented by the fit for purpose land administration approach, the respondents discussed the land tools based on participation of the community, the quality of the data and whether the data collection by the tools can adequately represent parcels, dependability was discussed, particularly who should be involved or responsible for the data collected, the flexibility of the tool; and also whether associated costs would be a factor in the perspective of the use of the land tool.

Community Participation

Respondents from the community were asked questions based on the concept of participation which queried whether or not they would be willing to be involved in the process of collecting tenure information and also whether they think the community should be involved. Figure 12, shows the responses from the community. Where all respondents responded positively to themselves being involved in the process, however 10% of respondents responded negatively to the entire community being involved in the process. While most respondents maintained that the community should be involved as they would hold the best knowledge on their properties and who owns what, the opposing view echoed that the community may not work well together and implied mistrust between other community members.

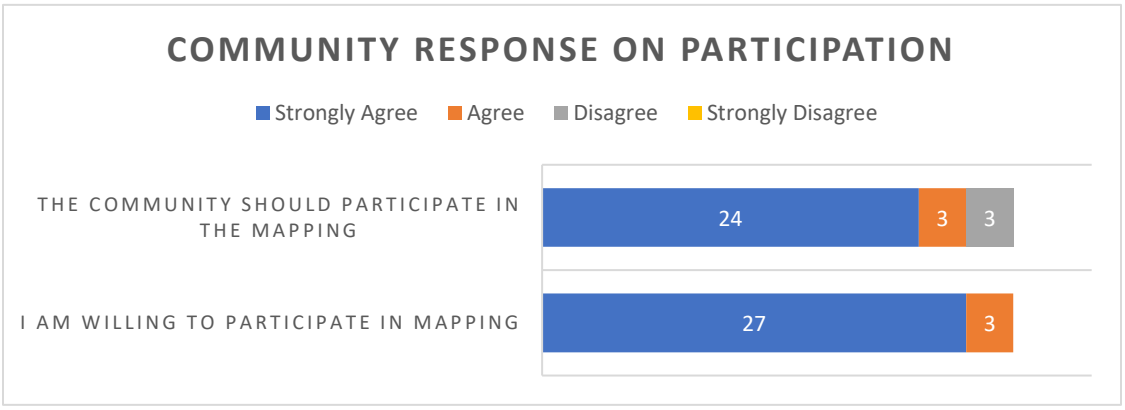


Figure 12 Community responses on perspective on participation

Professional respondents identify community participation as a key requirement for any attempts extra-legal documentation or any wide-scale mapping project as firstly it would strengthen any projects attempted to do such but also it would cut down on costs as the involvement from the community can be considered as contribution towards the delivery of the service. On the other hand, issues that could arise due to community participation were raised as concerns and possible implications. Respondents highlighted that the whole process of using the tools may perpetuate existing issues which may overwhelm the use of the tools. These issues in the form of boundary disputes, which remains an issue of contention in Jamaica, where "6 inches variations in boundaries" can cause severe disagreement. The point of political affiliation was also raised, which brings about two areas of concern. Firstly, in a community that has divided political affiliations, community members may not want to work with each other. Secondly, dependent on the governing political party implementing such an initiative, the receptiveness and willingness of the community may be dependent on the affiliations to the governing party. The political divisiveness within communities is a threat, regardless of the benefits to be received.

While some persons in informal settlements would be receptive to participating as this would be an option to claim their occupation, others would be apprehensive as the property they acquired was not done in legal ways and would be fearful of divulging information that could harm them.

Quality of Data

The perspectives on the quality of the data collected using the land tools was explored through asking the community respondents their views on the adequacy of the representation of the parcel boundaries, party information and the associated rights. They were asked whether they agreed or disagreed with the statement that the tool adequately represents their property boundary. All but one respondent responded positively, see figure 13. The common reason for agreeing to this statement was that they were able to see their property and identify the boundaries from the satellite imagery that was show. The respondent who disagreed stated that thought the boundary could be identified, all the neighbours, and community at large, would need to come together to verify that this is indeed the correct boundary. All respondents either agreed or strongly agreed that the party data can be adequately represented and approximately 96% of respondents responded positively to the representation of the associated rights, once again iterating the need for community verification.

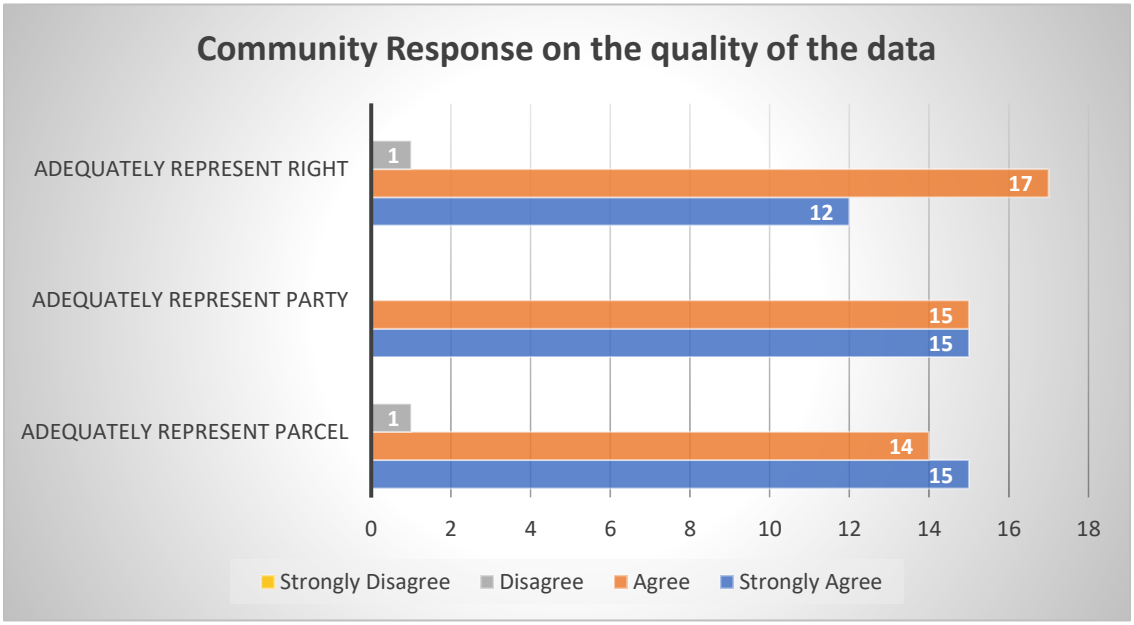


Figure 13 Community response on the representation of party, parcel and rights using the land tools

The perspectives on the quality of data and the usability of that from the land professional respondents vary based on their points of view. As mentioned previously, respondents were of the view that if the referee system could be bypassed or aided by the use of the tools to determine ownership and rights, it would be beneficial. On the part of the parcel representation, respondents noted that an accuracy of 50 cm is allowed by legislation for parcel boundaries, therefore if a land tool can provide this, then it would be acceptable. However, allowing an accuracy lower than this, would be a stretch and be problematic and would only work in very deep rural areas, where a 3m accuracy would not be as problematic. Another respondent further add that a survey is allowed to be tied to the National Grid (Jamaica grid 2001 (JAD2001) to an accuracy of +/- 3m, but the actual survey of the property boundaries still needs to be at a higher accuracy, as to this point that though there may be cheaper handheld devices that are able to achieve that mobile devices with an application may not be suitable and void of necessary checks and balances. The legislation in Jamaica stipulates fixed boundaries affixed with monuments. These legislations have been in use since 1889 in the case of the Registration of Titles Act and 1971 for the Land Surveyor's Regulations Act. Therefore, to change these practices that persons have become accustomed to would be a difficult sell to persons, especially in the case of introducing general boundaries.

Dependability

Dependability refers to the necessary actors that will be responsible for the data collected and will be needed to be key players. An exaggerated point among professional respondents was that of the importance of the social factor that would be needed for such tools to be used. It was noted that a strong social component would be needed that could not be provided by the various technocrats, but by institutions, such as the Social Development Commission (SDC), that has the experience and the tools for working in the community and providing extensive capacity building and sensitization that would be needed for the use of the tools to work. A community respondent stated that the Parish Council should be involved, as each parish should have its own representation. The sentiments of the majority of the community were divided between the National Land Agency, Ministry of Housing and not knowing who the responsibility should fall on, see figure 14. A common response was that the responsibility should lie with the organization who "deals with land", as they are equipped and not burden with other responsibilities. No respondent selected the 'Community' as an option for the responsibility of the data.

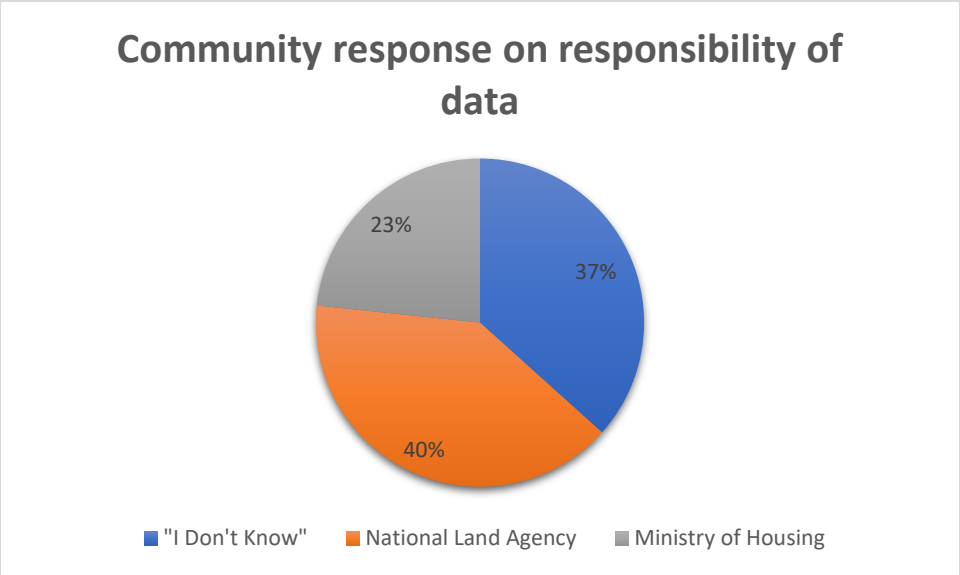


Figure 14 Community response on who should be responsible for the data collected using land tools

Flexibility/ Upgradability

The community was asked whether they would be willing to receive an intermediate title and upgrade in the future to a full title, where all but two respondents would be willing. The reason they gave was that it would be better to have some amount of proof of ownership, while those that disagreed did not see the point in not receiving a full title at the onset.

The perspectives of land professionals on intermediate titles were highlighted in the previous section. One respondent suggested the land tools would be useful to carry out an island wide mapping with the use of drones or other methods, from which a starter or intermediate title could be issued, and general boundaries used. From this, there would be the option to upgrade in the future to a title that would require a survey diagram, which would appease the land surveyors as they would see the first option as a threat. To upgrade to a full title, fixed boundaries would be needed, which would require the surveyor. Therefore, the data collected from the land tools would be used to update the cadastral index, then after it is upgraded, the survey diagram would be used to update the cadastral map.

Cost

Eight community respondents held the view that they would prefer a land surveyor for tenure documentation, even if it costs more than using the land tools. The common reason for this was that they trusted the land surveyors more as they were experienced, and the surveyor is usually correct. Of those that disagreed, the main reason was that they would go with whatever option costs less.

As it relates to cost, one respondent from the land professions stated that in order to use these land tools that would require general boundaries, would put a cost burden on the land holder, that they would not be willing to pay. This is due to our dense vegetation, where physical evidence of boundaries is not defined. This would require land holders to carry out some form of clearing around their property boundaries.

Summary of Results for Sub-objective 2

Sub-objective 2 aimed at looking at the perspectives of stakeholder on using innovative land tools. The results presented a general disconnect between the views of the professionals and the views of the community respondents. Generally, community respondents are more susceptible to the innovative land tools and are willing to participate in its use, as their interests lie in the security of their tenure. On the other hand, land professionals, while they do see where the land tools can be beneficial in providing land information, they are apprehensive about how it would fit in the current framework, specifically in terms of participation of the community and the issues it would present as well as the spatial framework, in terms of accuracy levels.

4.3 Suitability of Innovative land tools

Sub-objective 3 aims to determine the suitability of using innovative land tools in Jamaica. Land professional respondents were asked to describe the changes that would be required to the existing spatial, legal and institutional framework to facilitate the use of innovative land tools as well as the barriers and opportunities that land tools would present.

4.3.1 Required changes to the spatial framework

Systematic registration

One required change to the spatial framework would be that of compulsory registration. There would need to be systematic registration, where an area is declared as a project area and compulsory registration would be carried out. This would require for a change from fixed boundaries to general boundaries, which could be upgraded on the onus of the land holder.

General boundaries

The use of general boundaries would be used to update the cadastral index and as this is upgraded, the cadastral map would be upgraded. However, for general boundaries to be used, there would need to be a change in the level of accuracy required for parcel boundaries. While, the Special Provisions Act allows for the creation of a cadastral map and an accuracy of +/- 3m for the tying of the parcel to the National Grid, the Land Surveyor's Regulation still makes stipulations that require a rigorous survey of the parcel boundary, where the length of lines is stipulated, and a monument is required for every change of direction.

Digital cadastral submission

To have a seamless integration of the existing model, that has both highly accurate parcels, which is the cadastral map (compiled from survey diagrams), and lesser accurate parcel data, which is the cadastral index, the data captured by the land tools should be differentiated and be easily identifiable when combined with existing data. The varying levels of accuracy data would need to be represented as different colours. This would require a change from paper to digital submission of cadastral survey diagrams from the surveyors into the Surveys Department at the National Land Agency.

4.3.2 Required changes to the institutional framework

Amalgamation of institutions

The National Land Agency is the custodian of the cadastre and updates and maintains the information that is mostly provided by private land surveyors. One response on changes that would be required in terms of the institutional framework would be to merge the National Land Agency with the L.A.M.P programme that helps persons to obtain their Certificate of Titles at a lower cost. This will then facilitate the systematic approach to mapping project areas and also increase the number of adjudication committees that will be available to resolve land disputes and for tenure clarification.

4.3.3 Required changes to the legal framework

Land Tenure Clarification

Any spatial or institutional changes that would be required would need legislative changes to support these. Respondents indicated that there would need to be a change of how land tenure is viewed, where land is either held legally as a freehold or leasehold or there is squatting. There would need to be changes to the legal framework in the recognition of other forms of tenure. An approach similar to the Certificate of Comfort legislation in Trinidad and Tobago was given as an example. Currently, there are no legislations that govern or coordinate informal settlements or squatter settlements. The Trespassing Act has clauses that can be applied when dealing with these issues. There are also no legislations that address family lands, indicating the need for laws or policies that address these tenure forms.

Tenure documentation evidence

The current legal framework does not make provisions for the use of collecting voice data or for the use of crowdsourced data as evidence in tenure documentation, therefore legislations allowing this flexibility in terms of what is acceptable would be needed.

4.3.4 Barriers and Opportunities towards Implementation

Respondents were asked to provide barriers or bottlenecks that would inhibit the use of innovative land tools in Jamaica.

Barriers

Unwillingness from professionals

The common threat identified among respondents was acceptance by land professionals which would require a change from the conventional methods. One respondent related to the experiences from the process of passing legislation in 2013 that demanded all surveys be tied to the National Grid. They recalled that it was difficult to bring land surveyors on board to this change and it took many years, and even now it is still a topic of contention among the profession. Therefore, the change in mindset would be a challenge.

Lack of resources

Introducing such an initiative would require extensive capacity building for citizens as well as strengthening of institutions involved, such as the NLA, with staff, equipment and training. The human resources and administrative capacity is lacking in the current duties and are unable to adequately handle daily functions. Such an initiative would require additional resources and funding that the government is not in a position to provide. Therefore, to carry out such projects external donor funding would be needed.

Lack of awareness of citizens

One respondent identified that poor education of citizens would be a barrier to the use of innovative land tools. The level of education is important as some persons are not able to articulate properly and though they may be able to use a mobile device to make a call, the question is will they be able to understand the use of these devices to correctly and accurately collect parcel information. This is also coupled with the indiscipline culture of the country, where getting persons to do things at a particular point in time may be difficult.

Suitability in small islands

Another barrier to the use of the land tools would be its unsuitability for use in small island developing states. A point was made by a respondent, that the tools would be more suitable for larger countries, where there are vast land spaces that may be of lesser value as you go into rural areas. However, in small countries such as Jamaica and the Caribbean at large, there are very little areas where land value is low. Whether rural or urban area, land values are high especially due to the demand from foreign investors. This would then require highly accurate surveys with fixed boundaries, which the land tools cannot provide.

Lack of continuity of programmes

A respondent recalls the experiences of Korea, that when leaders change, the programmes instituted does not change but continue. They identify this as a barrier, as when the government changes in Jamaica, then the programmes may or may not continue, dependent on the issues of interest of the elected government. There is an election in Jamaica every five years, heads of organizations change, board of directors also change and policies change. For such an initiative to work, it would require continuity regardless of the leader.

Opportunities

Efficiency in surveying

There would be opposition from the surveying profession as the use of the tools could pose as a threat. If the tools were used to replace the conventional system and replace certificate of titles, then there would be resistance. However, it could create an opportunity for surveyors that would create efficiency in carrying out their work, if the land tools were used to create the cadastral map from which individuals would then need to upgrade to a Certificate of Title. Lack of information is one the biggest challenges faced by land surveyors. It would also create opportunities where they would be involved in the mapping and capacity building while using these tools.

Access to land information

The most common opportunity identified by respondents was that of completing the cadastre and having a cost-efficient method for updating the cadastre and maintaining this. The social aspect of the tool that allowed the collection of demographic data was posed as an opportunity to provide valuable and easily accessible information that would aid the National Land Agency in the deployment of the target population of their programmes and awareness campaigns. They would know what demography to target and how to change their current strategies to meet the demands of the country.

Summary of Results for Sub-objective 3

The aim of sub-objective 3 was to determine the suitability of using innovative land tools to update the cadastre. The results showed that its suitability would be dependent on various factors and changes that would need to be made to the current spatial, legal and institutional framework. The changes would require a change in the view of land tenure and how spatial data is collected, all enshrined in legislation. While there are benefits to using the innovative land tools to fill the gaps in land information, there would need to be institutional reform of the stakeholders.

5. DISCUSSION

This chapter will discuss the main findings presented in Chapter 4 based on the sub-objectives that were presented in order to determine the suitability of using innovative land tools towards the completion of the cadastre. This chapter will discuss in depth firstly the findings on the current status of the cadastre in Jamaica and how current practices impact its completion. Secondly, the various perspective of innovative land tools will be discussed and how this relates to existing literature. Thirdly, the spatial, institutional and legal changes to the framework that would be needed will be discussed based on discussions from the first and second sections and how the current status of the cadastre and the views on the alternative methods of using land tools would impact the use of these in Jamaica.

5.1 Implications of the current practices of the Jamaican cadastre on its completeness

The importance of having a complete cadastre was not lost on the minds of the professionals as all indicated the benefits of this as creating efficiency in work, especially for land surveyors who would benefit the most from having readily available and up to date information, significantly reducing time in which they conduct research. Though there has been various programmes aimed at increasing parcel registration and subsequently increasing cadastral coverage, however the progress has been slow across the island, especially in the parishes where these programmes have been prioritized for. The findings reveal several reasons for the lack of completeness of the cadastre, of which most were internal factors on the part of the institutions responsible as opposed to external on the part of citizens. The institutional reasons for the incomplete cadastre given by key informant, see table 4, such as lack of resources and political will can be classified as a failure in capacity building within the whole land administration system of the country. Not having a focus on institutional capacity when dealing with land administration activities has been one of the elements lacking in developing countries which result in the failure of projects that have been undertaken over the years (S Enemark & Williamson, 2004). Enemark & Williamson (2004) addresses capacity building on three levels: societal level, organizational level and individual level. The institutional drawbacks of the cadastre spans across all three levels, however, the organizational level that deals with the formal entities and their interactions with each other, such as between NLA and land surveyors, and the individual level, that addresses the functions of individuals with respect to education and training, will continue to be inadequate unless capacity building at the societal level is addressed (this level is the overall system that deals with its governing policies and principles). The failure to recognize the cadastre as a critical and important element of public infrastructure (Bennett, Tambuwala, Rajabifard, Wallace, & Williamson, 2012) has resulted in its lack of funding and maintenance and its placement as a priority issue by those that make decisions. This is evident as the current National Land Policy dates to 1997 and the most recent legislation that coordinates cadastral mapping is the Special Provisions Act of 2005. Hence the need for capacity building on the societal level to ensure the requisite policy reforms needed. It is therefore on the onus of the custodial authorities, such as the NLA, to bring this issue to the forefront, where politicians see the importance of the cadastre as a policy goal.

Among the reasons for incomplete cadastres as cited in literature, are the complexities in the registration process, the transaction costs and distance to registries (Williamson et al., 2010). These factors can be classified as external factors. However, though they are the most common reasons cited, they were not identified in the findings by any of the key informants. The only external issue identified by key informants was related to the social structure of Jamaica, where kinship in land is common. As mentioned in the previous chapter, the informal passing of land, where the land stays in the family and is not formally recorded is common. Individuals do not have the need or desire to register their parcels and therefore the parcel will not be reflected on the cadastre. It is difficult to fit this into the current model, as different generations usually

occupy one parcel with several structures. The way in which land is held in these areas does not fit into the formal process of land registration, therefore to obtain cadastral completeness, these existing structures and dynamics would have to be reflected as is.

5.2 Perspectives on innovative land tools

The findings based on the perspective from key informants and community respondents will be discussed based on four of the principles from the fit for purpose land administration. The principles of participation, flexibility, upgradability and inclusivity are all elements that must be considered when looking at the land tools and the implications that these may have towards its use or adoption.

Participation

The findings reveal a disconnect of the responses between the key informants and community respondents on the issue of participation. As an element of the fit for purpose land administration principles, participation in this sense entails participation of the community in the data capture elements of mapping and demarcation (Stig. Enemark et al., 2014). This bottom-up approach is seen as way to promote transparency and bridge the gaps found in land administration (Siriba & Dalyot, 2017). Key informants view participation of the community in the traditional top-down approach where the community is involved during the process of identifying their parcels, but a land surveyor maps the boundaries. Though professionals question whether communities can be involved beyond that due to a lack ability to understand mapping processes, the community respondents were able to identify and demarcate their parcel boundaries on the satellite imagery. Involvement of the community far beyond traditional approaches have been demonstrated beyond the conventional participation approach in several projects (Griffith-Charles et al., 2015; Ouma et al., 2017; Siriba & Dalyot, 2017). The community responded favourably in their willingness to participate in mapping, however the voices that expressed the opposing view cannot be ignored. Similar to the issue of mistrust among community members presented by (Griffith-Charles et al., 2015), the community expressed the unwillingness of community members to work together, though they may want to participate in the project. In a polarized society as Jamaica, where political ties are strong, the mistrust can extend from political affiliation, where the divide is present within the communities, where participation would be dependent on the political party in power at the time of implementation of the mapping project and whether the members of the community are affiliated with them or not.

Flexibility/ Upgradability

Stig. Enemark et al. (2014) presents the principles of flexibility and upgradability principles as elements that allow for the capture of spatial data based on use at the time and subsequently the allowance of incremental improvements to such methods and processes over time and as needs call for. The topic of providing intermediate documentation as a possible product from the use of the land tools was discussed from the interviews. The findings revealed that the use of innovative land tools, where general boundaries are recorded using the low-cost tools, would be acceptable if intermediate documentation was issued, then allowed to be upgraded through conventional surveys done by land surveyors. The issue raised from this would be what value would this documentation have for citizens, what legitimacy would financial institutions place on it and whether it would provide the same benefits as a Certificate of Title. If there is no value or benefits, then there would be no interest to obtain it. Given that an issued intermediary document would have limited and basic benefits, such as legitimate proof of ownership, the other problem that arises would be that citizens would not be willing to go and upgrade from this to a full title, especially if there is a large difference in the complexity of the process to obtain this. A second stage certification process carried out in Ethiopia, which

was a project to upgrade initial documentation was revealed a low demand for this second stage from the community as the perception was that the initial process was good enough (Bezu & Holden, 2014).

Inclusivity

Inclusivity in the fit for purpose land administration is depicted as the scope to include all tenure types that exist and are practiced in the society (Stig. Enemark et al., 2014). Therefore, the land tool should be able to represent the types of people to land relationship that currently exists. Key informants are of the perspective that the Certificate of Compliance (CoC) is representative of this, but on the contrary, even though it provides an alternative to the Certificate of Title, it still operates on the concept of privatized land ownership, as it requires the owner to provide documents that prove ownership. The CoC does not allow for the recognition of informal tenure relationships or family land tenure relationships. Documenting informal tenure types posed the question as to the effect that would have on the original freehold owner of the property. The views mirror that posed by (Griffith-Charles et al., 2015), where documenting informal tenure would legitimize illegality and encourage those practices, where 'squatters' manipulate the system, as they are aware of the law and use that to their advantage to claim land holdings. The view on documenting family land tenure types implied that this was an issue that could not be solved through documentation, as family land was an issue that was an internal problem within the family. Therefore, its documentation would be more of a National good, where information would be available, than a benefit for the citizens.

5.3 Spatial, Legal and Institutional Framework

Spatial Framework

The fit for purpose land administration proposes four principles upon which the spatial framework should be established that would be sustainable for developing countries to adopt. These include the focus in general boundaries over fixed boundaries, the use of high resolution imagery over field surveys, the change from a focus on accuracy and technical standards but relate accuracy to the required purpose and the opportunity to update and upgrade these to other methods as need arises (Stig. Enemark et al., 2014). The use of innovative land tools would require the adoption of general boundaries in Jamaica. Though the practice of using fixed boundaries and fixing these with monuments have been proven costly, it is a practice that have been a part of the Jamaican culture for over a century. The introduction of general boundaries would require the citizens to understand the differences between general and fixed boundaries in an effort to prevent future boundary disputes whenever there is an upgrade from general to fixed boundaries. General boundaries are also based on the notion of visible natural or artificial features that demarcate properties. The approach for Jamaica would have to be a mixture of methods with using satellite imagery and GNSS methods as satellite imagery assumes the visibility of general boundaries from an aerial view. The dense vegetation and the absence of clarity in boundary delineations in Jamaica would call for the methods of data capture to be flexible in various areas. Enemark (2013), discussed the use of low cost GPS or satellite imagery being more applicable for rural areas, while the high accurate surveys should be used in urban areas where land value is much higher. However, in small countries such as Jamaica, where land values are high and parcels are small, even in rural areas, the solution of using lower accuracy methods for spatial data may not be suitable, as echoed by the professionals.

The opportunity comes for the use of these methods where the cadastral index, which is not accurate, is currently being used across the country by all institutions, being the most complete and only data available. The updating of the cadastral index can be made possible using the land tools, while the cadastral map

continues to be updated with cadastral surveys as is currently being done, where the current spatial requirements of high accuracy would be kept.

Legal Framework

The legal concept put forth by the fit for purpose land administration creates a flexibility in the law that not only accounts for the not only the legal freehold tenure usually existing in developing countries, but to include the social tenure constructs that are practiced but not recognized (Stig. Enemark et al., 2014). It requires that the fit for purpose approach is reflected in law and that all tenure types are recognized and secured. The innovative land tools provide the system and platform that allows the flexibility for the recordation of such. The current legislation in Jamaica only concerns freehold tenure even though there is evidence of other tenure types existing. While the phenomena of family lands is not document, there has been extensive research on informal settlements. A squatter assessment from 2005 revealed that the existence of 754 'squatter settlements' with 20% of the country's population of 2.7 million at the time, living in these areas (Government of Jamaica, 2008). There are no legislations that address this, in fact when legally dealing with these informal settlements, clauses taken from the Trespassing Act are used. There presents an opportunity in which a continuum of land rights to be adopted.

Institutional Framework

Conventional land registration sees the government, authoritative authorities and land professionals playing a central role in collecting and maintaining property information (Rahmatizadeh, Rajabifard, & Kalantari, 2016). The use of the land tools that incorporate the use of citizens to play a role in collecting data and assuming a new position in the whole process would create a new relationship between government and citizens. The institutional framework posed by (Stig. Enemark et al., 2014) requires a holistic approach between all entities involved, a sustainable IT-approach, capacity development and continuum of services. There would need to be an overarching agenda set for the cadastre's development in Jamaica, that starts with its completion and maintenance set as a policy goal. This would lead to the holistic approach where the collaboration between the NLA, the land surveyors, politicians, lawyers and citizens is streamlined. The bottom-up approach where the citizens are actively involved reduces the volume of work faced by agencies, hence reducing some of the issues with lack of resources. However, the benefits to the citizens must be clear, as while recording parcels may serve a national good by providing needed information through the completion of the cadastre, if there is nothing to be gained for the citizens, in the form of documentation that proves ownership and has other benefits, then their motivation to participate will diminish. Therefore, it is imperative for a holistic approach amongst entities involved, inclusive of financial institutions, who currently only value and legitimizes a Certificate of Title annexed with a survey diagram. One of the issues with the programmes and projects introduced to increase cadastral mapping and land registration is the lack of continuity, where initiatives are dependent on the governing political party and their interests. Such infrastructures should be non-political, and initiatives should be statutory to insure against politicizing.

6. CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The research investigated the suitability of the use of innovative land tools for extra-legal tenure documentation towards the completion of the Jamaican cadastre. This was done through conducting interviews with land professionals and extra-legal tenure land holders to ascertain their perspectives on the current cadastral challenges that affect complete cadastral coverage and the use of innovative land tools for documentation. This led to the determination of the spatial, legal and institutional requirements that would be needed. The study found that there is potential for the use of innovative land tools and it could be used to solve some of the challenges as it is able to collect needed land information, however there are various barriers that would need to be addressed. The methods used in the research were found suitable to address the research questions. However, the study raised the question of how suitable these tools would be in smaller developing countries. There is therefore need to add to this research further by testing various land tools in Jamaica on a wider scale through a collaborative pilot project involving community and land professional stakeholders.

6.1.1 To explore the factors that prevent the completion of the cadastre.

The findings show various spatial, legal and institutional factors that have prevented the completion of the cadastre. Among them were the challenges faced with adjudication of boundaries, the ad-hoc way in which land registration is done and the political lack of will to regard the cadastre as an infrastructure. Though various projects were implemented to increase registration and subsequently increase cadastral coverage, institutional challenges, such as poor capacity building and failure to bring awareness to programmes, seem the most prevalent of the factors that continue to inhibit cadastral coverage.

6.1.2 To ascertain the perspectives of innovative lands tools to record extra-legal tenure in Jamaica by stakeholders.

Generally, there are many variations in the perspectives of the land tools and its use for tenure documentation between community respondents and stakeholders. Community respondents favoured the approach as they view it as a solution to provide them with documentation for their properties. On participation, most respondents were willing to participate. Key informants, on other hand were apprehensive about the tools, even though they acknowledged where it would be useful to solve some of the challenges faced. The land tools would be useful to provide an incremental approach to obtaining land information that would be useful for the government and land surveyors, however the usefulness towards citizens would be dependent on the legitimacy that the documentation would have that is usually on the onus of financial institutions.

6.1.3 To determine the suitability of using innovative land tools towards completion of the national cadastre.

The findings show a number of barriers that would affect the use of innovative tools in Jamaica for updating the cadastre. These include a lack of resources to sustain and maintain the capacity building that would be required, also the unwillingness from surveyors and land professionals to be open to the new approach. However, the most significant barrier is the question to its suitability in small countries, where land values are usually high regardless of urban or rural area. The suitability of the use of these tools and their applications to aid in the completion of the cadastre, would be dependent on the changes that would be required to be made to the spatial, legal and institutional framework, such as a change in the acceptance of general boundaries and a change in how land tenure is viewed.

6.2 Recommendations

This study investigated the suitability of the use of innovative land tools for extra-legal tenure documentation towards the completion of the Jamaican cadastre. The findings of the study provide a better understanding of the factors that need to be considered when aiming to implement an unconventional approach to land administration through the use of land tools. This study will inform policy-makers of the implications as well as possibilities on the use of innovative land tools. This study will also provide innovative land tools developers with new considerations that should be taken into account for the development and improvement of the land tools. The research also led to the following recommendations:

- Further research is required on the Jamaican cadastral system to evaluate its performance, which will reveal the gaps in the overall system, beyond just on cadastral coverage, and will show how well the system meets the societal need. For example, (Zhang & Tang, 2017) presents a performance assessment model that can be used to measure cadastral systems performance based on the indicators of Cost, Capability, Security and Service.

- Innovative land tools were created as a solution to the problems of the conventional land administration system, however there needs to be further research on other factors that would make the use of these tools favourable or not favourable for application in a country. For example, how does the size of a country or the cultural practices change the use of the land tools. Exploratory research is recommended, especially in small developing states to determine this.

- There is the need for a clear agenda to be set for dealing with land tenure clarification and the cadastral system by statute rather than as a political agenda to ensure continuity of such programmes. An amalgamation of institutions involved would be required to define a clear purpose of the cadastre. This along with an exploratory research on the tenure types that exists on ground would be needed before the use of innovative land tools can be applied.

7. REFERENCES

Alemie, B. K., Bennett, R. M., & Zevenbergen, J. (2015). Evolving urban cadastres in Ethiopia: The impacts on urban land governance. *Land Use Policy*, *42*, 695–705. https://doi.org/10.1016/j.landusepol.2014.10.001

Ali, D. A., Deininger, K., & Duponchel, M. (2017). New Ways to Assess and Enhance Land Registry Sustainability: Evidence from Rwanda. *World Development*. https://doi.org/10.1016/j.worlddev.2017.05.016

Ali, Z., & Nasir, A. (2010). Land Administration System in Pakistan - Current Situation and Stakeholders' Perception. In *FIG Congress 2010 Facing the Challenges – Building the Capacity*.

Antonio, D., Zevenbergen, J., & Augustinus, C. (2015). Social Tenure Domain Model: An Emerging Land Governance Tool. In *Advances in Responsible Land Administration* (pp. 251–268). CRC Press. https://doi.org/doi:10.1201/b18988-20

Apostolopoulos, K., Geli, M., Petrelli, P., Potsiou, C., & Ioannidis, C. (2016). A new model for cadastral surveying using crowdsourcing. *Survey Review*, 1–12. https://doi.org/10.1080/00396265.2016.1253522

Asiama, K., Bennett, R., & Zevenbergen, J. (2017). Participatory Land Administration on Customary Lands: A Practical VGI Experiment in Nanton, Ghana. *ISPRS International Journal of Geo-Information*, *6*(7), 186. https://doi.org/10.3390/ijgi6070186

Augustinus, C. (2010). Social Tenure Domain Model: what it can mean for the land industry and for the poor. In *Proceedings of the XXIV FIG International Congress 2010* (pp. 11–16). Sydney, Australia.

Augustinus, C., Molendijk, M., Lemmen, C., & Plessis, J. (2015). The operationalisation of the "continuum of land rights" at country level. In *World Bank Conference on Land and Poverty*. Washington, D.C.

Ayalew, D., Deininger, A. K., & Goldstein, M. (2011). *Environmental and Gender Impacts of Land Tenure Regularization in Africa Pilot evidence from Rwanda* (No. 5765).

Barnes, G., & Griffith-Charles, C. (2007). Assessing the formal land market and deformalization of property in St. Lucia. *Land Use Policy*, *24*(2), 494–501. https://doi.org/10.1016/j.landusepol.2006.08.001

Basiouka, S., & Potsiou, C. (2012). VGI in Cadastre: a Greek experiment to investigate the potential of crowd sourcing techniques in Cadastral Mapping. *Survey Review*, *44*(325), 153–161. https://doi.org/10.1179/1752270611Y.0000000037

Bennett, R., Tambuwala, N., Rajabifard, A., Wallace, J., & Williamson, I. (2012). On recognizing land administration as critical, public good infrastructure. *Land Use Policy*, *30*, 84–93. https://doi.org/10.1016/j.landusepol.2012.02.004

Bezu, S., & Holden, S. (2014). Demand for second-stage land certification in Ethiopia: Evidence from household panel data. *Land Use Policy*, *41*, 193–205. https://doi.org/10.1016/J.LANDUSEPOL.2014.05.013

Bittner, S., & Frank, A. U. (2002). A formal model of correctness in a cadastre. *Computers, Environment and Urban Systems*, *26*(5), 465–482. https://doi.org/10.1016/S0198-9715(02)00014-5

Bogaerts, T., & Zevenbergen, J. (2001). Cadastral systems — alternatives. *Computers, Environment and Urban Systems*, *25*(4–5), 325–337. https://doi.org/10.1016/S0198-9715(00)00051-X

Bryman, A. (2012). *Social research methods*. Oxford University Press.

Clarke, E. (1953). Land Tenure and the Family in four selected communities in Jamaica. *Social and Economic Studies*, *1*(4), 81–118.

Clarke, S., & Allen, L. (2006). Reforming the Land Sector in Jamaica. In *Shaping the Future XXII FIG Congress*. Munich.

DaCosta, J. (2003). *Country Experience in Land Issues: Jamaica*. Madison, Wisconsin.

de Vries, W. T., Bennett, R. M., & Zevenbergen, J. A. (2015). Neo-cadastres: innovative solution for land users without state based land rights, or just reflections of institutional isomorphism? *Survey Review*, *47*(342), 220–229. https://doi.org/10.1179/1752270614Y.0000000103

Enemark, S. (2013). Fit-for-purpose: Building Spatial Frameworks for Sustainable and transparent Land Governance. In *Proceedings of Word Bank Conference on Land and Poverty*. D.C., 8-11 April 2013.

Enemark, S., & Bell, K. (2014). Building Fit-for-Purpose Land Administration Systems, (7210), 16–21.

Enemark, S., Bell, K., Lemmen, C., & McLaren, R. (2014). *Fit-For-Purpose Land Administration*. Copenhagen, Denmark: International Federation of Surveyors (FIG.

Enemark, S., Mclaren, R., & Lemmen, C. (2015). *Fit-For-Purpose Land Administration Guiding Principles*.

Enemark, S., Mclaren, R., & Lemmen, C. (2016). Building Fit-For-Purpose Land Administration Systems: Guiding Principles. In *FIG Working Week 2016 Recovery from Disaster*. Christstchurch, New Zealand.

Enemark, S., & Williamson, I. (2004). Capacity Building in Land Administration - A Conceptual Approach. *Survey Review*, *37*.

Fekade, W. (2000). Deficits of formal urban land management and informal responses under rapid urban growth, an international perspective. *Habitat International*, *24*(2), 127–150. https://doi.org/10.1016/S0197-3975(99)00034-X

Food and Agriculture Organization of the United Nations. (2002). *Land tenure and rural development*. Rome, Italy: Food and Agriculture Organization of the United Nations.

Fusch, P. I., & Ness, L. R. (2015). Are We There Yet? Data Saturation in Qualitative Research. *The Qualitative Report How To Article*, *20*(1), 1408–1416.

Government of Jamaica. National Land Policy of Jamaica (1997). Jamaica.

Government of Jamaica. (2008). *A Rapid Assessment of Squatting in Jamaica*. Kingston.

Griffith-Charles, C. (2011). The application of the social tenure domain model (STDM) to family land in Trinidad and Tobago. *Land Use Policy*, *28*(3), 514–522. https://doi.org/10.1016/j.landusepol.2010.10.004

Griffith-Charles, C., Mohammed, A., & Lalloo, S. (2016). *Documenting experiences on STDM piloting in Saint Lucia and St. Vincent and the Grenadines*. Nairobi.

Griffith-Charles, C., Mohammed, A., Lalloo, S., & Browne, J. (2015). Key challenges and outcomes of piloting the STDM in the Caribbean. *Land Use Policy*, *49*, 577–586. https://doi.org/10.1016/j.landusepol.2014.12.018

Harvey, F. (2006). Elasticity Between the Cadastre and Land Tenure: Balancing Civil and Political Society Interests in Poland. *Information Technology for Development*, *12*(4), 291–310. https://doi.org/10.1002/itdj.20049

Huggins, C., & Frosina, N. (2017). ICT-driven projects for land governance in Kenya: disruption and e-government frameworks. *GeoJournal*, *82*(4), 643–663. https://doi.org/10.1007/s10708-016-9710-6

International Federation Of Surveyors. (1995). *The FIG statement on the cadastre*. Belconnen, A.C.T.: International Federation of Surveyors (FIG).

Koh, M., & Knight, G. (2014). LAMP II: A Land Registration Project in Jamaica. In *FIG Congress 2014: Engaging the Challenges – Enhancing the Relevance*. Kuala Lumpur, Malaysia: FIG.

Kumar, R. (2010). *Research Methodology : a Step-by-Step Guide for Beginners*. London: SAGE Publications.

Mantel, K., de Vries, W., & Kirk, M. (2017). Improving Local Government Services in Jamaica: Tapping into the Value of the Real Estate Market. Retrieved June 22, 2017, from https://www.gim-international.com/content/article/improving-local-government-services-in-jamaica

Meinzen-Dick, R., & Mwangi, E. (2009). Cutting the web of interests: Pitfalls of formalizing property rights. *Land Use Policy*, *26*(1), 36–43. https://doi.org/10.1016/j.landusepol.2007.06.003

Ministry of Land and Environment. (2002). *National Report on Sustainable Development in Jamaica*. Johannesburg, South Africa.

Mitchell, D., Clarke, M., & Baxter, J. (2008). Evaluating land administration projects in developing countries. *Land Use Policy*, *25*(4), 464–473. https://doi.org/10.1016/j.landusepol.2007.10.004

Mourafetis, G., Apostolopoulos, K., Potsiou, C., & Ioannidis, C. (2015). Enhancing cadastral surveys by facilitating the participation of owners. *Survey Review*, *47*(344), 316–324. https://doi.org/10.1179/1752270615Y.0000000009

National Land Agency. (2017). Parcel Statistics. Retrieved May 31, 2017, from http://nla.gov.jm/content/parcel-statistics

Ouma, S., Ochong, R., Antonio, D., Maina, D., & Trust, P. (2017). Making the Community Land Act Effective : the Case of Mashimoni Settlement in Nairobi County and Kwa Bulo Settlement in Mombasa County of Kenya. In *World Bank Conference on Land and Poverty* (pp. 1–20). Washington, D.C.

Palys, T. (2008). Purposive Sampling. In L. Given (Ed.), *The Sage Encyclopedia of Qualitative Research Methods* (Vol. 2, pp. 697–8). Los Angeles: Sage.

Potsiou, C. A., & Ioannidis, C. (2003). Low Cost Technologies and Techniques in Implementing Cadastral and Spatial Information Management Infrastructure. In *2nd FIG Regional Conference Technology and Cadastre*. Marrakech, Morocco.

Rahmatizadeh, S., Rajabifard, A., & Kalantari, M. (2016). A conceptual framework for utilising VGI in land administration. *Land Use Policy*, *56*, 81–89. https://doi.org/10.1016/J.LANDUSEPOL.2016.04.027

Rahmatizadeh, S., Rajabifard, A., Kalantari, M., & Ho, S. (2018). A framework for selecting a fit-for-purpose data collection method in land administration. *Land Use Policy*, *70*, 162–171. https://doi.org/10.1016/J.LANDUSEPOL.2017.10.034

Rajabifard, A., Williamson, I., Wallace, J., & Bennett, R. (2011). Spatially Enabled Society. In *Bridging the Gap between Cultures (FIG Working Week 2011)*. Marrakech, Morocco.

Shibeshi, G. B., Fuchs, H., & Mansberger, R. (2015). Lessons from Systematic Evaluation of Land Administration Systems. The Case of Amhara National Regional State of Ethiopia. *World Development*, *68*, 282–295. https://doi.org/10.1016/j.worlddev.2014.12.006

Siriba, D. N., & Dalyot, S. (2017). Adoption of volunteered geographic information into the formal land administration system in Kenya. *Land Use Policy*, *63*, 279–287. https://doi.org/10.1016/J.LANDUSEPOL.2017.01.036

Stanfield, J., Barthel, K., & Williams, A. (2003). *Framework paper for land policy, administration and management in the*

English-speaking Caribbean. Madison, Wisconsin.

Stanfield, J., Murtazashvili, J. B., Safar, M. Y., & Salam, A. (2013). Community documentation of land tenure and its contribution to state building in Afghanistan. In J. Unruh & R.C. Williams (Eds.), *Land and post-conflict peacebuilding*. London: Earthscan.

Steudler, D., & Rajabifard, A. (2012). Introduction. In Daniel Steudler & Abbas Rajabifard (Eds.), *Spatially Enabled Society* (p. 8). Copenhagen: The International Federation of Surveyors (FIG).

Tuladhar, A., Ali, D. Z., & Zevenbergen, J. (2010). Developing a Framework for Improving the Quality of a Deteriorated Land Administration System Based on an Exploratory Case Study in Pakistan. *Nordic Journal of Surveying and Real Estate Research* , *7*(1), 30–57.

UN-ECE. (1996). *Land Administration Guidelines*. New York and Geneva: United Nations Publication.

UN-ECE. (2005). *Land Administration in the UNECE Regions—Development Trends and Main Principles*. New York and Geneva: United Nations.

UN-HABITAT. (2002). Seminar on securing land for the uraban poor. Fukuoka, Japan: United Nations Centre for Human Settlements (HABITAT) ; United Nations, Economic and Social Commission for Asia and the Pacific.

UN-HABITAT. (2008). *Secure Land Rights for All*. Nairobi: United Nations Human Settlements Programme .

USAID. (2010). *Country Profile: Property Rights and Resource Governance, Jamaica*.

van der Eng, P. (2016). After 200 years, why is Indonesia's cadastral system still incomplete? In J. F. McCarthy & K. Robinson (Eds.), *Land and Development in Indonesia: Searching for the People's Sovereignty* (pp. 227–244). ISEAS–Yusof Ishak Institute. https://doi.org/DOI: undefined

Williamson, I. (2000). Best Practices for Land Administration Systems in Developing Countries. In *International Conference on Land Policy Reform*. Jakarta.

Williamson, I. (2001). Land administration "best practice" providing the infrastructure for land policy implementation. *Land Use Policy*, *18*(4), 297–307. https://doi.org/10.1016/S0264-8377(01)00021-7

Williamson, I., Enemark, S., Wallace, J., & Rajabifard, A. (2010). *Land Administration for Sustainable Development*. Redlands: ESRI Press.

Zevenbergen, J., Augustinus, C., Antonio, D., & Bennett, R. (2013). Pro-poor land administration: Principles for recording the land rights of the underrepresented. *Land Use Policy*, *31*, 595–604. https://doi.org/10.1016/j.landusepol.2012.09.005

Zevenbergen, J., De Vries, W., & Bennett, R. (2015). *Advances in responsible land administration* (1st ed.). Boca Raton: CRC Press.

Zhang, H., & Tang, C. (2017). A Performance Assessment Model for Cadastral Survey System Evaluation. In *Cadastre: Geo-Information Innovations in Land Administration* (pp. 33–45). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-51216-7_4

8. APPENDICES

8.1 Appendix 1 Interview Guide for Land Professionals

My name is Shauntelle Ricketts and I am currently pursuing a Master of Science degree in Land Administration within the Faculty of Geo-Information Science and Earth Observation (ITC) at the University of Twente in the Netherlands. I am conducting a research on Innovative Land Tools Approach towards the completion of the Jamaican Cadastre. This entails looking at the suitability of the use of these low-cost technologies to record land tenure information that exists outside of the formal tenure in Jamaica.

Any information that you provide in response to this questionnaire will be used for educational purposes only within this research. Your responses will remain confidential and you are not obliged to answer any of the following questions.

Thank you for your cooperation in carrying out this research.

Contact Information

Researcher: Shauntelle Ricketts

Tel: +18763636661

Email: shauntellericketts@gmail.com; s.o.ricketts@student.utwente.nl

Sub-Objective 1: To explore the factors that prevent the completion of the cadastre.		
Research Questions	**Interview Questions**	**Checklist**
What do land professionals view as the reasons for an incomplete cadastre?	Can you tell me about the cadastre and the process for updating it? What are the challenges that have prevented the cadastre from being completed?	1. What is the process for updating the cadastre? 2. Who are the actors involved? 3. What is the status of the cadastre? 4. What do you view as the reasons for an incomplete cadastre? 5. What does the incompleteness affect in terms of operations? 6. Is having a complete cadastre a policy goal?
What is the nature of intervention strategies implemented to address the issue of an incomplete cadastre?	What strategies have been adopted or implemented to increase the parcel coverage of the cadastre? What are the differences between the conventional methods and implemented programmes?	7. What programmes or projects have been implemented to address this? 8. Who are involved in these? 9. Where were these implemented and why these areas? 10. What progress has been made since the implementation? 11. Have any programmes been implemented in the past that have been discontinued? 12. What were the reasons for this?
How are these intervention strategies addressing the issue of an incomplete cadastre?	Can you tell me about the progress these implemented programmes have had towards completing the cadastre?	13. What is the projected estimate for the cadastre to be completed? 14. How many parcels have been registered under the programmes? 15. What do you think the benefits of having full cadastral coverage are?
What factors prevent land holders from accessing these intervention strategies?	Why do you think persons have not accessed these programmes?	- Accessibility of the services - Capacity of the services

Sub-Objective 2: To ascertain the perspectives of innovative lands tools to record extra-legal tenure in Jamaica by stakeholders		
Research Questions	**Interview Questions**	**Checklist**
What are stakeholder perspectives on documenting extra-legal tenure?	What are your views on providing documentation for extra-legal tenure land holders?	1. How important is it that all tenure types be provided with documented proof of ownership? 2. Who do you think should be responsible for providing this document? 3. What do you think about intermediate titles? 4. Do you think the community would be receptive to receiving intermediate titles?
Are stakeholders aware of innovative land tools being used for tenure documentation?	Are you familiar with the term innovative land tools?	5. Are you aware of the use of land tools for documenting land rights? 6. How did you know about it?
How do stakeholders view the quality and use of the data collected using innovative land tools?	What are your views on using these tools for data collection and updating the cadastre?	7. Do you think the community would be willing to participate in data collection? 8. Do you think they should participate? 9. Do you think parcel mapped by the community adequately represents their parcel boundaries? 10. Do you think the data collected adequately represents the ownership and associated rights of the parcel? 11. Do you think the data collected is good enough to be used to update the cadastre? 12. What are your opinions on the tools being used? 13. What do you think about the accuracy obtained from these tools? 14. Who do you think should be responsible for the data collected by the community? 15. What are your opinions on the cost of using these tools for mapping parcels? 16. Do you think its affordability would impact the completion of the cadastre?

Sub-Objective 3: To determine the suitability of using innovative land tools towards completion of the national cadastre.		
Research Questions	**Interview Questions**	**Checklist**
What changes are required to the legal framework to include this application?	Can you describe the changes in the legal framework that would be needed to use innovative land tools for tenure documentation?	1. Are there plans to secure non-freehold tenure? 2. Are there plans to change this? 3. How do you view a continuum of land tenure? 4. What legal structure would need to be in place to allow this?
What changes are required to the institutional framework to include this application?	Can you describe the changes in the institutional framework that would be needed to use innovative land tools for tenure documentation?	1. What institutions are involved in land registration? 2. What role can the community play in tenure documentation? 3. What resources would be needed? 4. What role would other institutions need to play? 5. Does the NLA have the capacity/resources to extend its services? 6. Should there be an island wide systematic tenure documentation project? 7. Who would be required to carry this out?
What changes are required to the spatial framework to include this application?	Can you describe the changes in the spatial framework that would be needed to use innovative land tools for tenure documentation? What would be the requirements to upgrade the data collected using innovative land tools? • Does it need to be upgraded?	1. What are the accuracy requirements for parcel data? 2. How important is it to meet this accuracy over having full cadastral coverage? 3. What are the benefits of maintaining this accuracy? 4. Do you think the accuracy obtained from satellite images is suitable for the cadastre? 5. Do you think the accuracy obtained from mobile GPS is suitable for the cadastre? 6. What accuracy do you view as the minimal acceptable accuracy for parcel data? 7. Do you think that the cadastre can be maintained with varying accuracies for parcels? 8. What challenges do you think this will present?
What are the possible opportunities and barriers to accepting innovative land tools towards completion of the cadastre?	Can you identify 3 opportunities and 3 barriers that would present itself towards the use of innovative land tools?	

8.2 Appendix 2 Structured Interview for Community Respondents

My name is Shauntelle Ricketts and I am currently pursuing a Master's of Science degree in Land Administration within the Faculty of Geo-Information Science and Earth Observation (ITC) at the University of Twente in the Netherlands. I am conducting a research on **Innovative Land Tools Approach towards the completion of the Jamaican Cadastre**. This entails looking at the suitability of the use of these low-cost technologies to record land tenure information that exists outside of the formal tenure in Jamaica.

Any information that you provide in response to this questionnaire will be used for educational purposes only within this research. Your responses will remain confidential and you are not obliged to answer any of the following questions.

Thank you for your cooperation in carrying out this research.

Contact Information
Researcher: Shauntelle Ricketts
Tel: +18763636661
Email: shauntellericketts@gmail.com; s.o.ricketts@student.utwente.nl

Please indicate your responses to the following questions by placing a tick ☑ in the box that best applies to you (only one tick per person unless otherwise stated). Provide detailed answers where instructed.

Section 1 : Land Tenure

1 How long have you been in possession of this parcel of land?

☐ Less than 1 year ☐ 11 - 15 years

☐ 1 - 5 years ☐ 16 - 20 years

☐ 6 - 10 years ☐ More than 20 years

2 How did you come into possession of this parcel?

☐ Rent ☐ Purchase

☐ Inherited ☐ Other_____

3a Have you ever attempted to get any proof of ownership for this land parcel?

☐ Yes ☐ No

If your answer to question 3a was Yes, please answer 3b and 3c. If your answer was no proceed to question 4.

3b Pleas indicate the type of proof.

☐ Certificate of Title ☐ Other _____

☐ Certificate of Compliance

3c Why did you seek to obtain proof of ownership?

_____

4 Why did you not seek to obtain proof of ownership?

_____

5 Are you aware of the procedures to obtain a Certificate of Title for your land parcel?

☐ Yes ☐ No

6 Which of the following programmes are you aware of? Indicate all that applies.

☐ L.A.M.P ☐ L.A.N.D ☐ Other_____

7a Have you ever accessed or tried to access any of these programmes?

☐ Yes ☐ No

7b State reasons for your answer

_____

8a How important is it to obtain documented proof of ownership for your property.

☐ Very Important ☐ Moderately Important ☐ Not Important

8b State reasons for your answer

_____

9a Who do you think should be responsible for providing this document?

☐ Parish Council ☐ Other_____

☐ National Land Agency

9b State reasons for your answer

_____

Section 2: Awareness of Land Tools

1a Are you aware of the use of land tools for documenting land rights?

☐ Yes ☐ No

1b If yes, how did you know about it?

_____

Section 3: Community Participation

1a I would be willing to participate in mapping my parcel boundary and land rights.

☐ Strongly Agree ☐ Agree ☐ Disagree ☐ Strongly Disagree

1b State reasons for your answer

_____

2a The community should be involved in the data collection process.

☐ Strongly Agree ☐ Agree ☐ Disagree ☐ Strongly Disagree

2b State reasons for your answer

_____

Section 4: Quality of Data

1a The parcel mapped by the community adequately represents my parcel boundary.

☐ Strongly Agree ☐ Agree ☐ Disagree ☐ Strongly Disagree

1b State reasons for your answer

_____

2a The data collected by the community adequately represents the ownership rights of the parcel .

☐ Strongly Agree ☐ Agree ☐ Disagree ☐ Strongly Disagree

2b State reasons for your answer

_____

3a The data collected by the community adequately represents the proprietor of the parcel.

☐ Strongly Agree ☐ Agree ☐ Disagree ☐ Strongly Disagree

3b State reasons for your answer

_____

4a The parecl data collected is good enough to be used for planning and development activities.

☐ Strongly Agree ☐ Agree ☐ Disagree ☐ Strongly Disagree

4b State reasons for your answer

_____

5a The data collected about ownership rights is good enough to be used for planning and development activities

☐ Strongly Agree ☐ Agree ☐ Disagree ☐ Strongly Disagree

5b State reasons for your answer

_____

6a The data collected about proprietor of the parcel is good enough to be used for planning and development activities

☐ Strongly Agree ☐ Agree ☐ Disagree ☐ Strongly Disagree

6b State reasons for your answer

_____

7a Please rate how you view the quality of the data collected using the tools.

☐ Very Good ☐ Good ☐ Acceptable ☐ Poor ☐ Very Poor

7b State reasons for your answer

_____

Section 5: Dependability

1a Who should be responsible for the data that the community collects?

☐ Parish Council ☐ Community

☐ National Land Agency ☐ Other_____

1b State reasons for your answer

_____

Section 6: Speed

1 What are your views on the length of time it took to map your parcel?

_____

Section 7: Flexibility

1a I would be receptive to receiving an intermediate land title?

☐ Strongly Agree ☐ Agree ☐ Disagree ☐ Strongly Disagree

1b State reasons for your answer

_____

2a I would upgrade to a full title in the future?

☐ Very Likely ☐ Somewhat Likely ☐ Not likely

2b State reasons for your answer

_____

Section 8: Cost

1a I would prefer a land surveyor to collect my parcel information even if this costs more.

☐ Strongly Agree ☐ Agree ☐ Disagree ☐ Strongly Disagree

1b State reasons for your answer

_____

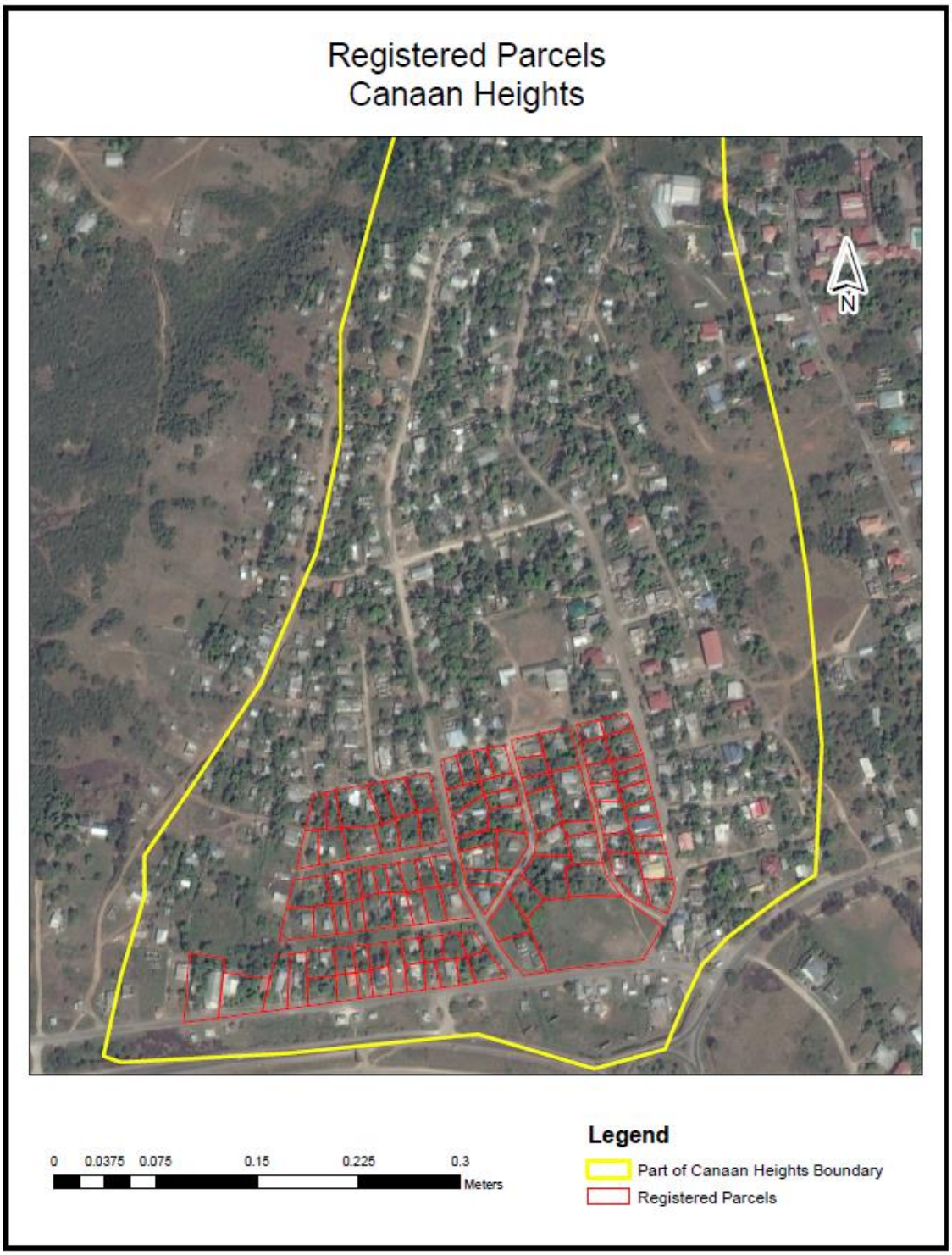
8.3 Appendix 3 Work plan of thesis

The figure below shows the stages of the research and the time that was allotted for each stage.

Activities	2017																2018							
Month	September				October				November				December				January				February			
Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Research Proposal Preparation																								
Fieldwork Preparation- Preparation of interview guides																								
Fieldwork																								
Collation of Fieldwork Data																								
Mid-thesis presentation																								
Data Analysis																								
Report Writing																								

Appendix 3 Thesis Work Plan

8.4 Appendix 4 Registered Parcels in Canaan Heights



Appendix 4 shows the registered parcels in the Canaan Heights community. The map shows that only parcels towards the entrance of the community are registered with freehold interest under the Registration of Titles Act.