Scientific Research Publishing

Current Urban Studies, 2023, 11, 619-640
https://www.scirp.org/journal/cus
ISSN Online: 2328-4919
ISSN Print: 2328-4900

Harnessing Geospatial Technologies for Sustainable Urban Planning in the Newly Created Cities in Uganda Using Rapid Physical Planning Approach (RAPPA): A Case Study of Hoima City

Charles Nyakwebara, Amin T. Kiggundu, Darious Kaijo, Emmanuel Bita Kaganzi, Cissy Nakawuki

Department of Architecture and Physical Planning, College of Engineering, Design, Art and Technology, Makerere University, Kampala, Uganda
Email: cnyakwebara1@gmail.com, Charles.nyakwebara@mak.ac.ug

How to cite this paper: Nyakwebara, C., Kiggundu, A. T., Kaijo, D., Kaganzi, E. B., & Nakawuki, C. (2023). Harnessing Geospatial Technologies for Sustainable Urban Planning in the Newly Created Cities in Uganda Using Rapid Physical Planning Approach (RAPPA): A Case Study of Hoima City. *Current Urban Studies, 11,* 619-640.
https://doi.org/10.4236/cus.2023.114032

Received: November 10, 2023
Accepted: December 24, 2023
Published: December 27, 2023

Abstract

Uganda created new cities in 2020 to strengthen its competitiveness for sustainable wealth creation and inclusive growth. However, this was not matched with capacities to move the process. Physical planning is one way through which to kick-start this process. Convectional planning processes demand lengthy procedures which hardly bear immediate solutions given the inadequate capacity to prepare sustainable plans. The Ministry of Lands, Housing and Urban Development (MLHUD) introduced Rapid Physical Planning Approach (RAPPA) to promote orderly urban development in the country. RAPPA had never been independently employed by urban local governments, hence the need to build capacity of local governments to capture, analyze and use data in planning decisions. The study employed mixed methods approach involving field reconnaissance surveys and GISlab drills. Findings indicate that Hoima city has multiple stakeholders including Technical Planning Committee, Executive, Council agents and land lords that participate in planning activities. About 90% of technical personnel had never had exposure to geospatial technologies. The study recommends use of simple open-source software like Quantum GIS to respond to planning problems, training and retooling of technical personnel to effectively participate in planning activities and to embrace RAPPA as a planning approach.

Keywords

Geospatial, RAPPA, Capacity Building, Physical Development Framework

1. Introduction

The world is urbanizing at an unprecedented rate, with more than half of the world's population living in cities (Cohen, 2017). Predictions indicate that by 2050 more than two-thirds of the world's population will be living in urban areas (Ritchie & Roser, 2018). In order to achieve national transformation and development, countries like Uganda embraced a strategy of creating new cities to provide the required public services. Both Vision 2040 and the National Development Plan III (NDP3) provide for creation of cities as way of strengthening the country's competitiveness for sustainable wealth creation, inclusive growth and employment. Subsequently, in July 2020, the Parliament of Uganda approved the creation of fifteen (15) new cities comprising of Arua, Entebbe, Fort Portal, Gulu, Hoima, Jinja, Kabale, Lira, Masaka, Mbale, Mbarara, Moroto, Nakasongola, Soroti, and Wakiso.

Four of the above cities (Arua, Gulu, Mbale and Mbarara) were to serve as regional cities while the rest would serve as strategic cities (NPA, 2015). The strategic cities were created basing on the strategic interests/resources in the respective regions, that is, Fort Portal as a tourism city, Jinja and Lira (industrial) and Hoima as an oil city among others. To date, ten (10) of the fifteen (15) new cities are operational, while the rest were planned to be operationalized starting 2023/2024 financial year. The ten operational cities are Arua, Fort Portal, Gulu, Hoima, Jinja, Lira, Masaka, Mbarara, Mbale and Soroti.

The creation of new cities and/or other urban authorities ought to be based on the established criteria which spells out preconditions for a place to be declared/elevated to a new urban status. One of the key requirements as laid out in the Local Governments Act (CAP 243) is for a place to be declared urban authority (Town/Municipality or City). It should possess a master plan for land use. Therefore, preparation of Urban Physical Development Plans (PDPs) is one of the ways to operationalize the cities as laid out in the National Development plan III (NDP3).

However, there is insufficient urban planning infrastructure such as base maps, equipped offices and skilled personnel in using modern technologies in urban planning. Conventional urban planning processes and approaches do not support quick geospatial data capture, analysis and modeling to produce required city plans, control and guide future development, yet planning needs and challenges continue to grow. There is therefore a need to match creation of cities with capacity and skills to use current technologies and approaches in order to support better urban planning.

All the ten new cities currently in operation were created by elevating existing municipalities to city status without due consideration of the criteria laid out in the Local Government Act, CAP 243. In the process of creating these cities, a number of rural sub counties were annexed to the existing municipalities, without putting into consideration a number of critical issues pertaining to the future growth and development of the cities.

Most of the annexed rural areas to form cities lack basic infrastructure and social services such as schools and hospitals. The annexation of new areas also created several planning and management challenges. Amidst manpower gaps, the new cities still have to operate and provide services. One of the critical services these entities have to provide is physical planning, which is essentially a decentralized service. Convectional physical planning processes demand lengthy procedures which hardly bear immediate solutions.

Against this realization, the Department of Physical Planning in the Ministry of Lands, Housing and Urban Development introduced the Rapid Physical Planning Approach (RAPPA) to facilitate delivery of planning solutions in a shorter time than the conventional processes and approaches. RAPPA had largely been used previously by the Ministry of Lands, Housing and Urban Development (MLHUD) to facilitate quick delivery of planning services albeit independent of Local Government practitioners, yet it is premised on providing planning solutions cheaply and in a short time. Hence, the need to build capacity of key urban local government practitioners in technologies and approaches that would help them capture, analyze, manipulate and display geospatial planning data in different urban contexts for urban planning decision making.

It is hoped that the capacity built would contribute towards achieving SDG 11 targets such as access for all to adequate, safe and affordable housing, sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management (UN, 2023).

2. Objectives of the Study

The main objective of the study was to build capacity of the technical personnel in the newly created city of Hoima by equipping them with required skills of Geospatial/Geographical Information System (GIS) technologies to capture, analyze and update Physical Development Plans through Rapid Physical Planning Assessment (RAPPA) with full stakeholder involvement.

Specifically, the study aimed at achieving the following objectives:

a) To undertake stakeholder mapping for Physical Planning using RAPPA in Hoima City;

b) To conduct geospatial training and capacity needs assessment in Hoima City council;

c) To conduct community participatory appraisal in Hoima City council;

d) To train technical personnel in Geospatial data collection and management for physical planning;

e) To prepare a physical development framework for Hoima city using RAPPA.

3. Literature Review

Sustainable Development Goal (SDG) 11 aims to create cities and human settlements that are inclusive, safe, resilient and sustainable. The UN Department of

Economic and Social affairs (2023) describe cities as centres of social, cultural and economic development and point out essential services including urban planning, transport systems, water, sanitation, waste management among others as crucial issues to achieving sustainable urban development. (UN, The Sustainable Development Goals Report, 2020) estimates half of the world population lives in urban areas where, a big number lack access to public transport, only 47% live within walk able distance to work.

About 24% of urban population live in slums; areas with the poorest living conditions characterized by limited access to sanitation, health, education services and having poorest environmental conditions, high crime rate and lack of decent housing. Among the targets to achieve safe, resilient cities is to enhance urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries. The indicator to measure this target includes proportion of cities with a direct participation structure of civil society in urban planning and management that operate regularly and democratically.

There is need to build capacity of city planners with skills to plan for sustainable cities to achieve the stated targets of SDG 11. Uganda as a member of UN has taken steps to create smart cities as per the UN-Habitat Smart Cities Agenda that calls for Smart City Planning and Design. The approach calls for use of new knowledge and ICT tools to promote urban planning and design to address evolving needs and challenges of urbanization.

As one of the ways to achieve Vision 2040, Uganda created new cities to improve service delivery and have resilient urban areas that are commercially viable. This calls for building city capacity to integrate and implement physical development plans for the newly created cities into 5-year City development plans. This is as well enshrined in the objectives of Uganda's Third National Development Plan (NDP III) and operationalization of the Physical planning Act 2010 as amended to support orderly development by undertaking Geospatial training to selected strategic cities.

Transforming from the local government status to self-autonomous status, cities are grappling with revenue generation. Cities depend more on locally generated revenue and central government funding. New cities have to manage optimal use of land use in order to increase local revenue generation to boost local taxes (Guillaume, 2020). Managing land use calls for planning tools that guide development such as land use zone maps and detailed plan lay outs. Producing those plans requires an efficient data collection and management system. However, the budgets of cities do not afford collection of complex data and advanced data acquisition systems that would be necessary to provide planning data.

Urban planning entails merging and understanding the interplay between human settlements, utility systems, communication networks and supply chains (UnearthLabs, 2022) using easy to use technologies. Geospatial (GIS) technologies provide this platform that would be difficult, time consuming and expensive

doing by the city planners or be funded by city budgets. GIS provides quick and rapid spatial appraisals with high level of accuracy, quick communication, requires simple to use systems to facilitate modeling of big data sets. However, skills in data management, visualization and spatial analysis are lacking among city planners in Uganda.

The main task of city planners is to predict future demand for services over limited space. Geospatial technologies assist in making such predictions (Longley, 1994). Predictions enable planners know trends of urbanization and related population growth, estimate range of environmental impacts, estimate future demand. This can be done through GIS modeling and operations like overlay analysis using a range of data including socioeconomic and environmental data collected and stored in GIS databases (Yeh, 1999). From this data a range of maps showing potential, constraint, conflict and suitability maps showing areas for development can be drawn (Schaller, 1992).

Urban planners use these maps to determine locations for future development (Yeh & Chow, 1996), (Chuvieco, 1993) and (Despotakis et al., 1993). Khirfan (2011) state that the incorporation of historical aspects in urban planning and GIS can play a role in providing linkage between town planning, analysis and historical research into present day urban designs. These technologies can also aid implementation of urban plans in carrying out environmental impact assessment and guiding on where mitigations can be put. Integration of Geospatial technologies in various areas of urban planning was clearly demonstrated in **Figure 1** by Yeh in 1999.

Cities are now advancing use of digital technologies in urban planning. These include satellite images, photo-interpretation software, crowd sourcing and participative cartography as tools for city planners to use in developing land use maps (Guillaume, 2020).

Geospatial Technologies have been introduced to city planners and applied in urban planning and management world over. The Kigali urban planning and management capacity building (KUPMCB), is a project by United Nations Development Programme (UNDP) that used Geospatial technologies to develop a Master plan for selected zones and ensuring environmental sustainability. It enabled integration of available plans with field data, aerial surveys and creation of thematic and suitability maps.

Geospatial technologies have been used elsewhere to avail quick means of acquiring and sharing spatial planning data. The Wexity-Logiroad, a data management platform as an example was developed to bring all city data including utilities, environment, settlements, tax system onto one platform to enable sharing knowledge to non-experts in GIS. The system can also answer spatial queries on population versus related available services and identify gaps for in planning.

Likewise in Johannesburg, South Africa, realizing that access to spatial data is slower than population growth, the World Bank (WB) with Global Environment Facility (GEF) established Global Platform for Sustainable Cities (GPSC) to

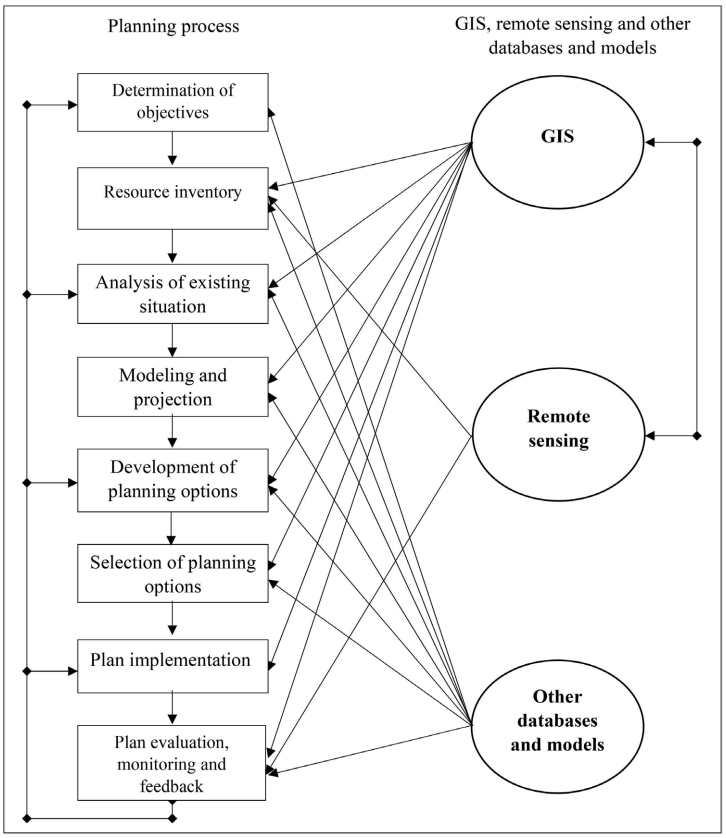


Figure 1. Integration of geospatial technologies in urban planning (Source: Yeh, 1999).

promote integrated urban planning in 30 cities of the developing world. The same platform brought together city planners at the European Space Agency (ESA) for demonstration of how to use earth observations and geospatial technologies in mapping and aiding planning key urban services (Wang, 2016).

In Libya, GIS was used to determine cities for long term development projects using overlay analysis. This was done to avoid human biases in selection of areas for development. The technologies helped determine most suitable areas (Baharek et al., 2019) while in Klang Valley region of Malaysia, geospatial technologies enabled integration of over one hundred layers of spatial data including socioeconomic, administrative, environmental, transportation data among others (Yaakup, Sulaiman, Musa, Ahmad, & Ibrahim, 2002).

This enabled development of an easy and friendly use of the system and a web-based GIS for Klang Valley to facilitate exchange of GIS data.

Important to note also is that geospatial technologies cannot be useful unless supported by decision makers to establish a skilled human work force, in a well-organized system. This calls for allocation of financial resources to facilitate investment in geospatial technologies (Yeh, 1999; Guillaume, 2020). Data is another important part of Geospatial technologies to facilitate its use in urban planning (Lo, 2007). Lack of data may limit application of these technologies. There is

need for geographic and textual data to run the system. City employees should be oriented in using these technologies to capture quick data from different sources and layers aided by GIS to support urban planning in new cities.

The Ministry of Lands, Housing and Urban development (MLH & UD, 2020a) emphasizes strengthening of institutional capacity for orderly urban and rural development. It calls for recruitment and training of urban development technical personnel at the central and local government levels as well as looking for funds for institutional capacity building in local governments and facilitating efficient and effective urban development and management.

RAPPA is a planning initiative by the Ministry of Lands, Housing and Urban Development to deliver a Physical Development Framework (PDF) aimed at guiding specific interventions that impact on space and influences land use patterns in a given time (MLH & UD, 2020b). RAPPA does not follow the conventional physical planning process (MLH & UD, 2020b), hence being Rapid. The Ministry adopted this approach upon realizing that there were many unplanned rural and peri-urban areas yet there were no real efforts directed towards controlling development in areas immediately outside of the boundaries of gazetted towns.

The Ministry further contends that this approach was also precipitated by absence of or inadequate comprehensive manuals or guides for local authorities while making planning decisions. RAPPA was seen as an avenue through which to prepare plans implementable under different circumstances to achieve specific targets with a rationale for choices and adaptation techniques. RAPPA emphasizes empowering local people to assume an active role in analyzing their own living conditions, problems, and potentials in order to seek a change in their situation.

RAPPA process is conceived to embrace five key features which include; flexibility and informality, on spot analysis, triangulation, multidisciplinary teamwork and mix of techniques. Within these broad features, RAPPA methodology revolves around four phases, namely; Preparatory phase, Inception phase, Planning phase and Approval phase. All these are accomplished in a period less than six (6) months as opposed to conventional planning process which takes between nine months to a year. RAPPA process is illustrated in **Figure 2** below.

The preceding literature highlights Geospatial applications in physical planning and the ongoing innovations and processes to improve the planning practice in Uganda. We notice the efforts by the Ministry of Lands Housing and Urban Development in Uganda to cover the technical gaps in the local government planning processes. However, there are still challenges associated with adoption of geospatial technologies in urban local governments especially in newly created cities. It is generally critical that best practices and innovative strategies that are transferable to local conditions are identified to improve the practice of physical planning in urban local governments especially in the new cities.

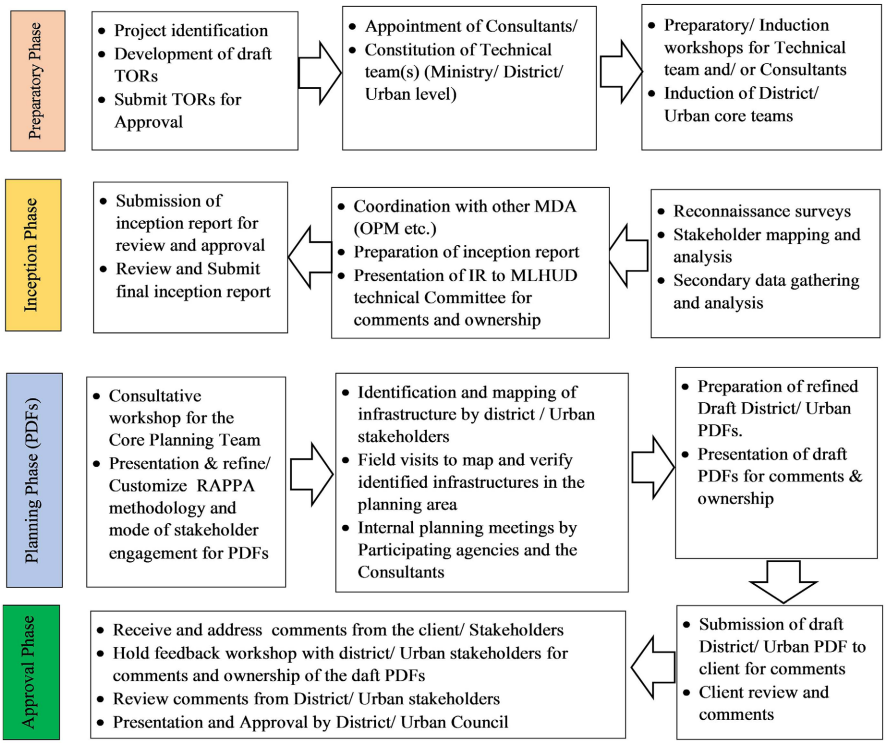


Figure 2. Flow diagram of PDF preparation process using RAPPA methodology. (Source: Physical planning department, ministry of lands, housing and urban development).

4. Methods

Considering the nature and purpose of the study, the process employed mixed methods research approach comprising of fieldwork, training sessions and practical exercises. A reconnaissance exercise involving preliminary studies to appreciate the prevailing situation in Hoima city was conducted to inform the design of a tailored capacity building RAPPA and Geospatial training manual. A stakeholder mapping session was conducted to identify the relevant departments/ sections/technical people to be involved in the project. This was followed by geospatial skills and capacity needs assessment with a view of assessing the level of urban planning skills among the city technical personnel. The assessment covered both individual and institutional capacity in the use of Geospatial technologies for sustainable urban planning. Participatory appraisals at city and Ward (village) levels were also conducted to assess the knowledge base of urban planning.

Geo-spatial lab setting, installation and training for skills and capacity building was undertaken involving; developing of specialized training manual, Labs setting and installation, skills building and training. As part of the training, participants were given an assignment to prepare neighborhood plans through RAPPA. Three working teams were constituted to cover three wards of Kibingo, Western and Bwikya /Kinubi in Hoima city. In line with the geospatial training program, participants collected primary data from the respective wards to sup-

plement the secondary data and generated different spatial layers. Each working team presented their results in form of maps/RAPPA frameworks and reports.

5. Findings of the Study

5.1. Status of Geospatial Application in Hoima City

In order for the project team to fully understand the context of this study, there was need to understand the current status of Geo-spatial application in Hoima city in Uganda. The study revealed that there was limited application of Geospatial technologies in Hoima city, mainly in the works and engineering department. Other departments did not have a clue as to how their day to day activities would benefit from Geo-spatial technologies and RAPPA. While at the onset of the study, all departments in the city were involved, it later emerged that there were varying levels of commitment amongst participants.

Whereas the training targeted twenty one (21) participants from six (6) technical departments, only seven (7) participants mainly from the works and engineering department managed to complete the program. Participants dropped off as the training program progressed. A post training survey indicated that participants who dropped out of the program had varying reasons ranging from family and office commitments to failure to link the training to their day to day office operations. Some participants were overly expectant that the training would directly enhance their current day to day operations, while others failed to comprehend Geospatial technologies in their operations.

5.2. RAPPA process in Hoima City

As pointed out earlier, the study based on five objectives to assess applicability of RAPPA in Hoima City. The following discussion presents the findings in line with the objectives of the study;

5.2.1. Stakeholder Mapping for Physical Planning in Hoima City

The first objective of this study was to conduct a stakeholder mapping for Physical Planning using RAPPA in Hoima city. This was one of the preliminary activities to aim at identifying the institutional and individual capacities for physical planning in the City. A stakeholder mapping session was conducted with members of the Technical Planning Committee (TPC) and the Urban Physical Planning Committee (UPPC) in Hoima city (**Figure 3**).

The Local Governments Act CAP 243 provides for all heads of department as members of the TPC, while the Physical Planning Act 2010 as amended provides for the Town Clerk, the City Physical Planner, the city Engineer, the city Environmental Officer, a Land Surveyor, an Architect and the officer responsible for Public Health in the city as members of the Urban Physical Planning Committee. Membership of these two committees is more or less the same although the TPC has slightly more members.

At the end of the stakeholder mapping session, it was concluded that there are five key categories of stakeholders involved in physical planning in Hoima city.

Senior Physical Planner giving opening remarks	Discussions on stakeholder mapping	Town Clerk giving closing remarks

Figure 3. Stakeholders mapping session in Hoima city.

These are; the Technical Planning Committee (TPC) and the Urban Physical Planning Committee, who are involved in all stages of the planning process, the Council/executive are involved in priority setting, policy formulation and approval of RAPPA Plans, Council agents are involved in mobilization and data collection while the land lords are involved during data collection and at planning proposal stages. It is however important to note that land lords are a very key stakeholder in physical planning since their involvement would be the first step in ensuring project ownership.

5.2.2. Geospatial Training Capacity Needs Assessment

The second objective of the study was geospatial training capacity needs assessment in Hoima city. The purpose of conducting this assessment was to identify the geospatial training gaps among the members of TPC/UPPC and the institutional capacity to use Geospatial technologies for sustainable urban planning. The assessment helped the project team to identify the training and capacity needs of the stakeholders at individual and institutional levels. The results of this assessment were used to inform the design of a specialized geospatial training manual.

Geospatial training capacity needs assessment process involved engaging Heads of departments/sections in Hoima city. Six departments; i.e. Administration, Production, Finance, Works and Technical services, Health and Education were involved in this assessment. The assessment also involved administering pre-designed tools to assess institutional and individual capacity needs in Hoima city.

Individual skills needs assessment was an attempt to identify individual capacities in using geospatial technologies. The study assessed individual participants on whether they had used Geospatial technologies before or not. The survey revealed that 40% of individuals within the participating departments had used a handheld GPS/GNSS receiver while 60% had not (Figure 4). This was a major skills gap given that use of GPS/GNSS is a basic geospatial technology for planning data capture.

Still under individual skills assessment, the survey also investigated the use of GIS software for map production among the participating departments. Only

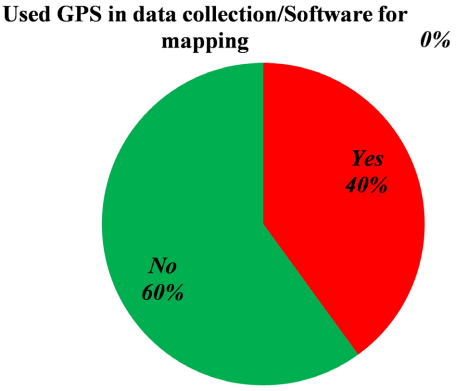


Figure 4. Use of GIS in data collection and Mapping.

10% of the respondents (Particularly in the physical planning section) had used GIS as a mapping tool, while 90% had not (**Figure 5**). This scenario was in line with the responses on the frequency of use of GIS software where 10% of the respondents indicated that they used GIS on a daily basis while 90% indicate that they had never used the software. GIS is a conventional application for map production for planning purposes (Yeh, 1999). Therefore, having a knowledge gap of 90% among stakeholders in the use of GIS was indicative of the training requirement in this specific area for the success of the project. ArcGIS was the software mainly used by those who indicated having used GIS before.

On the type of databases developed, participant indicated that they had developed raster databases. Across all the departments, respondents, regardless of whether they had used GIS or not, indicated that they would require GIS as an operational tool for their various activities. Participants pointed out a number of areas where GIS would be applied as indicated in **Table 1** below.

Based on the above, respondents appreciate the need for GIS technologies in their daily activities. However, at the time of the survey, only the Works and engineering department was using the GIS in their daily activities. There was a gap between available and required technologies in the department. This was picked as an area of interest during the design and implementation of Geospatial training.

The second area of assessment was institutional capacities with regard to Geospatial technologies and infrastructure. The survey revealed that of the ten variables assessed, only the Works department (Physical planning section) had the capacity and minimum infrastructure for Geospatial technologies. The other departments pointed out that at the minimum, they had some computers, running power, extension cables and UPS backups, but with no appropriate software. The production department on the other hand indicated having access to GIS lab and functional computers that would host GIS software but did not have all the necessary infrastructure.

The Works and Technical Services department is the most capacitated in terms of Geospatial technologies. But the department's capacity was mainly

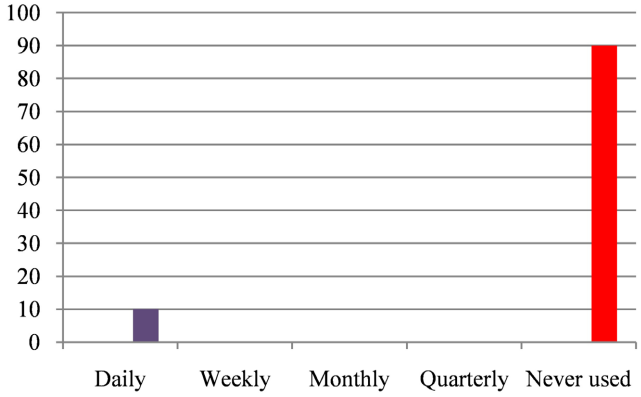


Figure 5. Frequency of use of GIS Software.

Table 1. Areas that require application of GIS technologies in Hoima City.

Response	Department					
	Administration	Production	Finance	Works	Health	Education
Mapping/land use planning				x		
Mapping sites		x		x		
Soil mapping		x				
Food chain value assessment		x				
Disease control					x	
Enumeration and assessment	x		x			
Property owner's register	x		x			
Locating health care facilities				x	x	
Locating garbage collection areas	x			x	x	
Locating properties			x			
Fleet management				x		
Road construction				x		
Installation of solar lights				x		
Land management	x			x		
Administrative unit boundaries	x			x		
Security for existing city infrastructure				x		
Location of schools						x
Location of sanitation facilities					x	x

concentrated in the physical planning section while other sections like Engineering only have access to printers/plotters for printing plans/maps. They also indicated having running power, extension cables and UPS back up with a few staff members capable of using GIS.

Generally, in terms of capacity, only the physical planning section in the works department had relevant capacity for Geospatial technologies (Table 2).

Table 2. Institutional geospatial capacities.

VARIABLE	DEPARTMENT					
	ADMN	PRODN	FINANCE	WORKS	HEALTH	EDUC
Availability/access to GIS Lab/Section		x		x		
Availability of functional computers for GIS		x		x		
Have computers/Laptops assigned for GIS work				x		
Availability of Geospatial positioning system (GPS)				x		
Availability of Printers and plotters for printing plans				x		
Other digital mobile data collection equipment in place				x		
Availability of Table, Chairs and storage cabins for plans				x		
Running power, extensions and back-up	x		x	x	x	x
Have staff/offices in the department using GIS technologies				x		
Has the department received GIS training from any partner				x		

This was mainly because the section hosts the Ministry of Lands, Housing and Urban Development PPUMIS[1] program. The rest of the city departments lacked capacity for Geospatial technologies.

It was found out, through the assessment, that Hoima city has a public library with a computer lab (Figure 6). The lab has about fifteen (15) desktop computers with appropriate capacity to install and run GIS software.

5.2.3. Community Participatory Appraisal in Hoima City Council

The third objective of this project was to conduct community participatory appraisal in Hoima city. The purpose of conducting this appraisal was to gather information to form a basis for designing the training manual that best suits local demand and challenges of Hoima City.

The appraisal was done through purposive sampling. Ward agents were selected from the different city divisions and were brought together and sensitized on urban planning using geospatial technologies. After the sensitization, four groups were formed to brainstorm and respond to planning questions that were put before them. Each group had its members from that particular division who knew the local socio-economic and geographical set-up of the division. At the time of executing the project, Hoima city was still operating under the four divisions of Mparo, Bujumbura, Busiisi and Kahoora Division[2] (Figure 7).

[1]Physical planning and urban management information system.

[2]Following the full operationalization of city status, these divisions were merged into two i.e. East city division, Bujumbura and Busiisi became East Division while Kahoora and Mparo became Western Division.

Figure 6. Hoima city public library hosting a computer lab.

Figure 7. Participatory appraisal groups in Hoima city.

At the end of the session, participants made presentations in regard to the appraisal questions. The presentation materials (flip charts) were later collected and data thereon put into a matrix and triangulated to identify the most common demands across the four groups (Figure 8).

Through participatory appraisal sessions (Figure 9), it emerged that all groups appreciated the fact that urban planning involves stakeholders. They identified some of the stakeholders including Technocrats, Political leaders, Business community and Development partners among others. They specifically indicated that Land lords, Development partners, Business community and Religious leaders were some of the stakeholders that raise the need for planning.

Triangulation revealed that well planned residential areas, taxi parks and healthcare services are the most demanded services across the divisions in Hoima city. However, Abattoirs/slaughter houses and recreational areas for mental and physical wellbeing of the people appeared in more than one group. Other services listed include schools, offices and roads among others. The appraisal generated a lot of learning experiences on urban planning, stakeholders in physical planning and community's role. It also generated empowerment and created a sense of local ownership, which is vital for urban planning.

5.2.4. Training of Technical Personnel in Geospatial Data Collection and Management for Physical Planning

The main objective of the study was to equip technical personnel with skills of geospatial data collection, management and using the same data to prepare physical

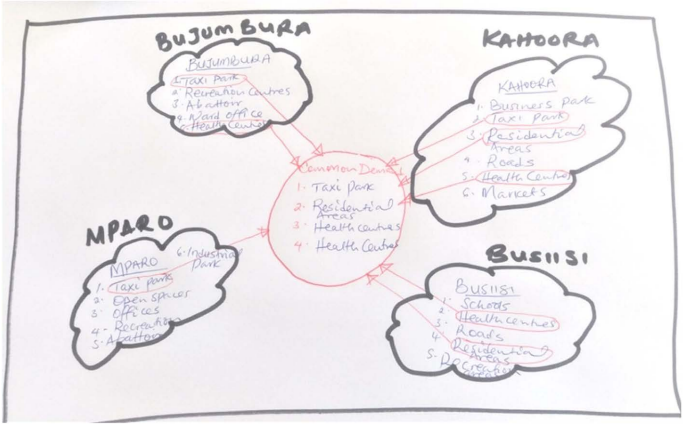


Figure 8. Triangulated findings from the four participatory groups.

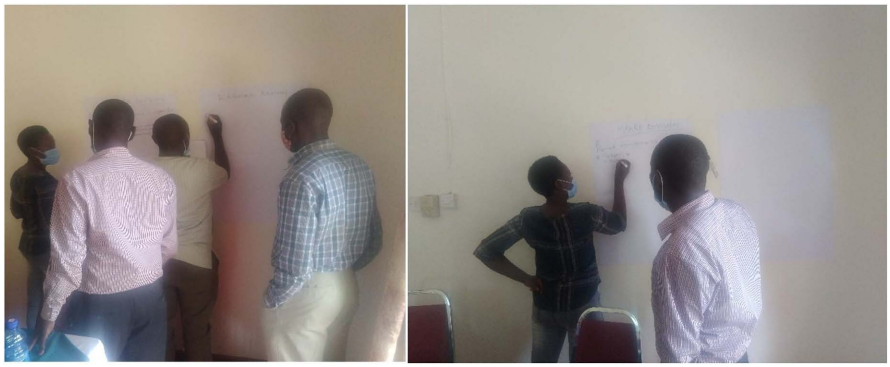


Figure 9. Participants during participatory appraisal session.

development frameworks (PDFs). As noted earlier the capacity needs assessment reveled that most technical personnel (90%) in Hoima city had never been exposed to geospatial technologies in any way. Hence, the project team working with a technical expert designed a tailor-made training manual to take care of these capacity gaps. The expert spearheaded the training of targeted technical personnel in Hoima city as were identified in the stakeholder mapping sessions.

A systematic approach was adopted for the training where important content and skills are identified, proper learning methods are used, training material made useful to participants, and that participants can perform work as expected when they are assigned tasks. This approach involved three main phases 1) Pre-training, 2) Training and 3) Post-training phase as indicated in **Figure 10** below.

During the pre-training phase, actual preparations were made in regards to the training module program. This phase involved developing learning objectives which were the intended measurable outcome that the participants would achieve upon completion of the course. The learning objectives were derived from capacity needs assessment identified at the onset of the project.

The second aspect in the pre-training phase was to design and develop training materials. This was done through critically examining the training needs and

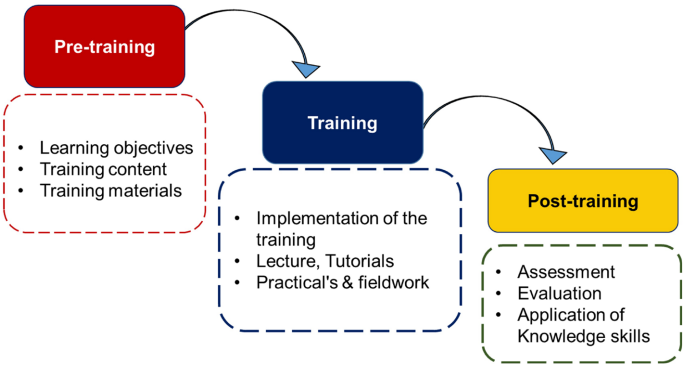


Figure 10. Schematic presentation of the PTPs training approach.

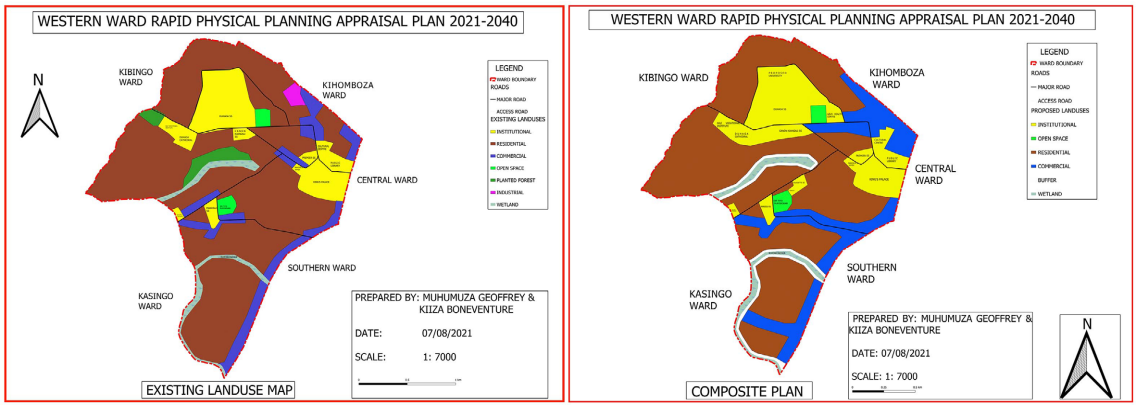
available resources. The training materials and activities were developed in line with the knowledge and skill gaps identified by training needs assessment. The **ADDIE** model was adopted during the designing and development of the teaching materials/activities. The **ADDIE** framework is a widely used instructional design that consists of five phases: Analysis, Design, Development, Implementation, and Evaluation (Serhat, 2017; Sink, 2014). The outputs of this phase were the training materials for instructors and participants designed and developed. These materials included; Course outline, Training Manual, Training aids and activity/exercise instructions.

The training phase involved the actual training delivered by the instructors. In this phase the material developed during the development phase were used to implement the activities in the course of the training. The module basically adopted a participant centred learning approach blended with hands-on training sessions coupled with the regular learner and instructor interactions. The participant-centred approach puts participant's interest as primary by acknowledging their needs as central to the learning experience (Dambudzo, 2015). The course content was delivered inform of lecture presentations, tutorials, discussions and practical sessions in the public library (**Figure 11**). Participants were given an exercise to prepare neighbourhood plans through RAPPA. The exercise was meant to assess the level skills gained through the training. A presentation was organized where participants presented their results. Basing on the results of the exercise, participants were able to exhibit some level of skills with regard to using geospatial technologies for urban planning and design. However, what remained unanswered was how to sustain and further improve on the skills gained through this training.

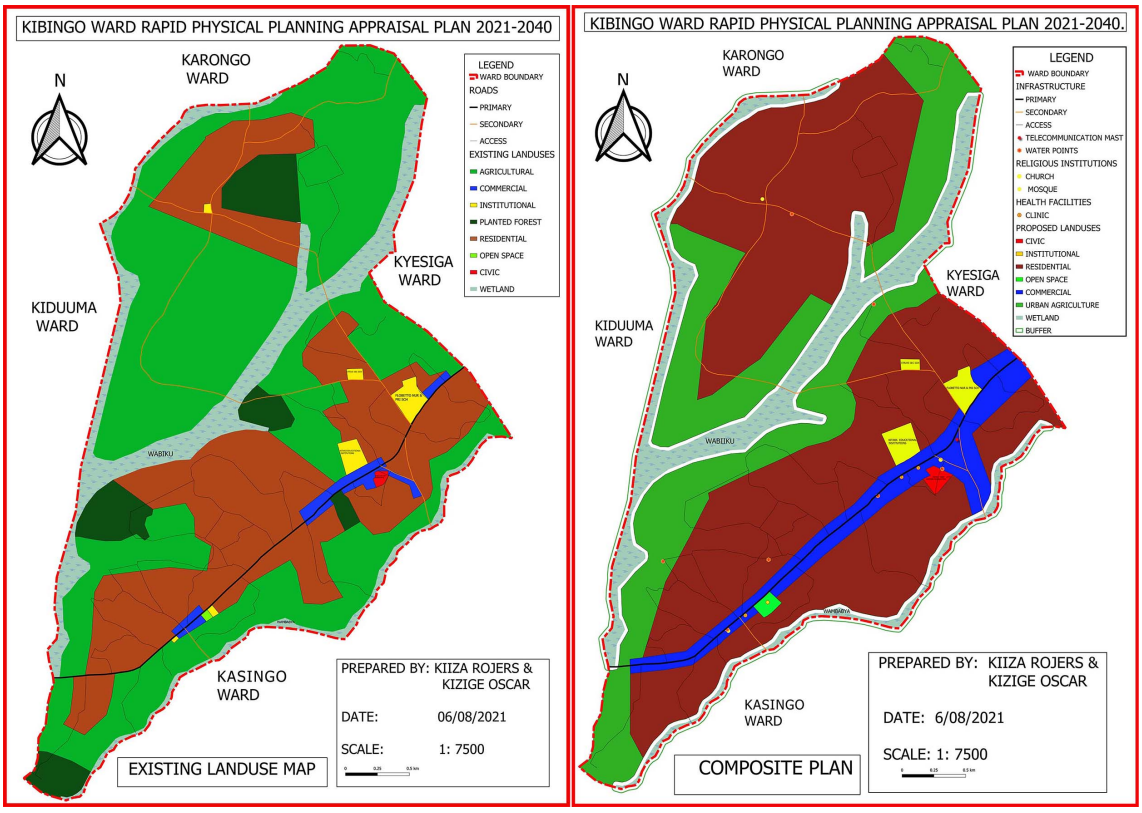
5.2.5. Preparation of Physical Development Frameworks for Hoima City Using RAPPA

As part of the training program, participants were tasked to prepare physical development frameworks (PDFs) for three wards in Hoima city. The technical personnel who took part in the training prepared PDFs for Kibingo and Western in Western Division and Bwikya (Kinubi) in Eastern Division (**Figure 12**). In line with the geospatial training program, participants collected primary data

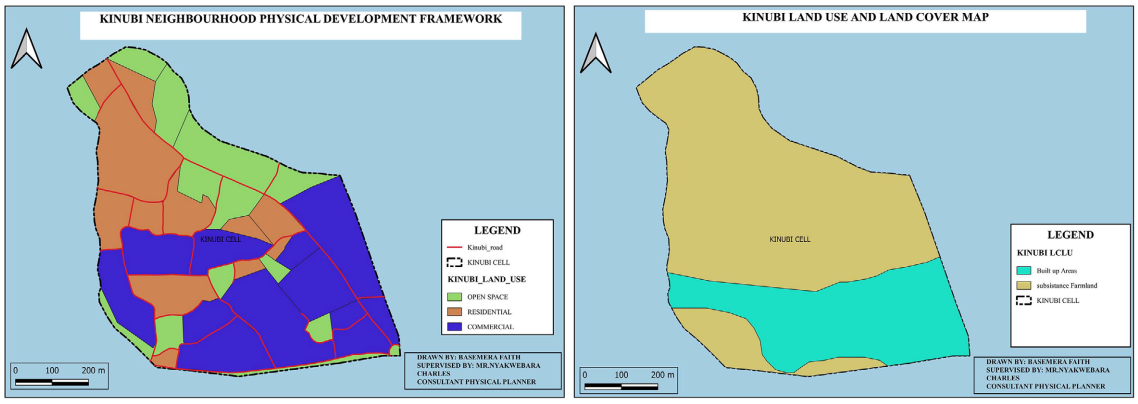
Figure 11. Participants attending Geospatial training in Hoima public library.



(a) Western Ward Physical Development Framework (PDF)



(b) Kibingo Ward Physical Development Framework (PDF)



(c) Kinubi (Bwikya) neighborhood (PDF)

Figure 12. PDFs for Western ward, Kibingo and Bwikya Wards.

(using mobile GPS/GNSS) from the respective Wards to supplement the secondary data and generate different spatial layers.

The three groups were given hands on guidance by the project teams from Makerere University and Ministry of Lands, Housing and Urban Development in the process of PDF preparation. Practical sessions on using geospatial technologies in map preparation, editing and visualization among others were organized. Through these exercises, participants demonstrated the link between the skills attained in the theory lectures and the real life practice. In a period of about one week, groups had prepared the three neighborhood plans which were presented as the final task of the project.

6. Conclusion

The focus of this project was to train and equip physical planning and urban development technical personnel in the newly created cities in the use of geospatial technologies to prepare Physical Development frameworks through Rapid Physical Planning Assessment (RAPPA). The approach emphasizes internal capacity building and use of minimum resources with full stakeholder involvement. The study therefore concludes that:

1) Hoima city has five categories of stakeholders including the Technical Planning Committee, the Executive, the Urban Physical Planning Committee (UPPC), Council agents and land lords. Each of these stakeholders has different roles in the planning process.

2) With about 90% of the technical personnel having no prior exposure to the use of geospatial technologies, a tailor-made geospatial training was able to lift the skills gap situation to about 60%. But this was mainly for technocrats in the works department.

3) It was possible for technocrats to team up and prepare PDFs for selected neighborhoods within the local government in a limited time.

4) Use of simple, cheap technologies/open source software such as mobile GPS essentials and Quantum GIS was also explored.

5) The participatory approach to planning emphasized the roles and responsibilities of different participants/stakeholders in a RAPPA undertaking.

From the above observations, the study notes that Physical Planning as a decentralized activity to Local Governments is a lengthy and costly undertaking. Local governments hardly have the resources required for this undertaking. Hence, there is the need for an intermediate approach that would respond to the Local Government quest for orderly and sustainable development. RAPPA as an approach evolved by the Ministry of Lands, Housing and Urban Development evolved RAPPA is a quick and inexpensive process to help ease the growing challenges of no planning in LGs. In Hoima, the RAPPA project was undertaken by LG technocrats following a geospatial training conducted by Makerere University under Research and Innovation Fund (RIF). The results of the study indicated that RAPPA is an idea that LGs can adopt if they are to ease on the decision making pressures related to physical planning. Stakeholders within the LG can be mobilized to participate and produce PDFs covering different spatial extents. PDFs could later form a basis for hiring planning consultants to undertake comprehensive physical planning studies as and when resources are available.

7. Recommendations

In view of the above study findings and the practical experience in physical planning practice, a number of recommendation are proposed for adoption to contribute towards improved visibility of physical planning in urban local governments including the newly created cities like Hoima city in Uganda:

Training, retraining and retooling technical personnel in Local Governments to appreciate and effectively initiate and participate in physical planning undertakings. The Ministries of Lands, Housing and Urban Development and that of Local Government could come up with a re-skilling program for local government technical personnel through tailor-made refresher courses. Using the experience from this project, it was found out that skills gaps existed in the LG entity even within core planning professionals. It is common practice that with passage of time amidst less exposure to practice, skills begin to dwindle. Besides, LGs lack tools and equipment like computers to support physical planning work.

Innovative funding arrangements for Physical Planning in Local Governments: Physical planning is one of the decentralized activities in LGs. Essentially, LGs are meant to finance physical planning activities largely from their local revenue unless special funding arrangements are made like in the case of funding from the MLHUD. Unfortunately, most LGs have very limited financial capacity to support meaningful planning projects. With limited resources, LGs should embrace RAPPA as a spring board for forward planning in their entities. The approach is rather flexible in that it can be applied to any spatial unit like a ward (in an urban setting) to come up with an understanding of land use patterns/characteristics in the area other than waiting for resources to conduct

comprehensive planning. It is easier for LG entities to locally mobilize resources for planning relatively smaller spatial units than for an entire town council, Municipality or city.

Harnessing open source geospatial databases and software: This project relied a lot on online databases from different government Ministries Departments and Agencies (MDAs). Government entities like Uganda Bureau of Statistics (UBOS), Ministry of Finance, Planning and Economic Development, Surveys and Mapping Department, National Forestry Authority (NFA) and Ministry of Water and Environment have uploaded reasonable data online which can support inter-institutional (integrated) Planning and data sharing and updating. Accessing online databases eases project execution and cuts costs and time. In the same way, since LGs do not have resources to procure and maintain licenses for planning software like ArcGIS, alternative open source software like QGIS and GPS essentials could be good options where extensive analysis is not required.

Regional approach to RAPPA to address the personnel gaps in LGs: It was demonstrated through this project that assembling a team of committed technical personnel for a planning project may not be an easy undertaking by any Local Government. However, it is possible to identify a pool of resources in terms of technical personnel within the geographical region. It is therefore, recommended that a regional approach be adopted to bring together technical personnel from the neighbouring LGs to undertake specific planning projects in a given LG. This will help to bring on board committed technical personnel to execute the project cheaply whilst learning from it.

Redefining the physical planning process to include RAPPA as a preliminary activity: As earlier noted, RAPPA is a relatively new approach in the physical planning domain. It has barely been tested on a range of projects. Prior to this project, RAPPA was only being implemented by the Ministry of Lands, Housing and Urban Development technical teams on a pilot basis. No attempt had been made to test the approach independent of Ministry technical teams. This project proved that once organized, a LG would put together technical and material resources to prepare PDFs on their own. However, this would only be dependent on availability of basic training and financial resources. It is therefore recommended that RAPPA be adopted and institutionalized as a preliminary stage in the planning process. It should be easy and participatory to enable LGs understand the gaps to be filled by comprehensive planning. This could be done as part of TOR definition to give a clear picture of the planning scope to the consultants besides reducing costs of conducting physical planning studies.

Acknowledgements

The Research Team is grateful to the Government of Uganda and Makerere University Research and Innovation Fund (Mak-RIF) for the trust and confidence to extend financial support for conducting this study on Harnessing Geospatial

Technologies for sustainable urban Planning in newly created cities in Uganda; conducted in Hoima City. The Research Team wishes to thank the Town Clerk[3] and technical personnel of Hoima City Council for facilitating and participating in this study. We also thank all stakeholders in Hoima who directly or indirectly invested their time and efforts in this study. We are greatly indebted to our Geospatial training experts, Dr. Allan Mazimwe and Mr. David Ofoyrwoth, whose input brought this study to meaningful fruition. Thank you for your invaluable efforts and calmness in handling the exercise. We are also grateful to the Department of Physical Planning in the Ministry of Lands, Housing and Urban Development and all other stakeholders who participated in this study.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

Baharek, K., Husam, A.-N. A., Hussein, M. R., Maruwa, S. A., Mohammed, O. I., Alfian, A. H., & Shattri, M. (2019). Urban Planning Using a Geospatial Approach: A Case Study of Libya. In A. Almusaed, A. Almssad, & L. Truong-Hong (Eds.), *Sustainability in Urban Planning and Design.* ItechOpen.

Chuvieco, E. (1993). Integration of Linear Programming and GIS for Land-Use Modelling. *International Journal of Geographical Information Systems, 7,* 71-83. https://doi.org/10.1080/02693799308901940

Cohen, M. (2017). A Systematic Review of Urban Sustainability Assessment Literature. *Sustainability, 9,* Article 2048. https://doi.org/10.3390/su9112048

Dambudzo, I. I. (2015). Curriculum Issues: Teaching and Learning for Sustainable Development in Developing Countries, Zimbabwe Case Study. *Journal of Education and Learning, 4,* 11-24. https://doi.org/10.5539/jel.v4n1p11

Despotakis, V., Giaoutzi, M., & Nijkamp, P. (1993). Dynamic GIS Models for Regional Sustainable Development. In M. Fischer, & P. Nijkamp (Eds.), *Geographic Information Systems, Spatial Modelling and Policy Evaluation* (pp. 235-261). Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-77500-0_15

Guillaume, J. (2020). Planning and Managing Africa's Cities: What Place for Technology Innovations? *The Journal of Field Actions, No. 22,* 52-57.

Khirfan, L. (2011). GIS, Town Plan Analysis, and Historical Archival Research: Understanding the Links between Inherited Built Forms and Contemporary Urban Design. *Urban Morphology, 5,* 39-53. https://doi.org/10.51347/jum.v15i1.3960

Lo, C. (2007). The Application of Geospatial Technology to Urban Morphology Research. *Urban Morphology, 11,* 81-90. https://journal.urbanform.org/index.php/jum/article/view/3934 https://doi.org/10.51347/jum.v11i2.3934

Longley, P. G. (1994). Research Paper. The Predictive Use of GIS to Model Property Valuations. *International Journal of Geographical Information Systems, 8,* 217-235. https://doi.org/10.1080/02693799408901995

[3]At the beginning of this project Mr. Godfrey Bamanyisa was the Town Clerk of Hoima City and was indeed helpful in setting the project in motion.

MLH & UD (2020a). *Ministry of Lands, Housng and Urban Development Strategic Plan 2020/21-2024/25.* Ministry of Lands.

MLH & UD (2020b). *Preparation of Physical Development Frameworks for Six Refugee Hosting Districts Using Rapid Physical Planning Assessment (RAPPA).* Ministry of Lands, Housing and Urban Development.

NPA (2015). *Second National Development Plan (NDP III) 2015/16-2019/20.* National Planning Authority.

Ritchie, H., & Roser, M. (2018). *Urbanization.* Our World in Data. https://www.ourworldindata.org/urbanization

Schaller, J. (1992). GIS Application in Environmental Planning and Assessment. *Computers, Environment and Urban Systems, 16,* 337-353. https://www.sciencedirect.com/science/article/pii/019897159290015J https://doi.org/10.1016/0198-9715(92)90015-J

Serhat, K. (2017). *The Eddie Model Instructional Design*. Educational Technology. https://educationaltechnology.net

Sink, D. L. (2014). Design Models and Learning Theories for Adults. In E. Biech (Ed.), *The Definitive Reference for Training & Development* (2 ed., pp. 181-199). ASTD Press.

UN (2020). *The Sustainable Development Goals Report 2020.* https://unstats.un.org/sdgs/report/2020/The-Sustainable-Development-Goals-Report-2020.pdf

UN (2023). *Department of Economic and Social Affairs*. United Nations Sustainable Development Goals. https://sdgs.un.org/#goal_section

UnearthLabs (2022). *GIS for Urban Planning: Benefits, Applications & Tools*. https://www.unearthlabs.com/blogs/gis-uses-urban-planning

Wang, X. M. (2016). *How Geospatial Technology Can Help Cities Plan for a Sustainable Future*. World Bank. https://blogs.worldbank.org

Yaakup, A., Sulaiman, S., Musa, N., Ahmad, M. J., & Ibrahim, M. Z. (2002). GIS as Tools for Monitoring the Urban Development in Metropolitan Region: A Case of Klang Valley Region, Peninsular Malaysia. In *GISDECO 2002.* Universiti Teknologi Malaysia Institutional Repository.

Yeh, A. G.-O. (1999). Urban Planning and GIS. *Geographical Information Systems, No. 2,* 877-888.

Yeh, A. G.-O., & Chow, M. H. (1996). An Integrated GIS and Location-Allocation Approach to Public Facilities Planning—An Example of Open Space Planning. *Computers, Environment and Urban Systems, 20,* 339-350. https://doi.org/10.1016/S0198-9715(97)00010-0