Human Capacity Development for the Application of Geospatial Technologies in Land Administration and Management in Rwanda

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Introduction

- Efficient utilisation of land and land resources is required by every country to achieve sustainable economic growth and development.
- Sustainable development entails meeting the needs of the present without compromising the ability of the future generations to meet their own needs (World Commission on Environment and Development, 1987)
- Land administration and management are very crucial in achieving sustainable spatial development (Williamson *et al*, 2010; Dawidowicz & Źróbek, 2017). Sustainable spatial development basically involves the use and development of land in a manner that results in economic, social and environmental sustainability.

Introduction Cont.

- Land administration and management has evolved since the advent of human civilization.

- The most significant aspect of this evolution is the application of geospatial technologies, in which land information is collected, stored, processed, retrieved and utilised through geographic and land information systems.

- No doubt, the application of geospatial technologies in land administration and management requires competent human resources the world over.

Introduction Cont.

- Due to advances in geographic and land information systems and developments in information and communication technologies, coupled with the forces of globalisation, it is imperative for every country that intends to achieve efficient and sustainable land administration and management to consistently pay attention to the development of human capacity, especially in the application of geospatial technologies.
- Rwanda is one of the few emerging economies in Africa with a well-established land administration and management system.
- As the country progresses towards a knowledge-based economy, the sustenance and efficiency of its land administration system largely depends on the capacity of its human resources.

The Concept of Human Capacity Development

- Human capacity development (HCD) is very essential for the effective functioning of the private and public sectors of every nation's economy.
- It is the process through which individuals, organisations and societies obtain, strengthen and maintain the capabilities to set and achieve their own development objectives over time (UNDP, 2009).
- This definition has been further modified by the United Nations Economic Commission for Africa (UNECA) in its capacity development strategy document. It defines HCD as the process through which individuals, groups, organisations and societies deploy, adapt, strengthen and maintain the capabilities to define, plan and achieve their own development objectives on an inclusive, participatory and sustainable basis.

The Concept of HCD Cont.

- The primary objective of HCD is to produce competent human resources to improve governance and enhance the welfare of the people. The cycle of HCD is shown in Figure 1.

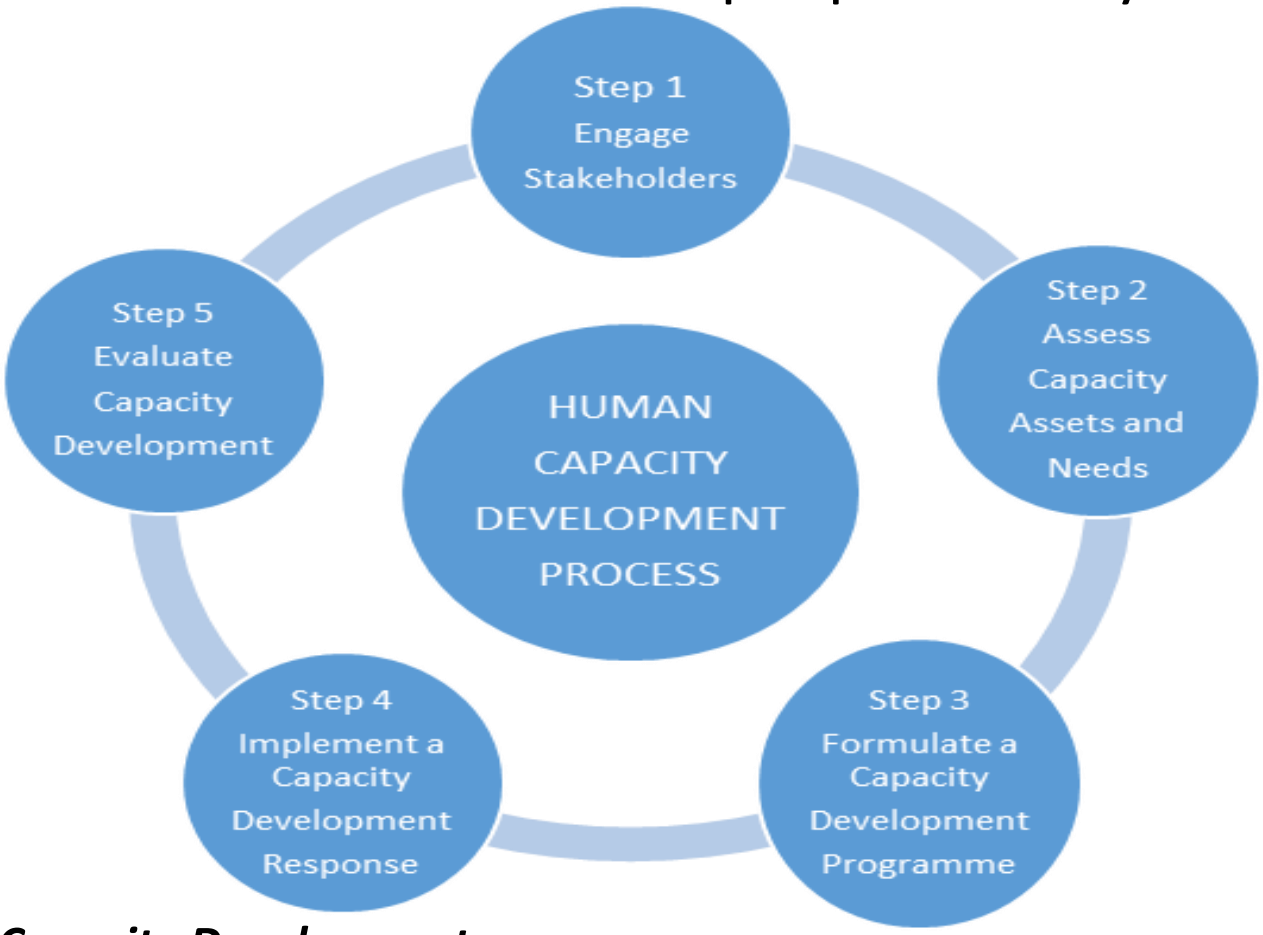

Figure 1: The Cycle of Human Capacity Development

Source: *Adapted from UNDP (2009)*

Human Capacity Development in Rwanda

- HCD in all sectors of the economy has been a major policy objective of the Government of Rwanda in its effort towards achieving sustainable economic growth and development.
- It is a key priority for achieving the country's socioeconomic transformation agenda envisioned in its Vision 2020 (UNFPA, 2017).
- In the last two decades, the government has undertaken several programmes and initiatives aimed at building capacity for the country's critical areas of need. The overall goal of these initiatives is to achieve national growth, improved governance and poverty reduction as well as produce sufficient human resources required to transform the country from low-income to middle-income status (NCBS, n.d).
- An important sector of the economy that is very crucial to the HCD efforts of the government is the tertiary education sector. This is because it provides the middle-level and high caliber manpower required for the smooth operation of the economy.

HCD in Rwanda Cont.

- Critical reforms have also been carried out in this sector.

- The most remarkable of these reforms was the consolidation of public universities in the country into a single public university (the University of Rwanda) in 2015 with the mandate to focus extensively on science, technology, engineering and mathematics (STEM) disciplines.

- However, despite this mandate by the government only a small number of graduates have been produced from these fields for the economy in the past few years as presented in Table 1.

Table 1: Graduates produced by all Tertiary Institutions in Rwanda, 2016 – 2017

Field of Education	2016		2017	
	No. of Graduates [a]	% [b]	No. of Graduates [a]	% [b]
Education	4566	19.3	5010	21.7
Arts and Humanities	212	0.9	440	1.9
Social Sciences, Journalism and Information	1138	4.8	1377	6.0
Business Administration and Law	8688	36.8	6566	28.4
Natural Sciences, Mathematics & Statistics	1367	5.8	1133	4.9
Information and Communication Tech	2544	10.8	1515	6.6
Engineering, Manufacturing & Construction	903	3.8	2850	12.3
Agriculture, Forestry, Fisheries & Vet.	948	4.0	931	4.0
Health and Welfare	2153	9.1	2186	9.5
Service	1116	4.7	1092	4.7
Total	23,635	100	23,100	100

Source: [a] *Ministry of Education (2018)*

[b] *Computed from a*

HCD in Rwanda Cont.

- In 2016 and 2017, the proportions of graduates from STEM to the total number of graduates from all tertiary institutions in the country as indicated in Table 1 were 33.5% and 37.3% respectively. These are far below those from non-STEM disciplines which were 66.55 and 62.7%.
- Except significant improvement is made, this scenario will obviously affect the availability of human resources for the application of geospatial technologies in the various sectors of the nation's economy. This is because the skills needed for the use of geospatial technologies are derived from the knowledge obtained from STEM disciplines.
- Although progress has been made in HCD for national growth and economic development in the last decade, much needs to be done to improve the quality of human resources in the country.

HCD in Rwanda Cont.

- HCD in Rwanda is based on three fundamental strata namely, individual, organisational and policy environment/institutional levels (Ndashimye, 2015). The trend in human development index (HDI) of Rwanda and those of other countries in East Africa is shown in Figure 2.
- The HDI of Rwanda has improved progressively in the last two decades. This may be attributed to the various interventions of the government within the period.
- Nevertheless, the HDI of the country is far lower than those of Sub-Saharan Africa and developing countries as shown in Figure 3, an indication than more HCD initiatives need to be embarked upon.

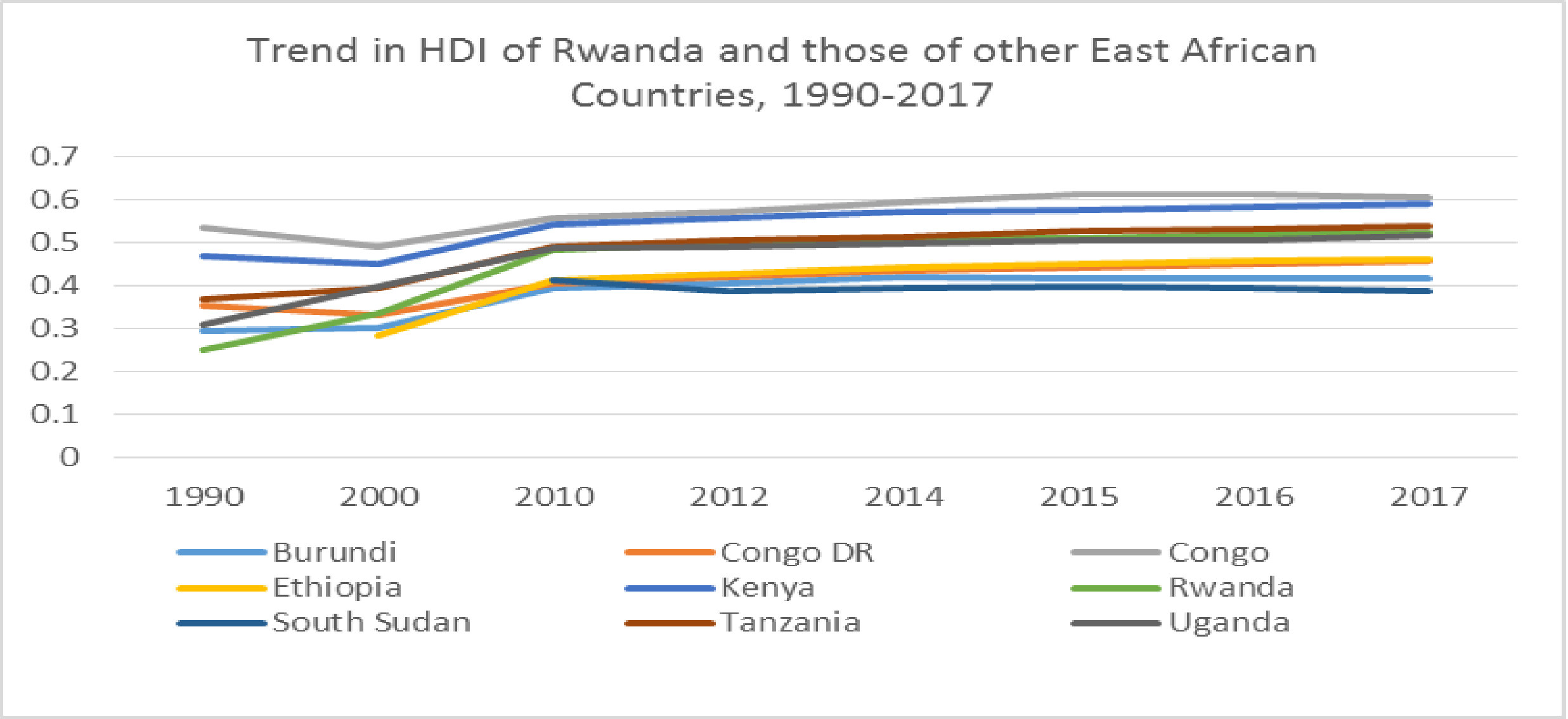

Figure 2: Trend in HDI of Rwanda and those of other East African Countries, 1990 – 2017 based on Data from UNDP (2018)

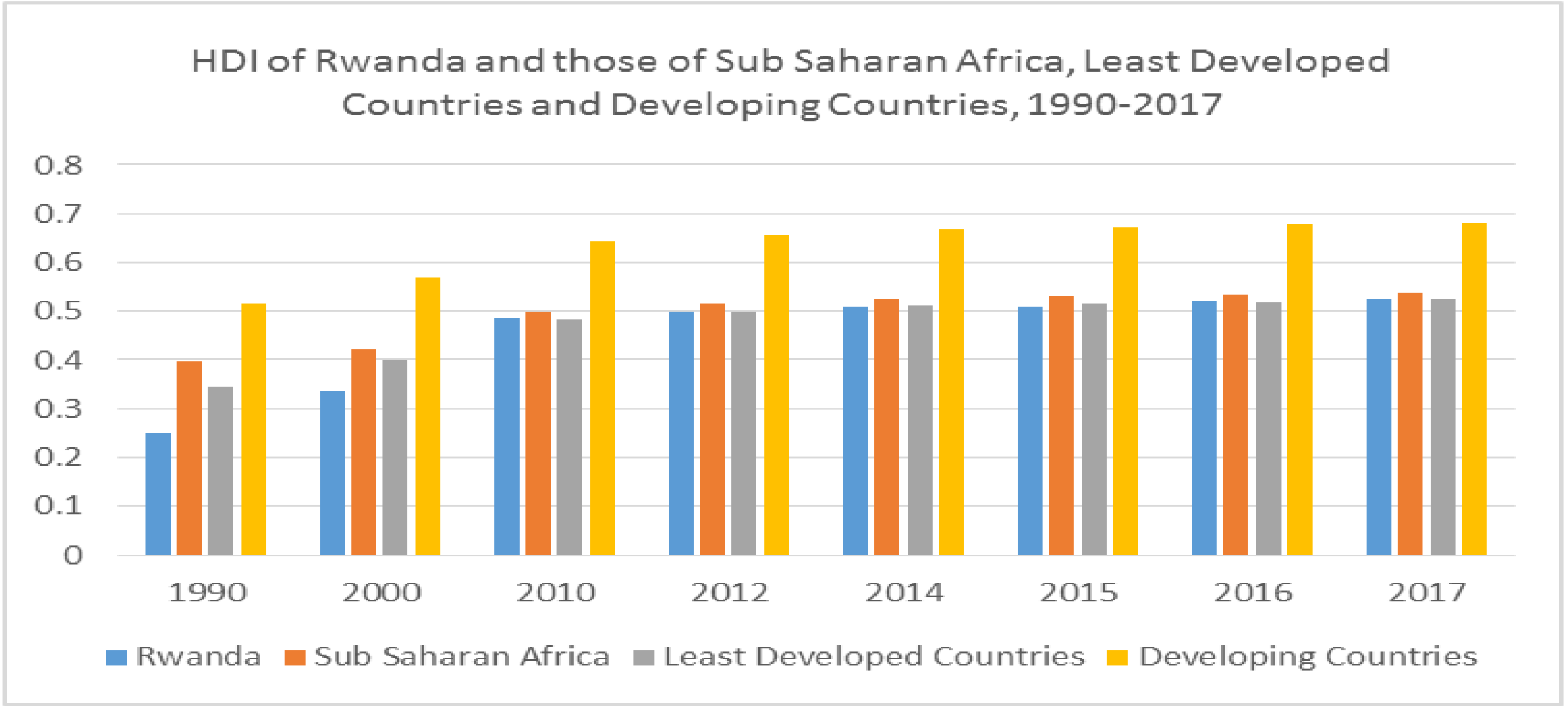

Figure 3: HDI of Rwanda and those of Sub-Saharan Africa, Least Developed Countries and Developing Countries, 1990 – 2017 based on Data from UNDP (2018)

An Overview of Land Administration and Management

- Over the years, several scholars and institutions have attempted to provide the definition of land administration that is widely accepted across the globe.
- The definition provided in the Land Administration Guidelines of the United Nations Economic Commission for Europe (UNECE) appears to be the most adopted definition in the literature in the last two decades.
- It defines land administration as the processes of determining, recording and disseminating information about the ownership, value and use of land when implementing land management policies. Such processes include the determination (sometimes known as the “adjudication”) of rights and other attributes of the land, the survey and description of these, their detailed documentation and the provision of relevant information in support of land markets (UNECE, 1996).

An Overview of Land Administration and Management Cont.

- Similarly, land administration is the way in which the rules of land tenure are applied and made operational (FAO, 2002). It is the management of a system of land rights (Lindsay, 2002).
- According to UN-GGIM (2015), land management is the art or science of making informed decisions about the allocation, use and development of the earth's natural and built resources.
- Economic, social and environmental sustainability cannot be achieved without good land management.
- Land management covers all activities concerned with the management of physical resources of land, including farming, mineral extraction, property and estate management and physical planning of towns and the countryside (UNECE, 2005).
- Land management and land administration are interwoven and inevitably inseparable. An essential commodity that links both functions is land information. Land information is simply information about land and land resources.

A Review of Land Administration and Management in Rwanda

- Land and land resources are very crucial to the economic growth and development of Rwanda. It plays an inestimable role in the poverty reduction strategy of the government as well as sustainable economic empowerment of the people.
- Rwanda is an emerging economy heavily dependent on agriculture. Sustainable agriculture particularly in the rural areas cannot be achieved without effective access to land by a larger proportion of the population.
- In the last two decades, the government has made significant progress in land administration and management in the country. This is examined here based on three aspects namely, legal, spatial and institutional aspects.

A Review of Land Administration and Management in Rwanda Cont.

Legal Aspect

- Land administration is built on policies and laws and further detailed in regulations and guidelines (SIDA, 2008).
- Several laws and regulations have been enacted to streamline land rights in the country as well as facilitate the land tenure regularization (LTR) programme of the government.
- Important among these laws are the Constitution of the Republic of Rwanda (2003), the National Land Policy (2004) and the Organic Land Law (2005).
- Other key legislations such as those relating to expropriation in the public interest (2007), mortgages (2009), the valuation profession (2010) and several Presidential and Ministerial Orders have been issued to enhance efficient land administration and management in the country.

Spatial Aspect

- No land administration system the world over can function properly without reliable spatial data and an effective spatial data infrastructure (SDI).
- SDI is the pivot of any land administration system.
- The Lands and Mapping Department was established in the Rwanda Natural Resources Authority (RNRA) to coordinate the mapping of the country for the purpose of producing cadastral plans of land parcels for registration through the land tenure regularization (LTR) project.
- The outcome of the LTR is that all the 10.67 million parcels of land in the country have been demarcated and entered into the database of the land administration information system, out of which 9.1 million land parcels have full information on claimants (Nkurunziza, 2015).

Institutional Aspect

- No country can maintain stability within its boundaries or sustain economic development unless it has land policies that promote internal confidence among its people and its commercial enterprises (UNECE, 2015).
- These policies must be implemented by good land governance institutions in order to achieve good land administration
- Land governance institutions in Rwanda involved in land administration and management in the country operate a top-bottom administrative structure. At the top of the structure is the Ministry of Natural Resources (MINIRENA) which is responsible for addressing issues of policy (RNRA, 2012).
- The effectiveness of these institutions in land administration and management has improved the quality of land administration in the country in the last decade.
- The quality of land administration in Rwanda and that of the entire Sub-Saharan Africa is presented in Table 2.

Table 2: Quality of Land Administration Index of Rwanda and Sub-Saharan Africa

Key Component	Maximum Point	Rwanda	Sub-Saharan Africa
Reliability of infrastructure	8	8	1.6
Transparency of information	6	1.5	1.8
Geographical coverage	8	8	0.7
Land disputes resolution	8	7.5	4.3
Total Index	30	25	8.4

Source: *World Bank (2015) as adopted by Deininger et al (2015)*

- Based on the key components of the quality of land administration index, the land administration system in the country is efficient in terms of reliability of infrastructure (100%), geographic coverage (100%), land disputes resolution (93.8%), but very deficient in terms of transparency of information (25%).
- Therefore, greater attention should be focused on access to accurate and reliable land information by all who need such essential resource. In today's digital world, such initiative is not possible without the use of geospatial technologies.

Geospatial Education and Training for Land Administration and Management in Rwanda

- Land administration is inherently geographical and good geospatial information is needed to manage geographic elements in a digital world (UN-GGIM, 2015).
- Geospatial technologies consist of modern tools that aid in the geographic mapping of the earth for a wide range of purposes. Basically, they are technologies relating to the collection or processing of data that is associated with location (AAAS, 2019).
- They include remote sensing, geographic information systems (GIS), global positioning system (GPS), internet mapping technologies, surveying, geodesy, photogrammetry and global navigation satellite system (Pin-Cheng, 2001; Satapathy, 2008 & AAAS, 2019).

Geospatial Education and Training Cont.

- Without geospatial technologies, the development of an effective land information system will be extremely difficult
- It is imperative to state that human resources are very crucial for the establishment and maintenance of any land information system and human capacity development is inevitable for the sustenance and survival of such system.
- Stuart *et al* (2009) carried out a survey of GIS professionals in Africa and found that there is limited human resource capacity, especially lack of trained personnel. They also discovered that this is the most significant factor limiting the wider use of geospatial technologies in the continent. It is also the view of UNCTAD (2012) that the application of geospatial technologies particularly in developing countries is largely hindered by insufficient human resources and challenges to capacity-building.
- This is further worsened by the limited number of higher learning institutions offering competency-based degree programmes in geospatial disciplines. This is the situation in Rwanda as indicated in Table 3.

Table 3: Number of Tertiary Institutions in Rwanda offering academic programmes in Geospatial Disciplines

Number of private tertiary institutions	29
Number of public tertiary institutions	2
Total number of tertiary institutions	31
Number of tertiary institutions offering programmes in geospatial disciplines	2
Proportion of tertiary institutions offering programmes in geospatial disciplines	6.45%

Source: *Extracted from Higher Education Council of Rwanda (2019)*

- As indicated in Table 3, only two tertiary institutions, representing 6.45% of all the tertiary institutions in the country offer academic programmes in geospatial disciplines.
- This situation has serious implications on the availability of competent human resources for the application of geospatial technologies in the country

Geospatial Education and Training Cont.

- In the context of HCD, the curriculum is very vital and should be updated regularly in order to produce professionals that can respond properly to the dynamics of today's digital world in terms of cutting-edge skills and competencies.
- According to the Guidelines for the development of Curricula on Land Governance in Africa (UNECA, 2017), *Curricula on land governance ought to include training on the development of affordable and accessible Land Information Management Systems (LIMS) responsive to Africa's unique circumstances (Guideline 21).*
- Consequently, HCD for the application of geospatial technologies should be structured to provide specific solutions to the land administration and management challenges of each country.
- It should also be a mainstream component of the land administration system and not an "add-on" (Williamson, 2001). In other words, it should be a continuous process of training within the gamut of spatial data infrastructure.

Methodology

- This study utilised primary and secondary data.
- Primary data were collected from landed professionals involved in land administration and management in the country, using structured questionnaires.
- Secondary data were obtained from the curricular of geospatial disciplines offered by tertiary institutions in the country. These institutions are the University of Rwanda and the Institute of Applied Sciences (INES).
- Geospatial disciplines offered by the University of Rwanda are Geography and Planning, Estate Management and Valuation and Civil, Environmental and Geomatics Engineering while that offered by INES is land administration and management. Oral interviews were also held with senior resource persons in these disciplines.

Results and Discussion

- Majority of the respondents are males (71%). This indicates that land administration and management in the country is dominated by the male gender.
- Most professionals involved in land administration and management in the country (84%) are University degree holders. This is a reflection of the fact that professional knowledge is required for the execution of these functions.
- About 45% of the respondents use GIS in managing land-related information. This implies that despite the fact that GIS is taught across all the geospatial disciplines, its application in land administration and management in the country is still limited.

- As indicated in Table 4, some key components of geospatial technologies are very marginal in the curricular of geospatial disciplines in the country. These are:

(1) Geostatistics

(2) Computer Programming

(3) Geospatial Data Mining

(4) Spatial Data Infrastructure

(5) Web-based Mapping

(6) Ethics in Geospatial Technologies Applications

Table 4: Key aspects of Geospatial Technologies covered by the Curricula of Geospatial Disciplines in Tertiary Institutions in Rwanda

Key Component	University of Rwanda			INES
	GEO	CEGE	EMV	LAM
GIS and LIS Applications	X	X	X	X
Geostatistics	X	X		
Cadastral Surveying	X	X	X	X
Remote Sensing	X	X		X
Computer Programming		X		
Spatial Data Infrastructure		X		X
Geospatial data mining				
Web-based Mapping		X		
Spatial data visualization		X		
Digital Cartography	X	X		
Geodesy and GNSS		X		X
Ethics in Geospatial Technologies Application				

In Table 4,

GEO = Geography

CEGE= Civil, Environmental and Geomatics Engineering

EMV = Estate Management and Valuation

INES = Institute of Applied Sciences, Ruhengeri, Muzanze

LAM = Land Administration and Management

Conclusion

- In recent times, geospatial technologies have facilitated and improved the efficiency of land administration and management in developed and developing countries of the world, including Rwanda.
- However, the effective application of these technologies in the execution of land administration and management functions depends on the availability of competent human resources.
- Effective collaboration between the stakeholders is very essential. Such cooperation is essential for sustainable capacity building to produce human resources with appropriate skills and competencies needed for efficient land administration and management in the country through the application of geospatial technologies.