Beni Atlas'

An interface for the informal city

by

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners. I understand that my thesis may be made electronically available to the public.

Abstract

A map is a chart or diagram that uses spatial relationships to communicate information. Through the medium of the map a desired goal can be impressed on people's minds as a first step to changing the environment. The history of mapping shows that changes in technology brought about ideologies of progress that were communicated in maps. The digital revolution has brought about an image culture that is changing the way we connect with space. Instead of physical rules limiting the way we interact with space, we are now able to redefine it entirely. As architect Richard Wurman writes in the preface of *The Exposed City*, digital maps allow people "to see the things they've always seen but never seen," and choose to respond to that new knowledge in space. Architects such as Richard Wurman, Buckminster Fuller, James Corner, Ole Bouman, Raoul Bunschoten and MVRDV, to name a few, have acknowledged the need to be involved in the design of digital mapping programs to maintain our position as advocates for quality built space.

Digital mapping techniques are considered by many to be a tool of agency for marginalized people in the developing context. The last twenty years have seen a wave of "public participatory GIS (geographic information system)" programs being initiated in communities around the world. Digital maps offer the ability to store and represent an infinite amount of information, make it available to the masses, and apply techniques to make it dynamic and interactive. Beni Atlas explores mapping theory, analyses current employment of digital maps and then employs what is learned to the design for a mapping framework for the community of Beni in the eastern Democratic Republic of Congo in partnership with a local university.

The design uses a framework methodology because the image of a map is never alone but is surrounded by a set of community programs and digital sequences that drive how a map is created, used, shared, stored, connected, etc. This framework is the atlas' (prime) that is taken to a new level of possibility with the use of digital technology. The goal of the framework is to unite data from bottom-up and top down sources, provide clarity and understanding for users, and become a tool that allows for communication and partnership between different actors in the community.

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3.4 Maps and Metadata of Beni

1.1 Introduction

Mapping is a fantastic cultural project, creating and building the world as much as measuring it and describing it. Long affiliated with the planning and design of cities, landscapes, and buildings mapping is particularly instrumental in the construing and constructing of lived space. In this active sense, the function of mapping is less to mirror reality than to engender the reshaping of the worlds in which people live.

– James Corner, The Agency of Mapping: Speculation, Critique and Invention (Corner 1999, 10)

Study of Mapping

Maps have existed throughout history as a means to understand spatial position within a surrounding context. The *Oxford Dictionary* defines the map as "a diagrammatic representation of an area of land or sea, showing physical features, cities, roads. etc.[1]" This is the typical definition of road maps that many people are familiar with. A second definition is that a map is "a diagram or collection of data showing spatial arrangement or distribution of something over an area.[2]" The range of imagery that can be called a "map" is therefore very broad, but what all maps have in common is that they always represent spatial relationships, be they of streets, stars, atoms, or system flows. The maps that this thesis addresses have two qualities: they represent the physical world at the visible scale ranging from a plot of land to the globe, and they communicate past, present, and future realities of the site. An atlas is a collection of maps that are published as a book or multimedia application.[3]

The medium of the map has changed over the centuries, as has the type of agency it provides for people to bring about change in their environments. For example, the digital map is a new medium developed over the past three decades that changes the possible content and reach of maps. The digital map is available to the global community and can be shared and manipulated by people despite their physical distance. The digital map can also represent complex data that cannot be easily mapped by hand and can serve to better understand and design complex systems. These capabilities have brought digital mapping to the forefront in recent years as a democratic tool. Public Participatory Geographic Information System (PPGIS) is a term representing a wave of initiatives occurring around the world in the past two decades that structure the involvement of the community in contributing data to improve equity and influence policy. Many initiatives have been deployed in underdeveloped countries with the hope of shedding light

1 Oxford Dictionary . "Map." http://www.oxforddictionaries.com/us/definition/american_english/map

2 Ibid.

3 Ibid., /atlas.

1–01 The Bayeux Tapestry that depicts the narrative of the 1066 Norman Conquest of England

1–02 First portolan map by Giovanni Domenico Cassini based on latitude and longitude points,1696

on complex issues related to land ownership, resource use, and other conflicts.

History of mapping reveals that mapping is a complex and fragile practice because it is dualistic and inherently political. Writer and landscape artist J.B. Jackson highlights the duality of the map in his book *Describing the Vernacular Landscape* in his example of how "forum follows function". He writes how a simple plan for a city piazza serves two purposes. For the inhabitant it is a place where people come together, whereas politically it is a space designed to bring together members who are aware of their communal responsibility.[1] Scholars of mapping such as Jerry Brotton and Armand Mattelart describe this same duality in maps from the renaissance, early modern, and modern periods.[2, 3] A common pattern emerges that the practice of mapping can benefit one party while simultaneously exploiting others, and that technology as an amplifier has the ability to achieve greater benefit or greater detriment. The vast application of digital mapping around the world and across disciplines suggests a need for mapping and design discourse to address what is effective design in the domain of digital mapping and how the full capabilities of digital mapping can be defined and explored. The research proposes that it is important as designers to establish what makes a well-designed framework for a map. The term "framework" is used because the image of a map is never alone but is surrounded by a set of programs and digital sequences that drive how a map is created, used, shared, stored, connected, etc. This framework is the atlas' (prime) that is taken to a new level of possibility with the use of digital technology.

Historical Shifts of the Map's Form and Function

By studying mapping through history, it can be determined that as the medium of the map changed with developments in technology, the function of the map also changed. In the *Atlas of Science: Visualizing What We Know*, author Katy Börner summarizes how maps changed over time.[4] In ancient times maps were primarily used for story telling. Although nothing was spatially accurate, key icons determined location and a sequence of events. Portolan charts in the 13th and 14th centuries grew more accurate and portrayed the expansion of empires and establishment of trade routes.[5] The maps were based on Ptolemy's Geographia, but were framed to benefit the political aspirations of the

1 John Brinckerhoff Jackson, Discovering the Vernacular Landscape (Yale University Press: 1984), 17.

2 Jerry Brotton, "Terrestrial Globalism" in *Mappings*, edited by Denis Cosgrove (Reaktion Books, 1999), 77.

3 Armand Mattelart, "Mapping Modernity" in *Mappings*, edited by Denis Cosgrove (Reaktion Books, 1999), 176.

4 Katy Börner, *Atlas of Science: Visualizing What We Know* (Cambridge: The M.I.T. Press, 2010), 10.

5 Ibid., 10.

cartographer's patron who was often a ruling monarch. The printing press allowed for the wider distribution of the same map, and the ability to restrict distribution to a single map that depicted desired political interests. The technology of the printing press also allowed maps to be compiled into atlases for the first time.[1] Mapping became more prevalent at the smaller scale with the end of the feudal serfdom and the shift toward land ownership. The first cadastral information was collected in what was known as a gazetteer in the seventeenth century.

The next developments in technology that changed the function of mapping were the combustion motor and the first electronic devices of the modern period. The role of maps shifted from having a purpose of accumulation to being used to also represent the complexities of cities and infrastructure networks in order to make them productive. Maps were used not just to convince people of land ownership, but also to involve them as active participants in the productive life of the city. The productive assembly line that drove the automobile and other manufacturing industries became mirrored in society.[2] Maps were used to design cities in which the individual became a productive participant in the way that they lived, circulated, and worked. Maps projected the benefits of this lifestyle. The first air and space travel reenforced the idea of a communal perspective of change. For the first time an image could be produced that looked down on a place in all exactitude.[3]

The final and current shift in mapping occurred with the advent of computation and the world wide web. Frederic Jameson in his book *Post-Modernism, or, the Culture of Late Capitalism*, describes the digital age as entering a whole new dimension. It has brought about an image culture that operates primarily in the digital realm and therefore has a disconnect from what occurs in physical space.[4] Digital maps attempt to bridge the divide by representing the flows of information of our increasingly complex environments using digital tools, a framework of hardware and software that prescribe the design and rules of functionality of the map. Technologies that support digital maps include GPS devices, applications on cell phones, GIS software, databases, code, and web applications. Although writing computer code is a skill possessed by few people, digital maps can be packaged into an interface that, like most machines, can be employed without the user understanding how the inner parts function.

1 Jerry Brotton, *Trading Territories: Mapping the Early Modern World* (Ithaca, New York: Cornell University Press, 1997), 160.

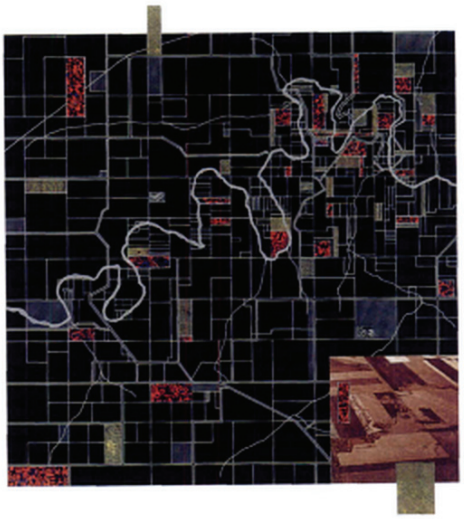
2 Mary McLeod, "Architecture or Revolution: Taylorism, Technocracy, and Social Change" in Art Journal, Vol. 43, No. 2, Revising Modernist History: The Architecture of the 1920s and 1930s (College Art Association, 1983), 132-147.

3 Buckminster Fuller, *Nine Chains to the Moon: An Adventure Story of Thought* (Philadelphia: Lippincott, 1938).

4 Frederic Jameson, *Postmodernism, Or the Cultural Logic of Late Capitalism* (Durham, NC: Duke University Press, 1991), 44.

How Architects Today Use Maps

There are many architects that have recognized mapping as an integral part of architectural practice. They recognize that buildings themselves are no longer objects alone in a landscape but are a part of the systems and networks that serve them. As architect Manuel Gausa describes in *Metapolis*, architecture will expand into the processes, networks, and territories that support and contain it and therefore mapping is a first step to develop strategies for shifting space.[1] Landscape architect and theorist James Corner argues that the role of the architect is shifting and that architects today have a responsibility to decipher increasingly complex environments by the practice of mapping. It is the only way by which architects can design buildings and cities that continue to respond dynamically to complex site conditions.[2] Corner's writing is reflected in his work that often uses hybrid map-drawing and collage as tools to better visualize the often invisible forces acting upon a site.[3] Dutch architects Winy Maas, Jacob van Rijs and Nathalie de Vries of MVRDV have done many experiments in creating "datascapes", imagining how data can visualize itself in a spatial way and begin to project design solutions.[4] Spatializing data has the ability to make information tangible by applying it to the physical reality that people inhabit.



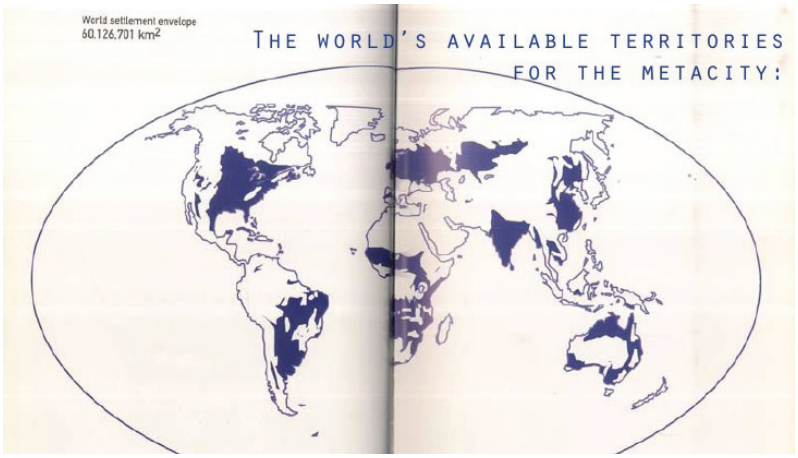
1–03 James Corner: *The Survey Landscape Accrued*

1 Manuel Gausa, *The Metapolis Dictionary of Advanced Architecture: City, Technology and Society in the Information Age* (ActarD Inc, 2003).

2 James Corner, "Agency of Mapping: Speculation, Critique and Invention," in *Mappings*, edited by Denis Cosgrove (Reaktion Books, 1999), 214.

3 Nadia Amoroso, *The Exposed CIty: Mapping the Urban Invisibles* (Routledge: 2010), 97.

4 Nadia Amoroso, *The Exposed CIty: Mapping the Urban Invisibles* (Routledge: 2010), 71.



1–04 MVRVD Metacity/Datatown

1–05 MVRVD Metacity/Datatown

Other architects have gone beyond just the design of maps to designing mapping as a participatory process. Raoul Bunschoten of Chora uses a design methodology called the "urban gallery", that involves the actors and agents of a community in experimental design discourse by building prototypes and testing scenarios.[1] In the 1960's Architect and theorist Buckminster Fuller proposed a theoretical *World Game* that would map and simulate events in real time.[2] The World Game would drive political decision-making and incite people into action. He believed that being able to see and interact with a big picture of the world would encourage a global response for corporate well-being.[3] Design plays a role in creating the structure by which a system's rules and actions can be employed and communicated and

Participation needs to differentiate between the demands of the clients and the desires of the users. Architects, needing clients with power and money, are usually on the side of those in power and willing to embrace and express in built terms the ideology and economics of these clients, to the exclusion of the desires of the potential users. There is thus a removal of the general public from the processes of architectural production, which in turn leads to a sense of alienation of the users from their environment.

– Architecture & Participation (Jones et al. 2005)

1 Raoul Bunschoten, "Points, Spirals and Prototypes," in *Architecture & Participation*, edited by Peter Blundell Jones et al. (Spon Press: 2005), 239.

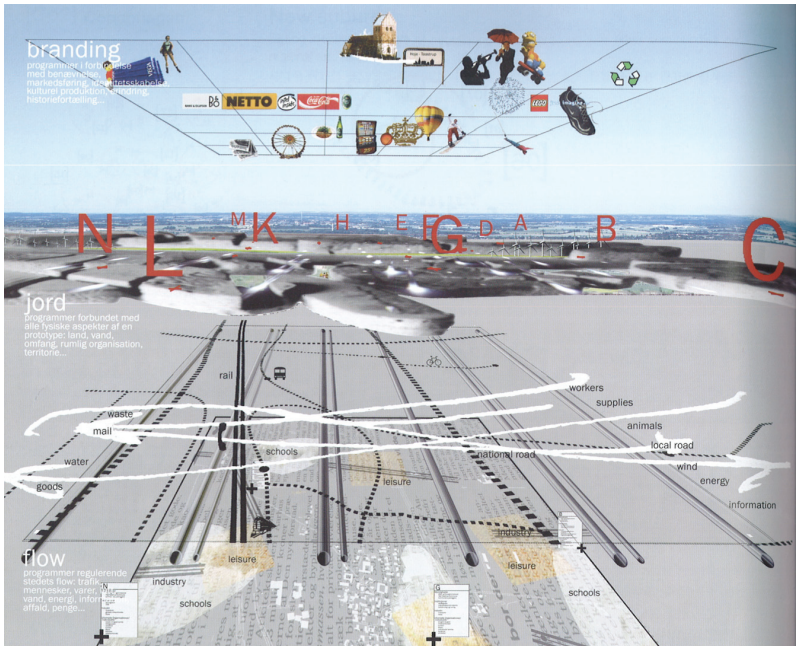
2 Buckminster Fuller Institute 2007. "Introduction to Buckminster Fuller's World Game." http://www.bfi.org/taxonomy/term/170/all

3 Ibid.

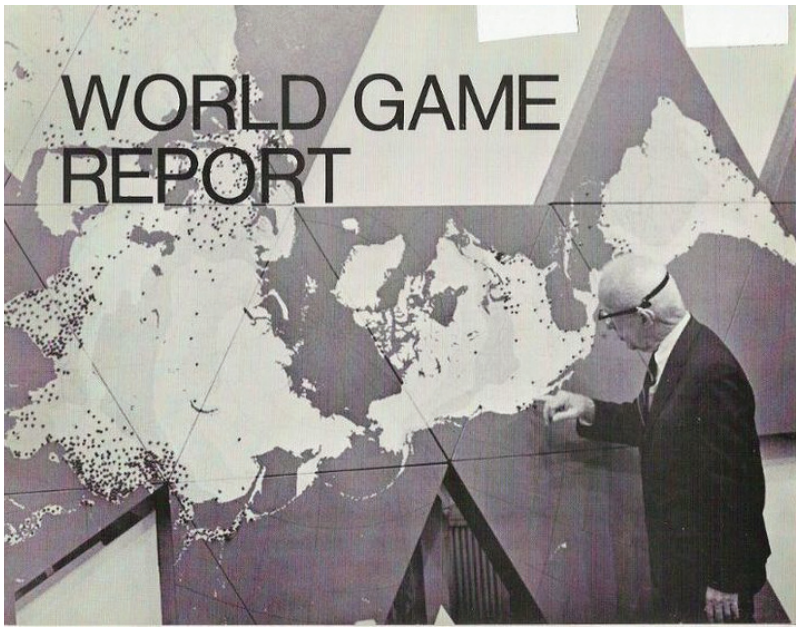
Conflicts are stepping stones in the unfolding of scenarios – tools triggering interaction between actors and agents that otherwise would not meet. Stepping stones are instruments for managing urban change.

– Raoul Bunchoten, Urban Flotsam (Bunchoten 2001)

therefore can provide answers even before it manifests itself in physical space. Before computers, events took place in physical space and therefore it was the architecture that regulated activities. Now many of the same relationships are replaced by a digital structure that defines a parallel set of rules that are often disconnected from space. Digital mapping is a design strategy that can bridge the gap between the digital and physical realms and perform as an autonomous structure of gathering and connection.



1–06 Diagram of the different layers of systems and networks of Copenhagen



1–07 Buckminster Fuller's World Game

Public Participatory GIS

There are areas, particularly in lesser-developed countries, that are subject to not only the complexities of rapid informal urban growth and very little data or documentation, but also additional layers of local conflict that stem from multiple, interrelated sources. It is situations like this that have sparked the Public Participatory GIS movement that is attempting to use mapping as a democratic tool to address problems from the bottom up. Renee Seiber in her article *Public Participation Geographic Information Systems: A Literature Review and Framework*, gives the definition and history of PPGIS and outlines critical questions within the domain. The term PPGIS originated in 1996 at meetings of the *National Center for Geographic Information and Analysis* where members were trying to define what the next phase of GIS would look like.[1] The term was meant to express how GIS would become a tool used by the public in order to better inform policy. PPGIS is essentially the involvement of non-expert actors and agents in the use of GIS technology to create maps. It is broad in its application because it has been used across a range of fields and across public, private, and non-profit sectors.[2] Although it has the words "public" and "participation", the level of participation varies and sometimes is limited to minimal input or analysis of outputs by the public. The field has received significant critique in recent years because there are examples of initiatives that have caused more harm than good. There are numerous factors that influence the outcome of a project such as the scale and culture of the place, the level of inclusion, the distribution of technology, levels of cartographic literacy, data appropriateness, data access and ownership, strategies of representation, and data quality and completeness.[3] The more recent free and open source software (FOSS) movement gives agency to small and limited capacity groups because they no longer have large start-up and overhead expenses to begin a project. For this reason open source has become appealing for community mapping projects in developing countries. Limited capacity groups still face additional challenges because they may be required to bend their goals to that of an outside funding agent, or work with technologies without adequate training or that may be incompatible.[4]

1 Seiber, Renee. "Public Participation Geographic Information Systems: A Literature Review and Framework." In *Annals of the Association of American Geographers* (Blackwell Publishing, 2006), 492.

2 Seiber, Renee. "Public Participation Geographic Information Systems: A Literature Review and Framework." In *Annals of the Association of American Geographers* (Blackwell Publishing, 2006), 493.

3 Ibid., 493-498.

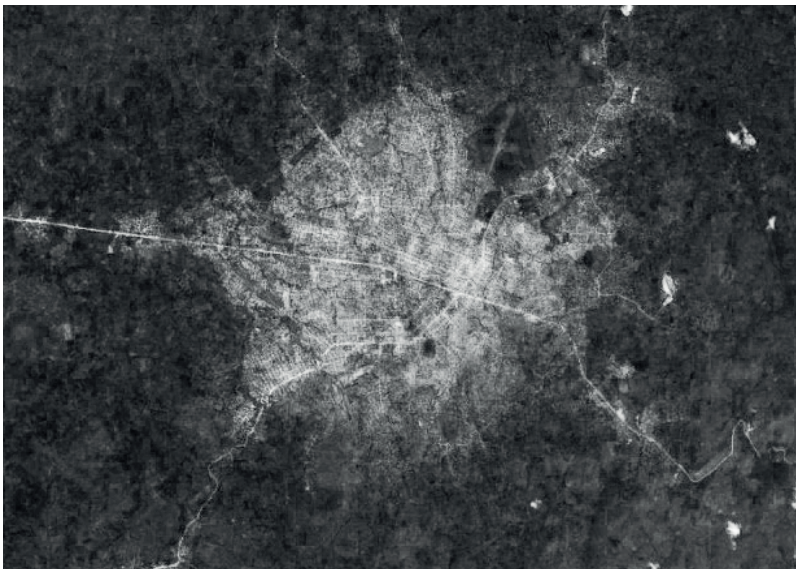
4 Ibid.,

Context of Beni, DRC

Most academics, policy makers, and practitioners interested in questions of war and peace share a remarkably similar approach to their topic; they look for causes of violence at the regional and national levels, and not in the realm of the local.

– The Trouble with the Congo: Local Violence and the Failure of International Peacebuilding (Autesserre 2010, 42)

Beni is a small city in the eastern great lakes region of the Democratic Republic of Congo (DRC). Like many cities in Africa it is growing quickly but with little intentionality because of the lack of resources and knowledge to develop urban strategy. Resulting challenges are that there is very little development of infrastructure or municipal services to support the population, and there is land conflict because of layered and confusing land administration strategies. Séverine Autesserre in her book *Trouble with the Congo: Local Violence and the Failure of International Peacebuilding*, argues that peacekeeping efforts have failed due to a centralized strategy of conflict resolution instead of, in addition to those actions, applying local resolution initiatives and making an in-depth attempt at understanding what is happening in the cities and the surrounding region.[1]

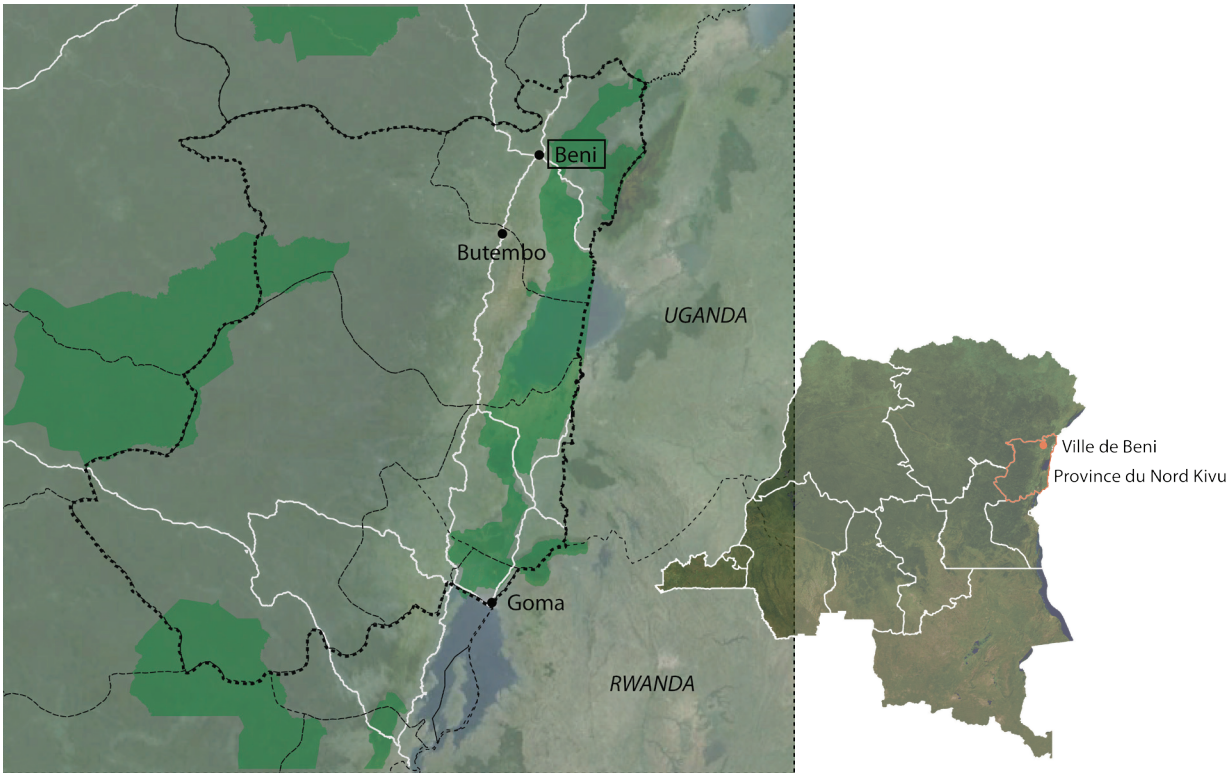


1–08 Google Earth Satellite image of Beni

The Christian Bilingual University of Congo (UCBC) is a university that was established in Beni in 2007 and has an active role in the community. In 2014 the university established the Integrated Research Institute (IRI) to promote collaborative research across faculties and with other community actors. One of the first initiatives of the IRI was the launching of their GIS program in response to the clear need to know more about the city and region. The IRI recently received grant funding to move forward with mapping research but realized that a comprehensive strategy would be necessary to achieve their short term and long term goals. I had seen this same need when I first visited Beni back in 2012, and when I began my thesis research in 2013 on the topic of digital mapping, sent them a proposal to partner with them to design a mapping framework for the city.

1 Autesserre, Séverine. *The Trouble with the Congo: Local Violence and the Failure of International Peacebuilding* (New York: Cambridge University Press, 2010), 42.

I had early discussions with leaders at UCBC and IRI to discuss the context of Beni and their goals for the project. I learned that the city does not have a city-wide power grid and that the municipality has no digital base map of the city. There is a growing 3G mobile internet network and an estimated 5-10% of adults have smart phones, though the number is growing exponentially each year. The university has no server or computer network at the present time because of intermittent power. This will also change as the university is setting up a solar panel system that will supply power around the clock. The IRI has particular interest in creating maps that address land conflict, agricultural methods, and basic demographic information. They also expressed interest in forming the maps into a platform that could be a resource for the community, and apply the newest developments in digital mapping, such as the ability to simulate and interact with data, or to collect reports from the public.



1–09 Location of North Kivu Province in the DRC and Beni within North Kivu

Framework

All of these ideas are laudable but there exists real challenges in implementing them, especially in a developing country. All of the challenges that Renee Seiber addresses in her article on PPGIS need to be considered in the establishment of a mapping program in Beni. The thesis proposes a framework methodology for organizing the community and digital processes so that the design of the program can be easily understood, critiqued, and manipulated by the project initiators. Buckminster Fuller's proposal is an example of a mapping framework. Even though it couldn't be realistically implemented, he

saw the need for an intellectual structure that establishes how the data is gathered, stored, shared, and interacted with. He realized that there is a structure of inputs and outputs. There is a community framework that is the structure of physical programs that feed data inputs into the machine; a digital framework is the digital processes that calculate, transform, and visualize the data; and finally another set of community processes implement changes in the physical environment as a response to what is learned from the map. PPGIS initiatives establish similar frameworks to that of Fuller's but they are actual implementations and are applied on a smaller and more focused scale than what Fuller imagined. The initiatives also differ considerably depending on the goals and purpose of each initiative. As drawn from my analysis of mapping theory, I will address a selection of precedent initiatives and my own initiative under the themes of agency of accumulation, participation, and re-territorialization. In the following chapters I will locate these dialectics within mapping theory, then analyse a selection of precedents through the lens of several questions I develop, and finally I will seek to respond to each of the questions in the design of the framework for Beni Atlas.

The research, titled Beni Atlas', studies theory of mapping, analyses a current use of digital maps, and proposes how current mapping tools can be applied in a designed framework to work for the more productive empowerment of a community in the developing context. It argues that digital maps are instrumental in shaping physical space, and challenges architects today to see design as a participatory process that goes beyond just the static forms of buildings. I am implementing and testing my methodologies by partnering with UCBC in Beni. The research proposes the design of a phased mapping framework that responds to the needs of the context, could be initiated by the university, and could become a tool that is owned by the community. The framework is comprised of a selection of open source digital tools and a proposal for how they might be combined into a wrapped interface. It also addresses the community framework that would be required for the digital framework to be grounded in the community, both for creating the inputs and receiving the outputs. The phases apply digital mapping tools in three levels of map creation: base maps, thematic maps, and an interactive map interface. The goal of the framework is to unite data from bottom-up and top down sources, provide clarity and understanding for users, and become a tool that allows for communication and partnership between different actors in the community.

1.2 Study of Mapping

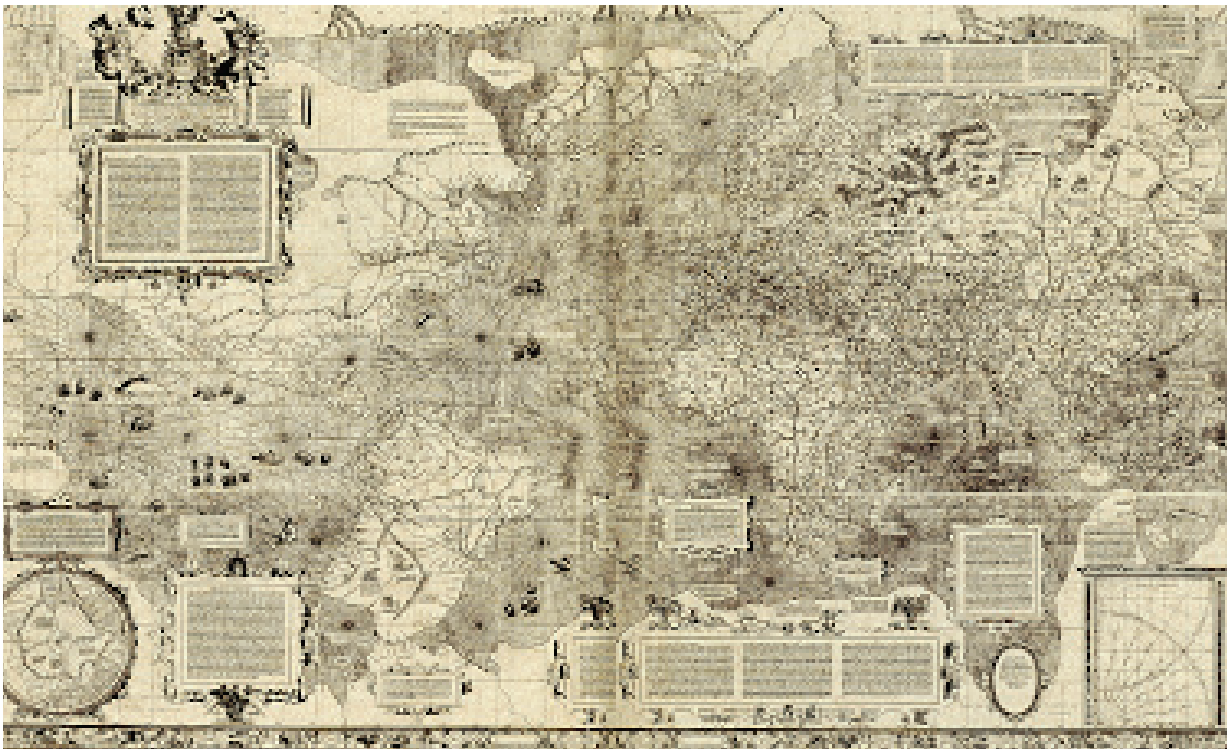
Form and function of the map

The framework was introduced in section 1.1 as the system of community and digital processes that are used to create a map and implement changes in a community based on what is learned from the map. Because the principal goal of the framework is to provide agency to a community, a useful reading of mapping theory is to explore how maps have provided agency in the past. Agency can be defined as an "action or intervention producing a particular effect.[1]" In mapping, the effect is being acted upon the site by a person or group that are the "actor" or "intervenor". Maps are therefore an intensely political tool because they are an expression of authority and are used to direct and control an environment to achieve a desired (particular) end. This is the maps root function.

Maps are created across multiple mediums, particularly today. People apply methods of mapping that have existing for hundreds of years such as hand-drawing, and employ other mediums invented at different points in history such as applying triangulation to drawings, creating prints, using GPS devices, or taking a photograph of the earth from space. As the map took on different forms throughout history because of changes in technology, its spatial function also changed. In studying different mapping applications in history, I have pulled out three particular functions of mapping that evolved at different times. The first function of the map was to primitively accumulate land and to state ownership over it; the next function with change in technology was to make the land productive, mostly made manifest in the design of cities that were being established by that time. The last function comes with the advent of digital technology that is using maps to redefine our physical environments altogether.

A study of these three general functions of mapping reveals that they have two characteristics in common. The first is that there is an ideology associated with each jump in technology of mapping. Ideology can be defined as "a visionary speculation, especially of an unrealistic

1 Oxford Dictionary . "Agency." http://www.oxforddictionaries.com/us/definition/american_english/agency



1–10 Spheres Tapestry called *Earth Under the Protection of Jupiter and Juno* by Bernard van Orley, 1520-30

or idealistic nature.[1]" The newest mapping techniques of each time period were often used to imagine and impose the ideas of a perfect society. The second shared characteristic is that each function is dialectical in the way it operates. To call something dialectical is to pose that it is "concerned with or acting through opposing forces.[2]". The following section explores these characteristics in order to give the map-maker a better understanding of the intricacies of mapping. By understanding the pursuit for perfection and the dialectics that exist in mapping, it is possible to become more sensitive designers. Drawing from the theoretical exploration I will pose a series of questions that can be asked of any mapping framework, and also see how maps have changed the fabric of Africa, particularly the Democratic Republic of Congo where I am proposing the design of a mapping framework.

Agency by primitive accumulation

The first and most basic form of agency of mapping is the process of imprinting one's intention onto the physical world by representing it on a map. As Rousseau describes in his book *On the Origin of the Inequality of Mankind*; "the first man, who, having enclosed a piece of ground, to whom it occurred to say this is mine, and found people sufficiently simple to believe him, was the true founder of civil society.[3]" *Primitive accumulation* is a term coined by Marx to describe how the capitalist movement was driven to expand and accumulate wealth. Although Marx does not speak of maps in his writing, he describes the technological expansion and territorial exploration that was achieved with the use of maps.[4] Although the map's role of primitive accumulation could trace itself to the beginning of history, it is with the technological inventions of navigation, the steam engine, and the printing press that mapping became an agent of widespread change. In the early modern world maps took the form of hand-crafted depictions ranging from the scale of land plots to the expansive discovery of new territories. The function of maps can be seen from two different perspectives. Perhaps the most visible purpose was for the progress and growth of the state. The other perspective is that maps served as a method to claim false ownership over land, and to represent biased imagery to distract and pacify the public. Primitive accumulation is dialectical because once an object is represented on a map, it at once gets simplified down to a point in a cluster of many nodes. The simplification makes the map easier to imprint on people's minds, but also disconnects it from the richness and complexity of the real place.

1–11 World Map by Gerard Mercator, 1569

1 Oxford Dictionary . "Ideology." http://www.oxforddictionaries.com/us/definition/american_english/ideology

2 Oxford Dictionary . "Dialectical." http://www.oxforddictionaries.com/us/definition/american_english/dialectical

3 Rousseau, Jean Jacques. *On the Origin of the Inequality of Mankind*, 1754.

4 Marx, Karl. *Capital Volume 1*. (Penguin Classics, 1990), 870.

A primary example of maps with the function of primitive accumulation are some of the maps that were created in the early modern period (1500 – 1800). In his book *Trading Territories: Mapping the Early Modern World*, Jerry Brotton describes how the maps created in that time were primarily tools to visualize and establish imperial authority by depicting territorial conquests and commercial trade routes.[1] Brotton describes the example of the "Spheres" tapestry, a map of the globe commissioned by Joao III of Portugal that depicts the trade routes along the coast-line of Africa and Asia. The map itself embodies the places on the map by being made of the very materials of wealth that were being brought back from the distant lands. The king and queen are portrayed on the map as divine stewards over the territory. Maps such as these, however inaccurate compared to maps today, impressed themselves onto the culture of the day and allowed the crowns to succeed at their political and commercial exploits.

After navigation, the printing press was the next technological advancement that changed the form of mapping. For the first time maps could be distributed to the masses. Geographers at that time were hired by sovereigns to visualize their spatial interests and even establish monopolies on which maps were widely distributed. Brotton describes Mercator and Ortelius as two such geographers who found their niche in the field and learned the balance of being politically sensitive while still following the trends of the market.[2]

1 Brotton, Jerry. *Trading Territories: Mapping the Early Modern World* (Ithaca, New York: Cornell University Press, 1997), 19.

2 Ibid., 153.

1–12 Stanley Mortensen's journey in the west and east of the Congo.

Mapping as primitive accumulation impacted Central Africa during colonization when King Leopold II of Belgium claimed the Congo basin as his personal land to transform Belgium into an empire. Beginning in 1870 he sponsored the explorer Sir Henry Morton Stanley to lead the expedition to plot out what would become the Congo Free State and would initiate the European colonial race on Africa.[1] Mortenson's charts of the Congo River basin removed the last unknown territory from European maps and delineated areas of British, French, Portuguese, and Belgian control. At the Conference of Berlin in 1885, Leopold used his knowledge to convince the US and European powers to formally acknowledge his ownership of the territory.

The preceding examples demonstrate how the main function of maps at the time was to accumulate new territory by imprinting an image of it onto society. Either the process of mapping can be viewed as progress or the very opposite. Mezzadra and Neilson explain in their article *Fabrica Mundi: Producing the World By Drawing Borders* that representing objects on a map transforms space into a commodity that can be bought and sold and causes it to lose its true character and take on a "phantom-like objectivity.[2]" It allows decisions to be made on the "object" without having to think of the complexity of the real place. It can also express an ideology of progress in the way that the intentions are communicated.

Agency by optimization

Maps would change form and function again with the invention of the telegraph, combustion engine, and electrical devices. Mapping began to become increasingly scientific and take on the form of complex networks and flows that served the purpose of making land, and particularly cities, more productive. In 1950 Norbert Wiener described; "The city is primarily a communication center, serving the same purpose as a nerve center in the body. It is a place where railroads, telephone and telegraph centers come together, where ideas, information and goods can be exchanged.[3] A part of making the city and territory productive was to involve the public as active participants in the process. Once again a dialectic exists as productivity can be viewed as either growth and progress or as the transformation of the city into an objectified machine. Participation can similarly be viewed as the public being encouraged to be active participants towards a communal goal, or the

1 Adam Hochschild, *King Leopold's Ghost: A story of Greed, Terror, and Heroism in Colonial Africa* (Houghton Mifflin, 1999).

2 Sandro Mezzadra and Brett Neilson, "Fabrica Mundi: Producing the World by Drawing Borders," In *Scapegoat: Architecture, Landscape, Political Economy: 04 Currency*, edited by Adrian Blackwell et al. (CreateSpace Independent Publishing Platform, 2013), 8.

3 Norbert Weiner, Karl Deutsch, and Giorgio di Santillana, "The Planners Evaluate Their Plan," analysis of the "Weiner defense plan for cities," *Life* vol. 29, no. 25, December 18, 1950, 85.

participation as docile and distracted citizens that leaves space for exploitation. Maps are used to design the networks and cities but also to represent the ideologies to the public.

In Armand Mattelart's essay *Mapping Modernity*, he traces the origin of the "network" back to France where charts were created to coordinate movement through military barracks. The word also came from biological connections such as the nerves in the body.[1] By the mid 17th century, France boasted of an optical telegraph network over 5000 kilometers in length.[2] As the telegraph reformed communication, development of the railway network reformed transportation. Many writers, geographers, theorists, and engineers speculated on how the new freedom in communication and movement would create ideal, democratic societies that mirrored the concept of the Greek agorra.[3]

Organized networks were also used to make cities more efficient. One example is the Haussmann renovation that cut networks of boulevards through the old city of Paris. Though the project greatly improved sanitation and movement through the city, critics denounced the project as a way to be able to keep military control of the city, and to impress the population with the monuments that were the focal points of the grand avenues. Walter Benjamin in his book *The Arcades Project* describes the great public monuments and exhibitions as "phantasmagoria", a distraction to keep the minds of people proud of the accomplishments of the state and too busy to question authority.[4] Along with the great monuments there were also large exhibitions during the period that displayed maps and artefacts of progress. Mattelart points out how the universal exhibition was represented by a miniature globe that symbolized human community and communication.[5]

New inventions in the 1900s of the electric telegraph, radio communications, and aviation, all supported a vision that shifted beyond the state to the international community. The participative role of the citizen was bolstered with the communal viewpoint introduced by travel into space. Even before a photograph of earth was taken from space that showed the earth in perfect accuracy and entirety, theorists and scientists predicted the communal perspective that the image would solicit. In Buckminster Fuller's 1938 book *Nine Chains to the Moon*, he describes how the optimization of the worlds resources called for "vertical thinking and holistic views of the universe". An efficient civilization seemed a thing to grasp when humanity could look back

1 Armand Mattelart, "Mapping Modernity: Utopia and Communications Networks," In *Mappings*, edited by Denis Cosgrove (Reaktion Books, 1999), 174.

2 Ibid., 176.

3 Ibid., 178.

4 Walter Benjamin, *The Arcades Project*, edited by Rolf Tiedemann, translated by Howard Eiland and Kevin McLaughlin (Belknap Press, 2002).

5 Armand Mattelart, "Mapping Modernity: Utopia and Communications Networks," In *Mappings*, edited by Denis Cosgrove (Reaktion Books, 1999), 180.

on itself introspectively to develop strategies for human progress.[1]

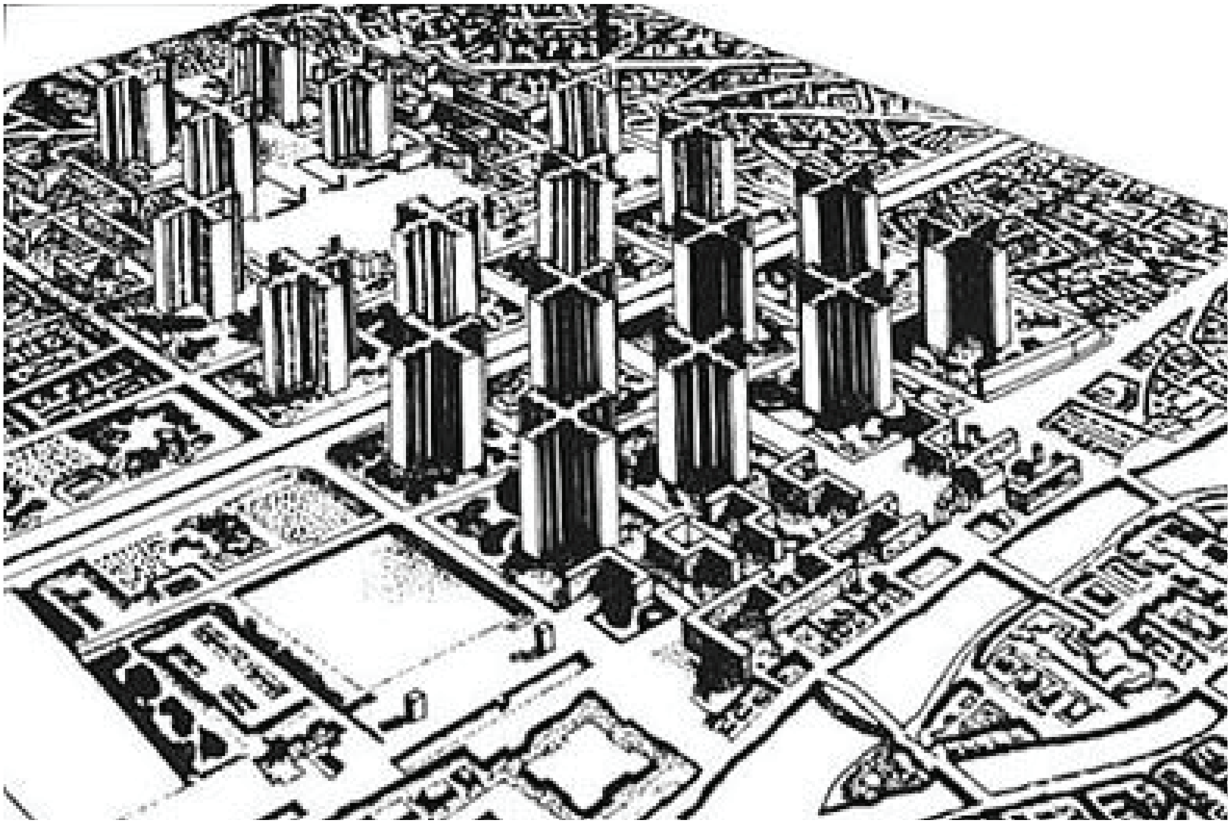
In the same way that maps were being used to design efficient European and American cities and encourage a participative ideology, mapping was also used to project an ideology to affirm the reasons for having a colonial presence in Africa and also to make the cities efficient for collecting and shipping the goods back to the colonizing state. In the book *Kinshasa: Tales of the Invisible City*, author Filip De Boeck writes about a simplified "African village" that was displayed at the 1930 World Exhibition that promoted an Africa that was inferior and in need of European influence. It is but one example of how the way Congo is pictured renders "invisible" the actual place. He writes;

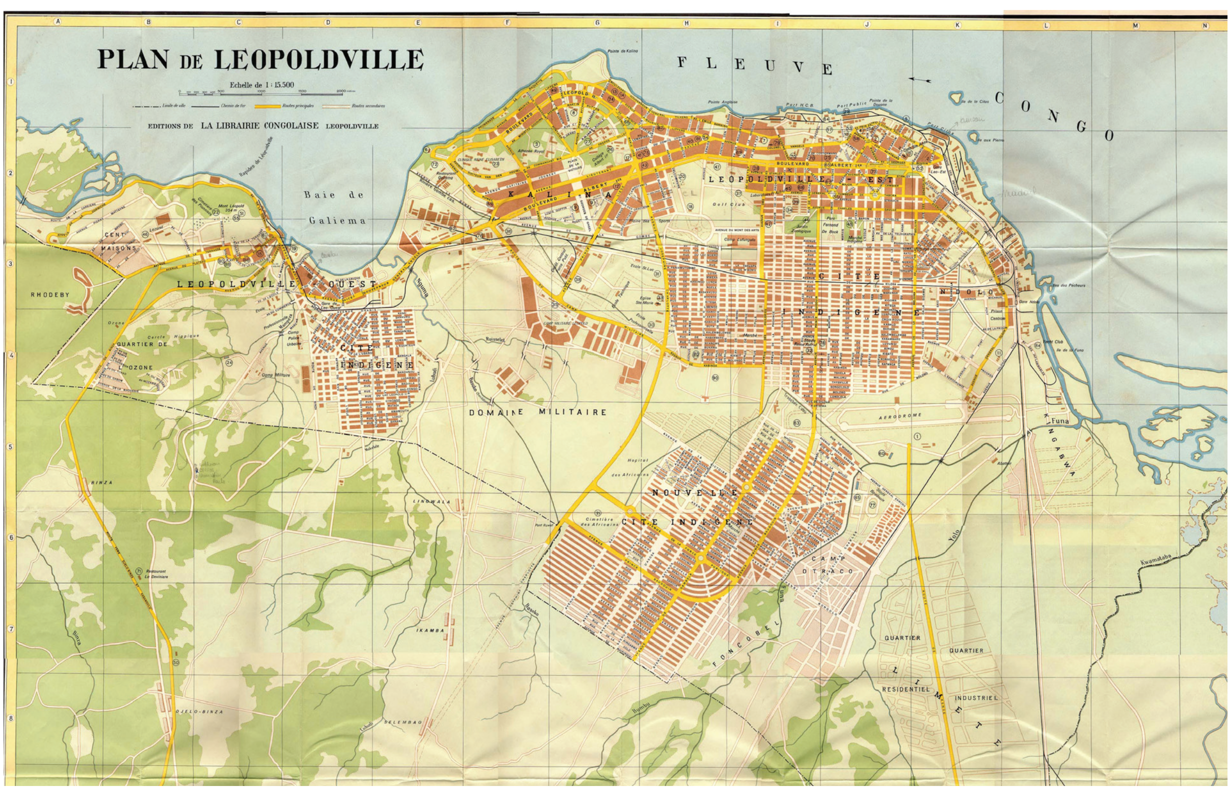
> *The great discrepancy which is generated in the mirroring process between this topos, the Congo of the imagination, and the topicality of the physical Congo, seems to go unnoticed by most. The strength of the imagined place renders invisible the reality of the African site. What the African Village of the 1930 World Exhibition revealed is precisely this rupture, this fault line between representation and reality which is so characteristic of the problematic place of "place" in the colonial and postcolonial contexts.*[2]

1–13 Photograph called Earthrise taken on first manned mission to the moon in 1968

1 Buckminster Fuller, *Nine Chains to the Moon: An Adventure Story of Thought* (Philadelphia: Lippincott, 1938).

2 Filip de Boeck, *Kinshasa: Tales of the Invisible City* (Leuven Univ Pr, 2014), 22.




PLAN DE LEOPOLDVILLE
EDITIONS DE LA LIBRAIRIE CONGOLAISE LEOPOLDVILLE
FLEUVE
CONGO
Baie de
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LEOPOLDVILLE - OUEST
LEOPOLDVILLE - EST
KALINA
CITE
INDIGENE
DOMAINE MILITAIRE
NOUVELLE
CITE INDIGENE
QUARTIER
RESIDENTIEL
QUARTIER
INDUSTRIEL
LIMETE

1–15 Le Corbusier's Ville Contemporaine

In addition to representation of the Congo back home and changing their own capital to be like Paris, the Belgians also developed the capital city of Leopoldville into a productive city. De Boeck describes how the Belgian state worked to establish an indigenous working class similar to the proletariat in their own nation state, and put them in their (participative) place in society by the use of "state technologies of power and control.[1]" The Belgians were fearful of the illness and degenency associated with the Congo and therefore their prime strategies were to sanitize the spatial layout of the villages by creating a new settlement typology and restricting the movement of colonized citizens. The plan of Leopoldville located the western "Ville" at the center and the "Indigenous Cite" to the periphery with a buffer zone in between.[2]

These types of city plans were not limited to Kinshasa. Much of the planning in colonial cities in Africa adopted similar spatial strategies. In his book *Planning Power*, Ambe J. Njoh compares the planning of cities across states that were colonized by the British and French. Although their style of governance was very different, Njoh argues that many of their spatial strategies were much the same. One significant change was how colonizers implemented their own land ownership legislation in territories originally based on communal ownership. It began by colonizers trying to purchase land from local chiefs and went so far as to create legislation that defined "unoccupied and ownerless land" as property of the colonnial state.[3] The colonies needed qualified administrators and so designed suburban neighbourhoods with large plots and European style homes to attract Westerners.[4] Administrative centers were often placed on the highest elevation and immediately to the outside was the commercial zone tied to a seaport or railway station. Housing for the indigenous people was denser and located separate from the white neighbourhoods further in the periphery. Even though he doesn't describe Kinshasa in his book, the image Njoh paints is very similar.

1–14 Plan of Leopoldville (Kinshasa)

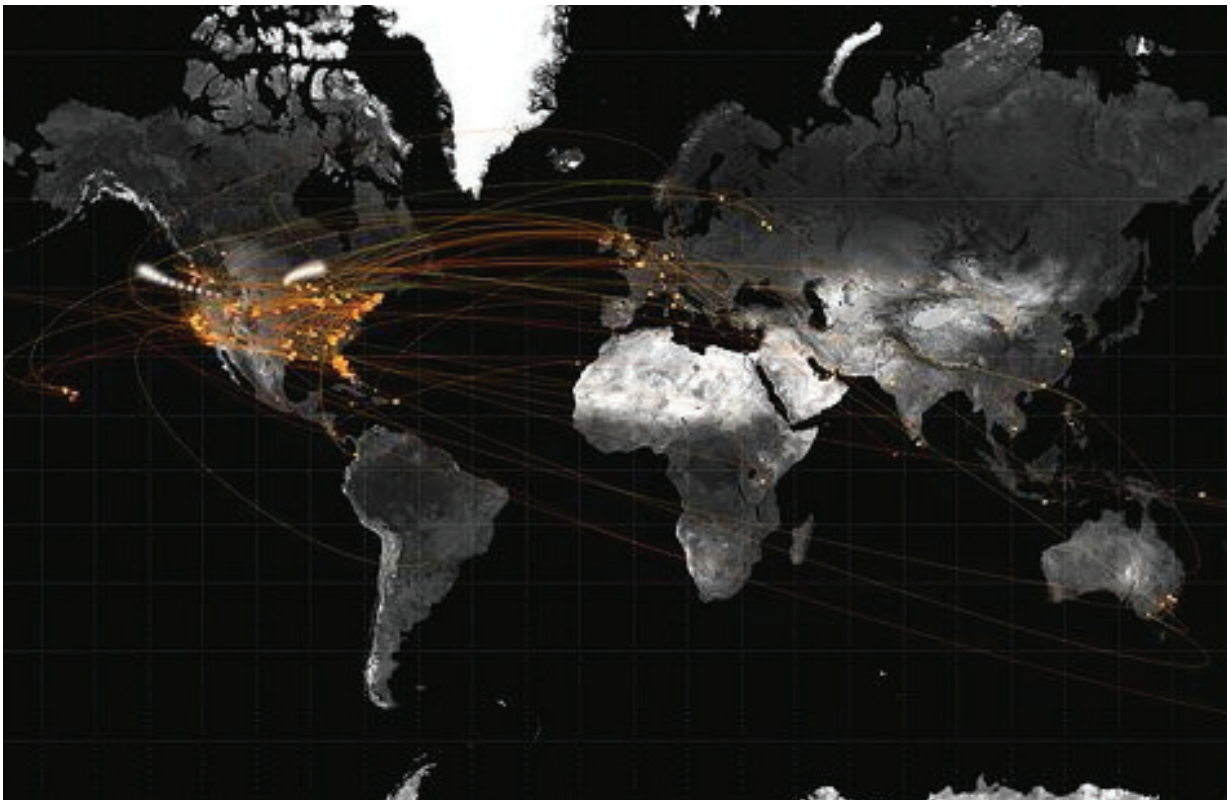
The map's ability to oversimplify reinforces the dialectic of the relationship between representation and production. Although an object is not yet built, it still represents an imagined result in society and therefore imprints itself there whether or not it portrays the real truth. Mezzadra and Neilson describe it well in *Fabrica Mundi* when they touch on the very title of their article; "The use of the expression fabrica mundi signals, in the form of a slippage, the cartographer's awareness of the fact that representing the world on a map also means producing

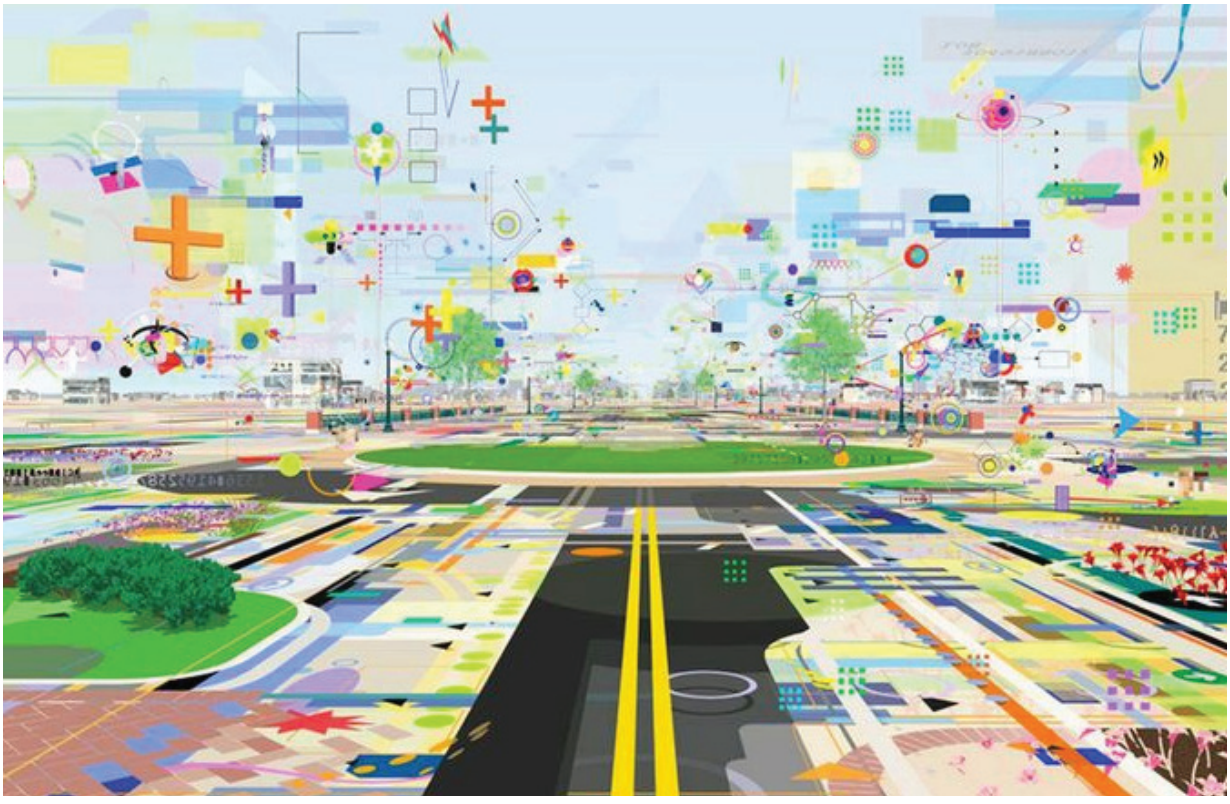
1 Ibid., 24.

2 Ibid., 28.

3 Ambe J. Njoh, *Planning Power: Town planning and social control in colonial Africa* (UCL Press, 2007), 27.

4 Ibid., 30,





1–16 Twitter pings in 38 hours

it.[1]" Maps functioned to design the societal machines that would bring the west into a modern world. Critics would argue that participants in the efficient network thought that they were actively participating to produce positive change, but it was only a mirage to hide the realization that they were themselves transformed into a commodity to be exchanged.

Agency by re-territorialization

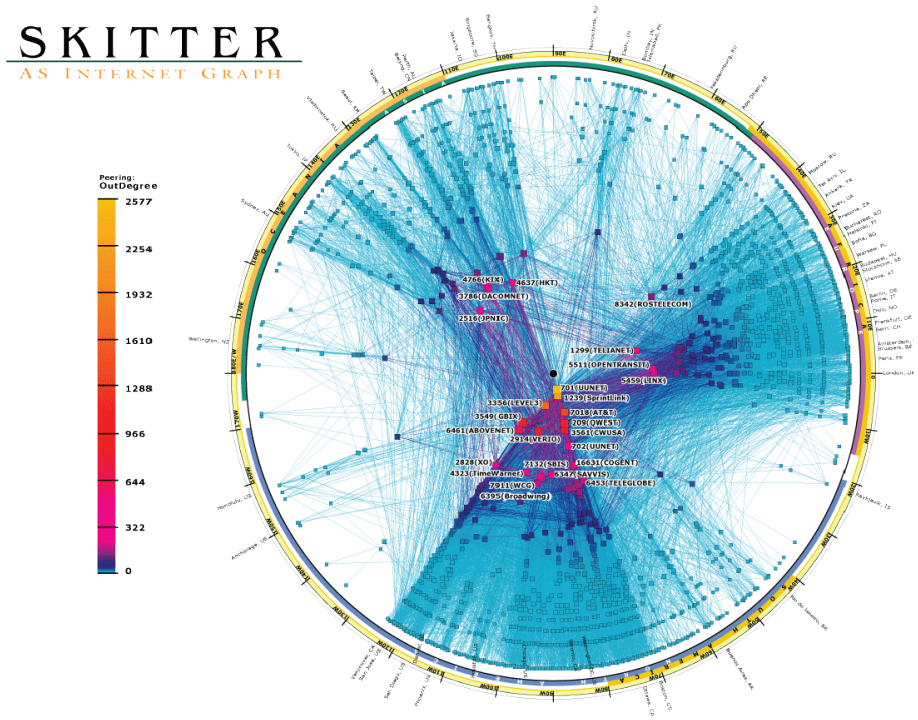
Territory is the politics of a space since it is defined as an area that is under the jurisdiction of a ruler or state.[2] The term "re-territorialization" was coined by Gilles Deleuze and Félix Guattari in their writing *A Thousand Plateaus* as the political restructuring of space by the design of new power.[3] Since then the term has been used to describe the affect of mass media on global culture. Re-territorialization is used in this discussion to describe the potential of the digital map to redefine the politics of the space it represents. The digital map re-territorializes by offering a new, community contributed knowledge that can drive political decision making. Agency by re-territorialization not only expands on the previous two forms of mapping agency, it also creates new opportunities. Expansion is possible because unlike the traditional forms of agency that are only designed by a select few who direct the development of society, digital technology offers the ability to distribute agency to the masses. Two key capabilities that digital tools have are the ability to store data beyond human capability and the ability to represent a dynamic image. Because the computer's memory is as long as the space available to store the data, the digital map could represent an indeterminate amount of information and can change what the user sees over time. Unlike the physical world, it defies physical laws and is capable of instantaneous inter-connectedness that does not exist in physical space and opens up a realm of opportunities. Re-territorialization is also dialectical in nature. It takes the dualities of the other two forms of agency and exponentially increases their scope and consequences. Similar to the other two forms of agency, re-territorialization could be considered the ultimate democratic tool for solving political and social problems around the world. The other side reveals that the system is still designed and therefore has someone in the role of designer or monitor of the system who establishes the rules and can perhaps even change them. A third dimension of digital map-

1–17 Space Intelligence Agency, Automatic City

1 Sandro Mezzadra and Brett Neilson. "Fabrica Mundi: Producing the World by Drawing Borders." In *Scapegoat: Architecture, Landscape, Political Economy: 04 Currency*, edited by Adrian Blackwell et al. (CreateSpace Independent Publishing Platform, 2013), 8.

2 Oxford Dictionary . "Territory." http://www.oxforddictionaries.com/us/definition/american_english/territory

3 Gilles Deleuze and Félix Guattari, A Thousand Plateaus: Capitalism and Schizophrenia, translated by Brian Massumi (University of Minnesota Press: 1987), 10, 54.


SKITTER
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3786(DACOMNET)
2516(JPNIC)
8342(ROSTELECOM)
1299(TELIANET)
5511(OPENTRANSIT)
5459(LINX)
701(UUNET)
1239(Sprintlink)
3356(LEVEL3)
2018(AT&T)
3549(GBIX)
209(QWEST)
6461(ABOVENET)
3561(CWUSA)
2914(VERIO)
702(UUNET)
2828(XO)
7132(SBIS)
16631(COGENT)
4323(TimeWarner)
6347(SAVVIS)
7911(WCG)
6453(TELEGLOBE)
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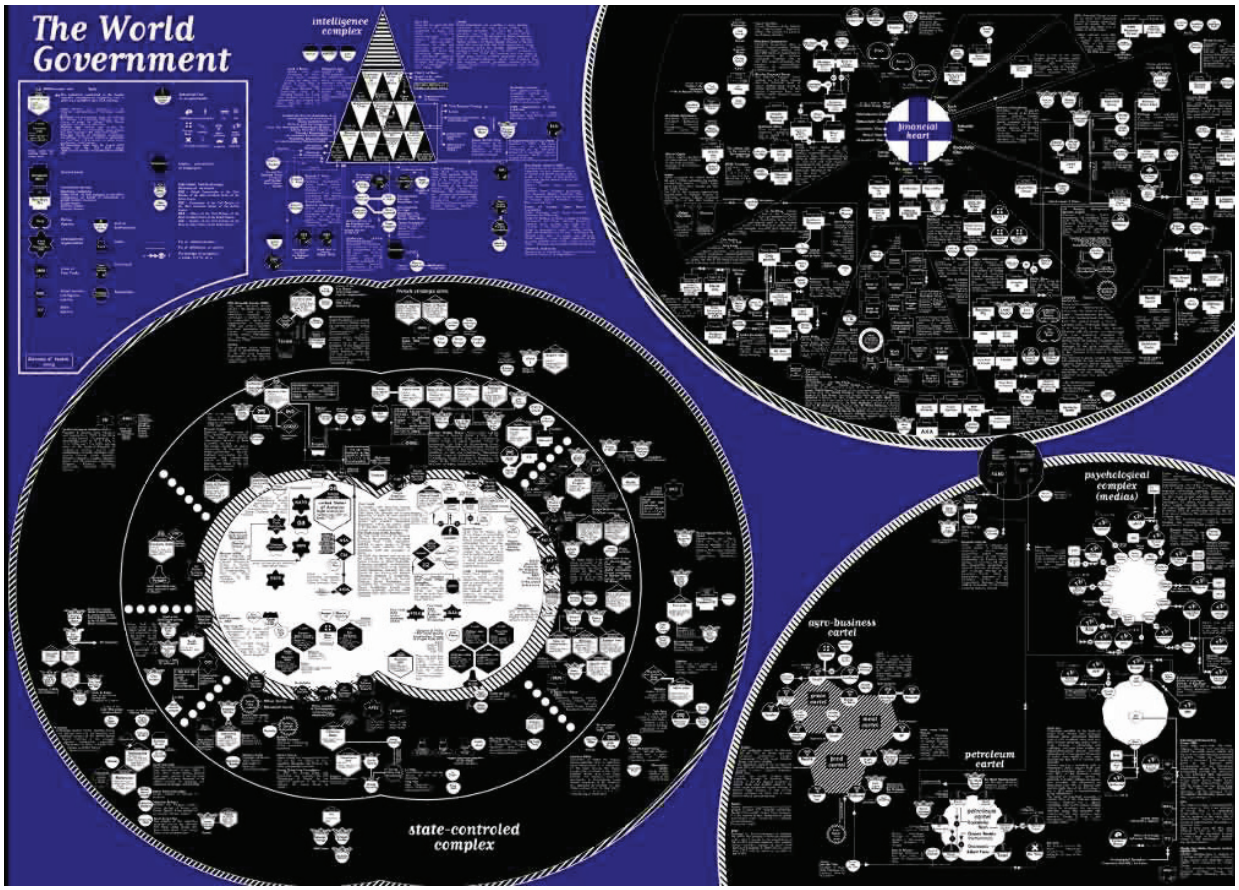

The World Government
intelligence complex
financial heart
psychological complex (medias)
agro-business cartel
petroleum cartel
state-controled complex

ping is the opportunity to get so lost in the ideology of the represented space that it can no longer function in real space. The digital map offers the greatest opportunity for change but the greatest danger to cause harm in a massive way.

1–18 Skitter Internet Graph by the Cooperative Association for Internet Data Analysis (CAIDA)

Just as the first two functions of mapping have their associated ideologies that came with the advent of new technologies, the case is no different in the digital era. Armand Mattelart in *Mapping Modernity* describes how the ideology of the growing communication network mirroring Greek democracy transformed with the invention of computers into an ideology of the "information agora".[1] If information could be made available to everyone, the concept was that the world could become a democratic "global village". In 1994 Al Gore proposed his idea for an "Information Superhighway". He presented it as a network that " will circle the globe with information highways on which all people can travel...The GII will not only be a metaphor for a functioning democracy; it will in fact promote the functioning of democracy by greatly enhancing the participation of citizens in decision-making. And it will greatly promote the ability of nations to cooperate with each other." Critics, however, considered these utopian ideals folly. In one of the first texts to locate problems of the communication network, authors Simon Nora and Alan Minc saw the network as the guarantee of a "new global mode of social regulation" and proposed national independence in the installation and maintenance of it's own databanks.[2]

1–19 The World Government, 2003 by Bureau d'études

Frederic Jameson in his book P*ostmodernism, or, the Cultural Logic of Late Capitalism*, tries to resolve what it is that brings the digital period to a new dimension. He describes the digital age as the instigator of an image culture where a large amount of human experience is lost in the image realm and creates a "disjunction point between the body and its built environment". He defines the change as "Mutation in space - postmodern hyperspace - that has finally succeeded in transcending the capabilities of the individual human body to locate itself, to organize its immediate surroundings perceptually, and cognitively to map its position in a mappable external world.[3]" He describes the hyperspace as a space we haven't learned how to represent and challenges the need for "an aesthetics of cognitive mapping" to help us to re-situate ourselves.

Brian Holmes in his essay *Counter Cartographies* and Ole Bouman *Re: Orientation*, highlight the same problem as Jameson and offer their current perspectives. Holmes brings his readers through a selection of mapping and graphing projects using the newest research in

1 Armand Mattelart, "Mapping Modernity: Utopia and Communications Networks," In *Mappings*, edited by Denis Cosgrove (Reaktion Books, 1999), 185.
2 Ibid., 186.
3 Frederic Jameson, *Postmodernism, Or the Cultural Logic of Late Capitalism* (Durham, NC: Duke University Press, 1991), 44.

mapping computation and proposes that they are resolutions to the spatial chaos that Jameson describes two decades earlier.[1] I agree with him that the tools have now reached the capability (or are very close) of creating such an aesthetic, but disagree that the maps he discusses (see figures *1-18* and *1-19*) offer the type of digital-physical orientation that Jameson refers to. The maps bring agendas to the forefront but do not provide an avenue for acting on that knowledge. Bouman also proposes current tools to offer the solution, but he goes one step further to realize that connecting the map with the community is no easy task. He outlines three barriers that must be overcome in uniting digital maps with the physical environments they represent: For an idea to turn into a change there needs to be "political-administrative underpinning", there needs to be cohesion between gaps across scales, and architects must stop thinking that the execution of ideas is outside of their scope.[2] Images can hold an ideology that can't function in reality until we establish the programs and frameworks necessary for the maps to have physical agency. Tafuri writes in his essay *Toward a Critique of Architectural Ideology*; "Architecture as the ideology of the Plan is swept away by the reality of the Plan the moment the plan came down from the utopian level and became an operant mechanism.[3]" These realities are important because if we can't connect maps to real space then we risk being lost forever in the world of images and our minds becoming entirely disconnected from our physical bodies. As advocates for quality, physical, built space, architects need to firmly oppose this direction of digital media.

Participation needs to differentiate between the demands of the clients and the desires of the users. Architects, needing clients with power and money, are usually on the side of those in power and willing to embrace and express in built terms the ideology and economics of these clients, to the exclusion of the desires of the potential users. There is thus a removal of the general public from the processes of architectural production, which in turn leads to a sense of alienation of the users from their environment.

– Architecture & Participation (Jones et al. 2005)

Response

By studying theory that outlines the different forms and functions of mapping, it is clear that there is a consistent rift between what is intended and what is produced. James Corner in his essay *Agency of Mapping* argues that a map is never neutral and that it always has underlying intentions. Ideology can be an effective driver because it motivates innovation and positive change but there is a need to learn from the experience where a too simplified version of the world can actually mean doing the opposite of what was intended. From studying what I have determined as three functions of mapping I have drawn out several questions that can be asked of maps: *Accumulation* asks of the map whether it allows the individual to represent their own

1 Brian Holmes, "Counter Cartographies ," In *Else/Where: Mapping new cartographies of networks and territories*, edited by Janet Abrams and Peter Hall (University of Minnesota Press, 2006), 20.

2 Ole Bouman, "Re: Orientation," In *Else/Where: Mapping new cartographies of networks and territories*, edited by Janet Abrams and Peter Hall (University of Minnesota Press, 2006), 57.

3 Manfredo Tafuri, "Toward a Critique of Architectural Ideology" "Per una critica dell'ideologia architettonica." In *Contropiano 1*, translated by Stephen Sartarelli (1969), 28.

information and how it might personally benefit them. It also asks whether their interaction with the map is at all personal or if they become objectified into raw information. *Optimization* asks of the map whether users are cooperating to accomplish a greater goal and what that goal might be. It also asks who is in control and whether users are full participants, partial participants, or only have the semblance of participation. *Re-territorialisation* asks what the scale of the initiative is and if it can be extended, if the map redefines space by changing the way a person perceives or interacts with it, if the map is personalized for users, and if the framework is administratively grounded by having programs in place that affect change.

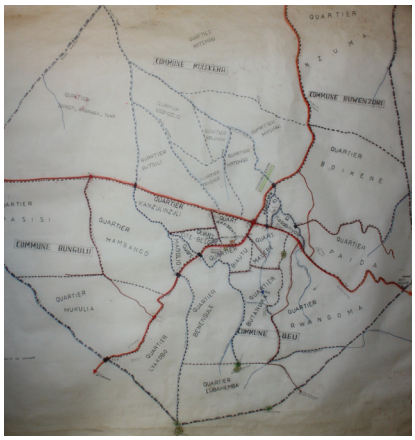
Although James Corner in *Agency of Mapping* does not address the problem of the image disconnect, he opens up a perspective of what mapping is capable of. Without even focusing on digital tools he outlines that maps can personalize themselves to the user, not necessary presenting itself in the orthogonal view that we are most familiar with (Corner defines this as "drift"), maps can work in a rhizomatic way that establishes networks, and that maps can run through interactive simulations.[1] All of these capabilities hold great promise for how they can offer ways of learning about our physical communities and propose ideas that can then move through the sometimes challenging process of implementation. As a response to my exploration of the theory around the functions of mapping, I have learned that a map framework needs to find ways to root into the community and needs to clearly address the realities of how people establish themselves on the map and participate with the map to change their circumstances in real space. In the following section I will address the context of Beni where I am designing a mapping framework, and then will review a series of interfaces, frameworks, and concepts and establish how they align with my critical explorations.

1 James Corner. "Agency of Mapping: Speculation, Critique and Invention." In *Mappings*, edited by Denis Cosgrove (Reaktion Books, 1999), 213-300.

1.3 Context

Summary

Beni is a small city in the province of North Kivu that has an estimated population of 300-400,000 inhabitants and covers an area of approximately 184 square kilometers.[1] The city appears to be growing quickly as rural villagers are migrating to the city for employment and security. There is very little intentionality in directing the growth of the city or knowledge of the city's general makeup. Beni was established in 1929 by Belgian colonialists as an administrative outpost because of it's strategic location close to the border of Uganda. Beni had very little colonial influence in the years before independence in 1960 because the population of the town remained very low during that time.



1–20 Hand-drawn map of Beni from the Office of Urbanism

Form

The city has four "communes" that are divided by the Routes Nationales no. 2, no. 4, and no. 44 that cross at the city's central "rond-point" (round-about). The only street that is paved is the main road running north-south. The communes are each divided into six to twelve "quartiers" (thirty in total) that each have their own administrative office. There are several streams and small ravines that traverse the city and are used to define many of the neighbourhood boundaries. There are hundreds of bridges throughout the city, many of them informally constructed out of logs and timber. The northeast and particularly the southeast communes have a hilly terrain that climbs up steadily toward Virunga National Park that borders the east of the city.

There are households within the city that are considered a "slum household" as defined by UN-Habitat because they lack one or more of the following:

> *Durable housing of a permanent nature that protects against extreme climate conditions, sufficient living space which means not more than three people sharing the same room, easy access to safe water in sufficient amounts at an affordable price, access to adequate sanitation in the form of a*

1 Rapport Annuel de l'Adminstration de la Ville de Beni pour l'Annee 2014

1–21 Map depicting partial water grid

1–22 Map from the mayor's office depicting administrative divisions


République Démocratique du Congo—Province du Nord-Kivu
VILLE DE BENI
SUBDIVISIONS ADMINISTRATIVES
Légende
Limite de la Ville
Limite de quartier
SAYO Nom de quartier
LAO Nom de cellule
Cour d'eau
Vieux village
Grand-route
Colline avec courbes hypsométriques
Grande hauteur
Hauteur basse
Cimetière
Localisation d'institution
ECHELLE
1/165 000 Cm
NE PIRATEZ PAS CETTE CARTE S.V.P.
Vers Mbau -Oicha
Vers -Kyatsaba -Mangina
Vers -Butembo -Lubero
Vers -Bulongo -Kasindi
Vers Mangolikene
Vers Kalau/Supe
Vers Bulungu
LES 4 COMMUNES dans leur Couleur
BEU
Quartiers
1. LUBAHEMBA
2. LYAKOBO
3. BIAUTU
4. BENENGULE
5. BUTANUKA
6. MALEPE
7. RWANGOMA
10. SAYO, 9. MATEMBO
MULEKERA
Quartiers
1. BUNDJI
2. KASANGA-TUHA
3. BUTSILI
4. TAMENDE
5. KALINDA
6. NGONGOLIO
7. MATONGE
8. MASIANI
BUNGULU
Quartiers
1. PASISI
2. MAMBANGO
3. MUKULIA
4. CITE-BELGE
5. KANZULINZULI
6. MABOLIO RESIDENTIEL
RUWENZORI
Quartiers
1. NZUMA
2. NGADI
3. BOIKENE
4. KASABINYOLE
5. MABAKANGA
6. PAIDA
SUPERFICIES SUR DIAGRAMME
BENI 184,34 Km²
BUTEMBO 190,22 Km²
BEU 59,71 Km² ± 30 %
BUNGULU 37,81 Km² ± 20 %
RUWENZORI 33,41 Km² ± 18 %
MULEKERA 53,31 Km² ± 29 %

private or public toilet shared by a reasonable number of people, and security of tenure that prevents forced evictions.[1]

1–23 One of the main roads in Beni

Based on my observations of the city I estimate most of the households in Beni as having one or two "shelter deprivations" and would not be classified as living in extremely poor conditions meaning that households lack more than three basic shelter needs.[2] Houses are typically built out of wood and earth or brick with corrugated metal or thatch roofing and are located on individual plots of land. Land is administered by the neighbourhood cadastral offices that are managed by Heads of District ("Chefs du Quartier"). The city has no city-wide power, water, or sewer grid. There is a partial water grid near the centre of the city. The rest of the city gets their water from either personal or shared fountains, wells, or springs, and for sanitation either use personal septic systems or communal latrines. There are several businesses that have established partial power grids that run off of diesel generators.

Culture

The culture of the city is very much that of a large village. Most people get around the city on foot and so the streets are always populated. There is farming on small plots within the city. There is a significant informal retail sector of market stalls, fuel stations, money exchangers and street vendors that occupy centres that are spread through the city. The second form of transportation is by "moto" (motorcycle taxi) and main intersections or land-marks generally have a "stage" (stop) with motorcycles available to hire. Many of the streets could be considered footpaths because they are not traversable by car. Although the larger streets have names, they are known informally and people find their way around using landmarks. An important type of landmark in the city is the "rond-point". Round-abouts are often established by neighbourhoods throughout the city as community landmarks and places to gather. Because there is no electricity, food is purchased daily from open-air fresh-food markets and cooking is done on charcoal stoves.

1–24 An example of the many walls that people who have enough money build around their properties

Players and Resources

UCBC is a university that was established in Beni in 2007 and offers degree programs taught in English and French across applied sciences, social sciences, and humanities.[3] The university applies three principles of "academic inquiry, community engagement, and institutional service" that are meant to encourage participative learning that asks how problems can be solved to meet the needs of the population.[4] In

1 "UN-Habitat: State of the World's Cities 2006/7," http://ww2.unhabitat.org/mediacentre/documents/sowcr2006/SOWCR%205.pdf.

2 Ibid.

3 "Université Chrétienne Bilingue du Congo," http://www.ucbc.org/.

4 Ibid.


VENTE PIECES DE RECHANGE

1–25 A woodworking shop at the side of the road

2013 the university established the Integrated Research Institute (IRI) to promote collaborative research across faculties and with other community actors. One of the first initiatives of the IRI was the launching of their GIS program in response to the clear need to know more about the city and region. The IRI recently received grant funding to move forward with mapping research but realized that a comprehensive mapping framework would be necessary to achieve their short-term and long-term goals.

With it's first funds the IRI arranged two weeks of training in the use of ArcGIS, a survey application called ODK Collect (OpenDataKit) and a GPS tracking application called GPS Essentials. The IRI purchased eight smart phones that could be used for field data collection. The IRI performed a search for existing maps of the city and discovered that only a few hand-drawn maps exist with very little information. Knowledge is restricted to what the local chiefs know of their neighbourhoods and a few localized hand-drawn maps from several neighbourhood cadastral offices. The IRI approached the municipality to measure their interest in the project and received a very positive response.

Project Needs and Objectives

The thesis uses Beni as a context to formulate a mapping framework. I identified the following project needs and objectives that the framework should address:

1–26 Commercial street selling automobile and other mechanical parts

Big plans but start small: Maps have not been used in the city and therefore it is important for the framework to introduce maps into the community sequentially before publishing maps of more sensitive themes. For example, mapping could eventually be used to map the problem of land conflict in the city and region by using knowledge and transparency as a first step to resolution. The framework can be brought out in several phases as a response to the need to start small but eventually map the bigger issues. The creation of a base map is a good starting point because it can serve as a valuable reference layer that all other data can be built on, and can work to establish key information that is necessary for future data analysis such as road names, neighbourhood boundaries, and points of interest. It also gives the GIS team time to hone their skills with the GIS tools.

Demographics: A second step for the community to know more about itself would be to perform a demographic survey. The last formal census was thirty years ago and the population is unknown. Other useful information could be obtained such as household infrastructure information for power, water, and sanitation, and migration data describing where people came from when arriving to the city. Although this type of information may not be immediately valuable to the population, the data could be analysed in research to inform next steps of the city's development and build up a historic understanding of how Beni was formed.


MAISON
DEXIL

1–28 Sample of the small ravines that traverse the city

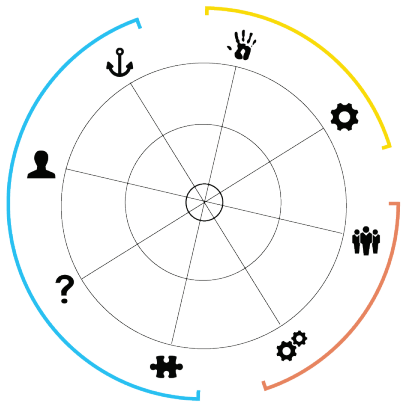
Framework that grows with the development of infrastructure: There is a lack of dependable electricity in Beni that greatly influences where work can be performed and where the digital processes can take place. At the beginning of the project any volunteers or researchers would need to work off of personal or university laptops. For this reason and also because the internet is slow and expensive, it would not be possible for participants to download or purchase proprietary software. It is necessary for the framework to propose open source and easily transferable data collection and framework solutions that can then grow over time with the formal infrastructure of the city and the university.

Map as community resource: The region has 3G internet and the use of smart-phones is on the rise, but my estimate is that it is still only limited to 5-10% of the (adult) population though the increase will be exponential over the next few years. For the map to be made available as a community resource it is important that a program is in place that disseminates the maps in both physical and digital mediums. A second program needs to be established to consult the community and involve them in the creation of the maps. The framework must address these physical community programs as clearly as the structure of digital tools. Dissemination strategies can include making the digital map available on a computer in the university library, publishing them in community journals, and painting the maps as murals around the city.

1–27 Women selling bananas in an informal market area

Innovative and extensible: Digital mapping tools have capabilities that allow for activities that include aggregating data from different sources, collecting and reporting, networking, and running simulations on a map. The methods allow community members to have the ability to actively contribute to a dynamic map of the city. The framework can imagine how these methods could be used to respond to specific problems in the city of Beni and can be designed to be extensible so that it is able to include additional thematic layers and functions that can be added in the future.

1.4 Study of Mapping Frameworks



Does the user add to the map?

Does the user gain agency?

Are the users active participants?

Is there shared agency?

Is the framework scalable?

Is the framework redefining space?

Is the framework personalized for users?

Is the framework administratively grounded?

1–29 Wheel diagram rating the functions of the framework

The following chapter outlines a selection of mapping framework precedents. Precedents include work of Chora, Stamen Design, Extreme Citizen Science, MIT Media Lab, and Engagement Game Lab among others. The selected precedents have different ambitions and methods to demonstrate how broadly digital mapping tools can be employed. The first four precedents are web and mobile interfaces that have been developed and used in North America and are on the front-line of digital mapping capability; the other four are frameworks that have been established as part of development initiatives mostly in Africa. The goal of the framework analysis is to understand the tools and methods used by each initiative and how they respond to the context, and to look at them through a lense of questions drawn from the theoretical discussion. The questions are the following:

From the function of accumulation:
Does the user add anything personally to the map?
Does the user gain agency?

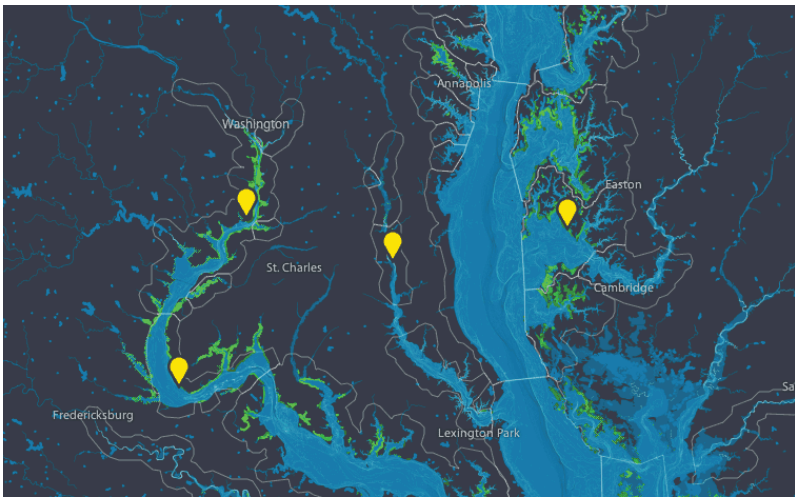
From the function of optimization:
Are the users active participants?
Is there shared agency?

From the function of re-territorialization:
Is the framework scalable in space and time?
Does the framework redefine space by changing the way a person perceives or interacts with it?
Is the framework personalized for users?
Is the framework administratively grounded by having programs in place that affect change?

Sequence diagrams describe the process of inputs and outputs in each framework and the relationhipss between agents, the technology, and users. Grey boxes represent the community processes and black the digital processes. The analysis uses three terms of “framework”, “platform”, and “tool”. For the purpose of describing the precedents, a framework is the full structure of the mapping program, a platform is a wrapped portion of a digital framework, and a tool is a digital element that is being used within the digital framework or platform. The circular diagram like the blank one in figure 1-20 visualizes the

theoretical questions by giving a low medium or high ranking for each question. Each precedent has a general description followed by a paragraph outlining the site, players, and tools, and a paragraph reviewing how the project responds to the theoretical questions.

By analyzing each framework in this way, the intention is to learn from the community and digital techniques that were used, uncover the dialectics present in the frameworks, and determine the level of success the designers had in meeting their ambitions.



1–30 Screen-shot of Chesapeake Bay Grasses interface

Chesapeake Bay Grasses by Stamen Design

The Chesapeake Bay Grasses map is a simple and elegant website that was designed by Stamen Design. The interface was designed to visualize information about the wetland grasses in the region. The map allows users to interact with the content and comprehensively displays a large amount of data. A user starts by looking at the map as a whole, but by moving the mouse across the screen, can choose to select a region to zoom in and view in more detail. For example, by selecting a region one can discover the specific trends of water temperature, salinity and turbidity, and see what plant species grow there. The user can also see data through time by selecting a different point on the time-line or pressing play to watch time pass in a stop-motion sequence. Graphs beside the map dynamically summarize the data from whatever region or time that is selected.[1]

The scale of the project is the entire region of Chesapeake Bay, Virginia and the agent is the Chesapeake Bay Program. The program works to protect and restore the bay and is a region-wide partnership of groups from multiple levels of government, organizations, and citizen advisory groups.[2] Anyone with access to the Internet can view the

Scale/Place
REGION: Chesapeake Bay, Virginia USA

Agents
Chesapeake Bay Program

Users
Anyone

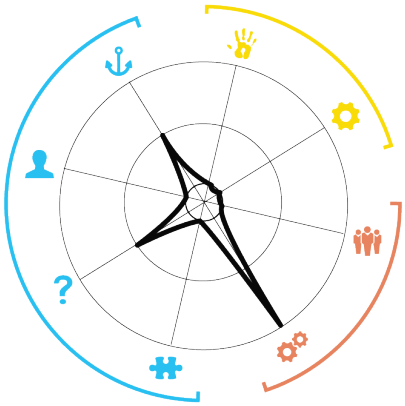
Processes/techniques
Aggregation

Tools
Leaflet
D3

1 "Chesapeake Bay Grasses," http://www.chesapeakebay.net/visualization/baygrasses/#8/38.100/-76.187?year=1984&compare=2013&chart=temp.

2 "Chesapeake Bay Program," http://www.chesapeakebay.net/.

Chesapeake Bay Program
A Watershed Partnership

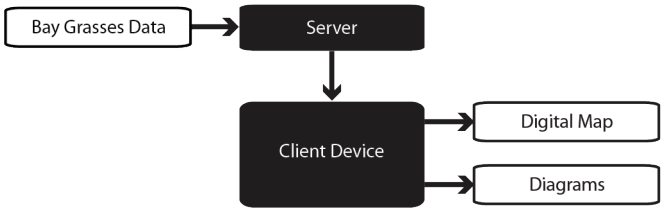


1–31 Wheel diagram rating the functions of the framework

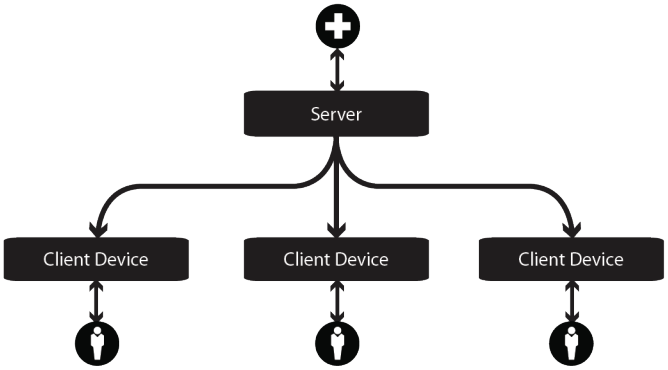
- Does the user add to the map?
- Does the user gain agency?
- Are the users active participants?
- Is there shared agency?
- Is the framework scalable?
- Is the framework redefining space?
- Is the framework personalized for users?
- Is the framework administratively grounded?

maps, though the content likely draws researchers along with similar individuals or groups that contribute to the Bay Program. The map aggregates and represents years of data collected by the Bay Program. The website was created using Javascript, the Javascript mapping API Leaflet, and the data management API D3 (Data Driven Documentation). The Leaflet library was used to build the interactive map, and D3 adds additional dynamism to the data displayed on the map and the corresponding graphs.

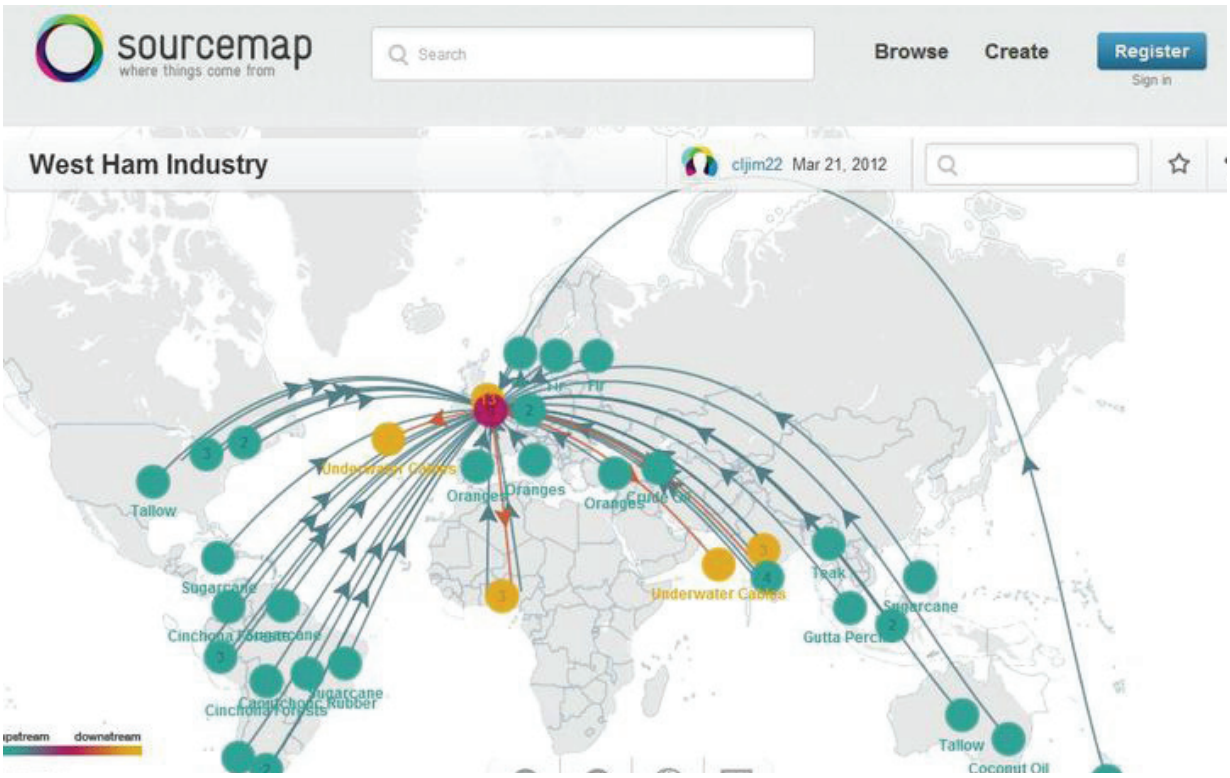
The map of the grasses contributes an idea to society by being an accurate and comprehensive source that displays data that the program deems important. It might be more difficult for other groups to do development that would have negative impact on the wetlands if the visualization would predict a negative impact. In this way the website gives shared agency to the Chesapeake Bay Program to be an authority on issues related to the wetlands. Other groups such as individuals living in this region do not have any input into what is displayed on the website, but do gain knowledge by being general viewers of the content. The project redefines space by representing data about the region that a user could not process visually and therefore offers a new perspective that may influence decisions in the site. The map is indirectly administratively grounded because it can be assumed that the Chesapeake Bay Program organizes their community initiatives based on what they have learned from the visualization of the data.



1–32 Framework diagram: Processes



1–33 Framework diagram: Relationships



1–34 Screen-shot of Sourcemap interface

Sourcemap

Sourcemap is a software tool that locates and connects the people and places that are involved in the process of making a product and putting it on the market. The project started as research at the MIT Media Lab and then became an enterprise software start-up. The tool allows companies to create a supply chain map of their business so that they can understand the big picture and more easily manage vendors, shipments, and inventories, and analyse risk, cost, and environmental impact. Companies can also share the map with their customers to promote transparency about their products. Users have the choice of having a private, semi-public, or public platform and can choose to use the tool to connect and communicate with suppliers and manufacturers along the chain. To date the enterprise software has been used by global brands in pharmaceutical, apparel and furniture sectors. A free Sourcemap option is available for anyone who wishes to create and publish a supply chain map.[1]

The scale of the framework is global and Sourcemap is the agent of the framework who makes sure that the servers are secure and operating. There are two levels of users of the framework: The first level is the companies that are using the framework and the network along the supply chain; the second level is the consumer who can see the network if it is made public. The map connects nodes of information and

1 "Sourcemap," http://www.sourcemap.com/.

Scale/Place
GLOBAL

Agents
Sourcemap

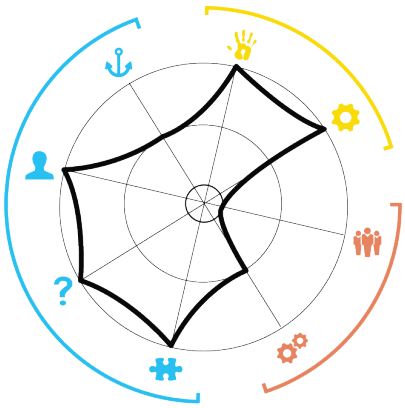
Users
Business
Academia
Consumer

Processes/techniques
Networking

Tools
Desktop Software
Cloud Database

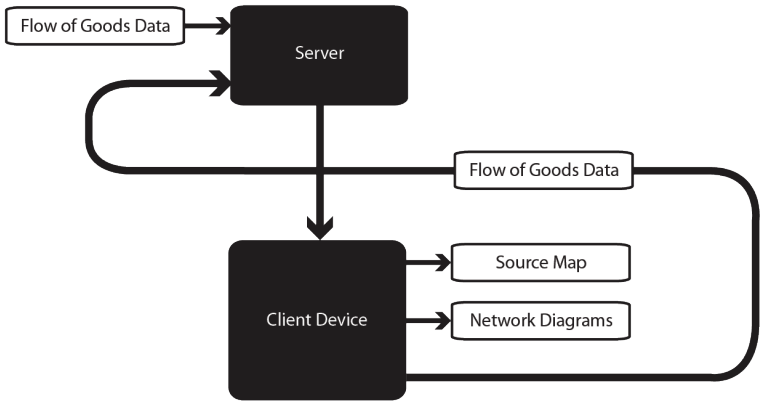
presents the networks visually to the user. Sourcemap does not share what specific set of tools they use, but they have created a desktop application that connects to a cloud of servers.

Sourcemap offers agency to companies to make more calculated decisions based on being able to see the big picture and understand and therefore better address the weakest points of the supply chain. On another level it provides a certain amount of shared agency to buyers to select products based on where they come from and pushes for common transparency in the commercial sector. The framework is scalable because any number of companies can choose to use the tool. The map shows a simplified strategic image when zoomed out and shows more details when zooming in. The framework redefines space for the reason that it gives a spatial footprint to a product and decisions affecting that footprint can then be manipulated in response to the information. The framework allows the software to be personalized to suit the needs of the company.

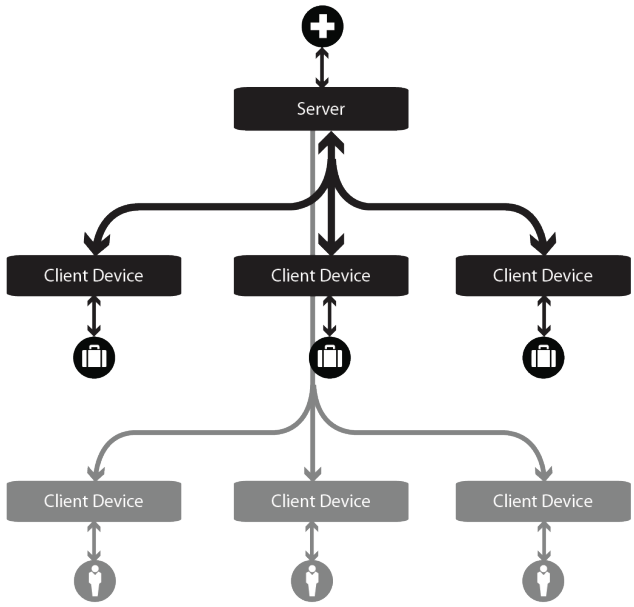


1–35 Wheel diagram rating the functions of the framework

- Does the user add to the map?
- Does the user gain agency?
- Are the users active participants?
- Is there shared agency?
- Is the framework scalable?
- Is the framework redefining space?
- Is the framework personalized for users?
- Is the framework administratively grounded?



1–36 Framework diagram: Processes



1–37 Framework diagram: Relationships

Community PlanIt by Engagement (Game) Lab

Community PlanIt is a framework that can be employed by a municipality or organization to involve the community in assessing community needs through participation in an interactive digital environment. By giving reports and voting on different elements, a community member can participate in an ongoing discussion of community needs and what physical measures might be implemented to meet them. The framework uses a base map of the city so that reports and discussions can be visually localized and analysed by location.[1] An example of a Community PlanIt initiative is a city-wide visioning project called Detroit 24-7 in partnership with Detroit Works Project Long Term Planning. The game occurred over 21 days with 1033 registered players and over 8400 comments.[2]

The framework is at the scale of the neighbourhood or the city. Community PlanIt is the agent in partnership with a local municipality, organization, or institution. While Community PlanIt is in charge of making sure the digital game runs smoothly, the two groups together plan the vision and objectives for the game and the partner group is responsible for coordinating the supporting programs in the commu-

1–38 Screen-shots of description of the game on the Community PlanIt website

Scale/Place
CITY

Agents
Community PlanIt
Municipal Government

Users
Community Member

Processes/techniques
Collecting/Reporting

Tools
?

1 "Community PlanIt," https://communityplanit.org/.

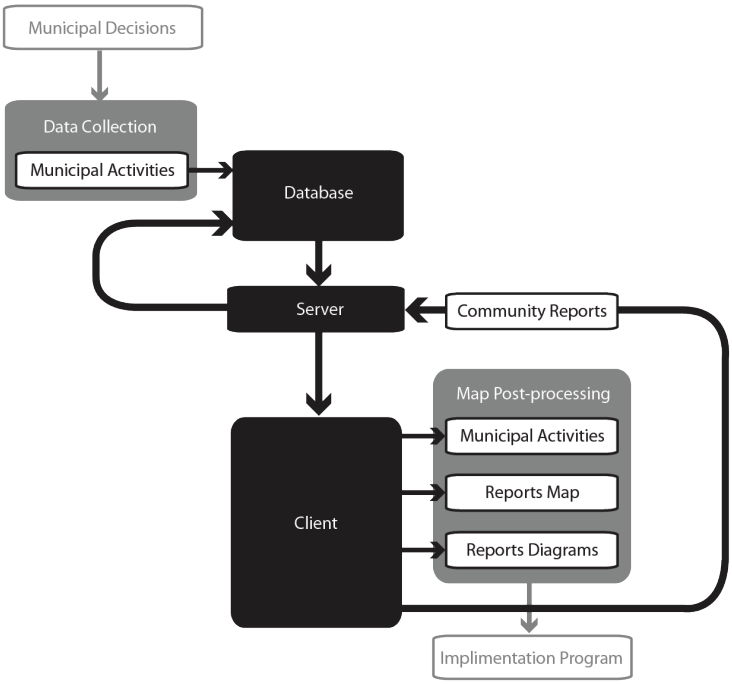
2 Eric Gordon, "Gaming City Planning: Community PlanIt in Detroit," *States News Service*, June 13, 2012.

nity. The users are any community members who wish to be involved and have internet access. The framework employs game mechanics to motivate users and crowd-sourced reporting to collect and analyse the data from users.

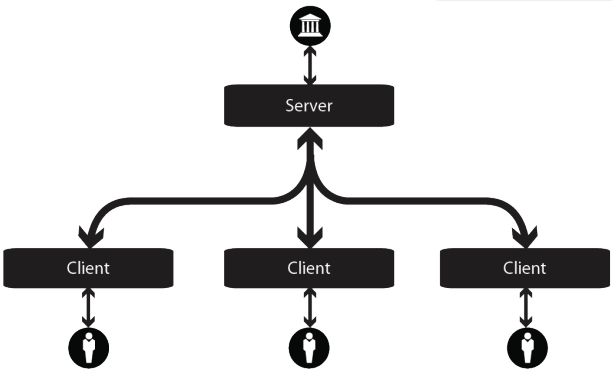
Community PlanIt is intended more for shared agency than individual agency. The user contributes democratically to the game along with other users, but their contribution is evaluated as one node out of many and the parameters of the game are preset by the game creators. For this reason the personal contribution, agency, and participation are only partial. The project is highly scalable as different versions of the game can be created to suit community objectives in different cities. The framework only partially redefines space as it offers a user the opportunity to express how they think the city should change but does not visualize it. Users have a profile that allows them to navigate the game and vote and comment. It is the role of the municipality or other community partners to design a program to implement community actions that respond to the information collected from the framework.

1–39 Wheel diagram rating the functions of the framework

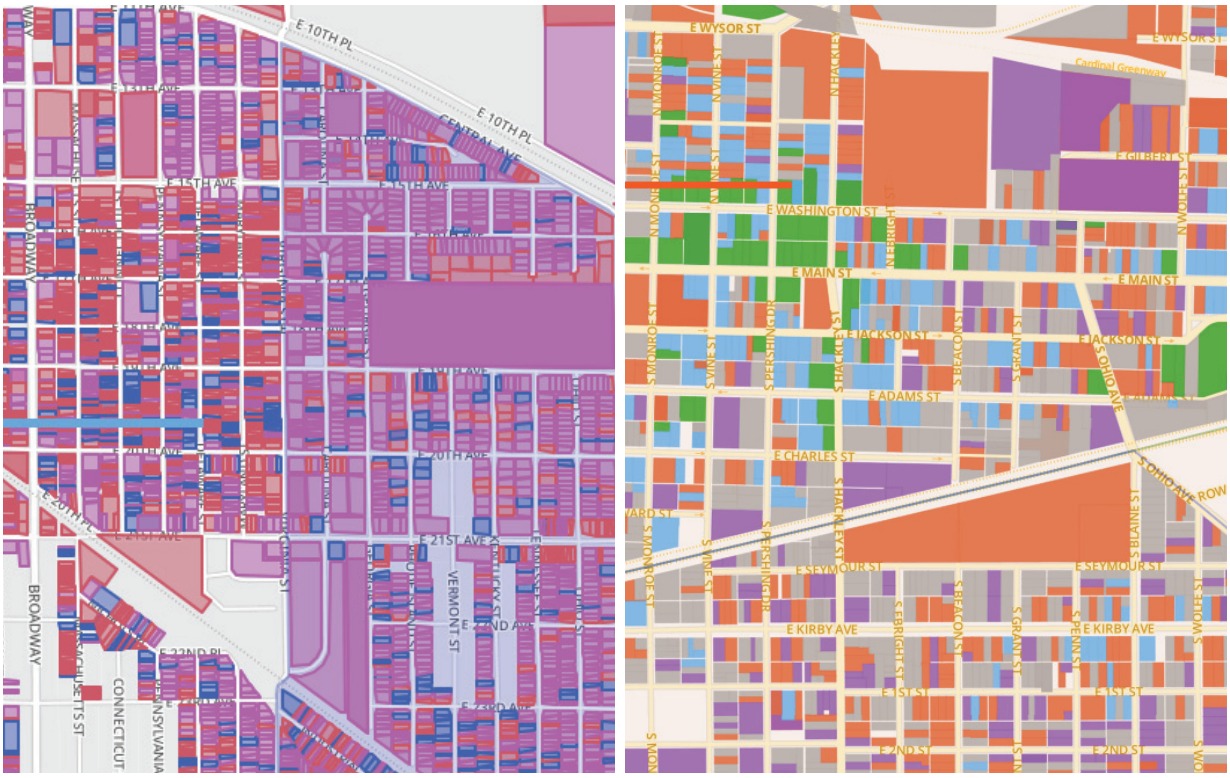
- Does the user add to the map?
- Does the user gain agency?
- Are the users active participants?
- Is there shared agency?
- Is the framework scalable?
- Is the framework redefining space?
- Is the framework personalized for users?
- Is the framework administratively grounded?



1–40 Framework diagram: Processes



1–41 Framework diagram: Relationships



1–42 Screen-shots from LocalData website describing two initiatives in Gary and Muncie Indiana

LocalData

Local data is a tool that allows organizations, governments, and researchers to be able to better collect and work with spatial data. Instead of using paper maps and surveys, LocalData combines those tools into a digital framework that automatically updates on the map as the data is collected. The base map and custom surveys are prepared in advance and then connected on the cloud with the LocalData smart-phone application. A group of participants can then go around town to collect data using their phones.[1] LocalData has been deployed in over twenty cities, mapping spatial data such as vacancies, site selection for transportation hubs, and supply chain logistics. They plan to expand their capability to include non-spatial data like education and health data, environmental data, and transit data. An example of one of their projects is the mapping of vacant properties in the city of Muncie Indiana in partnership with the consulting group Place Economies and the municipal government. Fourteen students from the University of Pennsylvania participated in the data collection and documented 4286 lots in four days.[2]

The framework is at the scale of the neighbourhood or city. The agents are LocalData in partnership with the municipal government, an organization, or an institution. Users are the partnering agents, however

1 "LocalData," http://localdata.com/.

2 "LocalData In Action," http://localdata.com/case-muncie.

Scale/Place
CITY

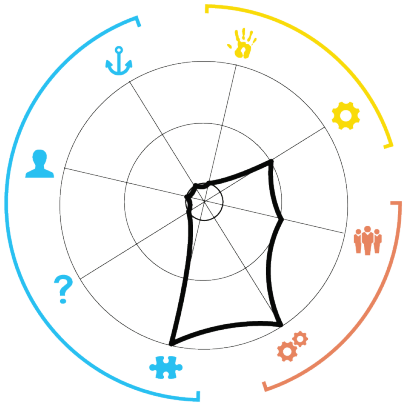
Agents
LocalData / Corporate Consultants
Municipal Government
Organizations
Universities

Users
The partnering agent(s)

Processes/techniques
Collecting/Reporting

Tools
HTML5
JavaScript
Leaflet
Node.js
MongoDB
PostGIS

LocalData



1–43 Wheel diagram rating the functions of the framework

Does the user add to the map?

Does the user gain agency?

Are the users active participants?

Is there shared agency?

Is the framework scalable?

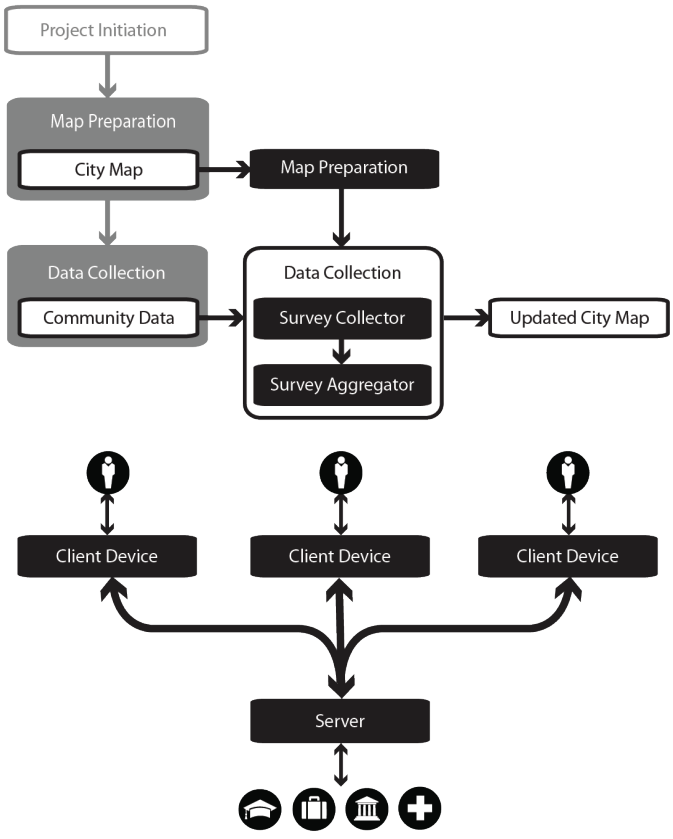
Is the framework redefining space?

Is the framework personalized for users?

Is the framework administratively grounded?

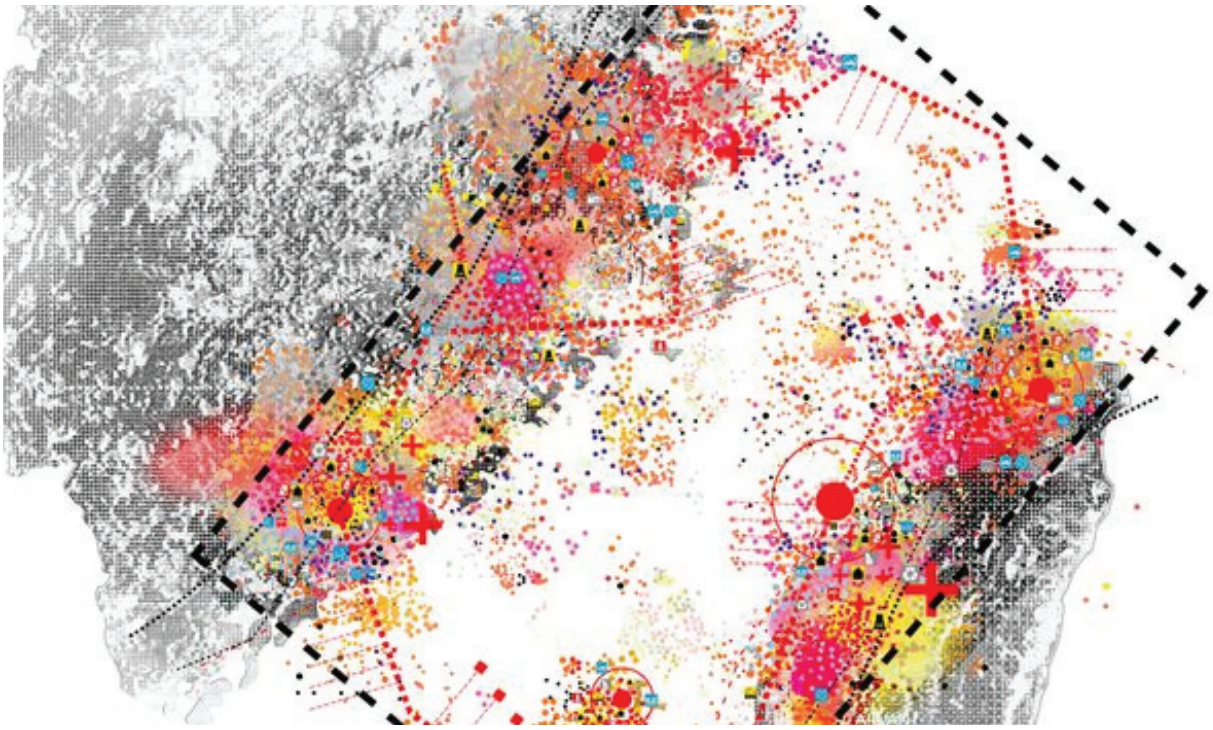
the participants of the data collection can also be considered users. They would primarily be students, organization volunteers, or community members. The framework is designed for the purpose of data collection. Although the data is represented during the collection of the data, what happens to the resulting data is at the discretion of the partnering agents. The method that the framework employs is collecting and reporting with a select group of participants. The framework is built with HTML5 and Javascript using the Leaflet and Node.js libraries. They employ an open-source document database called MongoDB but are working to transition to an open-source SQL database called PostGIS.

Only partial individual agency is gained because the user is participating as a collector of information that is prescribed by the organizers of the initiative (the agents). Agency for this framework is more for the agent than the user. The person might be involved because they agree with what the data collected will be used for. There is only partial participation in the initiative because the participants do not necessarily have a say in what information they are collecting. There is shared agency because there is generally a community goal for each initiative. For example, the collection of vacant lots and buildings in Muncie will allow planners to make decisions based on the data, that in the long run will benefit the city. The project is scalable because it can be implemented anywhere with other partners and initiatives.



1–44 Framework diagram: Processes

1–45 Framework diagram: Relationships



1–46 Map from the atlas showing combined networks within the region of the Taiwan Strait

Chora Taiwan Strait Atlas

Taiwan Strait Atlas is a research initiative lead by Chora Architects to map the area of the Taiwan Strait. The goal of the project is to promote collaborative projects across the strait by creating a comprehensive set of maps that document the shared history, ecology, movement, trade, and potential developmental opportunities of the region.[1] Chora is partnering with two local universities in both China and Taiwan who are then reaching out to various stake-holders and community groups. The project team performed thorough research to create a detailed base map of the region. They are then layering more informal information collected from community charrettes that involve stakeholders and community participants in a series of design scenarios. The maps and research will be published as a hard-copy atlas.

The framework has a regional scale and the agent is Chora. They intentionally remain the sole agent to present the atlas with as little bias as possible; however, they attempt to involve as many user groups as possible. There are two levels of users of the map. Participants in the project's community programs represent all user groups and contribute by providing their ideas and feedback in the scenarios. Other users will be the people who read the published map. The framework uses two mapping techniques of aggregation and simulation to collect and represent data. Aggregation is the main technique because the creation

Scale/Place
REGION: Taiwan Strait

Agents
CHORA

Users
Universities
Organizations
Businesses
Governments
Community Members

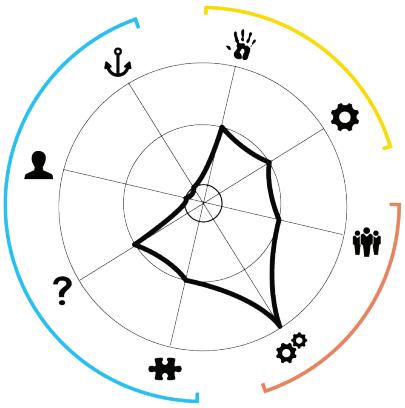
Processes/techniques
Aggregation
Collecting/Reporting
Game/Simulation

Tools
Map Editor
Field Notes/Printed Maps

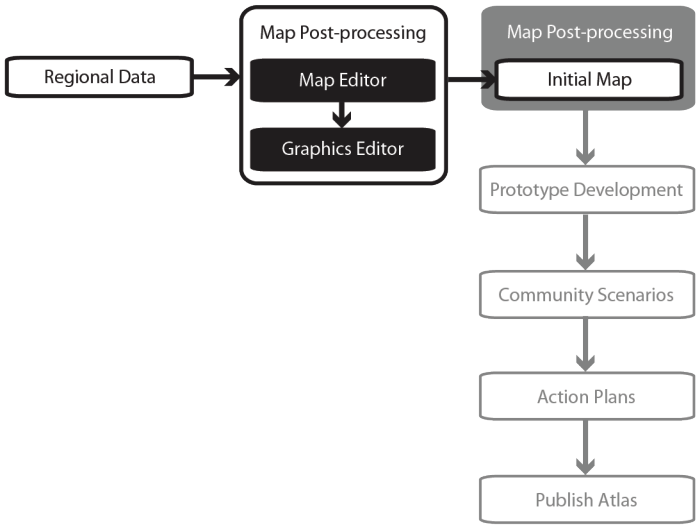
1 "Chora Research: 2006 to CURRENT Taiwan Strait Smart Region," http://www.chora.org/?p=139.

of the atlas is primarily a collection and curation of data from different sources. Simulation is a secondary strategy to involve participants in a series of scenarios for community action prototypes that Chora develops in response to the data. Chora uses a GIS map editor and then relies on printed maps to present the prototypes and scenarios.

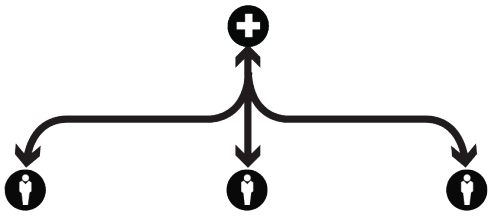
Participants have a partial imprint on society and individual agency because they are able to participate in the community charrettes that are contributing to the research of the region. Participation is limited because it involves only a small group of individuals. The common goal of the initiative is the creation of an atlas that will foster interest in development and problem solving in the region to shift focus to future economic opportunities between China and Taiwan instead of past tensions. The initiative is at a very large scale covering an entire region and yet also addresses the finer grain of local communities. The project could not be reproduced elsewhere because it is very customized to the context, but the methodologies could be reapplied. Although "Action Plans" are included as the final methodology for the project, it is uncertain how they would be implemented in the communities and region.



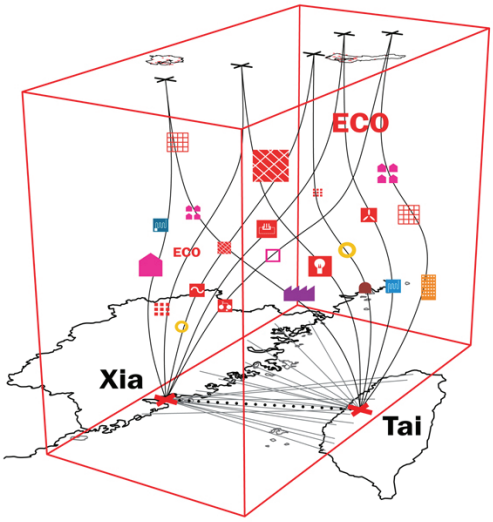
1–47 Wheel diagram rating the functions of the framework



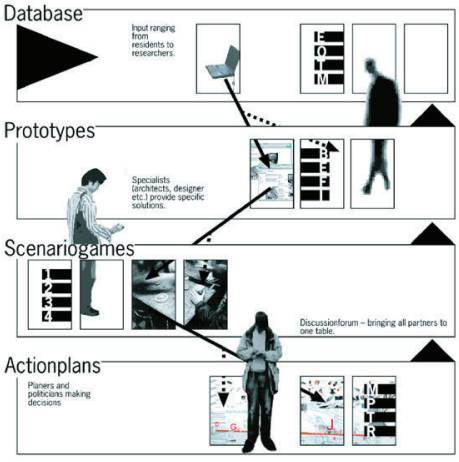
1–48 Framework diagram: Processes



1–49 Framework diagram: Relationships



1–50 Diagram showing relationships across the strait



1–51 Chora methodologies for Taiwan Strait Atlas project

1–52 Team of students working on mapping scenario from Xiamen Climate Change workshop

1–53 Photo of Map Kibera field collection

Map Kibera

Map Kibera is a community information and advocacy framework that was put in place for the Kibera slum in Nairobi. The goal was for young locals to participate in creating a map of the slum and for the program to gain momentum as a mapping, media, and advocacy tool by and for the community of Kibera.[1] The initiative used phases of initial mobilization, applying the tools, developing action plans, advocating on behalf of the community, and then entering negotiations with the local government and community leaders. Initial mobilization involves connecting with community groups, organizations, and municipal officials to develop partnerships and begin the discussion of what the framework could provide for the community. The second step is to learn about the community by creating an initial base map, discovering people's stories, and analysing the information to determine community response. The third phase involves sharing the findings with the community and leadership, establishing future goals, and agreeing on leadership for the framework. The fourth step involves reaching out to the community through a wide range of mediums to bring issues to the forefront, and the final step is the negotiations with decision-makers to bring about change in the community.[2]

The initiative is at the scale of the neighbourhood. The agent was a small team of Americans who launched the initiative but quickly put it into the ownership of a team of Kibera locals. The users of the framework are community members of Kibera that wish to reach out and use the tools that are available. In the initial phases Map Kibera used collecting and reporting with a group of participants to form the

Scale/Place
NEIGHBOURHOOD: Kibera, Nairobi

Agents
Map Kibera

Users
Community Members

Processes/techniques
Collecting/Reporting

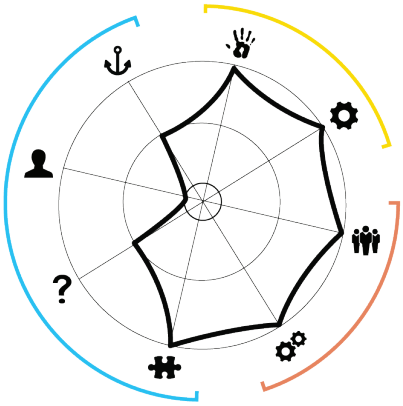
Tools
OpenStreetMap
JOSM Editor
Field Papers
OSMAnd
Ushahidi
Wordpress

1 "Map Kibera," http://www.mapkibera.org/.

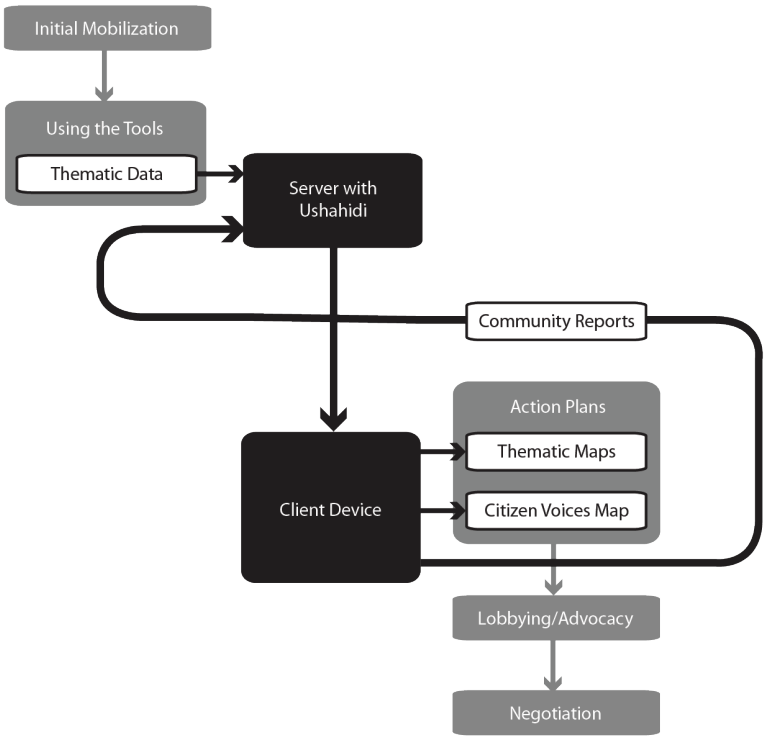
2 "Map Kibera: Methods," http://www.mapkibera.org/work/methods/.

initial map, and then later expanded it into a crowd-sourcing platform. They use several open-source tools for the data collection that include OpenStreetMap (OSM) and other tools that extend OSM including Java OpenStreetMap (JOSM) Editor, Field Papers, and OSMAnd. Field Papers is a tool that allows field notes with a scan-code to later be photographed or scanned and then digitally geo-located. OSMAnd is a smart-phone application for field data collection.

The initiative has a high ranking in the areas of individual and communal agency. People can have personal contribution and agency by adding their information to the map and getting involved in the community programs. There are many avenues and levels of participation in the framework that include contributing to the mapping or forms of media and advocacy. The shared goal of the initiative is to "make the invisible visible" by putting Kibera on the map and creating an outlet for communication between the community and also from the community to the city, nation, and the world.[1] The methodologies and tools as applied in Kibera can be expanded to other slums as has already been done in the slums of Mathare and Mukuru in Nairobi. By mapping the unmapped and giving citizens a voice on the map, space is redefined by being associated with voices and potentials for the space. There is a community framework in place that establishes community action plans based on the information, advocates for changes, and then negotiates with decision makers on behalf of the community.



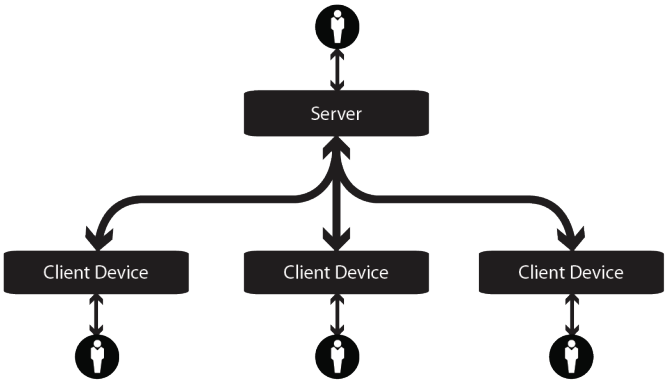
1–54 Wheel diagram rating the functions of the framework



1–55 Framework diagram: Processes

1 "Voice of Kibera," http://voiceofkibera.org/.

1–56 Framework diagram: Relationships



1–57 Image of one of the Map Kibera murals painted around the neighbourhood

1–58 Security map of Kibera

Data collection platform: Ushahidi

Map Kibera uses a platform called Ushahidi (Swahili for Testimony) for their data collection/reporting, a crowd-sourcing data management system developed to map reports of violence in Kenya. Since then it has been employed as an openly available platform that can be used by other initiatives around the world. 60,000+ maps have been deployed using Ushahidi in 159 different countries.[1] The Ushahidi software is built with Kohana (a PHP framework) and has features that include the ability to map data interactively, to organize and filter data by time, and to manage multiple data streams such as text messages, e-mail, twitter, and web-forms. Ushahidi can only be analysed under the banner of the initiatives that employ it because in being provided as a tool it was disconnected from the community framework that localizes it. Initiatives that employ Ushahidi have had various degrees of success because they choose how they implement the tool.

1 "Ushahidi," http://www.ushahidi.com/.

1–59 The Sapelli application being used in the forest

Citizen Science: Forest Management in Congo Brazzaville

The Extreme Citizen Science (ExCiteS) group at University College London (UCL) is in the process of developing and testing a framework they have developed for working with indigenous communities who live in some of the most remote regions in the world. In Congo there are many indigenous villages that overlap logging concession areas that threaten their way of life. The goal of the initiative is to give indigenous people a voice so that they can protect the forests that they depend on for their subsistence.[1] The framework is a combination of a community engagement protocol called "Free, Prior, and Informed Consent" (FPIC) and a digital framework called Sapelli.[2] The community framework involves steps of gathering representatives of the community and proposing the project. If they receive consent to proceed, they involve the community in participative design to determine what information in the forests is important and should be collected. The next step is training community members in using the tool and finally sending participants to document different elements of the forest. In 2013 a team from ExCiteS went to Congo Brazzaville for six weeks and tested the framework in eight villages. The villages included indigenous groups that do either farming or hunting/gather-

Scale/Place
REGION

Agents
UCL ExCiteS
Forests Monitor, NGO

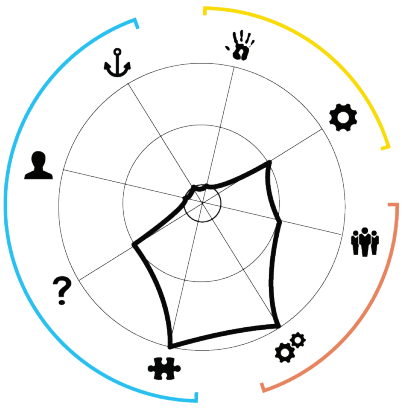
Users
Organizations
Businesses
Government
Community Members

Processes/techniques
Collecting/Reporting

Tools
Sapelli

1 "Extreme Citizen Science: ExCiteS," https://www.ucl.ac.uk/excites.

2 Matthias Stevens et al. "Taking Participatory Citizen Science to Extremes" *Pervasive Computing* April-June (2014): 22.



1–60 Wheel diagram rating the functions of the framework

Does the user add to the map?

Does the user gain agency?

Are the users active participants?

Is there shared agency?

Is the framework scalable?

Is the framework redefining space?

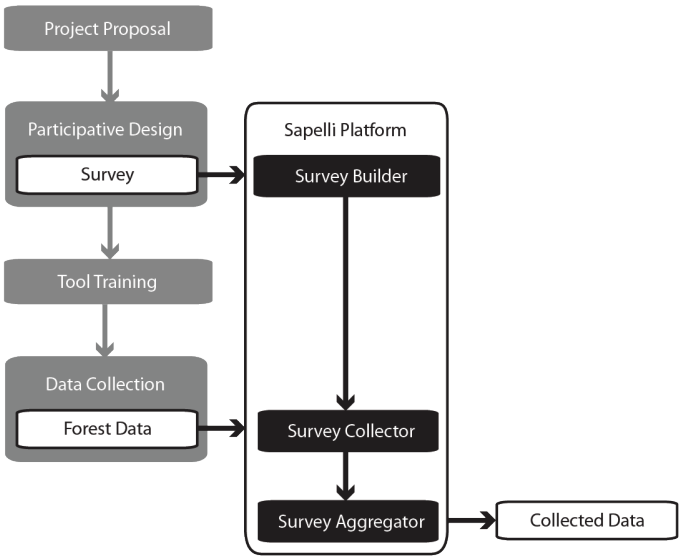
Is the framework personalized for users?

Is the framework administratively grounded?

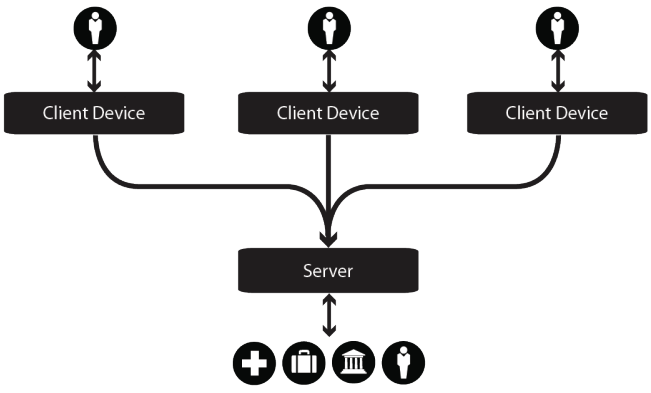
ing, had varying remoteness from urban areas, and were located on multiple forestry concessions that have different environmental and social obligations.

The initiative is at the scale of the region and the agents are UCL ExCiteS in partnership with an intermediary NGO called Forests Monitor. The users are Forests Monitor and any other regulatory organizations, the logging companies, the government, and the indigenous villagers. The framework uses the digital mapping technique of collecting and reporting with a team of participants, and uses a smartphone application that ExCiteS developed called Sapelli.

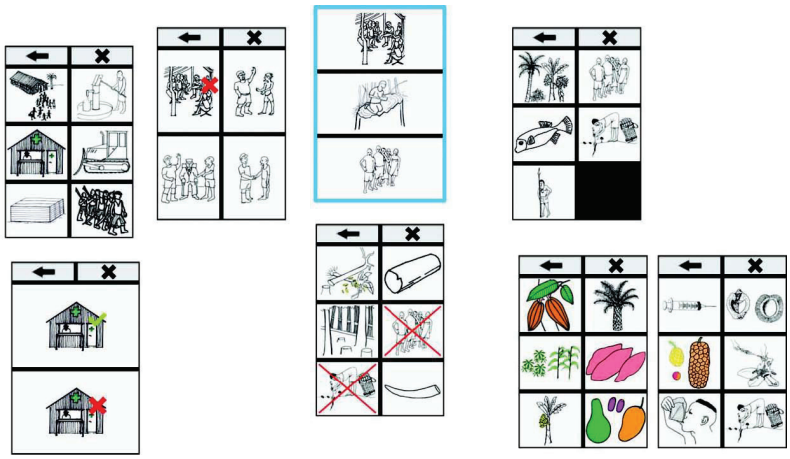
The framework gives the user partial agency to contribute to a project that they think is important, but mostly the project is for communal agency to give the whole community a voice in forest management. There is partial participation because users are following a structured procedure, even though they participate in the design of it. The project is highly scalable because the same community methodologies can be applied in different places and the digital framework is meant to accept custom designed surveys. Space is partially redefined because



1–61 Framework diagram: Processes



1–62 Framework diagram: Relationships



1–63 Example of visual survey

the parts of the forest that are considered valuable by the villagers can now be communicated as valuable to other stakeholders. A forest that might commonly be perceived as an abstract idea of trees, can now be understood by the complex array of species that inhabit it. The framework is not yet administratively grounded because there is no strategy in place for how the data will be used to benefit the indigenous groups; the data is only useful if it can influence policy.

Data collection platform: Sapelli

Sapelli (named after an endangered tree in the Congo rainforest) is a digital framework in development by the ExCiteS group. The platform was designed to simplify the creation of the surveys and streamline it with collection and aggregation tools.[1] The interface is a visual decision tree that users navigate to report on different elements in the forest. Although the interface is designed to be completely visual, there are also options to display images with text or just text depending on the targeted user. To work in remote areas the application is designed to send data only if it senses a strong internet connection, and there is also an option to send the data in multiple SMS strings. In the earlier developments of Sapelli, ExCiteS tried to build off of existing open-source survey tools from Open Data Kit (Open Data Kit); however, they found them too complicated and limiting for their purposes and so developed their own platform from scratch.

Data collection platform: Cybertracker

The Sapelli platform resembles a first-generation platform called Cybertracker. It is worth mentioning because it was developed in 1995 for the original purpose of tracking wildlife, but since then has been employed around the world in the varied domains of scientific research, indigenous knowledge, environmental education, forestry,

1 "Sapelli," https://www.ucl.ac.uk/excites/software/sapelli.

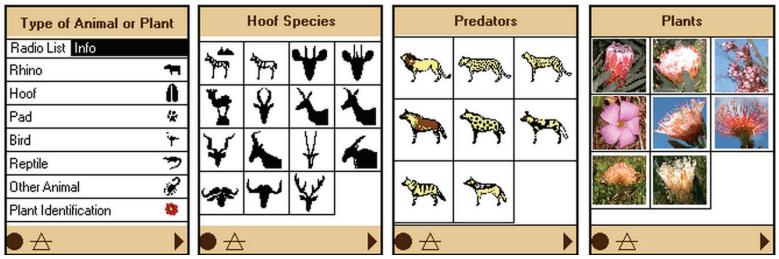
farming, education, health, crime prevention, and disaster relief.[1] The framework was first developed for use on rugged handheld computers but later expanded for use with smart-phones. The framework includes Cybertracker software that allows the user to customize the application and later aggregate, analyse and export the resulting data. The application is available for most mobile devices and has the ability to register a user's track and specific waypoints on the way to a destination.[2] An example of a framework that employed the Cybertracker platform is a community forest management project that took place in Tinto Cameroon in 2005. The project had very similar objectives to the more recent ExCiTes project.[3]

1 "CyberTracker," http://www.cybertracker.org/background/our-story.

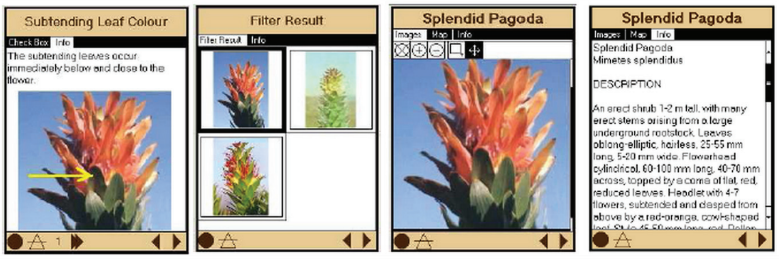
2 "CyberTracker: Software," http://www.cybertracker.org/software/introduction.

3 Michael K. McCall and Peter A. Minang, "Assessing Participatory GIS for Community-Based Natural Resource Management: Claiming Community Forests in Cameroon." *The Geographical Journal* 171, No. 4 (2005): 340-356.

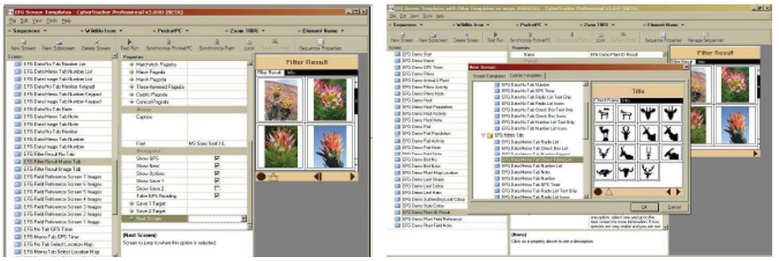
1–64 CyberTracker screen designs



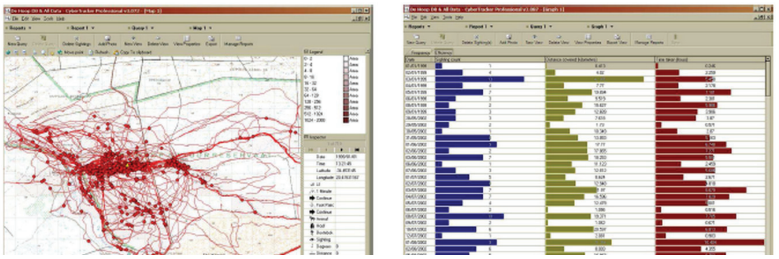
1–65 CyberTracker electronic field guide

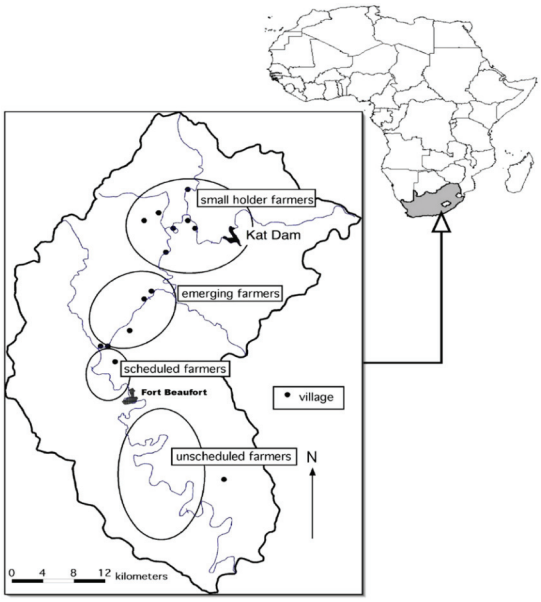


1–66 Designing an application



1–67 View and export maps and data





1–68 Map showing the Kat Basin in South Africa with the stakeholders

Game theory not only suggests stable solutions to resource allocation problems but also points to the social loss and volatility of existing arrangement among various agents. The value of awareness raising is not less important than that of solution crafting.

– Game Theory and Policymaking in Natural Resources and the Environment (Dinar et al. 2008)

1–69 (facing) Image demonstrating the KatAware software

Game Theory: Evaluating Water Allocation in the Kat Basin, South Africa

One last example of a different approach to digital mapping is the use of companion modeling – a combination of role playing games and cooperative game theory – to aid in the management of shared resources. Both of these methods were applied in the management of water resources in the Kat Basin region of South Africa.[1] Role playing games are the involvement of all stake-holders in a game that represents as realistically as possible the factors involved in the resource management. The game has two goals of getting the stake-holders to understand all of the problems and to negotiate, and also allow the game administrators to study how the stakeholders respond when they play the game. By consulting the stakeholders on all factors and seeing how they act within the game, the administrators can develop a theoretical simulation that can calculate optimal results for all stake-holders and make future predictions.[2] The software that was developed for the theoretical simulation is called KatAware. Both the role playing game and the cooperative game theory have the objectives to cooperatively maintain the ecology of the region while individually gaining a profit (or in the case of village leaders, having a satisfied village). The games will always be a simplification because they cannot predict all environmental and political factors that may influence the region. They also assume that all stake-holders report to a single body that governs water release from the dam and that nobody can cheat.

Scale/Place
REGION: Kat Basin, South Africa

Agents
Academic researchers
Water Users Association

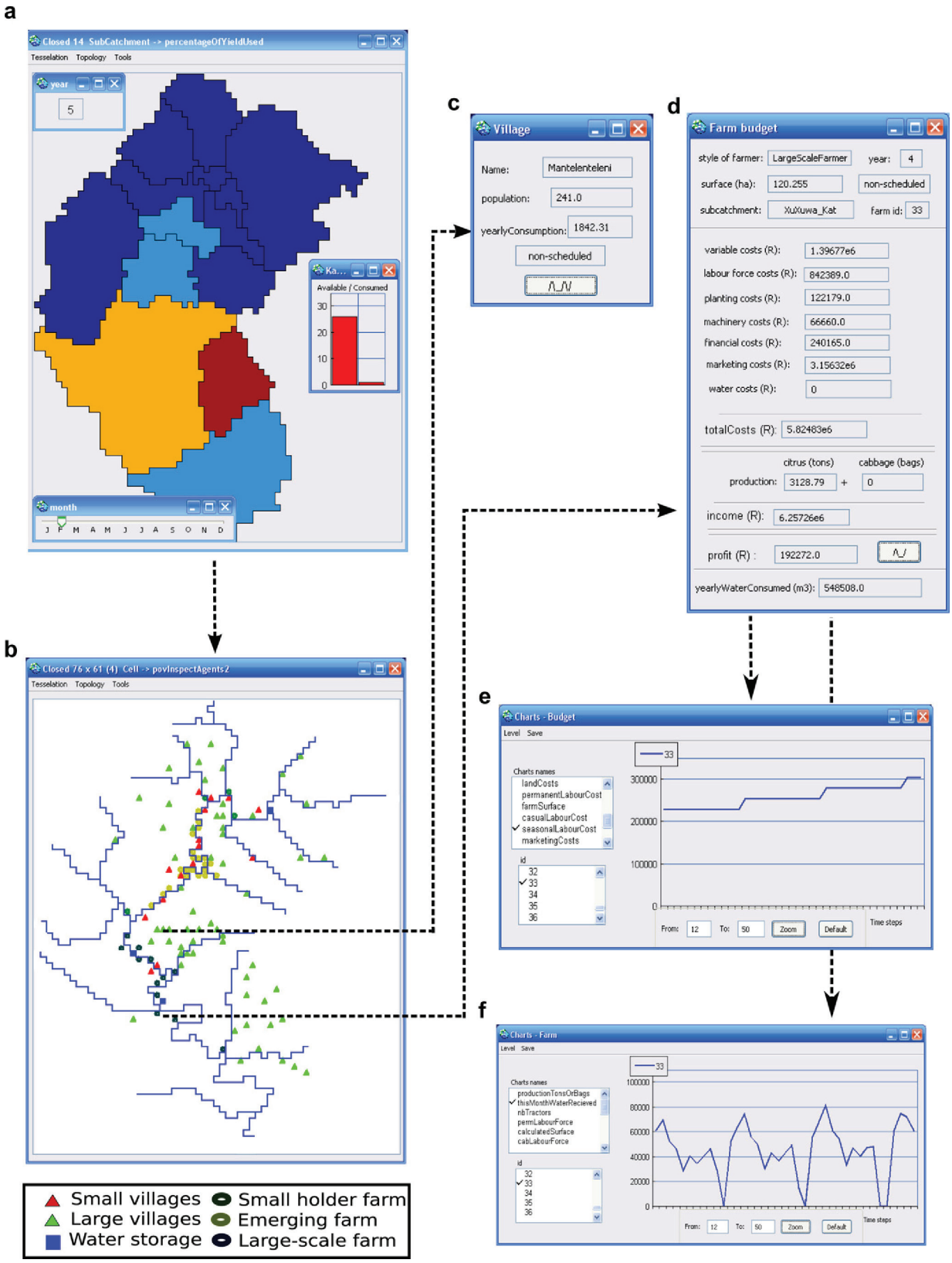
Users
Organizations
Businesses
Government
Community Members

Processes/techniques
Game/Simulation

Tools
KatAware
Map game board

1 Ariel Dinar et al., Game Theory and Policymaking in Natural Resources and the Environment, (New York: Routledge, 2008), 85.

2 Ariel Dinar et al., Game Theory and Policymaking in Natural Resources and the Environment, (New York: Routledge, 2008), 103.


a
Closed 14 SubCatchment -> percentageOfYieldUsed
Tesselation Topology Tools
year
5
Ka...
Available / Consumed
30
20
10
0
month
J F M A M J J A S O N D
b
Closed 76 x 61 (4) Cell -> povinspectAgents2
Tesselation Topology Tools
Small villages
Large villages
Water storage
Small holder farm
Emerging farm
Large-scale farm
c
Village
Name:
Mantelenteleni
population:
241.0
yearlyConsumption:
1842.31
non-scheduled
d
Farm budget
style of farmer:
LargeScaleFarmer
year:
4
surface (ha):
120.255
non-scheduled
subcatchment:
XuXuwa_Kat
farm id:
33
variable costs (R):
1.39677e6
labour force costs (R):
842389.0
planting costs (R):
122179.0
machinery costs (R):
66660.0
financial costs (R):
240165.0
marketing costs (R):
3.15632e6
water costs (R):
0
totalCosts (R):
5.82483e6
citrus (tons)
cabbage (bags)
production:
3128.79
+
0
income (R):
6.25726e6
profit (R) :
192272.0
yearlyWaterConsumed (m3):
548508.0
e
Charts - Budget
Level Save
Charts names
landCosts
permanentLabourCost
farmSurface
casualLabourCost
seasonalLabourCost
marketingCosts
id
32
33
34
35
36
33
300000
200000
100000
0
From:
12
To:
50
Zoom
Default
Time steps
f
Charts - Farm
Level Save
Charts names
productionTonsOrBags
thisMonthWaterRecieved
nbTractors
permLabourForce
calculatedSurface
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32
33
34
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36
33
100000
80000
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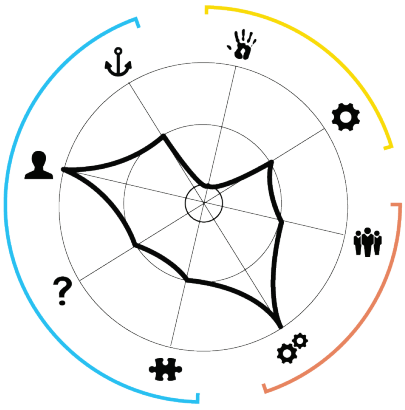
20000
0
From:
12
To:
50
Zoom
Default
Time steps

The framework is at the scale of the region and the agents are researchers in partnership with the Water Users Association (WUA). The users are the organizations and political bodies that address and govern water allocation, the farm businesses that use water for irrigation, and villagers that use water for domestic use. The digital technique that is employed is using games and simulations to collect, gather, and represent flows of data. The tools that the framework employs are a physical board game map and the simulation software called KatAware.

The framework creates partial agency by allowing stake-holders to make their individual problems known. The business owners, leading officials, and village chiefs participate in the framework on behalf of their respective employees, citizens, and villagers. The shared agency is that the negotiations and simulated findings can influence the creation of water management policies that can benefit everyone in the region. Although the companion modeling method can be applied in other places that have common pool resource disputes, the software KatAware is customized very specifically to the context inputs and would need to be redeveloped to respond to a whole new set of variables. Space is redefined because the map reveals problems and proposes resolutions to a complex collection of problems that until this point were only seen and understood in fragments. The games are personalized very specifically to the variables provided by the stakeholders and the context. The framework is partially administratively grounded because the findings from the games will be discussed and will inform a water management plan that the UWA will submit to the Department of Water Affairs and Forestry.



1–70 Wheel diagram rating the functions of the framework

Does the user add to the map?

Does the user gain agency?

Are the users active participants?

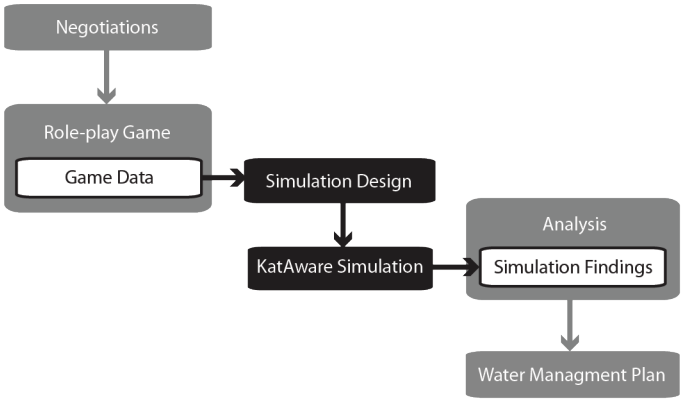
Is there shared agency?

Is the framework scalable?

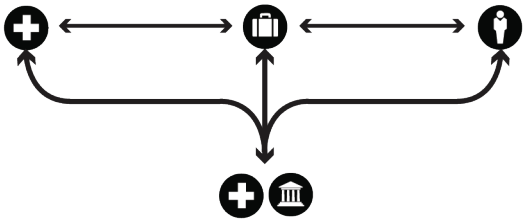
Is the framework redefining space?

Is the framework personalized for users?

Is the framework administratively grounded?

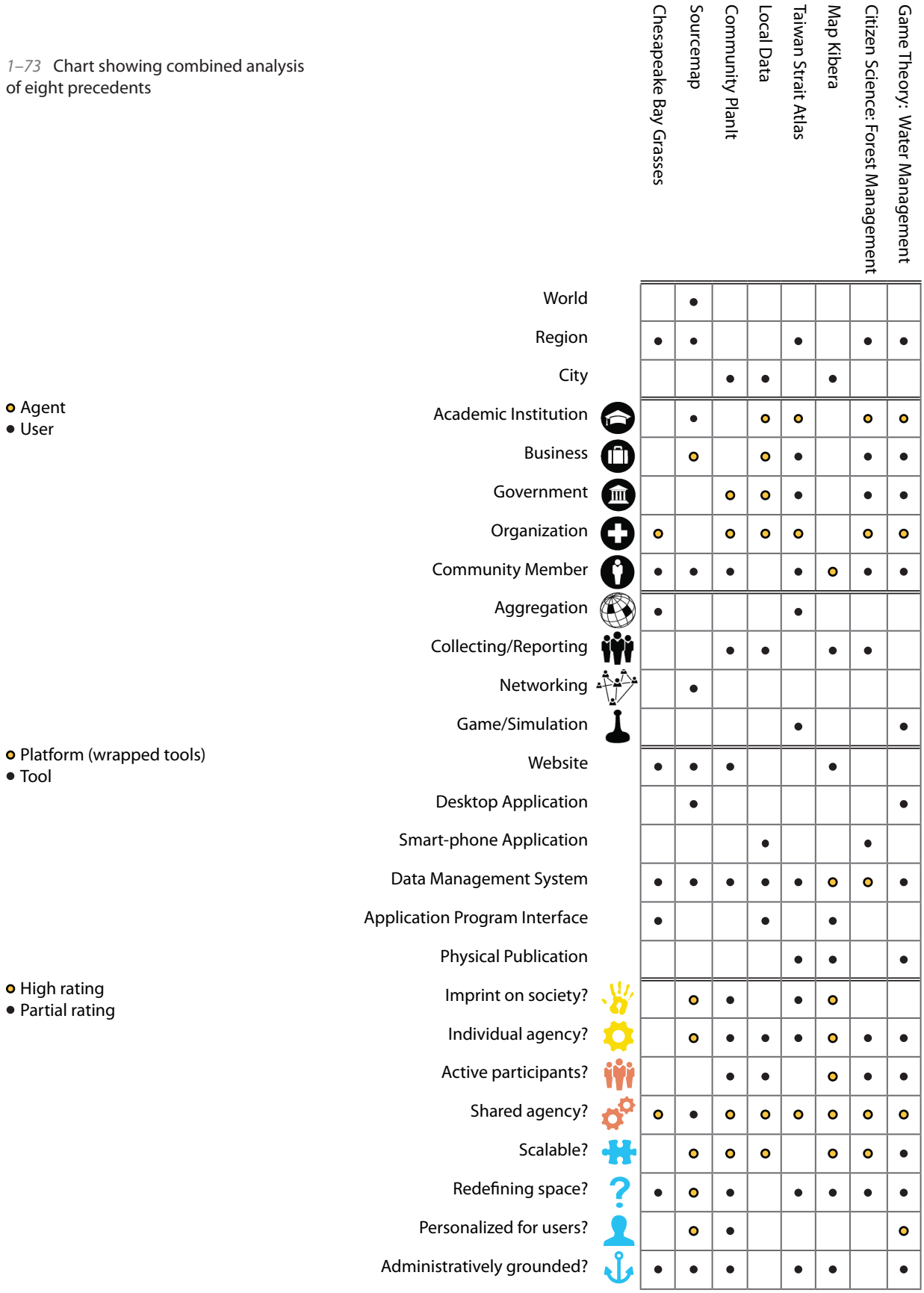


1–71 Framework diagram: Processes



1–72 Framework diagram: Relationships

1–73 Chart showing combined analysis of eight precedents

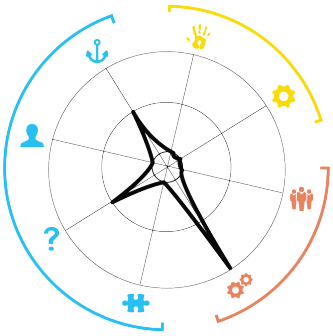


Conclusions

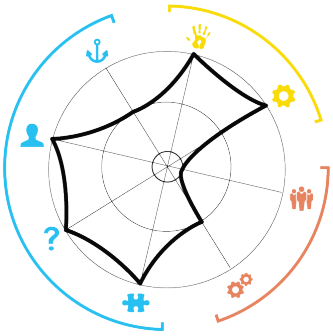
The precedents demonstrate how widely digital maps are being applied around the world, and how they traverse disciplines and combine subjective discussions of sociology and the precision of computation. Each precedent offers helpful insights into the community methods and digital techniques and tools that were applied in each context. The precedent frameworks always employed at least one of the following digital mapping techniques: Aggregation, Collecting/Reporting, Networking, or Game/Simulation. Collecting/Reporting is the most commonly used technique, though some frameworks apply it publicly while others limit it to a group of participants. All of the frameworks use different types of databases and servers online to host their digital components, the exception being Taiwan Strait Atlas and Game Theory precedents that use in-person negotiation and use offline databases to document the interactions. Only the precedents from the developing or underdeveloped contexts produced physical artefacts as a part of the process.

The precedents are also useful by comparing how they responded to the questions drawn from the mapping theory. Although diagramming the theoretical questions does not give objective results, it allows the shapes to be compared and to see very quickly where each project has its focus. The diagrams also demonstrate that no project is the same, and no project is strong in every area. It is possible to see and understand familiarities in the shapes. For example the Chesapeake Bay Grasses framework and the Taiwan Strait Atlas have similar forms except that Taiwan Strait Atlas has higher ranking in the area of personal accumulation. It is logical that they are alike since they are both designed to display complex data in the form of an atlas to the public. Taiwan Strait Atlas went a step further by arranging community programs to envision what the city could look like next. Another set of similar shapes is LocalData and the Citizen Science project. Both projects focus on data collection with a team of participants. The ExCiteS project does more to redefine space for the average person because it is mapping a theme that has never been mapped before. Most of the frameworks have agents that are local intermediary organizations, and express the intention of being administratively grounded; however, none show concrete examples of how the data collected informs change in the physical environment.

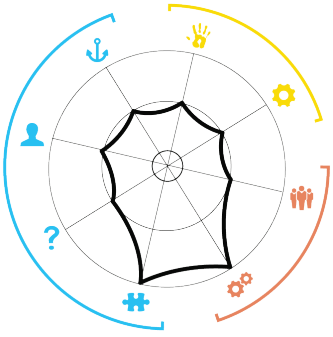
Each precedent has certain strategies that could be applied in Beni. Chesapeake Bay Grasses demonstrates a strong interactive web interface that displays complex data; Sourcemap and Community PlanIt demonstrate how a person can interact with a map from a personal profile that allows for customization and personal input; Local Data and Citizen Science use different methods of data collection and methodologies for personal involvement; Map Kibera and Citizen Science have thoroughly developed community frameworks and apply wrapped platforms for their data collection and management; Taiwan Strait Atlas and Game Theory use strategies of personal interaction and game playing to receive community feedback.



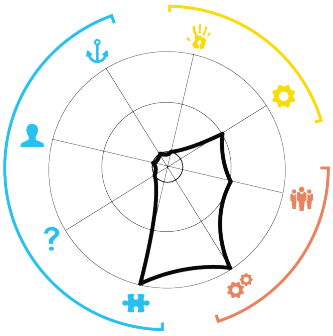
Chesapeake Bay Grasses wheel diagram



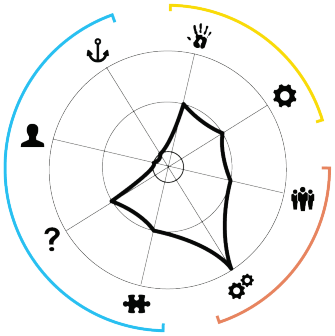
Sourcemap wheel diagram



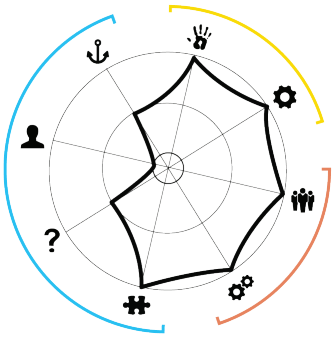
Community PlanIt wheel diagram



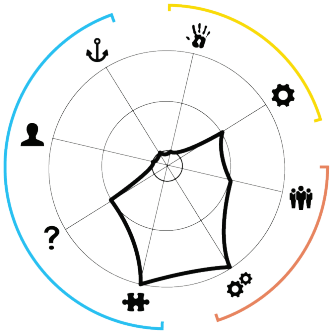
LocalData wheel diagram



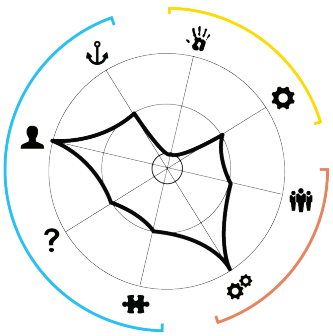
Taiwan Strait Atlas wheel diagram



Map Kibera wheel diagram



Citizen Science wheel diagram



Game Theory wheel diagram

1–74 Combination of eight wheel diagrams for comparison

Application

By looking back on the objectives for the project and the frameworks presented in this section, it is possible to determine what kind of tools and methodologies could be applied to the framework in Beni. The scale of the initiative will begin in the city and neighbourhood but can later extend to aggregate data from regional, national, and global data sets. The agent is the IRI at UCBC and the users will be the community, but like Map Kibera the framework can be handed over so that the community can become the agent. To begin with the framework will produce physical publications to best disseminate the maps in a community that is not very familiar with the practice of mapping. The next addition would be a simple website likely using a javascript mapping API library like the Chesapeake Bay Grasses project. Because there is no existing digital map of Beni, *Collecting/Reporting* will be the first technique employed to build the elements of the map with a team of participants similar to the LocalData and Citizen Science projects. The framework can later be extended to use other techniques to solicit more engagement, expand the reach to other devices, and make the data personal and interactive such as what Sourcemap, Community PlanIt, Map Kibera, and Game Theory seek to do in different ways. These initial thoughts will be developed further in the next chapter that proposes a detailed design for the Beni framework.

Beyond the technical and community elements, it is also possible to predict what dialectical questions the Beni framework will have to address. The same lens of questions applied to the precedents can be applied to the framework proposed for Beni. Just like the other precedents the framework will have strengths and weaknesses, but analysing it in this way helps to see the gaps and to see where the map might not be doing what it intends to. Below are some speculations on ways that the Beni framework might respond to the same theoretical questions:

Accumulation: The map gives community members the option to place their businesses, organizations, and institutions on the map and other themes they consider relevant such as infrastructure and security. The map will allow the university to expand its research and become an authority in the domain of GIS and development in Beni. The maps will also become utilized by the municipality in city planning decisions. When the IRI progresses to map land conflict like they intend to, the map will bring disputes out in the open. Revealing land tensions could cause additional conflict but in the long term would reduce conflict.

Participation: Allowing the public to access and contribute to the map is a way of placing the map as a tool for the community. Because only a small percentage of people have smart phones or internet access, it is very important that the GIS group finds multiple avenues to connect with the community. This can include making both the physical and digital maps accessible in the library, publishing physical maps to be

distributed to the community, and holding participatory workshops to gather community input. If there is enough associated action in the physical environment that is having a reflection on the map, then the participation can be defined as active and not just the semblance of participation. IRI is the entity in control of launching the framework, and they need to be wary about using that position for the purpose of exploitation. A way to reduce this risk would be for the university to give the tool over to the community. The framework could be managed by a committee made up of community stake-holders.

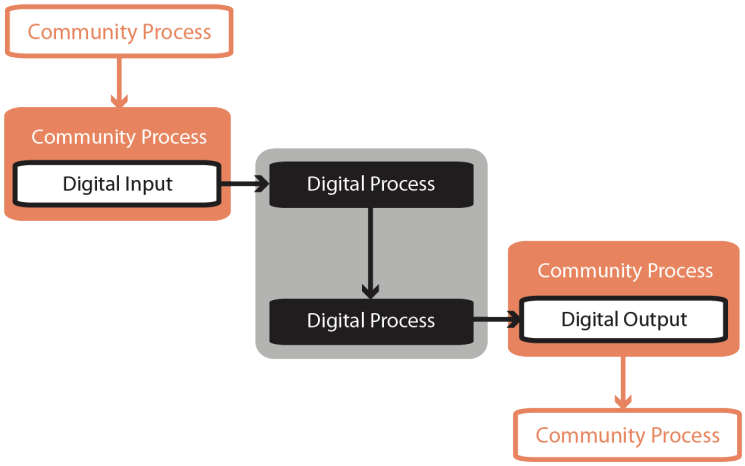
Re-territorialization: The overarching ideology of the project is that mapping can be a way for the community to learn about itself and therefore allow leaders to be able to make more educated decisions about the city's growth. It also allows citizens to democratically express their thoughts and ideas about the city and contribute to an expression of the city's identity. Though the ideology is an important driver to bring the project forward, it is important to maintain a realistic perspective. The reality is that there is nothing to stop people from using the knowledge from the maps to make decisions that have a negative impact. That does not mean that the project should not be pursued since the positive impacts still outweight the negative. It is important for BeniAtlas to develop future programs that can initiate strategies to respond to what is learned from the map. For example, a study of current waste disposal methods has no impact on the physical environment until there is a solution proposed that can improve the current system.

2.1 Framework Design and Implementation

Design Methodology

The following section outlines the design of a digital mapping strategy for Beni that responds to the context and objectives listed in the last chapter. The objectives are to plan big but start small, to get demographic information of the city, to develop a framework that grows with the development of infrastructure, to establish the map as a community resource, and to design it to be innovative and extensible. The project employs a framework methodology because it gives structure to the various inputs, components and processes that are being used to create a desired output. The framework requires the designer to be specific about what the goals are for the project and provides flexibility in how it is implemented. The inputs of the digital framework are a range of bottom-up data that is collected from community activities, and top-down external data obtained from outside sources. The digital framework outlines a series of tools and processes that use the inputs to prepare working maps, collect and formulate the data, and prepare it for interaction by users, either by hard-copy publication or digital visualization.

The complete framework can be divided into two components: the digital framework that outlines the digital tools and processes, and the community framework that organizes the community programs necessary to collect the data, distribute the maps, and initiate community response.



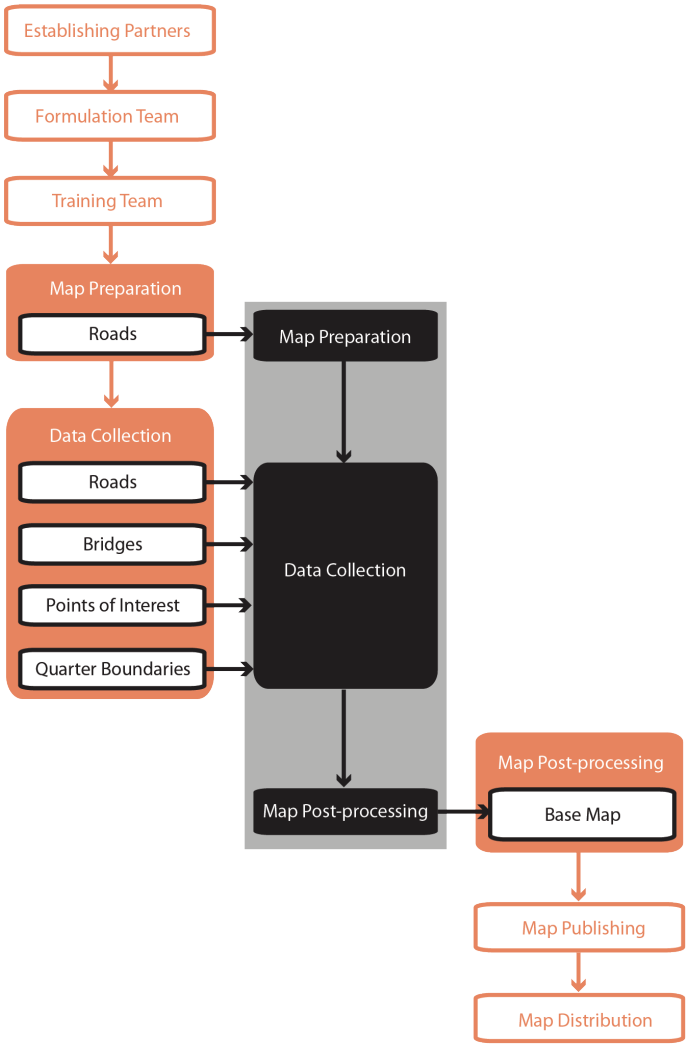
2–01 Diagram showing example of community and digital processes. The solid boxes are elements that will be broken down further in later diagrams and clear boxes are elements that are in their final form. The black boxes are the digital processes and red are the community processes. Where red and black boxes overlap, the community process is handing over an input or taking an output from the digital process.

As the project objectives make evident, the context of Beni does not allow for the framework to be implemented all at once. Time is needed in the implementation of the framework to allow for community readiness and the development of infrastructure and resources to support the project. To respond to these contextual realities the design of the framework is broken down in stages to collect simple data inputs and have simple representation of the data, before moving to collecting more complex data inputs and having a more complex representation of the data. The scope of the framework is to establish the steps to developing a community mapping interface that can be easily employed and manipulated by a local team.

The design has been divided into four possible extensions of the program's mapping capacity: *Base Collection*, *Detailed Collection*, *Digital Visualization*, and *Digital Extensions*. *Base Collection* is the creation of a base map in order to introduce maps into the community sequentially before publishing maps of more sensitive themes, and to provide a valuable reference layer that all other data can be built on. *Detailed Collection* extends the data inputs to include detailed surveys of neighbourhoods for migration data, demographic data, and household infrastructure data. *Digital Visualization* makes the outputs available online and offers a route for future bottom-up inputs to be added. *Digital Extensions* proposes how top-down sources can be added as a resource to the framework, how crowd-sourced reporting can be a dynamic bottom-up input, and how interactive techniques can enhance the user experience. At this point in the research only the first stage of the framework has been implemented. The following paragraphs will describe the initial base collection in depth and, based on reflections from this first stage, will propose how the project might move forward into the subsequent stages.

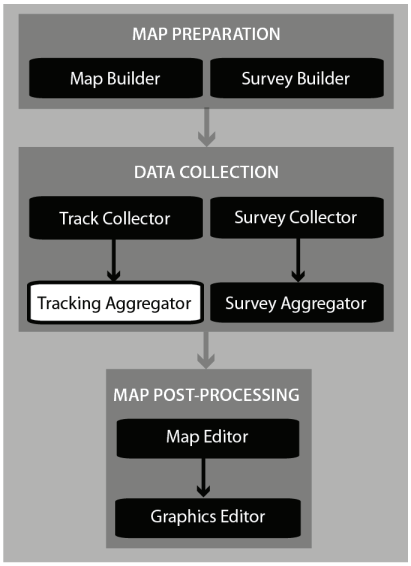
Design Implementation

The base collection was spearheaded by IRI in consultation with the municipal government and myself. The inputs were roads, bridges, points of interest, and quartier boundaries; the desired output was to produce a base map to be published in the community. The data collection was performed by a team of community and school participants that were recruited by advertising the project within the university and the community. The base collection had a significant community component because it was important to firmly establish the initiative in the community of Beni. There was a long process of establishing partners, formulating a team, training the team, researching existing maps, and preparing a working map by tracing a satellite image. Before this project there was no existing map of the city for volunteers to be able to use to locate themselves and so it would have been impossible to assign a group of volunteers to map a specific area without knowing where its limits were to begin with. The digital side of the framework used a selection of open-source tools for the steps of map preparation on the computer to prepare the working map and survey, data collection in the field using mobile devices, and then map post-processing back on the computer to analyse and edit the map.

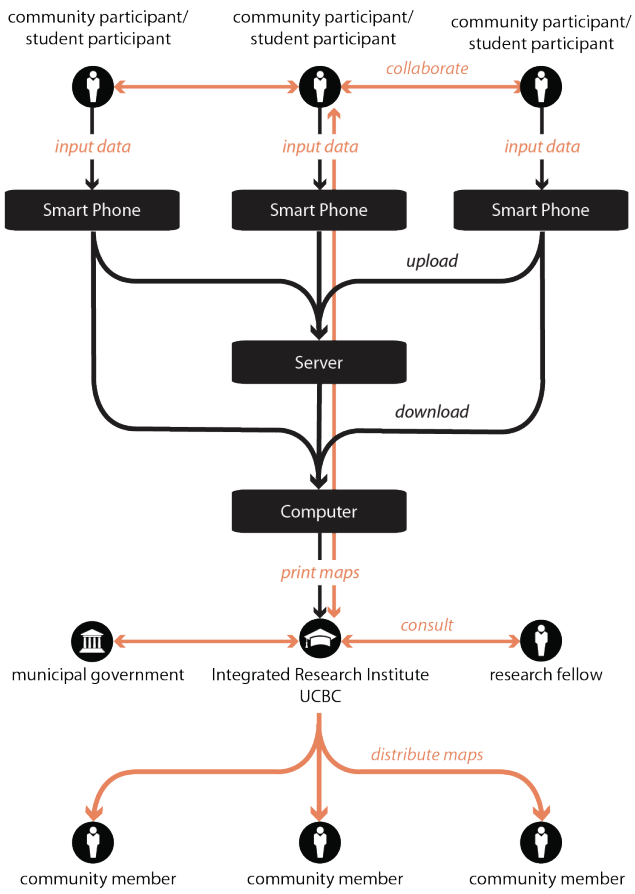


2–02 Diagram showing community and digital components of framework for *Base Collection*

digital processes
community processes



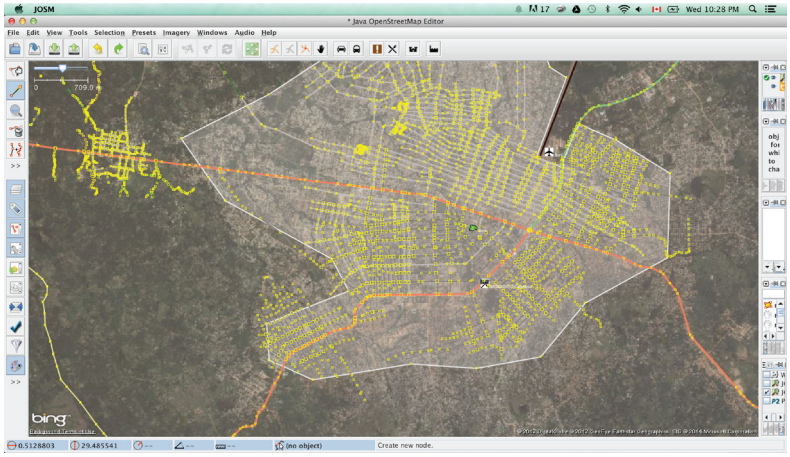
2–03 Diagram showing breakdown of Map Preparation, Data Collection, and Map Post-processing from figure 2–02 into the specific digital tools used by each



2–04 Diagram showing relationship of agents and users for *Base Collection*

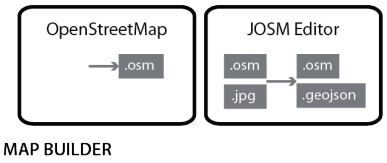
digital connections
community connections

The working map was traced in an offline editor for OpenStreetMap (OSM) called Java OpenStreetMap (JOSM) Editor. Basic roads were uploaded to OSM because other open source tools that I selected used the OSM map. By adding the roads to OSM they are automatically made available for the Track Collector and Survey Collector tools.



2–05 Tracing the satellite image of Beni in JOSM Editor

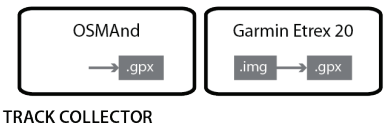
2–06 Creating assignments for the field collection



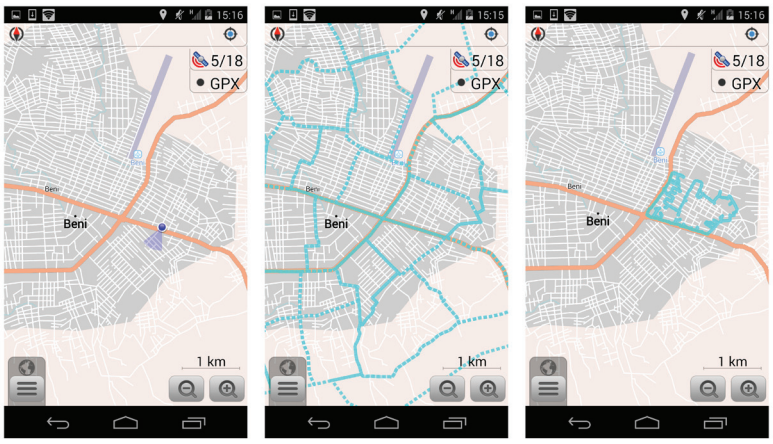
2–07 Selected tools for the *Map Builder* function and the input/output file types

Originally the intention was to use existing neighbourhood boundaries as the extents to assign to groups who would collect data in the field. Since no boundaries exist, the city was divided up into areas that were of a manageable size for the groups to take responsibility for. The lines were drawn in QGIS over the satellite image and then saved as a gpx file to be added as a layer to the Track Collector tool.

OSMAnd was selected as the Track-Collector tool because it can download the updated roads from OSM, take the gpx assignments file as a layer, and download the maps so that they can be made available offline. The tool has the ability to mark a user's current location, log the track where a user has walked, and log waypoints. The Survey Collector tool was used instead of OSMAnd for the purpose of logging wapoints because this part of the OSMAnd application was found to be confusing for users.



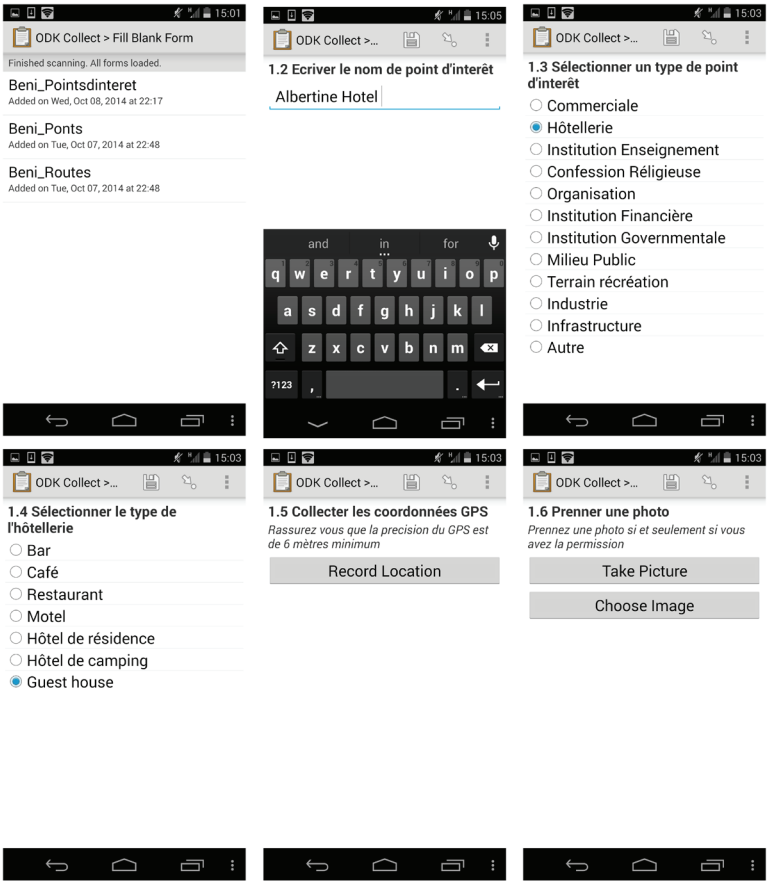
2–08 Selected tools for the *Track Collector* function and the input/output file types



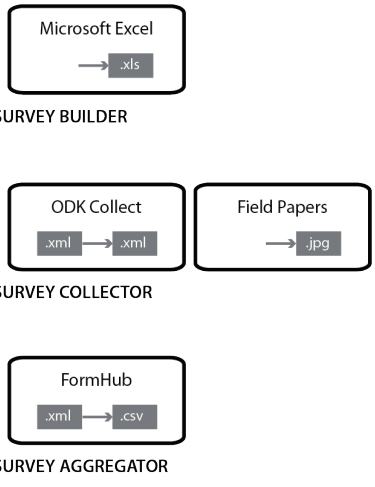
2–09 Traced roads and assignments on OSMAnd application

Garmin GPS devices were used as a back up to the phones. They perform all of the same tasks as OSMAnd but are more durable and have a much longer battery life.

While the OSMAnd tool was used for locating a user on the map and tracking a user's movement, the Survey Collector was used for the main task of collecting the new data points. A tool called ODK Collect acted as the Survey Collector. It allows forms to be completely customized, offers options for styling the form, and does not need consistent web access. It also has the important capability of making the form available in multiple languages. The Survey Collector is a valuable tool because it decreases the margin of error in data by providing multiple choice answers. An enumerator can still choose the option "other", but only if it doesn't fit any of the already specified options. Unlike OSMAnd where waypoints are marked with an ID that is associated with the information that is written on the field notes, ODK offers GPS coordinates and photos as a survey question so that it remains associated with the data. IRI created three different forms: one collecting information for roads, one for bridges, and one for points of interest. The forms were created in Excel, uploaded as xls files to FormHub, and then uploaded to each of the phones.



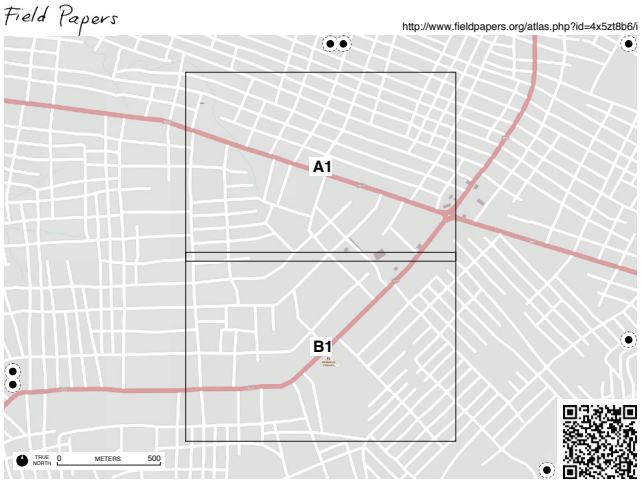
2–10 Survey questions on ODK Collect application



2–11 Selected tools for the *Survey Builder*, *Survey Collector*, and *Survey Aggregator* functions with their corresponding input/output file types

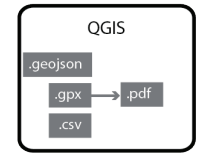
To ensure that no data would be lost because of battery life or technical difficulties with the phones, a second Survey Collector tool called Field Papers was employed. It is a tool that offers a digital component for the ease of physical note-taking. Similar to OSMAnd, the tool connects to the OSM map and then exports a selected area of choice

as tiled PDF pages. The front page is a legend showing how the following pages are tiled using letters and numbers (A1, A2, B1, B2) to identify each page. Each page is also marked with a scan code so that when the page is later photographed or scanned it can be brought into the JOSM editor to be traced digitally. The scan code functions to geolocate each page of the field papers.

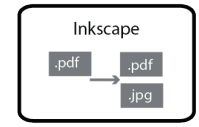


2–12 Legend page of one of the field papers (assignment B1)

2–13 Page A1 of the B1 assignment with field notes



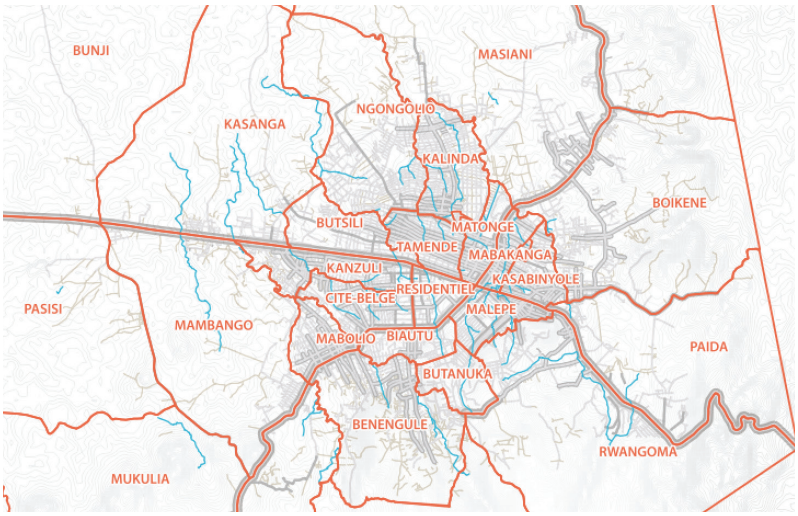
MAP EDITOR



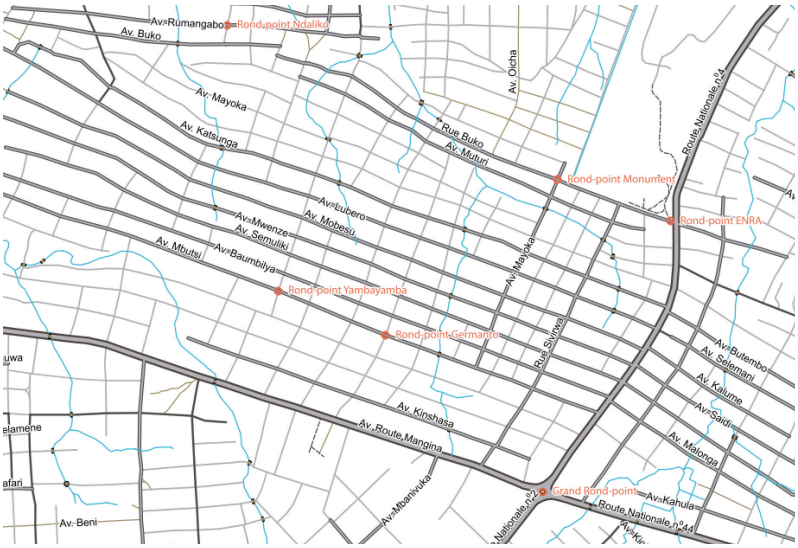
GRAPHICS EDITOR

2–14 Selected tools for the *Map Editor* and *Graphics Editor* functions with their corresponding input/output file types

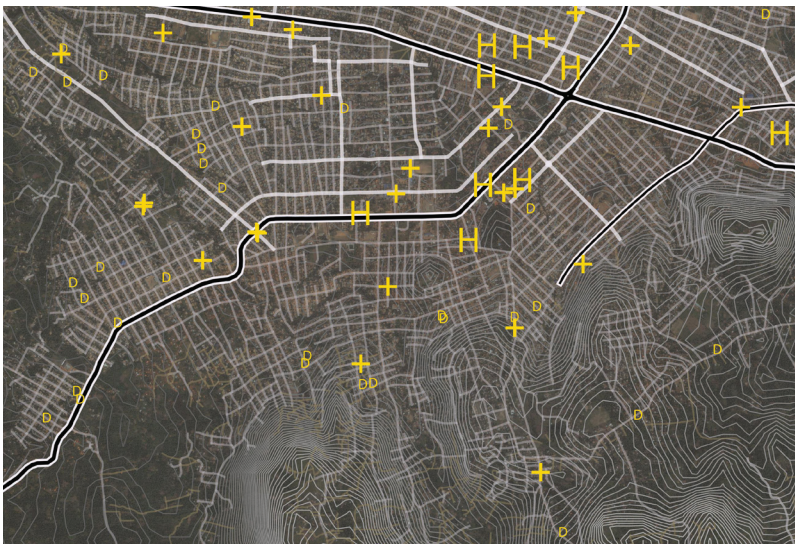
Finally after the preparation of the tools and phones, recruitment, and training, thirty volunteers divided into ten groups and went around the city to collect the data for the base map. The collection of quartier boundaries was a separate task with select participants because it involved connecting with each neighbourhood cadastral office and asking the district chiefs to show the boundaries. Afterwards the data was taken off of the phones. For OSMAnd and Garmin it was pulled directly off of the phones by usb connection and for ODK Collect was uploaded back to the FormHub server and then downloaded from the server back to the computer. The data from ODK had to be edited extensively in Excel before bringing the data as a csv file into QGIS. The field papers were used as a reference where data was sometimes incomplete.



2–15 Map showing neighbourhood boundaries (note: they are still in the process of being resolved)



2–16 Map showing round-abouts and roads with their names (if they have a name)



2–17 Locations of hospitals, health centers, and "dispensaires" (small clinics)

Reflection

Data collection in Beni was a slow process that was more about connecting with people than it was about registering the data points. For the points of interest the enumerators often sat down and explained the project to the organizations they were asking to be placed on the map. People were always doubtful at first because the finished map would often have no immediate benefit to them. A schoolmaster wondered why they should bother contributing to the map if it would not get them the funding and materials they desperately needed. A nurse at a small "dispensaire" (health clinic) was worried that being located on a map would make it easy for the government to come and close down the clinic for not having the proper credentials. At the same time they understood the benefit that the map would offer and liked that it was a university and community led initiative. Community members would be able to more easily find out where schools, health centers, and different commercial areas are located. Being located on a map would be a way for businesses or schools to become better known in the community to increase their clientele or student enrolment. In the event of a disease outbreak it would be easier to determine where people live so as to contain or find the source of the disease. One of the biggest accomplishments is resolving the neighbourhood boundaries. Although it took months working in partnership with the Mayor's office and cadastral offices and going out in the field to trace the boundaries using GPS tracking, the boundaries have now solidified the areas that each cadastral office is responsible for. Above all the map would be a step forward to understanding the city for future city planning and could be used in future to resolve land disputes.

The *Base Collection* stage begins to meet the objectives set out for the project by creating a map that is ready to be published in the community and by laying out the groundwork of a map that can be easily updated and built on with future layers. The main challenges were the incompatibility of some of the tools, dependence on tools that had servers that were sometimes down, and the learning curve of knowing how to use so many different tools, many of which could instead be combined into a simpler, more comprehensive system. The tools were appropriate to start with however, because there were no costs outside of the phones and laptops except providing water and transportation allowance to volunteers. The use of these open-source tools demonstrates how non-experts can map their own community. The following section offers a discussion of avenues of how the base map can expand to further meet the objectives of the project.

2–18 IRI training session with volunteers

2–19 Data collection in the field

2–20 Data collection in the field

2–21 Editing the map


KASANGA
NGONGOLIO
Rond-point Ngongolio
Rond-point la Race de Vainqueur
Rond-point Canana
BUTSILI
Av. Baumbilya
Av. Mobesu
Av. Mutugha
Av. Route Mangina
Rond-point Kanzuli
KANZULI
Av. Bashu
Av. Mayelamene
Av. Safari
Av. Beni
Av. Kiombwe
CITE-BELGE
Av. Mbaniv
Av. Baswagha
Av. Mwera
Av. Du 30 Juin
MAMBANGO
MABOLIO
BIAUTU
Route Nationale n°2
BENENGULE

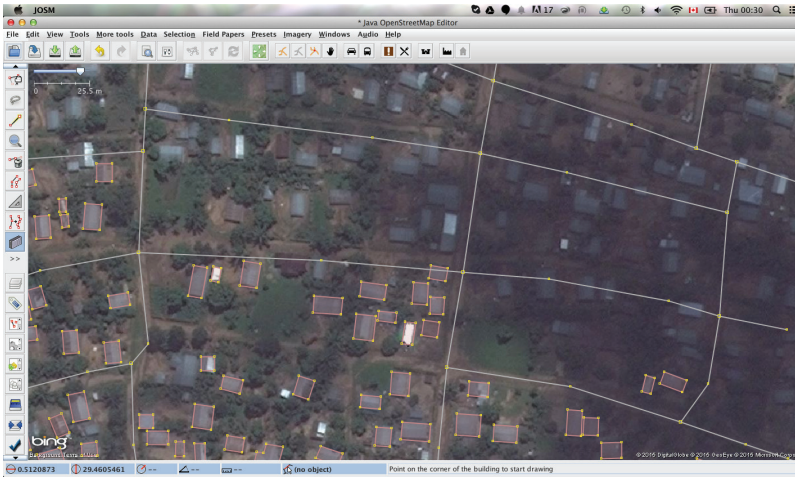
2–22 Resulting base map at 1:20 000


BUTSILI
TAMENDE
Av. Mwenze
Av. Semuliki
Av. Mbutsi
Rond-point Yambayamba
Rond-point Kanzuli
Rond-point Kanzuli
te Mangina
huwa
ngo
Av. Musema Kweli
KANZULI
Av. Mayelamene
Av. Safari
Av. Beni
nbwe
RESIDENT
CITE BELGE
Rue Kohobe
Av. Mwera
Av. Baswagha
Route Nationale n°2
Route Kitsanga
MABOLIO
BIAUTU
Av. Lyangoma

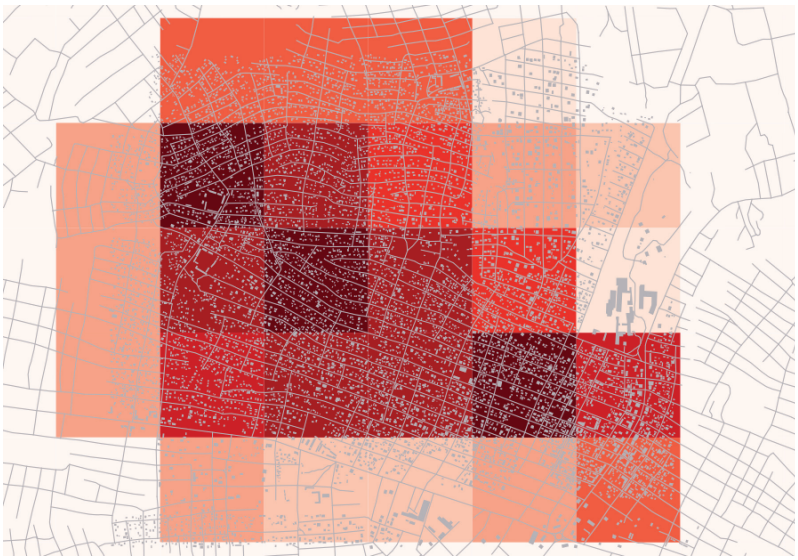
2–23 Base map at 1:10 000 showing points of interest in Quartier Residentiel

Further Development: Detailed Collection

The next way to grow the framework would be to begin collecting more detailed information at the scale of the neighbourhood. *Detailed Collection* could be done with all of the same tools and processes that were used for the base collection. A new set of community processes would need to be planned including the preparation and running of workshops that can get community feedback about the mapping program and also make the neighbourhood aware of the upcoming surveys. This is necessary in a community that is not familiar with the practice of door-to-door surveying. The information collected from the survey can fit into three categories of migration data, demographic data, and infrastructure data. The digital steps in the framework involve the building of the survey, the collection of the data, and the editing of the map. In the post-processing the demographic data can be layered onto the original base map.

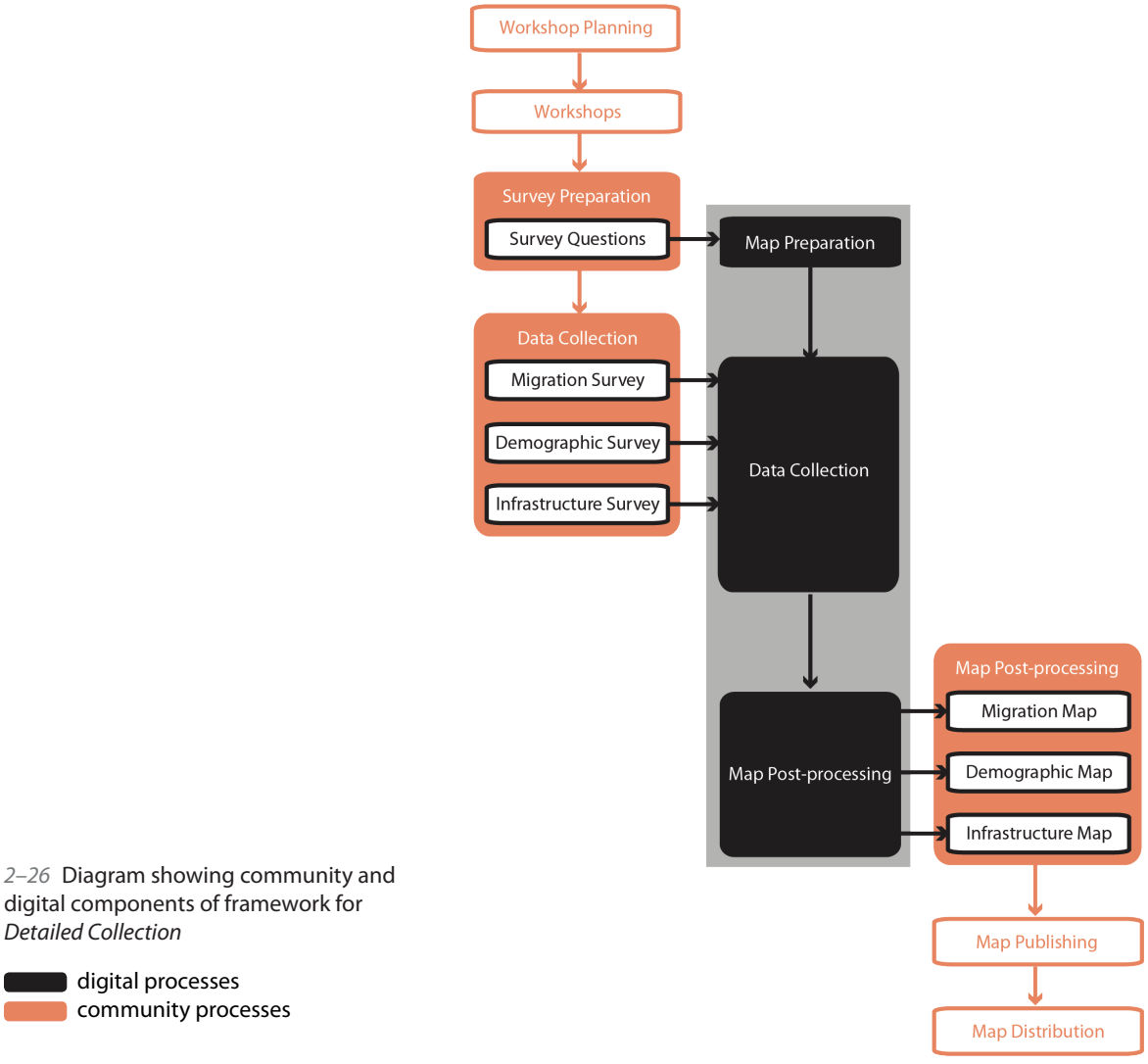


2–24 Tracing building footprints in JOSM Editor



2–25 Using QGIS to count the data from each building footprint and represent the quantity in each quadrant by colour

Instead of tracing roads like for the preparation for the base map, for the neighbourhood surveys it is necessary to trace the buildings. Because of the informal nature of the buildings, households could easily be missed or surveyed twice if not marked down on a map. Another reason is because once a neighbourhood has been surveyed, that data can be used along with size and number of structures in the rest of the city to estimate the population of Beni. The demographic analysis can be applied to neighbourhood boundaries or to a set grid in order to create a gradient of comparison across the city while de-identifying the data from the individual households. Three very different neighbourhoods in the city could be surveyed to begin with to collect a range of data that can be representative of the city.



2–26 Diagram showing community and digital components of framework for *Detailed Collection*

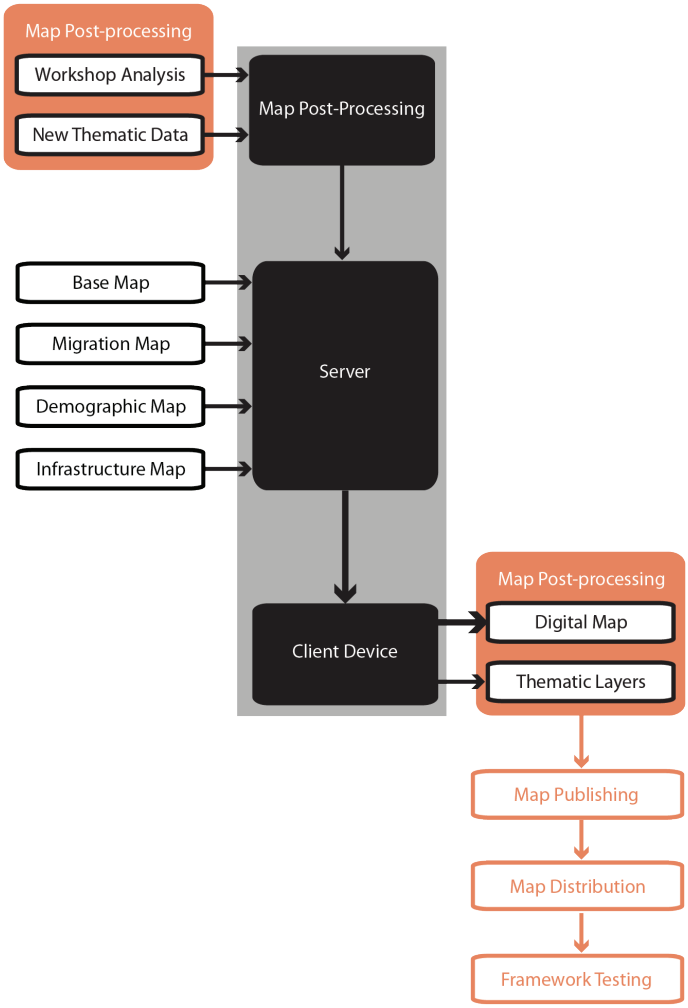
Further Development: Digital Visualization

A second avenue of development is to represent the map in a digital interface. The design of an interface responds to the project objectives because it allows the content to be easily updated, can layer data from top-down and bottom-up sources, and creates a new avenue of participation from the community. The goal of this stage of the framework is to propose a very simple set of tools that are free and widely available so that the application can be developed and manipulated by non-experts. The tools and mapping techniques were selected by experimenting with the building of a raw beta version of the application. Similar to the previous two stages, the interface can be implemented as a simple and more static digital map before considering additional ways of extending the map's capability. The first stage can be the development of a simple digital map that allows users to turn on and off a few layers (i.e. points of interest, streams, roads, and bridges) and click and zoom to a particular neighbourhood to see more detailed information.

Publishing on the web is becoming increasingly accessible to non-experts because of the abundance of open-source mapping tools and libraries. There are many existing proprietary and open-source tools to choose from so that the digital map does not need to be created from scratch. In developing the beta site as a non-expert, one of the first decisions was to use an application programming interface (API) to make the map. APIs are libraries of components that are used for making software applications. The beta application uses an open-source Javascript API called OpenLayers 3. Javascript was the coding language of choice because it is the language of the web and is most commonly used for web mapping applications. OpenLayers 3 was selected out of the many APIs available because it has broad capabilities, is flexible in customizing components, has thorough descriptions of all of the library's components, and has a very large and active support network. The digital catalogue in the appendices outlines several more APIs that were researched before selecting OpenLayers 3.

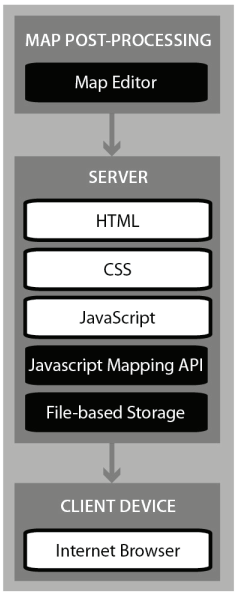
Another question was what kind of server to use. There are a multitude of proprietary and open source servers that are designed specifically to manage map data. They are called Web Map Services (WMS) as prescribed by the Open Geospatial Consortium (OGC).[1] The advantage that WMS offers is that a request is made to the service, the image is processed by the server and then sent back to the client as an image or set of image tiles. The disadvantage is that it adds another layer of complexity and could be subject to change and compatibility problems. The beta website uses a generic server that could either use cloud hosting or dedicated hosting. This means that instead of the map server preparing the image and sending it to the client, the client's browser draws the map elements if they are vector based.

1 "Open Geospatial Consortium," http://www.opengeospatial.org/

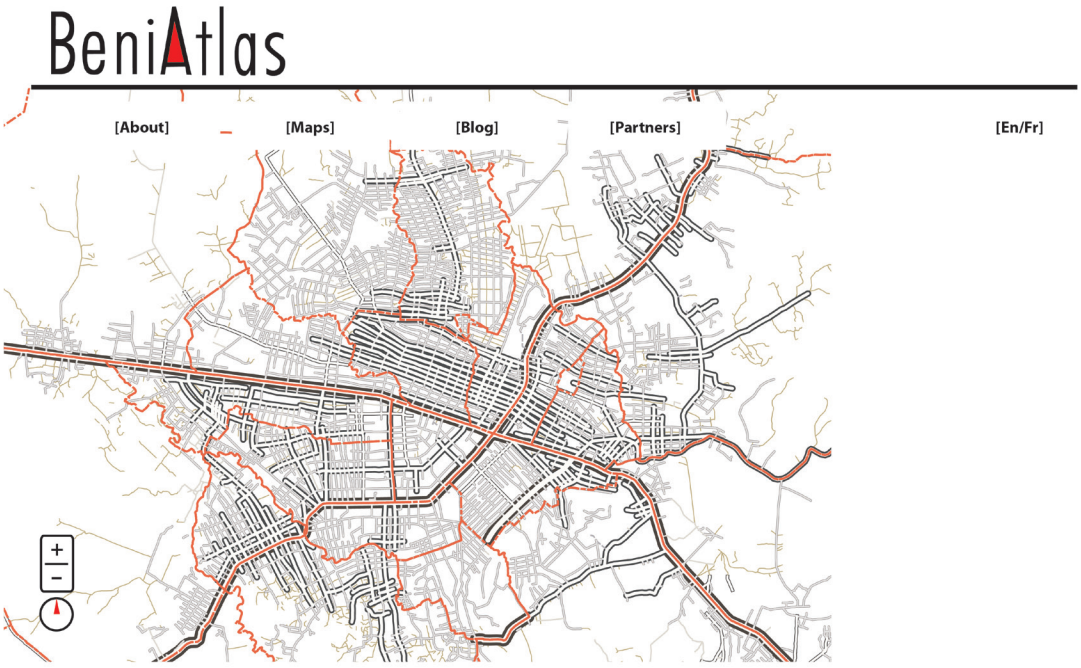


2–27 Diagram showing community and digital components of framework for *Digital Visualization*

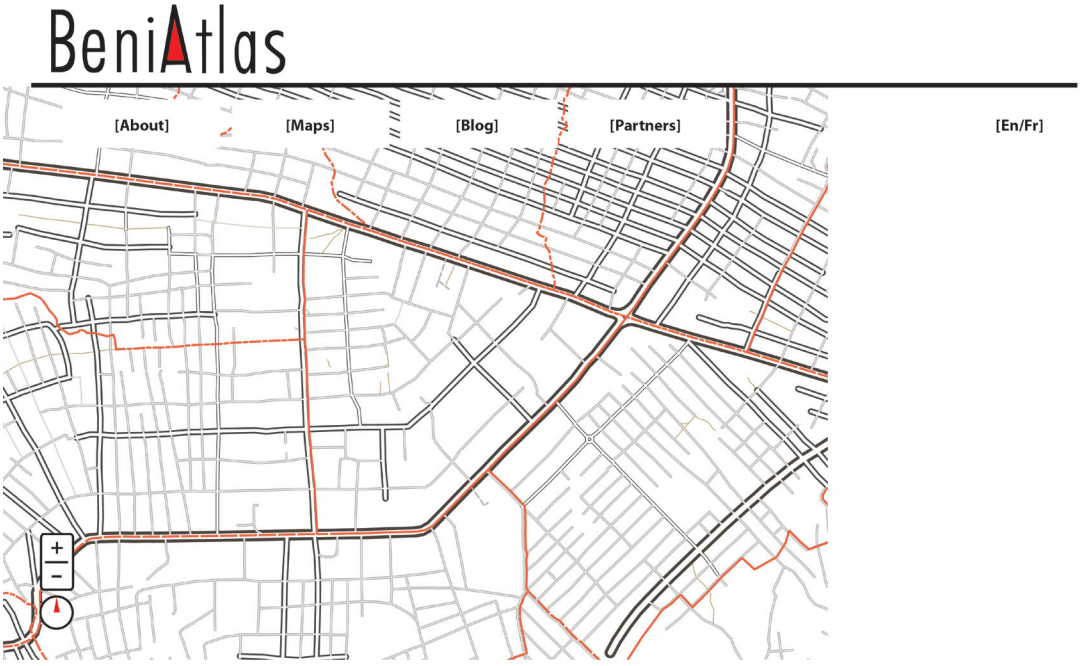
digital processes
community processes



2–28 Diagram showing breakdown of Map Post-processing, Server, and Client Device from figure 2–27 into the specific digital tools used by each



Ville de Beni

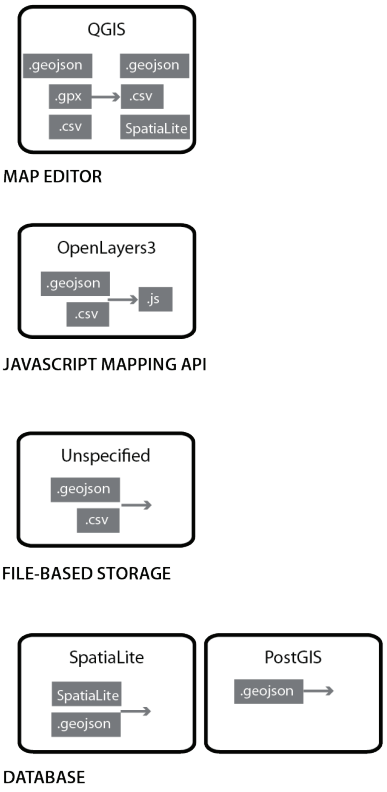


Quartier Residentiel

2–29 Beta application showing city and option to select and zoom to a neighbourhood

How the data is stored is another choice with many options. The beta application uses a file based system to store the data. This is the simplest choice because the application can refer to javascript and xml files that store the respective geometries and point data. Each layer on the map is a file in the data folder on the server. This method is a good way to start but has limitations once the map wants to take on more interactive functionality such as crowd-sourcing. At that point the application would need to shift to use a database system. There are two well known open-source databases called PostgreSQL and SQLite that offer database extensions for spatial objects: PostGIS and SpatiaLite. SQLite is a lighter and transferable system that is good for stand-alone applications or early web development, and PostGreSQL is more bulky but has many more features. It is probably the database of choice when considering multi-user database access. PHP and SQL would need to be used as the back-end languages to access the data.

The only extra infrastructure required to set up the basic website is a web host. Once the framework is established, thematic data from new research can be inputted into the system as well as any data obtained from the workshops. The data can be styled dynamically in the code instead of being a fixed image. For example, the road widths can change as a user zooms in and out of the map. The beta application successfully demonstrates the zoom-in, layer selection, and neighbourhood zoom options, but is crude and needs to be further developed to be a fluid interface for users. Additional elements that need to be considered are the creation of a tutorial to introduce users to the interface, formulating it into an offline application option, making it compatible with mobile phones, and making the application as accessible as possible. If computers or phones can't work with the interactivity, the user should be brought to a collection of static maps that show the same content. There would still need to be a program in place to publish hard-copy maps in the community since not everyone will be able to access them electronically.

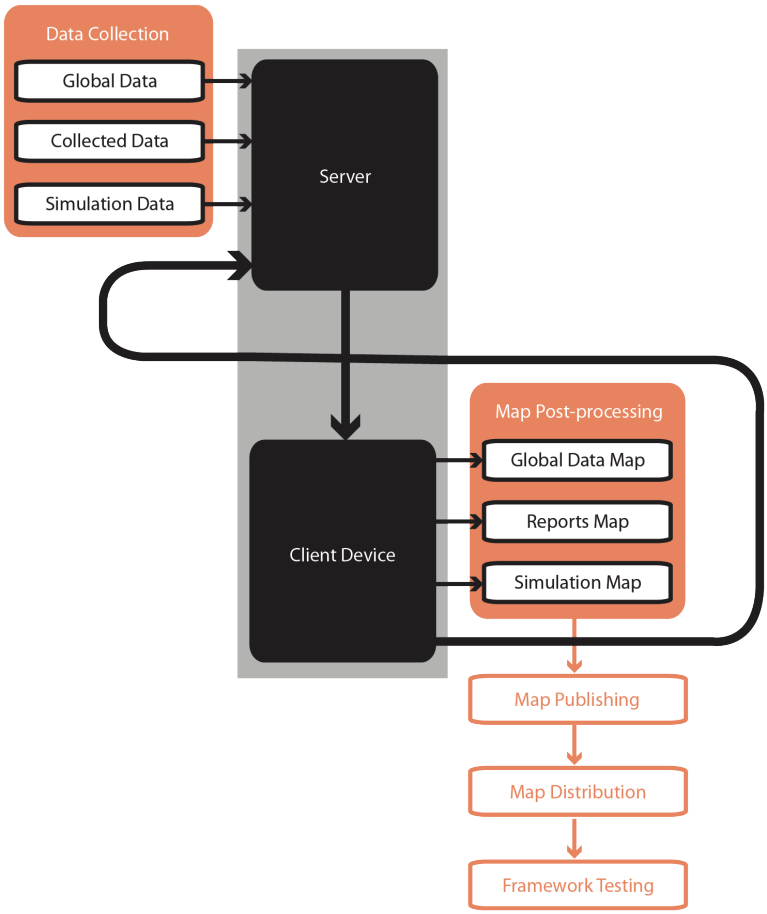


2–30 Selected tools for the *Map Editor*, *Javascript Mapping API, File-Based Storage,* and *Database* functions with their corresponding input/output file types

Further Development: Digital Extensions

A final proposal for extending the framework is to use the most recent techniques in digital mapping to increase the scope of inputs and also make the represented map dynamic, allowing for a new level of community engagement. Digital technology allows the map to become dynamic and intelligent by being able to collect data from other sources and from the public, compare and analyse it, and simulate possible outcomes. To demonstrate how non-experts can contribute to even a more complex interface, I developed the basic website further to include examples of aggregation, crowd-sourced reporting, and simulation techniques. Although much development would be needed to make it a smooth and completely comprehensive interface, the idea is that by using the most open-source and globally available tools, control can be put completely into the hands of the community without needing significant outside influence.

2–31 Beta application showing the map zoomed into a selected neighbourhood



2–32 Beta application showing data from ACLED at the national scale

2–33 Diagram showing community and digital components of framework for *Digital Extensions*

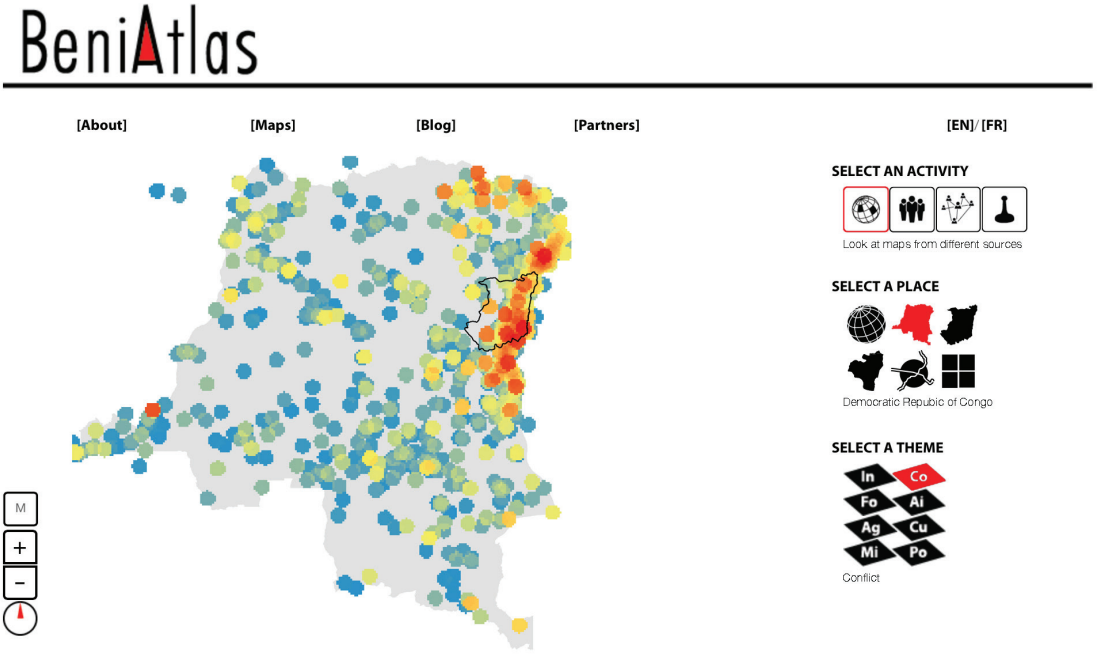
digital processes
community processes

(a) Global aggregator

Global aggregator is an extension to the framework that imagines how top-down data that is already publicly available can be aggregated into one place to make it available for educational use and comparison with other data sets. Because the spatial data can be represented in code, it is easy to curate and represent in an online map. Although the first aggregations would require finding the data, transplanting it, and creating static diagrams that describe it, the data could eventually be fed live into the site and for the diagrams could adjust accordingly.

The beta website demonstrates the aggregation extension with data collected from the Vision for Humanity Peace Index and the Armed Conflict Location and Event Data (ACLED) Project. The reason for using two different data sets is to experiment with how they can be curated on the site and explore data that belongs to various scales. Vision of Humanity Peace Index is a global index that ranks countries based on 22 qualitative and quantitative indicators of peace that include measuring levels of internal and external conflict, safety of cit-

2–34 Beta application showing data from Vision of Humanity at the global scale


BeniAtlas
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Look at maps from different sources
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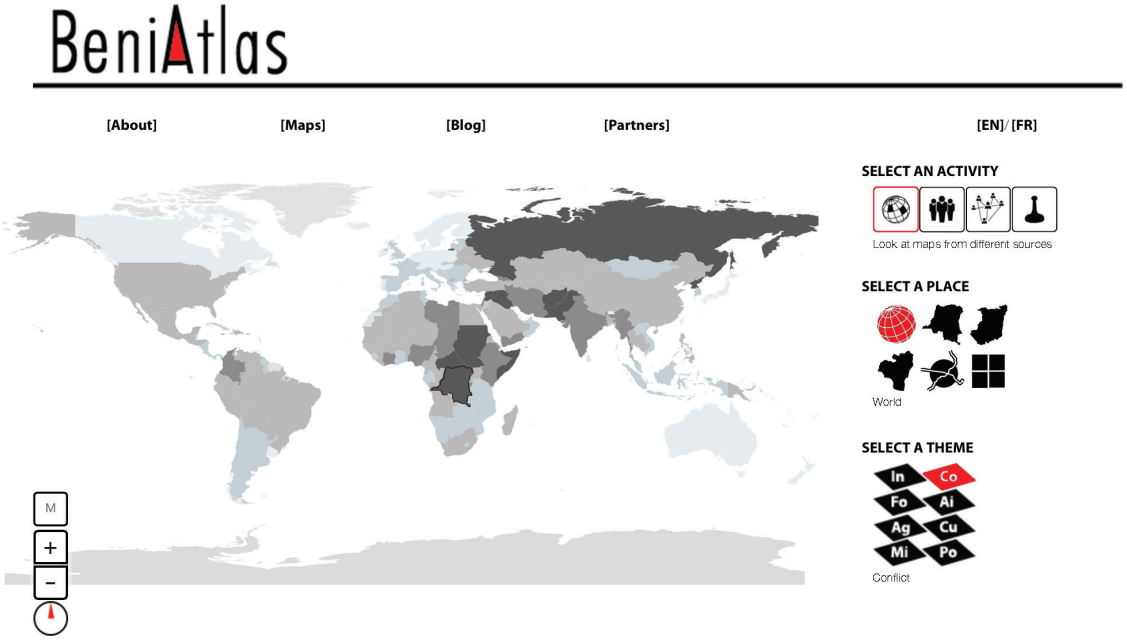
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izens, and levels of militarization.[1] ACLED is a collection of political violence data in Africa that includes event locations, dates, and other details.[2] It can be presented in different levels of detail at the scale of the continent, country, province, or region. The data is a series of xml files that are referred to and styled using Javascript and OpenLayers3. Javascript with another API called Data-Driven-Documents (D3) can be used to create graphs that respond to the data and automatically update as it changes.

2–35 Beta application showing road condition reports

(b) Reporting/collecting

The widespread use of smart phones with GIS capability has offered a way for the general public to contribute to the gathering of data. Instead of going door to door with surveys, it is possible for someone to find the survey online or on an associated application where they can report a specific piece of information that is geo-located. This capability would require establishing a form that can collect the data and a system for verifying the data before it gets published. The Beni framework could either set up its own system, or use an existing one such as Ushahidi that was introduced in section 1.4.[3]

The beta application demonstrates the Collecting/Reporting method by allowing a user to report on the state of infrastructure in the city of Beni. Javascript with Openlayers 3 allows the user to draw a point on the map and submit a description of the condition of the infrastructure. It is also possible to vote on a report to confirm its importance and make it appear larger on the map. The beta version registers the input on the map immediately, whereas in the real version there would have to be a verification process to determine whether the report is true. Similar to the aggregation extension, graphs can summarize combined statistics from the reports.

(c) Game/Simulation

2–36 Beta application showing bridge condition reports

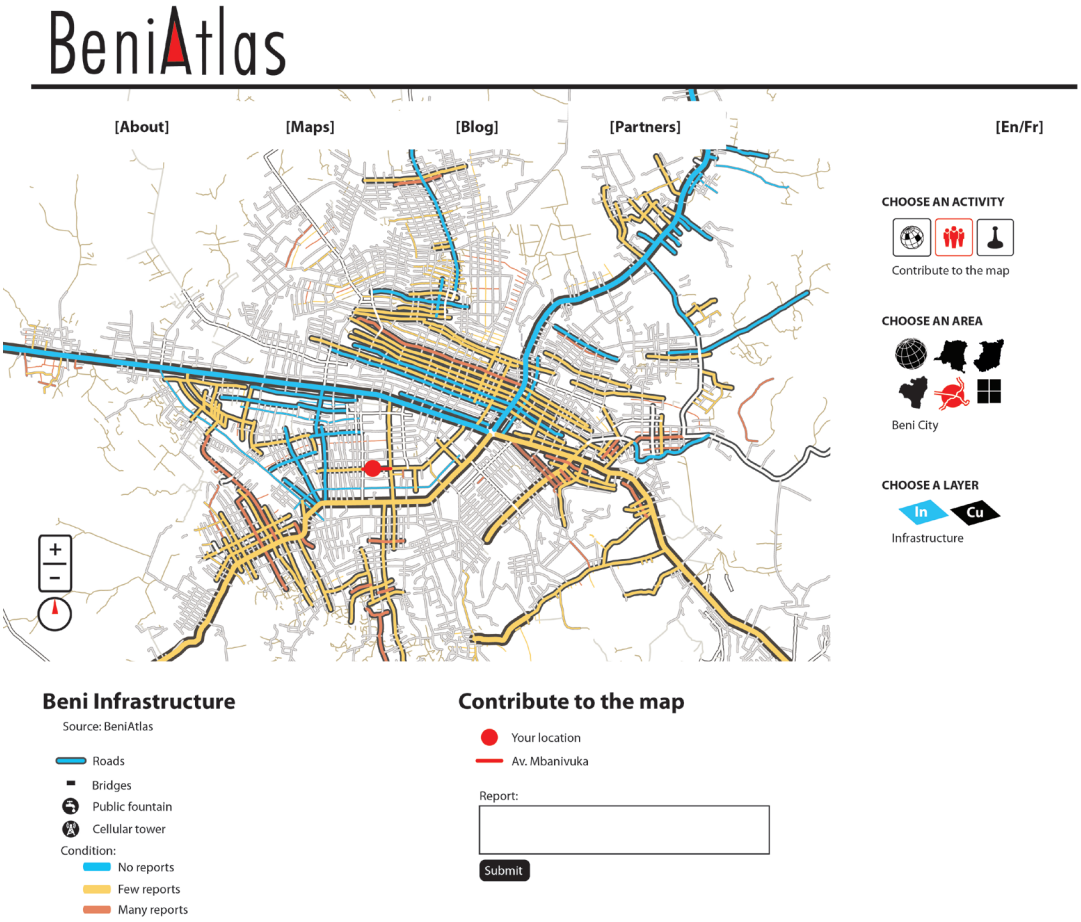
Digital tools offer the ability to imagine different futures on top of a map. Simulation is a way to propose designs and see outcomes that would not be easy to understand otherwise. The IRI is establishing partnerships with organizations working within the forestry and agricultural sectors where using simulation with maps could serve as an educational tool to demonstrate how changes in the sector could bring about long term benefit.

For example, research indicates that the continued use of charcoal for cooking, particularly in densely populated urban areas, is causing unnecessary deforestation. Efficient stoves have been developed as well as biomass briquettes as an alternative to charcoal, but people do not realize the negative impact that using charcoal has on the environment

1 "Vision for Humanity," http://www.visionofhumanity.org/.

2 "Armed Conflict Location & Event Data Project," http://www.acleddata.com/.

3 "Ushahidi," http://www.ushahidi.com/.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Roads
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Public fountain
Cellular tower
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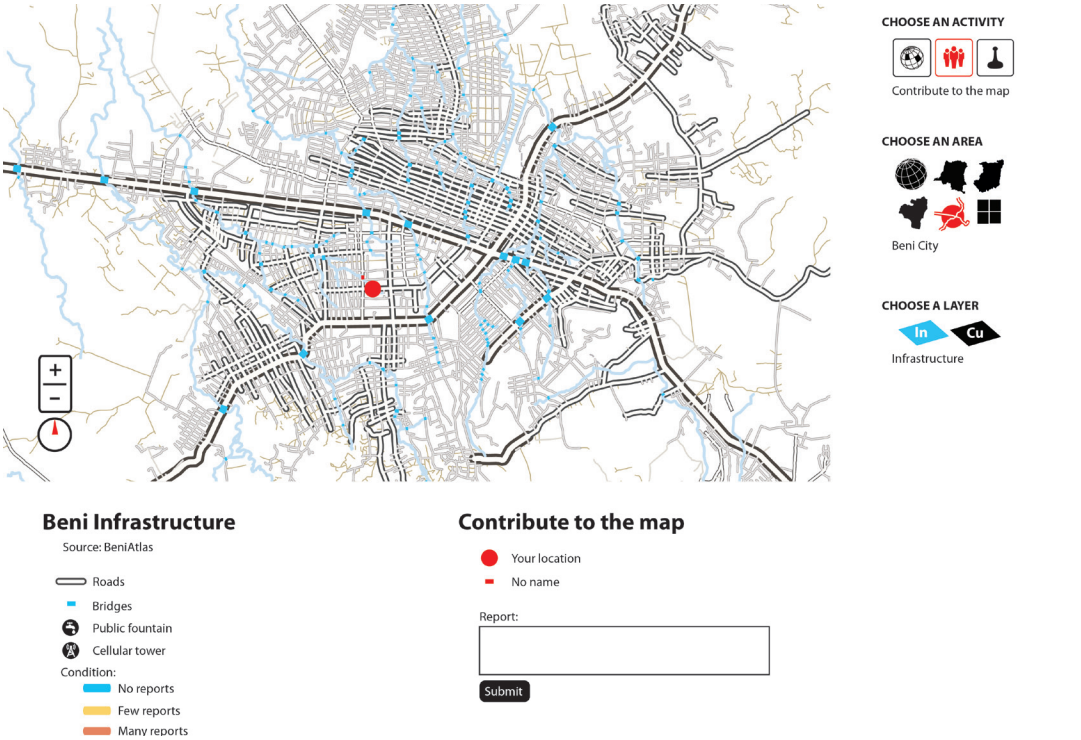
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Many reports
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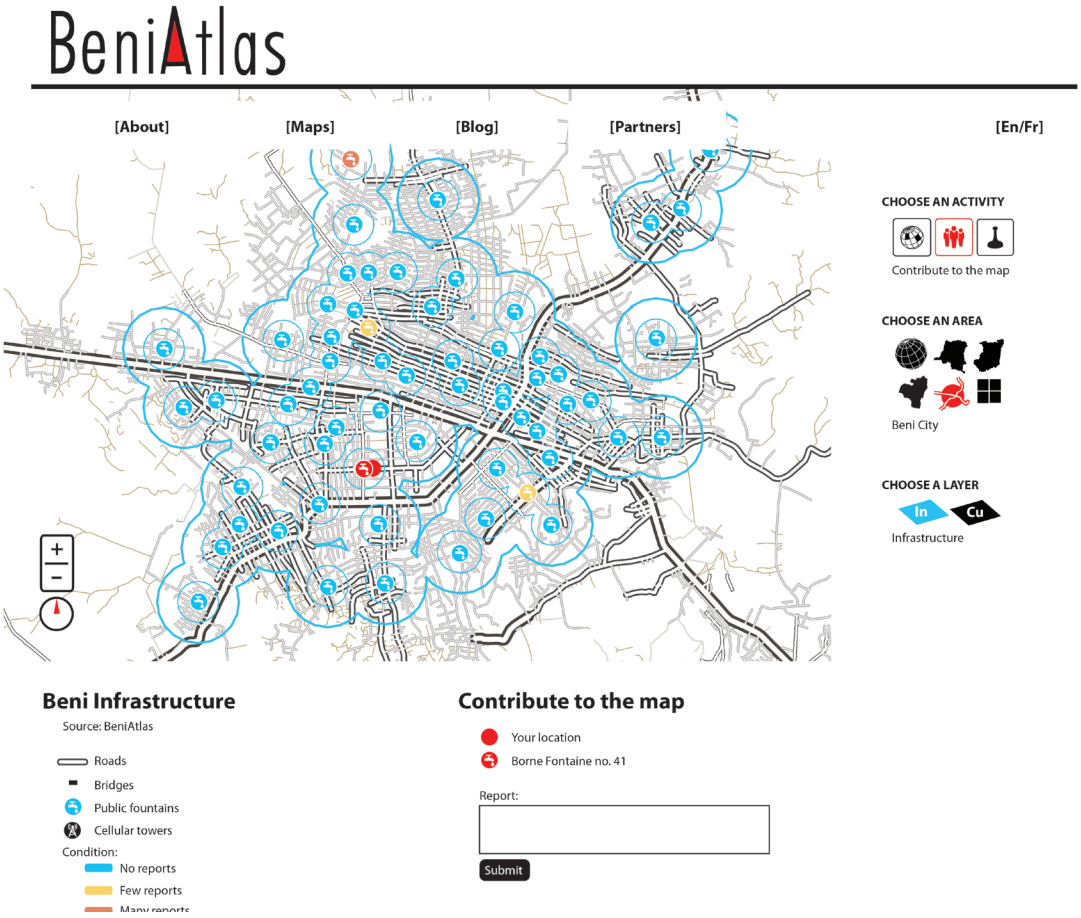
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Contribute to the map
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Source: BeniAtlas
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Public fountains
Cellular towers
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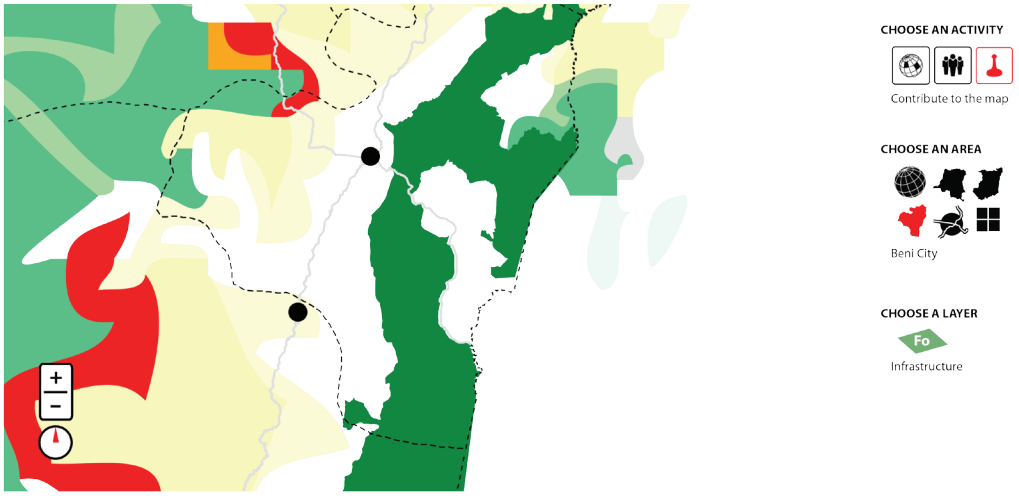
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Infrastructure
Forests in Beni Region
Source: IOP Science
Simulate

and are hesitant to change old habits.[1] Game/Simulation could be used to simulate the effects that the continued use of charcoal will have on the forests and how the impact can be lessened by making decisions to use alternate methods.

2–37 Beta application showing monitoring of fountains

1 Romy Chevallier and Mari-Lise du Preez, "Timber Trade in Africa's Great Lakes: The Road From Beni, DRC, to Kampala, Uganda" *South African Institute of International Affairs (SAIIA) Research Report 11*, July 2012.

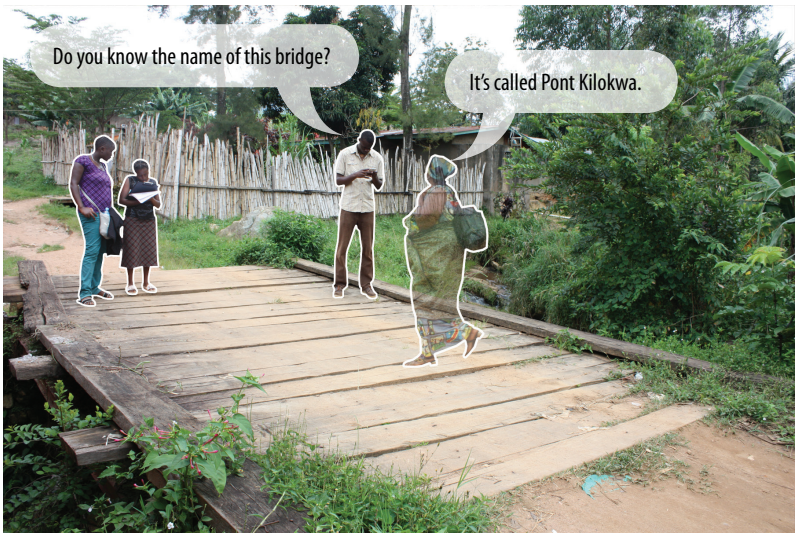
2–38 Experimentation with Beta version of what forestry simulation could look like

2.2 Storytelling

The following sequence of images tries to give the reader a better understanding of what the implementation of the framework would look like in Beni. It imagines scenarios where the map is useful for the community and where it might present challenges.

Participants walked around the city and took notes of the names, type, surface, and condition of roads. On more major streets some of the road names could be found on make-shift signage that was fixed to the outsides of compound walls. In other instances, the particpants asked locals and determined that the road was known by a certain name. The participants confirmed the road name by asking multiple people. It was common for smaller roads not to have names.

2–39 Enumerators collecting road information



In a similar way to the roads, participants also collected the name (if applicable), type, size, construction, and condition of bridges. Beni has hundreds of bridges of all shapes and sizes because of the network of small ravines that traverse the city. Large bridges often have a sign beside the bridge while smaller bridges are known more informally and are usually called by the same names as the creeks.

2–40 Enumerators collecting bridge information

Points of interest were collected under the categories of commerce, hospitality, educational institution, place of worship, organization, financial institution, governmental institution, health facility, public place, recreation, industry, infrastructure, and other (if it did not fit in any of the categories). Based on the category selected in the survey, the enumerator could then choose a subcategory. In this image the category was "public place" and the subcategory was "market".

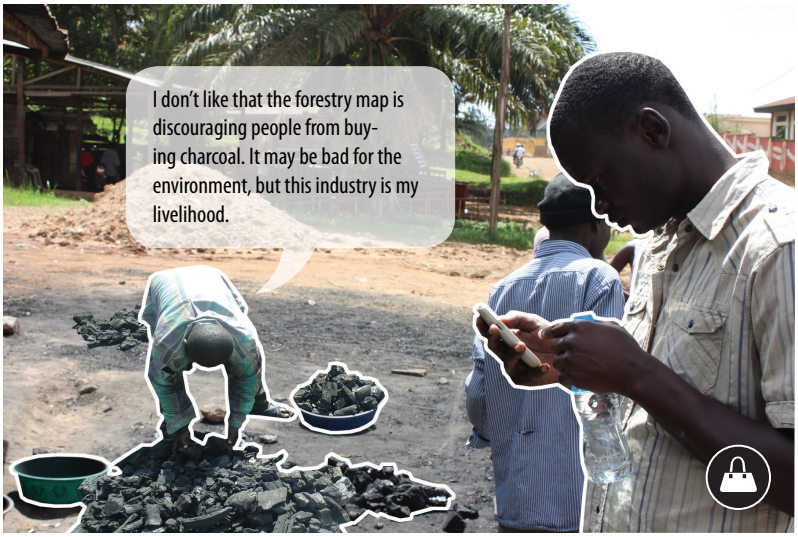
Many people that the groups encountered recognized the value of the map to help with way-finding in the city. A map allows someone to be able to share what street they live on or where their business is located.

Performing the base collection in the field was an effective way to increase community awareness about the project. The survey included an input for phone-numbers if people were interested in receiving more information about the project and news about upcoming workshops and events.

2–41 Enumerators collecting information on points of interest

The IRI used a procedure of informed consent to obtain data for points of interest. The participants explained the project to the heads of organizations, schools, health centres, etc. and only took the information and coordinates if consent was given. Many people were suspicious of the project at first and disappointed that it would provide no immediate benefit, though once they understood what it was about they often changed their minds. On occasion a person would refuse to have their site added to the map.

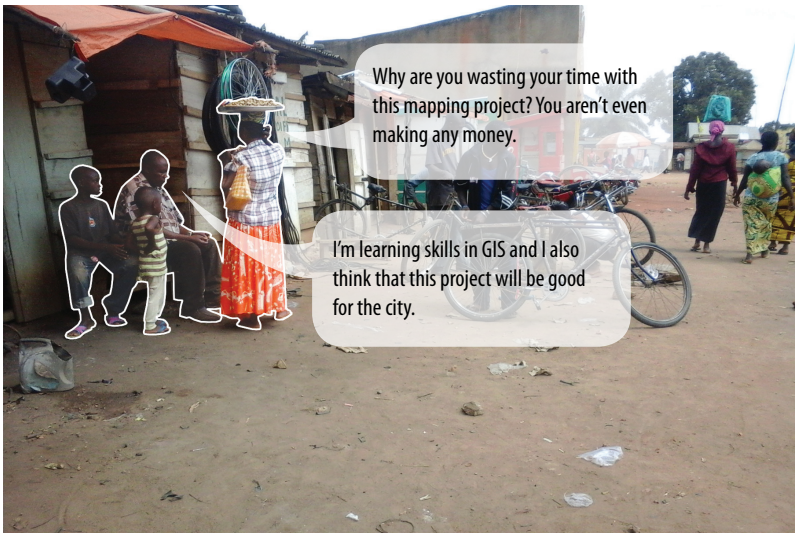
One valid concern for people was the validity of their operation and ability of the state to possibly acquire the map to use for corrupt purposes. Some organizations, schools, and health centres exist to meet community need and might not have the official paperwork they need to be formally recognized on a map.



Another concern is that the maps would affect people's livelihoods because the public might change what they decide to buy. At the same time maps have the potential of initiating new commercial ventures.

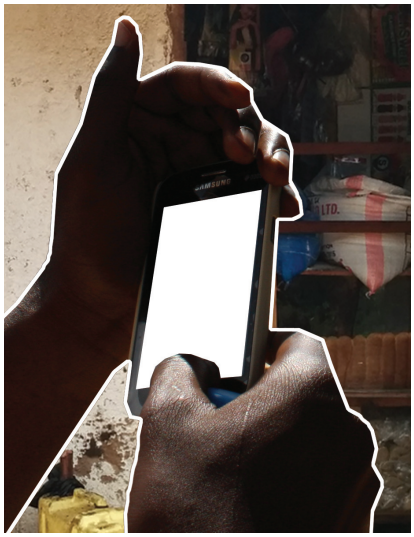
2–42 Enumerators collecting information on points of interest

2–43 More examples of points of interest



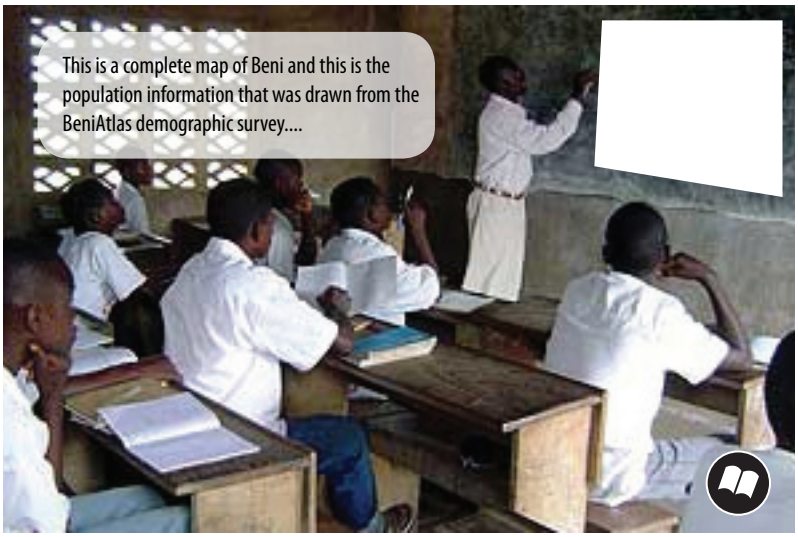
Participants in the project were unpaid and so they likely received critique from family or friends asking why this work was worth their time.

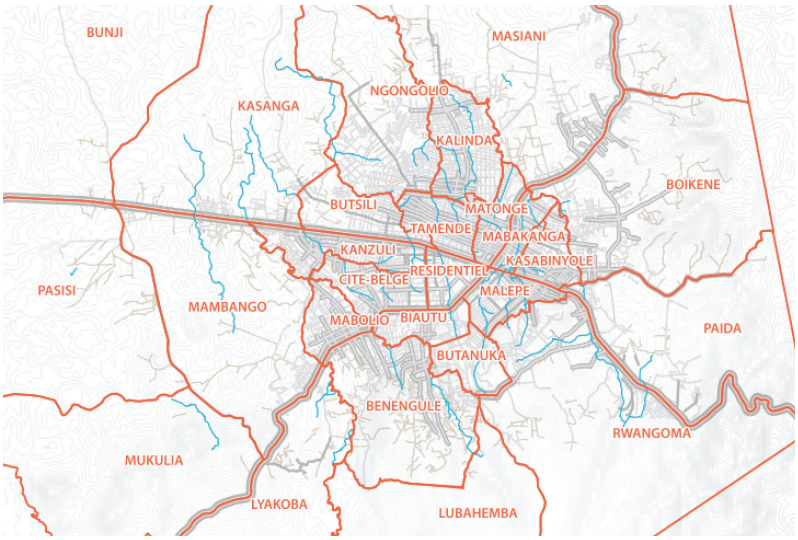
Several months later....



Now the woman from figure *2-41* can advertise where her business is located and even her friends and family can direct potential customers her way.

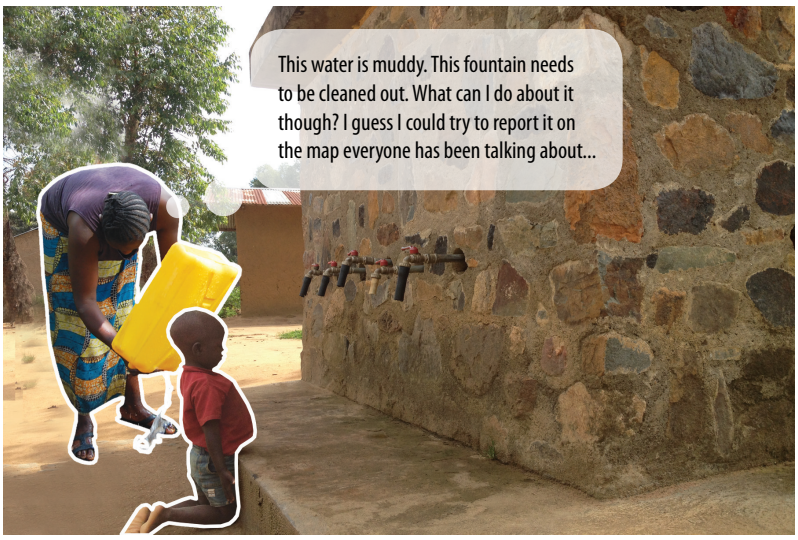
2–44 Imagining how map might be used for way-finding

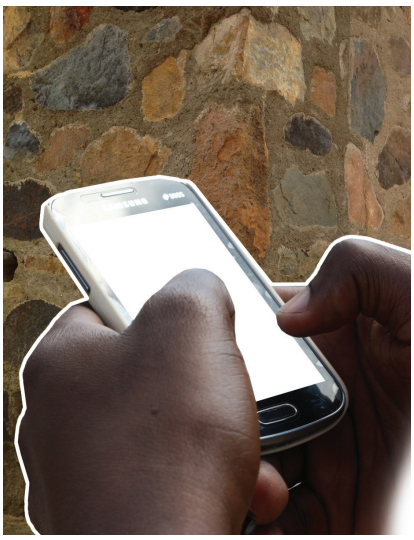


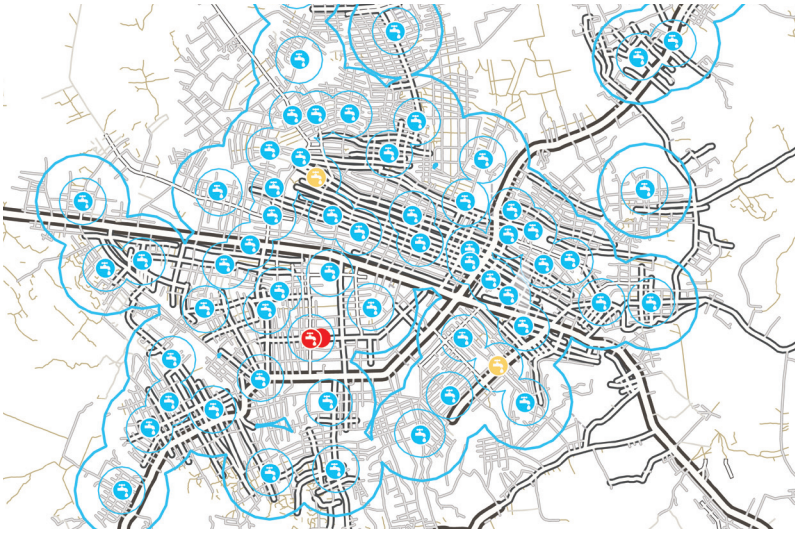


Beyond learning from a map of Beni, students can also potentially contribute their own research and reading of the city to the framework.

2–45 Imagining how map might be used for education and research



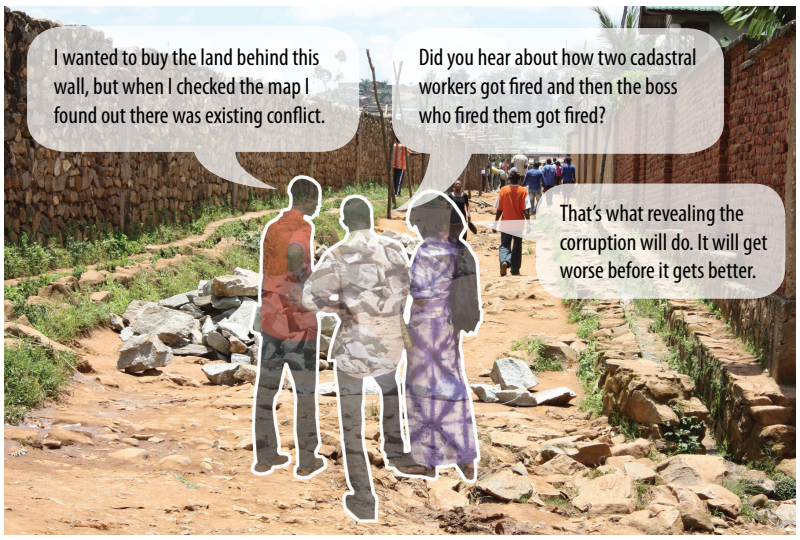


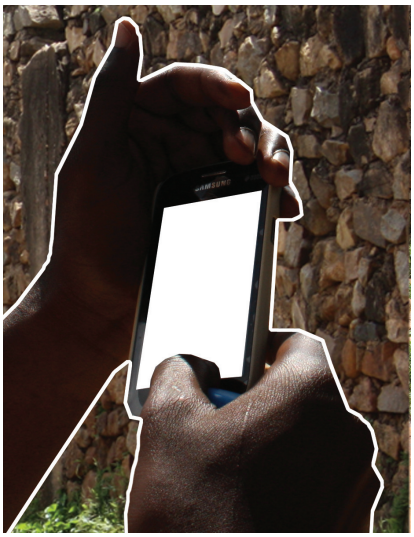


Two weeks later...

The map can be used to monitor the condition of infrastructure in the city. By allowing the public to contribute and discuss issues, solutions can be more efficiently developed by the municipality and the community.

2–46 Imagining how map might be used for crowd-sourced reporting





The map can eventually be developed to map reports of land conflict; however, because there are powerful people who benefit from the currently corrupt system, trying to uncover it will present new difficulties that are hard to predict.

To be continued...

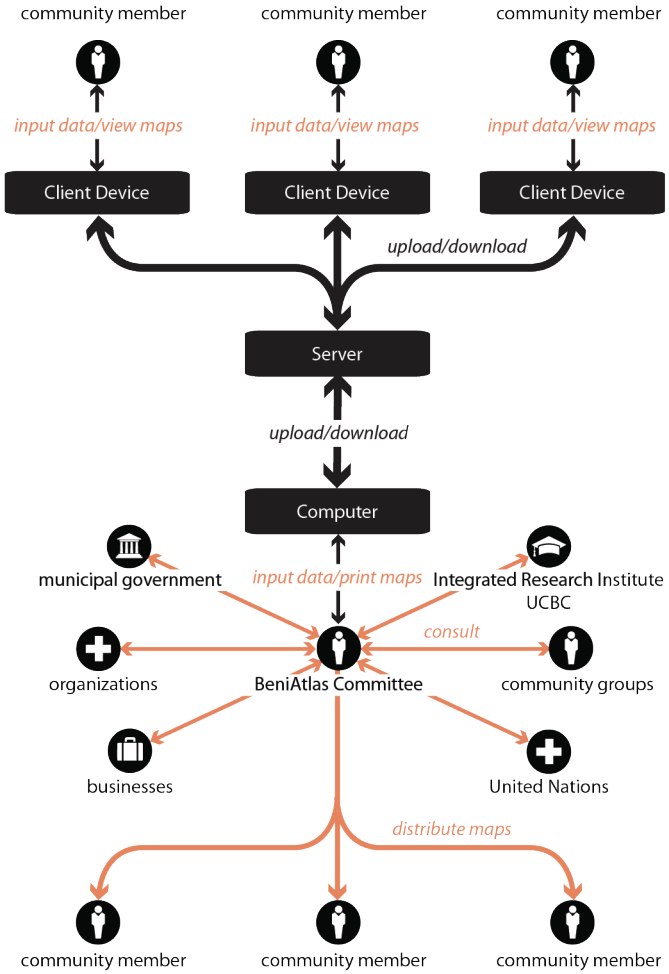
2–47 Imagining the discussion and affect of mapping land conflict

2.4 Discussion

The process of designing the framework and testing it reveals the detail involved in the planning and then implementation of a mapping framework. As the precedent studies suggest, each framework has strengths and weaknesses depending on what the goals are for each. If we spoke to the creators of the precedent frameworks they would probably describe them as infinite works in progress. For example the Cybertracker software has transformed considerably in its two decades of existence. It is important to be self-critical and recognize that there are always ways that the design can be improved. This section reviews the strengths and weaknesses of the framework as it is currently proposed and reflects on if it meets the objectives established in the previous chapter, how it might be improved, and how the framework methodology could be applied to other projects.

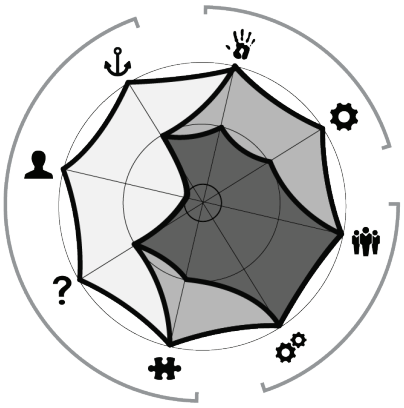
A strength of the framework is that it meets most of the objectives that were established in response to the context. The framework meets the objective of starting small by offering a collection of simple open-source tools and proposing that the framework grow in stages that allow participants become proficient with the tools and the community accustomed to the wider use of mapping. The framework still establishes the structure for bigger plans in the future. For example, the beta interface could be further developed to incorporate mapping of land conflict. The framework meets the objective of collecting demographic information by outlining the tools and process that could be used to accomplish that task. The framework also meets the objective of growing with the development of infrastructure. The framework proposes tools that do not require internet access and are open source so that they can be installed freely on personal laptops. The framework proposes publishing the maps in the community because a large percentage of the population still do not access computers. The beta version of the web application uses the most openly available coding languages that can be read from any browser. Lastly the framework partially meets the objective of being innovative and extensible by exploring opportunities of future development and growth. The project acknowledges that any mapping framework is very customized to each context and must recognize the community processes that are connected to it. By specifying existing tools that can fit into one another or designing custom tools so they can be interchanged, a different community could apply a different arrangement of the tools based on their needs.

A weakness of the framework is that in its current state it is very much in the ownership of the university. Similar to most of the mapping precedents, it was necessary to establish a partnership with a local intermediary that was very familiar with the context and had the resources and interest to pursue the project. The risks of partnering with an intermediary is that too much power and control can be put into one place, and despite best intentions, the data that is collected can become biased to suit the needs of the university with less concern for the community. The university is an asset in establishing the framework and getting it off the ground, but to better ensure that the framework is adopted as a tool by the community it is necessary for the university to let go of it institutionally and put it in the ownership of a group formed by interested community members and representatives from a range of community actors. Even though the university is highly invested in the community and the community framework includes workshops for community input, the university can still be seen as an outside entity. The scenarios in the previous section suggest that the framework (and even the digital components) get accepted and employed by the community, but in reality it is a slow and challenging process.



2–48 Diagram showing relationship of agents and users for *Visual Extensions* and how framework can be managed by a group that is made up of community representatives

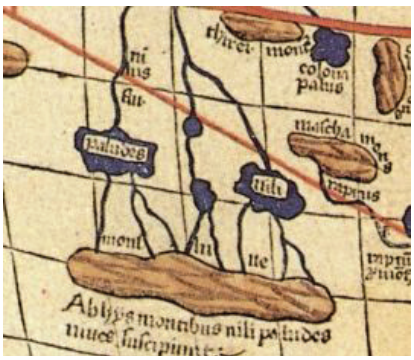
digital connections
community connections



2–49 Wheel diagram projecting the rating of the functions of the BeniAtlas framework in stages

By analysing the Beni framework in the same way as the precedents, it is clear that the Beni framework does not receive a high rating in response to all of the questions. The darkest shaded area is the rating of the framework after the first three phases that are thoroughly developed and therefore could be implimented at any time. At the completion of the three phases there is shared agency and participation in the initiative but most of the other categories are still low because there is only partial personal contribution through community workshops. By fully implementing the extensions on multiple themes that are inititiated by the community the rating could expand to the light grey area. To obtain a full rating in all areas would require further development by introducing personal profiles and establishing a system for how data that is collected can directly inform policy.

The future of mapping will likely see more complex frameworks like this one and even to the scale that Buckminster Fuller imagined but with a network of frameworks. It will be a necessary response in the time of the anthropocene where the human population is so large that we have the ability to affect the geological makeup of the world. Not only will monitering of both natural and man-made systems become more common, the gap between the digital image and real space will continue to get more blurry as the interface between them thins. Human beings will try to do what they can to influence change in their environments and with their creativity will develop tools to address the growing complexity. As James Corner writes, "the function of mapping is less to mirror reality than to engender the reshaping of the worlds in which we live.[1]"



2–50 Ptolemy's Mountains of the Moon from the Geographia

On a clear day in Beni one can get a glimpse of the Rwenzori mountains in all their magnificence. Many people call them the "Mountains of the Moon". Because I was curious where the name came from, I looked it up and discovered that the mountains were first depicted on Ptolemy's map of Africa in his Geographia. He cited the source from the tales of the Greek merchant Diogenese who claimed to have journeyed inland from the East African coast and came upon a mountain range that fed two lakes that were the source of the Nile.[2] He supposedly took the name "Mountains of the Moon" ("Lunae Montes") from the natives he met there. From that point on the Mountains of the Moon would be found on maps of the next several centuries until further exploration would determine that there was no clear mountain that was the source of the Nile (there are several mountain ranges that in fact feed the Nile). Nevertheless, it has been widely accepted that the Rwenzori were the mountains that Ptolemy referred to and they have since adopted the name of Mountains of the Moon. It is yet another example of the power of the map to fix an idea onto the physical world.

1 James Corner, "Agency of Mapping: Speculation, Critique and Invention," in *Mappings*, edited by Denis Cosgrove (Reaktion Books, 1999), 10.

2 "The Philadelphia Print Shop: The Mountains of the Moon," https://www.pps-west.com/mountmoon.html


SALON

2–51 View down the main road toward the Rwenzori Mountains

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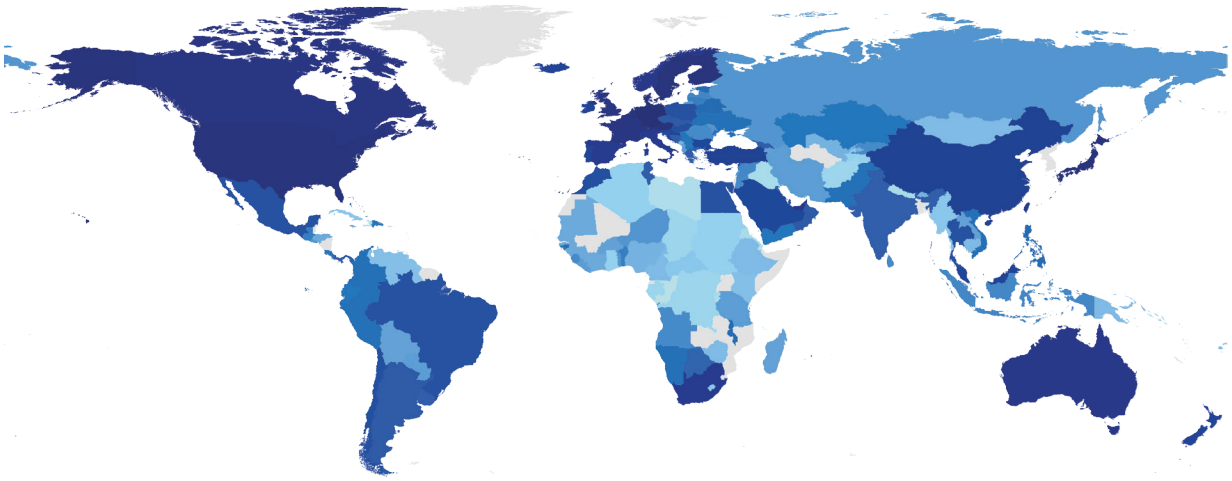
Appendix A: Congo by Mapping

A–01 Street in Beni

A–02 The road from the Mpondwe border to Beni

Infrastructure

The Democratic Republic of the Congo faces possibly the most daunting infrastructure challenge on the African continent. Because of continued conflict the DRC's road and rail infrastructure is seriously damaged, and the vast geography, extensive forests, and large river network only complicate the development of new networks. The DRC's economic activity is concentrated in three distinct centers that form a triangle – Kinshasa in the southwest, Lubumbashi in the southesast, and Kisangani in the northeast (African Development Bank Group 2011). There is no well developed infrastructure linking these three cities, particularly for road and rail. Power and ICT is somewhat developed along the Kinshasa-Lubumbashi axis, though there is no fiber optic network to speak of and the main power transmission line is in need of major rehabilitation. The rest of the country is almost entriely void of power and ICT coverage, although GSM coverage (mobile) has been recently expanded in the east. With respect to transport infrastructure, many regions of the DRC (notably the southeast and northeast) are better connected with neighboring countries' infrastructure corridors than they are with domestic ones. Beni is primarily serviced through the Mpondwe border with Uganda, through which all imported and exported products come and go (African Development Bank Group 2011). The small stretch of road from Beni to Mpondwe is a short 80km but the journey takes twice as long as it should because of the rugged dirt roads and ill-maintained bridges.

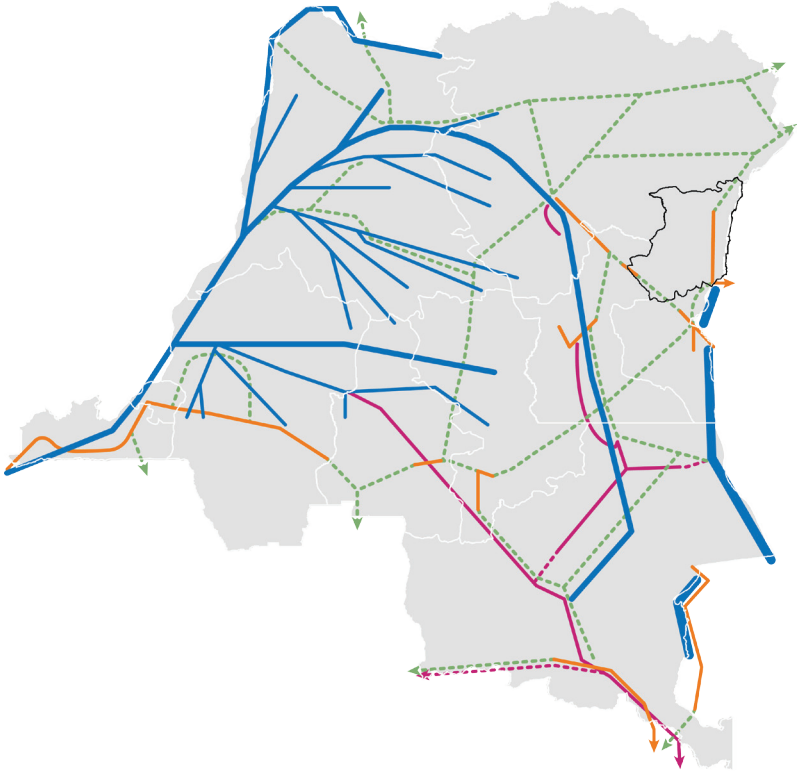


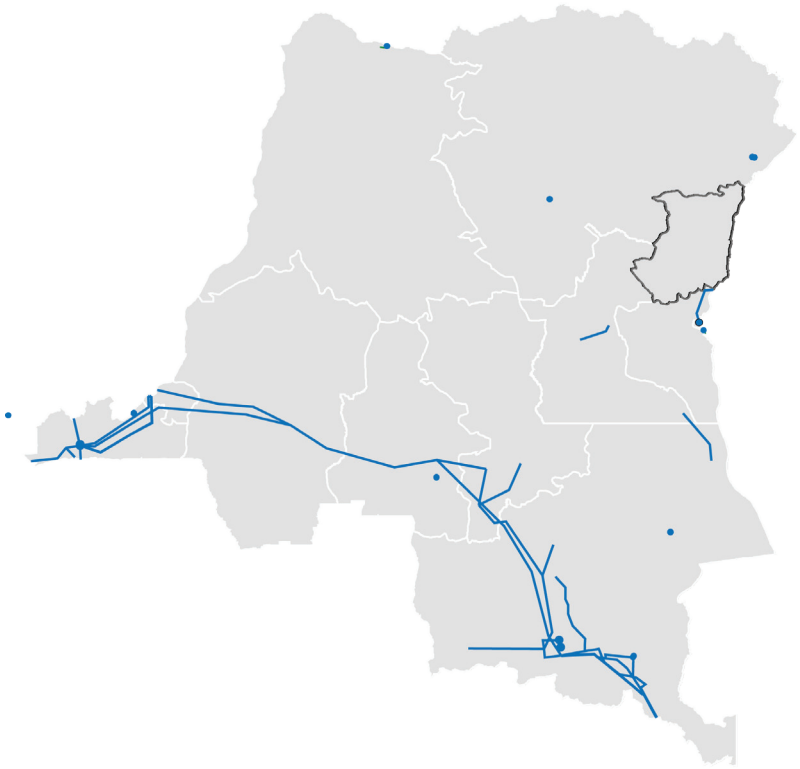
A–03 World Bank 2011 Infrastructure Index

- 1.27 – 2.12
- 2.12 – 2.54
- 2.54 – 2.96
- 2.96 – 3.43
- 3.43 – 4.26

A–04 National ground transportation networks

- Paved roads
- Unpaved roads
- Rail
- Rail (not operational)
- Waterways

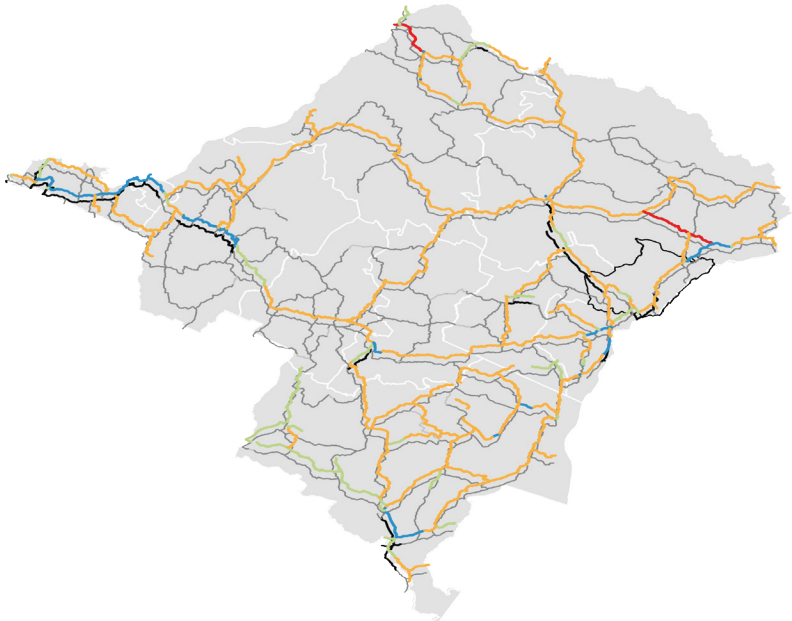




A–05 National medium and high voltage electricity transmission network

Electrical transmission lines

Power plant



A–06 National road network showing road surface types on the lower layer and road conditions on the upper. For roads not shown the conditions are unknown

Asphalt

Gravel surfaced

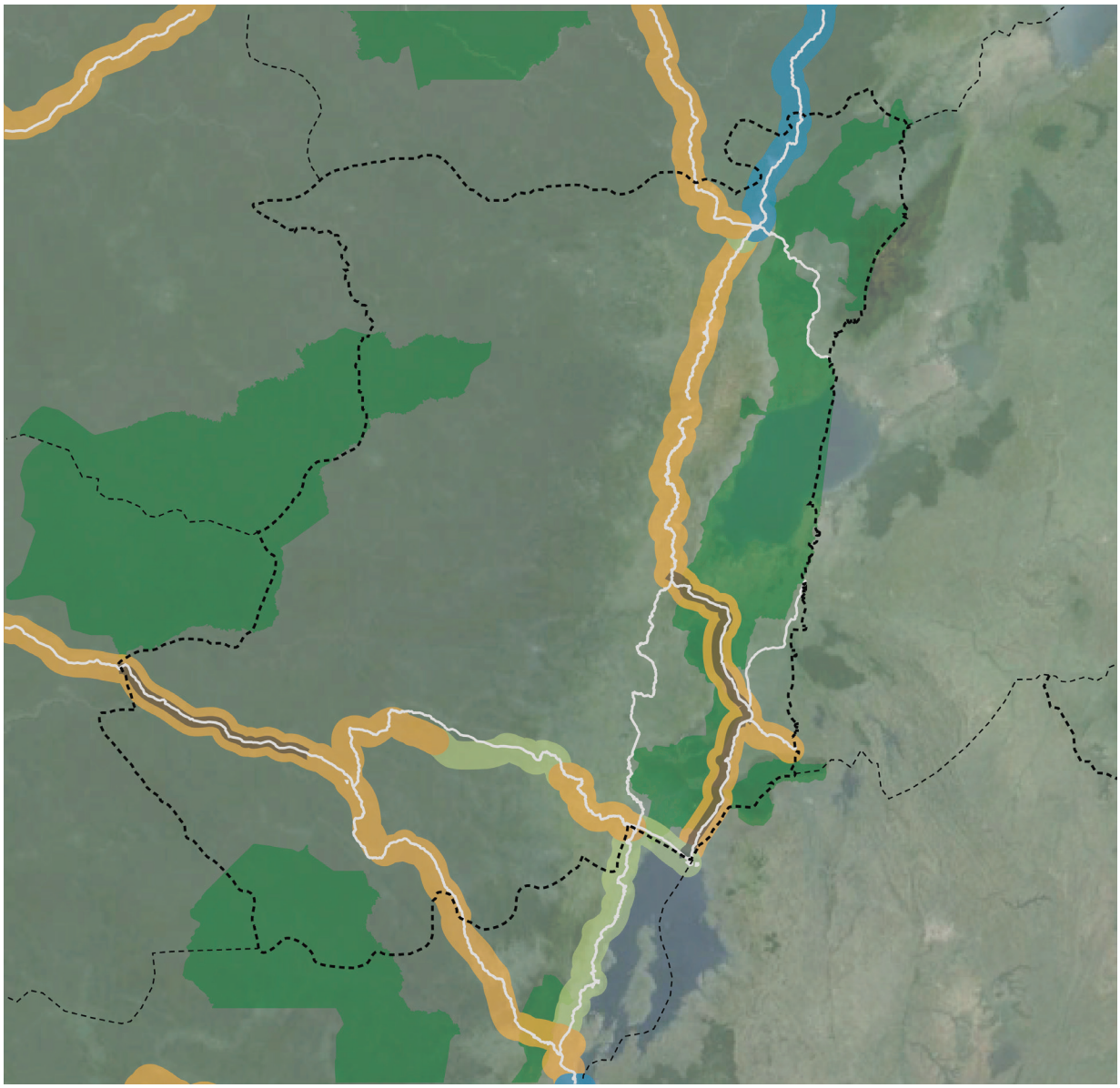
Earth road

Good

Average

Bad

Very bad



A–07 Road conditions map overlaying Open Street Map and Google Earth image

Roads

Asphalt roads

Good condition

Average condition

Bad condition

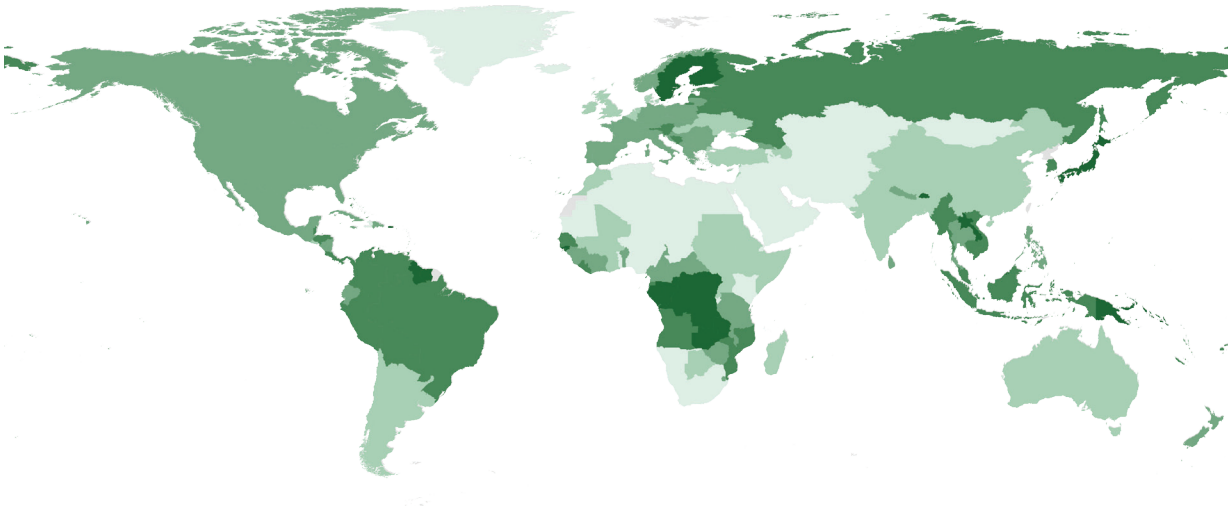
A–08 Family in North Kivu selling charcoal

Forestry

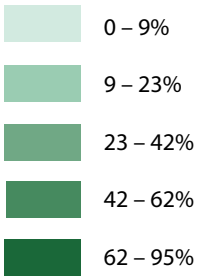
The Eastern Great Lakes Region of the Democratic Republic of the Congo has an uneasy interdependance among people and between people and nature. Since civil war finally ended in 2003, the challenge remains of preventing conflict and fostering cooperation for sustainable development (SAIIA). The DRC has 155.5 million ha of forestland including half of Africa's rainforest and is the country with the second largest extent of forest in the world. Another important element is that a significant proportion of DRC's largely rural popoulation is dependant on forests for part of their subsistance (CIFOR). Although deforestry in the DRC is very low at only 0.2% per year, the distribution is uneven with the greatest impact occuring in the Kivu provinces. Reasons are the proximity to centers of high population and also the need for agricultural land (CIFOR). There are three timber sub-sectors in the DRC: the Formal Timber Sector, Informal Timber Sector, and Fuel and Charcoal Sector.

(a) Formal Timber Sector

Out of the 155.5 million ha of forest, approximately 20 million ha are granted as timber concession to about 60 companies, although only 12 are in operation using half that concession. Most timber from the formal sector is transported by river, primarily as logs, to Kinshasha. The timber is destined almost exclusively to the European market - principally France, Belgium, Portugal, and Italy (Forests Moniter).



A–09 World Bank 2011 Forest Index (% Land Area)



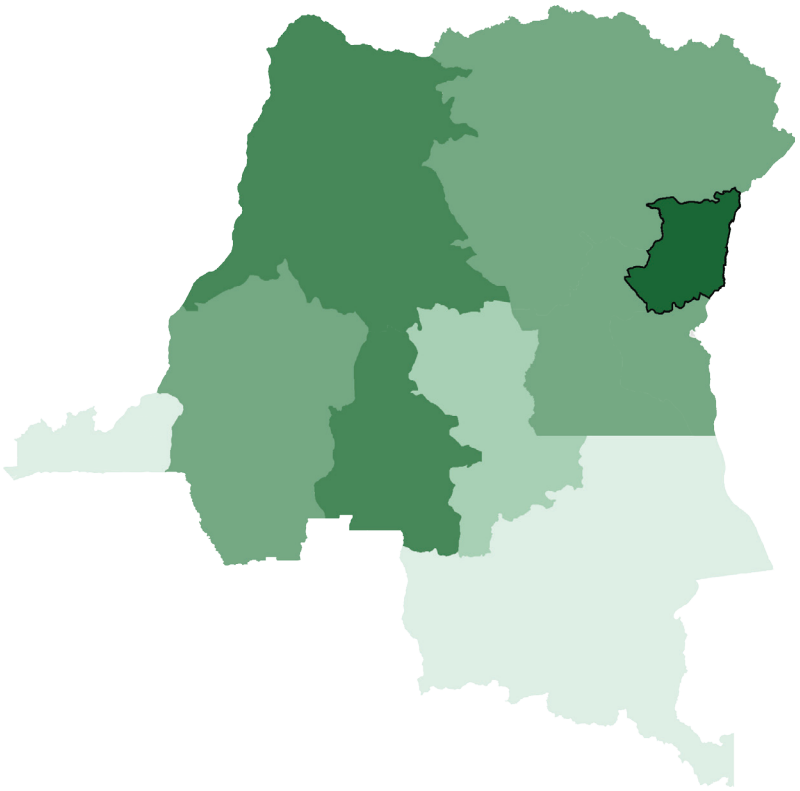
(b) Informal Timber Sector

Timber is one of the key industries moving through Beni, however informal. The bulk of timber from East African markets is from the DRC. About 80% of it leaves and crosses the border into Uganda, the most popular timber trading route being from Beni, through the Kasindi-Mpondwe border post, along the Northern tansit corridor to Kampala, Uganda, and then on to Nairobi, Kenya (SAIIA). There are estimated 8000 small-scale logging companies ranging from a few individuals who join together to harvest timber two or three months a year, to permanent enterprises with a dozen or more regular employees (Forests Moniter). The flow is unregulated with very little revenue for the country of origin, and although there are many sustainable standards for internationally exported timber, this timber is exported almost entirely to the region of East Africa. One estimate states that the informal trade is double the size of formal trade reported by the DRC (SAIIA).

A–10 Percentage of forests in Africa that are in DRC

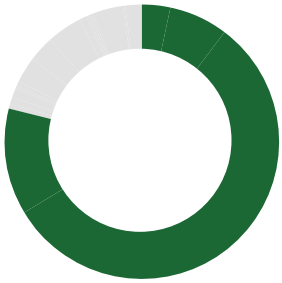
(c) Fuel Wood and Charcoal Sector

Wood is a primary necessity for all Congolese people, especially those living in a rural environment. Wood energy accounts for 80% of all domestic energy consumed in the DRC (Forests Moniter). Only 10% of homes across the country have electricity creating a lack of alternative energy sources and therefore wood is very commonly used for fuel because of it‘s readible availability and low initial investment (SAIIA). National wood energy consumption is about 72 million m3 per year. This is a very disproportionate number compared to the formal (0.3 million m3) and informal (2 million m3) sectors. This means that the overwhelming majority of wood harvested in DRC is used locally for heating and cooking (Forests Moniter). Possible solutions to reduce pressure on natural resources are to increase the area of plantation forests, use better designed hearths to reduce charcoal consumption by 50-60%, and raise awareness of hearth efficiency (SAIIA).

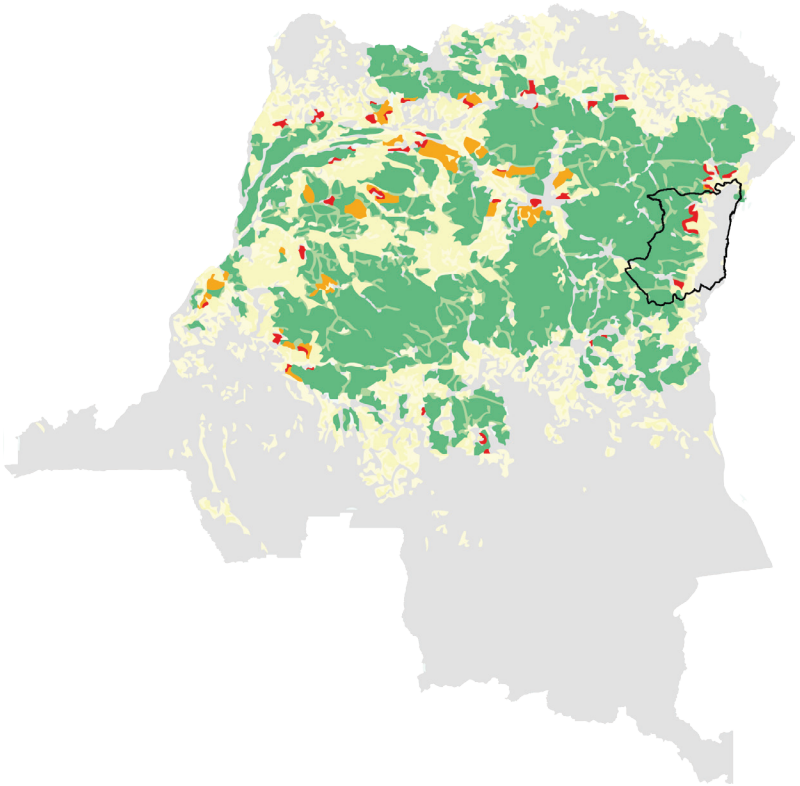


A–11 Percentage forest degradation by province

0%
< 1%
1 – 2%
2 – 4%
4 – 6%



A–12 Percentage of forested land in DRC



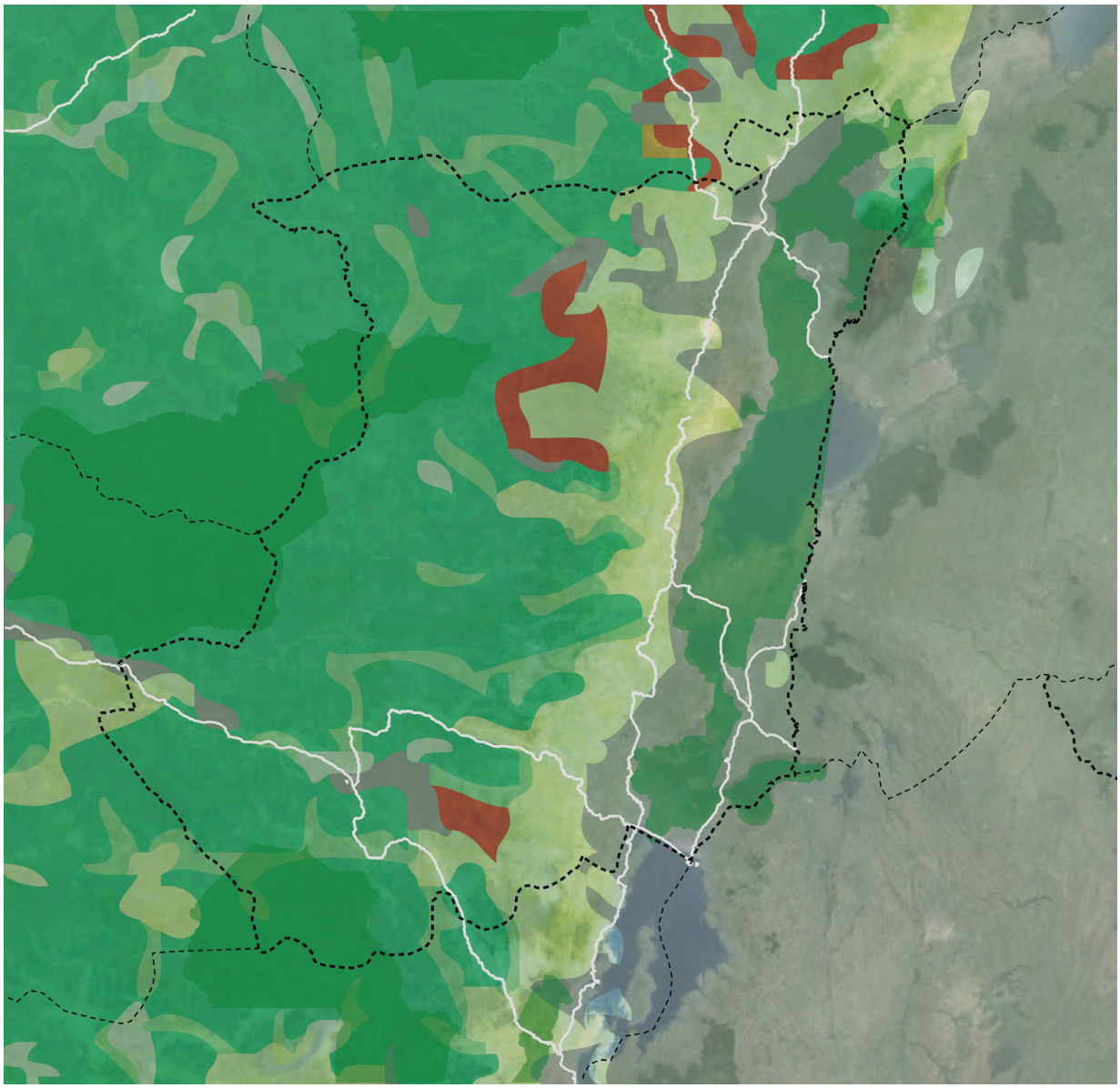
A–13 Intact forests and probable areas of deforestation

Degraded primary forests 2010

Intact primary forests 2010

High probability of agriculture areas expansion (model–based prediction)

High probability of selective logging expansion (intact forests within actively managed concessions)



A–14 Forests map overlaying Open Street Map and Google Earth image

Roads

Degraded primary forests 2010

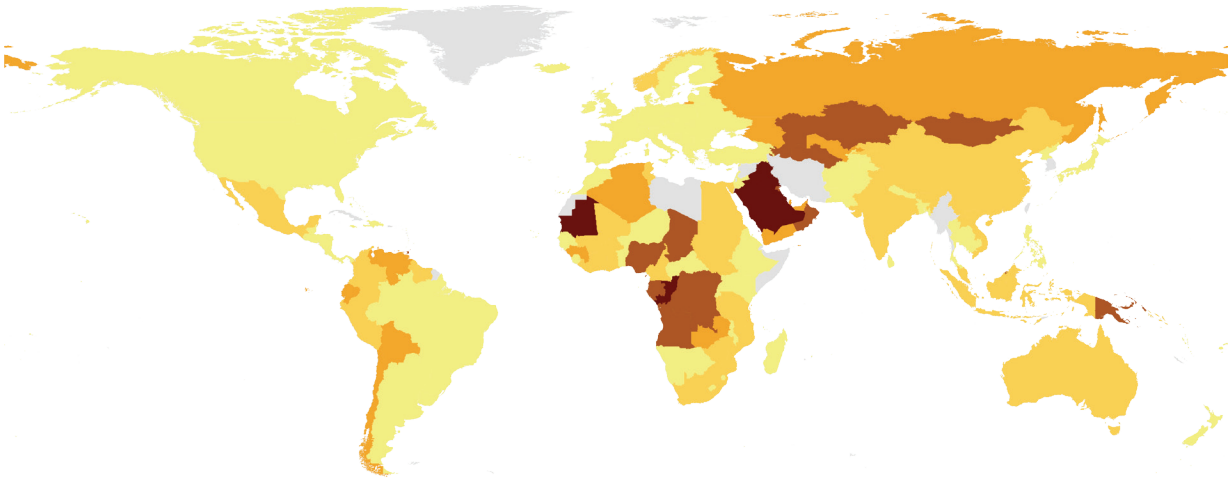
Intact primary forests 2010

High probability of agriculture areas expansion (model–based prediction)

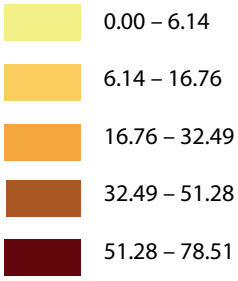
A–15 Child mining for gold

Mining

The DRC is very rich in mineral wealth, having seventy percent of the world's coltan (an essential material in most mobile devices), fifty percent of the world's cobalt reserves, and thirty percent of the world's diamond reserves. It also has important potential for gold, uranium and manganese. Under Belgian colonisation the mining industry flourished and continued under the Mobutu regime. The looting of minerals was a major contributer to the Congo Wars in the 1990s, dissension only increased by the lack of infrastructure and a center of power at the far west of the country. The DRC is subject to what some call the "resource curse". No other country in Africa presents such an extreme combination of potentials and problems. Reform measures are being strongly encouraged to create a new legal framework and a set of standards aimed at improving practices as a means to obtain development objectives. However, in the name of "good governance", strategies are often denying the political dimensions of the socioeconomic considerations associated with the management of this sector. Encouraged, conceived, and often implimented from abroad and/or with the participation of international experts, the very origins of these reforms create problems of the legitimacy of their application and approbation by the national and local authorities (Campbell).



A–16 World Bank 2011 Total Natural Resources Rents (% of GDP). Total natural resources rents are the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents. Estimates based on sources and methods described in The *Changing Wealth of Nations: Measuring Sustainable Development in the New Millenium*

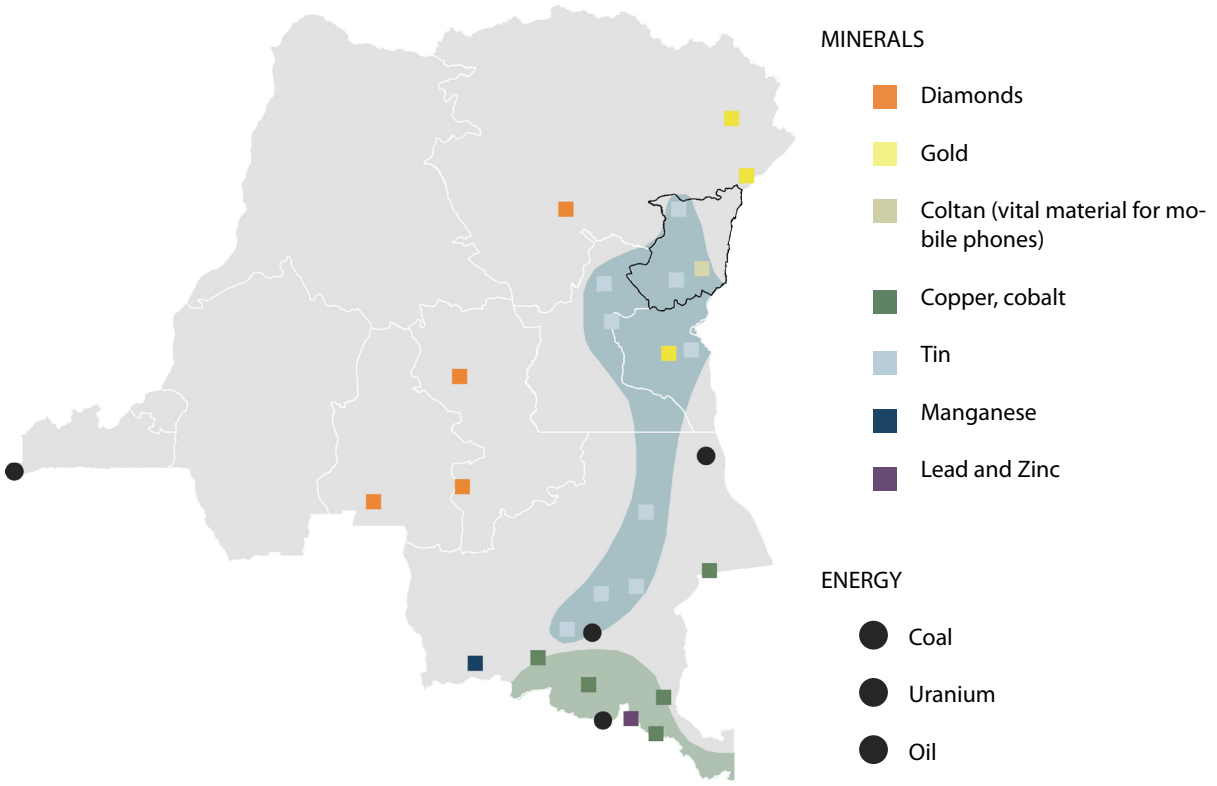


Artisinal Gold Mining

Artisinal gold production is a substantial contributor to the local economy in and around Beni. There are twelve main regions with artisinal and small-scale gold mining in North Kivu: Walikale, Masisi, Lutunguru, Manzia-Luholy-Lubereri, Mohanga, Lundjulu-Loiki-Ubiro, Lubero, Makwasu, Lutela (includes Manguredjipa), Biabune-Loya and Bilolo-Mobissio-Abakuasimbo (Congo Gold). Up until now, very limited exploration has been conducted at these locations apart from the prospecting and simi-industrial exploitation that was conducted by a Belgian colonial company at Manguredjipa. North Kivu's artisinal gold mining communities have been under heavy pressure during the past fifteen years of violence with additional problems steming from relative isolation, poor state of roads, and complete dependance on regional traders.

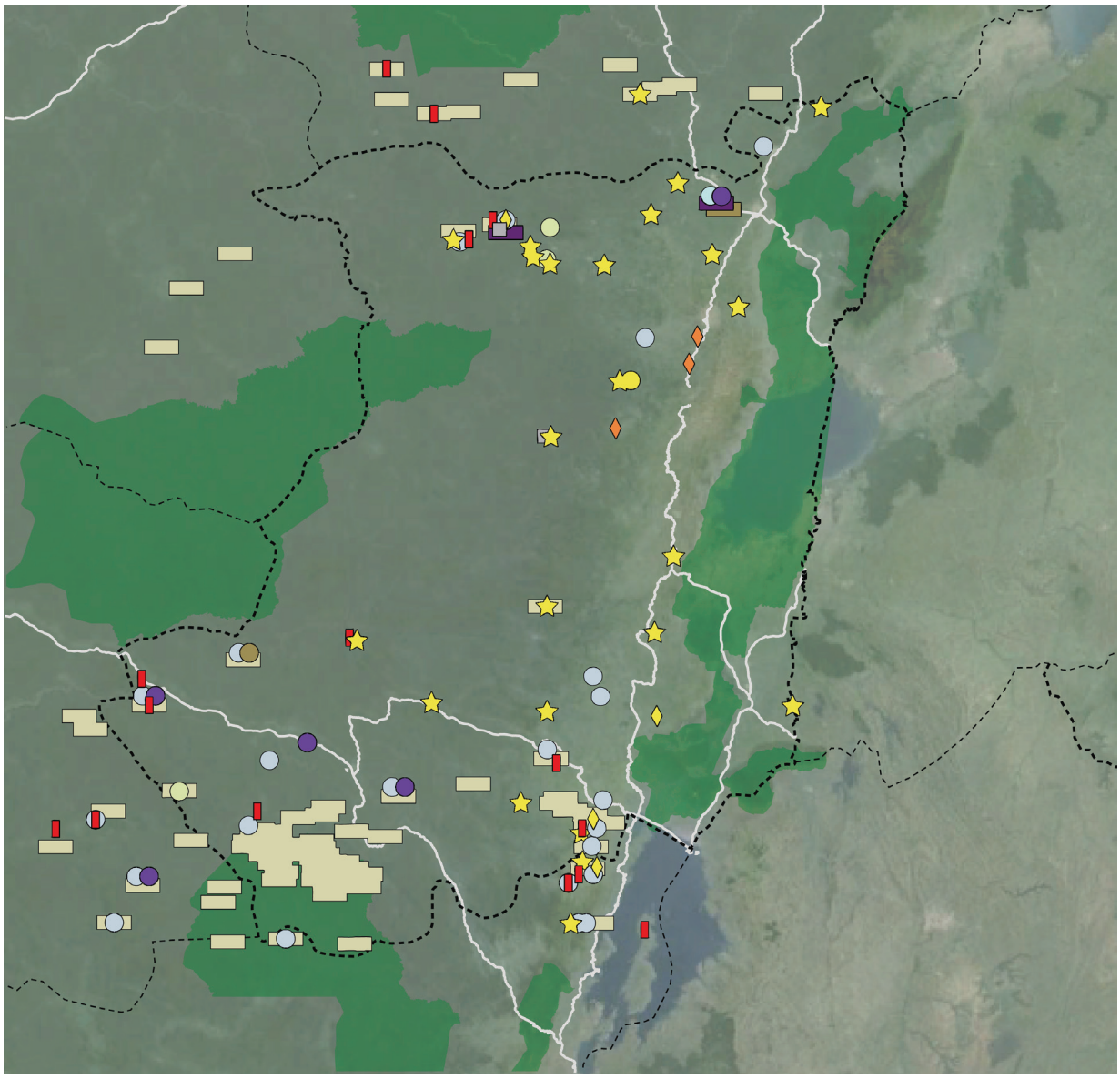
Manguradjipa

Manguradjipa is an example of a large mining village located in the jungle 100km west of Beni and is the center of sprawling gold-mining communities. Several thousand people live in Manguredjipa, while anywhere from 30,000-45,000 in the 10,000 square kilometers of surrounding forests and mountains. Until very recently, miners operated without protection from state security, and Mayi-Mayi groups would periodically come and "disturb them". Recently however the threat of militia attacks decreased with presence of a recently deployed FARDC regement (Congo Gold). Violence in the area is still considerable however. There are many bandit groups who are often organized by FARDC soldiers that extort payments from miners; gangs of young villagers pretend they are militias, and there is a large amount of robbery on the roads to and from the mines. Another challenge the miners face is an accumlation of exuberent fees and taxes imposed by corrupt agents of the Provincial Mining Division and national government authorities. The inability to pay for papers within the legal space



provokes people to conduct illegal artisinal mining activities instead. Portions of road are so deteriorated that only 4x4 vehicles can get through. The only practical modes of transport are light motorcycles, bicycles and lengthy treks on foot. On average, a truck takes one to two weeks to cover the last forty kilometers to Manguradjipa. Lastly, the region witnesses serious violations of human rights, especially against women and children (Congo Gold).

A–17 Sites of high mineral wealth



A–18 Mine locations North Kivu

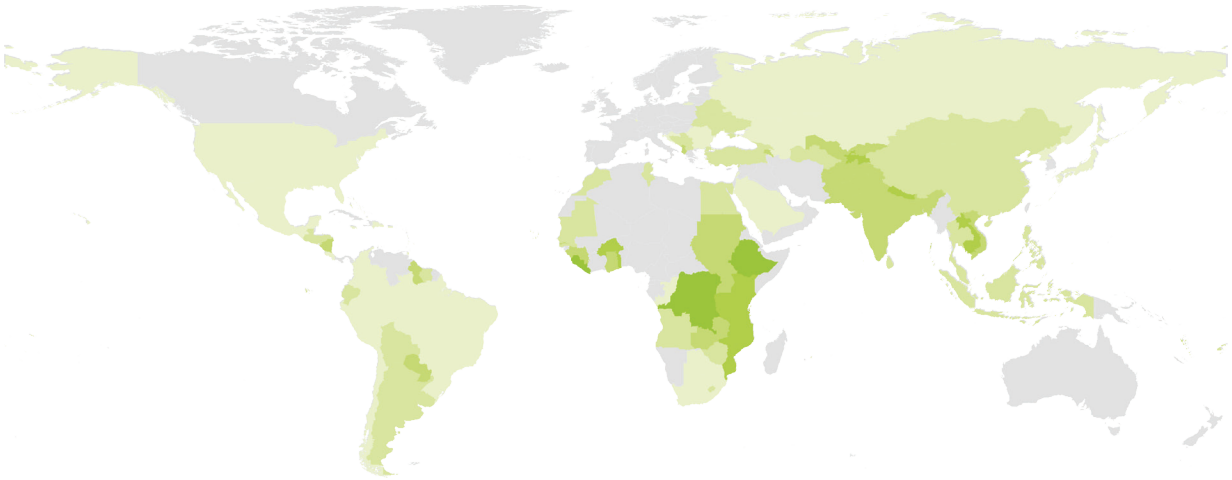
- Coltan
- Niobium
- Tin
- Tungsten
- Gold
- Diamond
- Monazite
- Beryllium
- Tourmaline
- Garnet
- Bauxite
- Zircon
- Phosphate
- Platinum

A–19 Farmers growing coffee (IRIN)

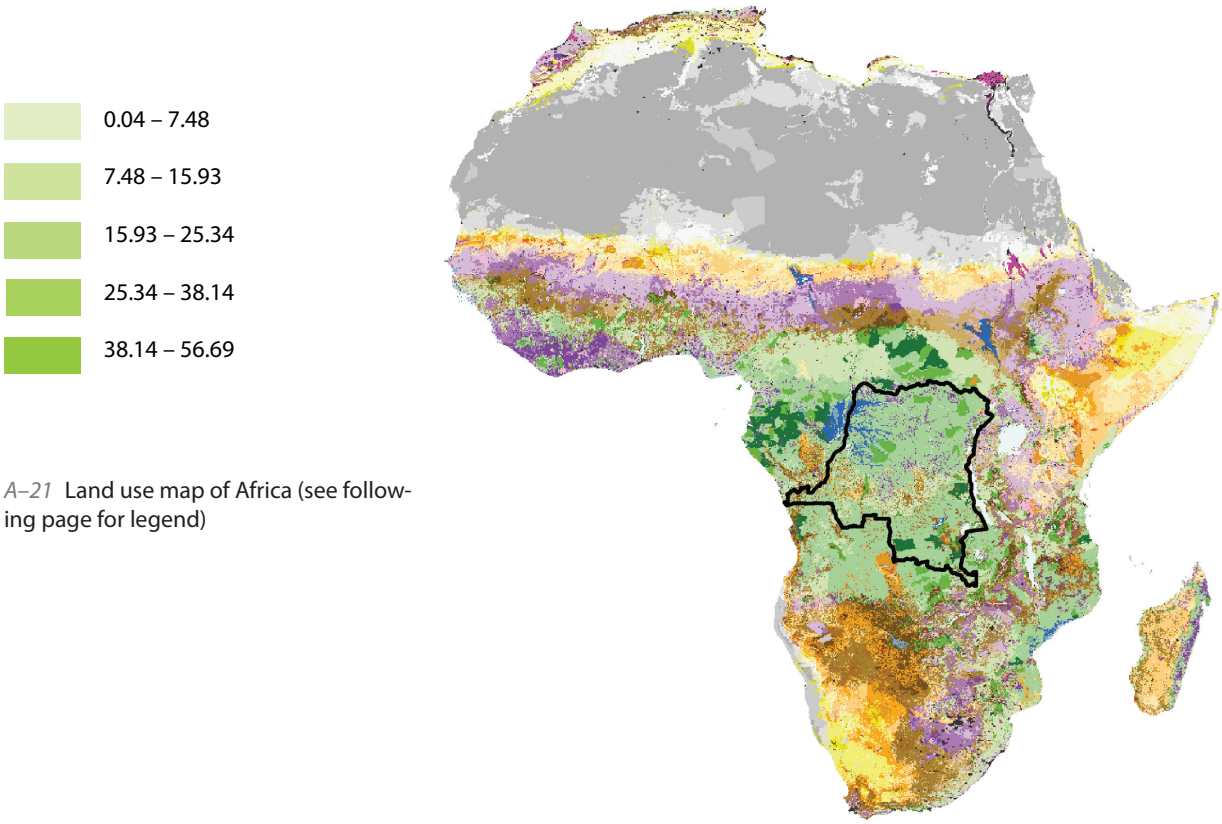
Agriculture

A large portion of the population in the DRC is very much dependant on agriculture for their livelihoods. The most common crops in the North Kivu region are: potatoes, sweet potatoes, casava, taro, yams, wheat, beans, cow peas, bambara beans, soybeens, groundnuts, rice, bananas, plaintains, and maize (FAO). Agriculture was severely reduced during the recent years of civil unrest, and many traditional crops are no longer grown (IRIN).

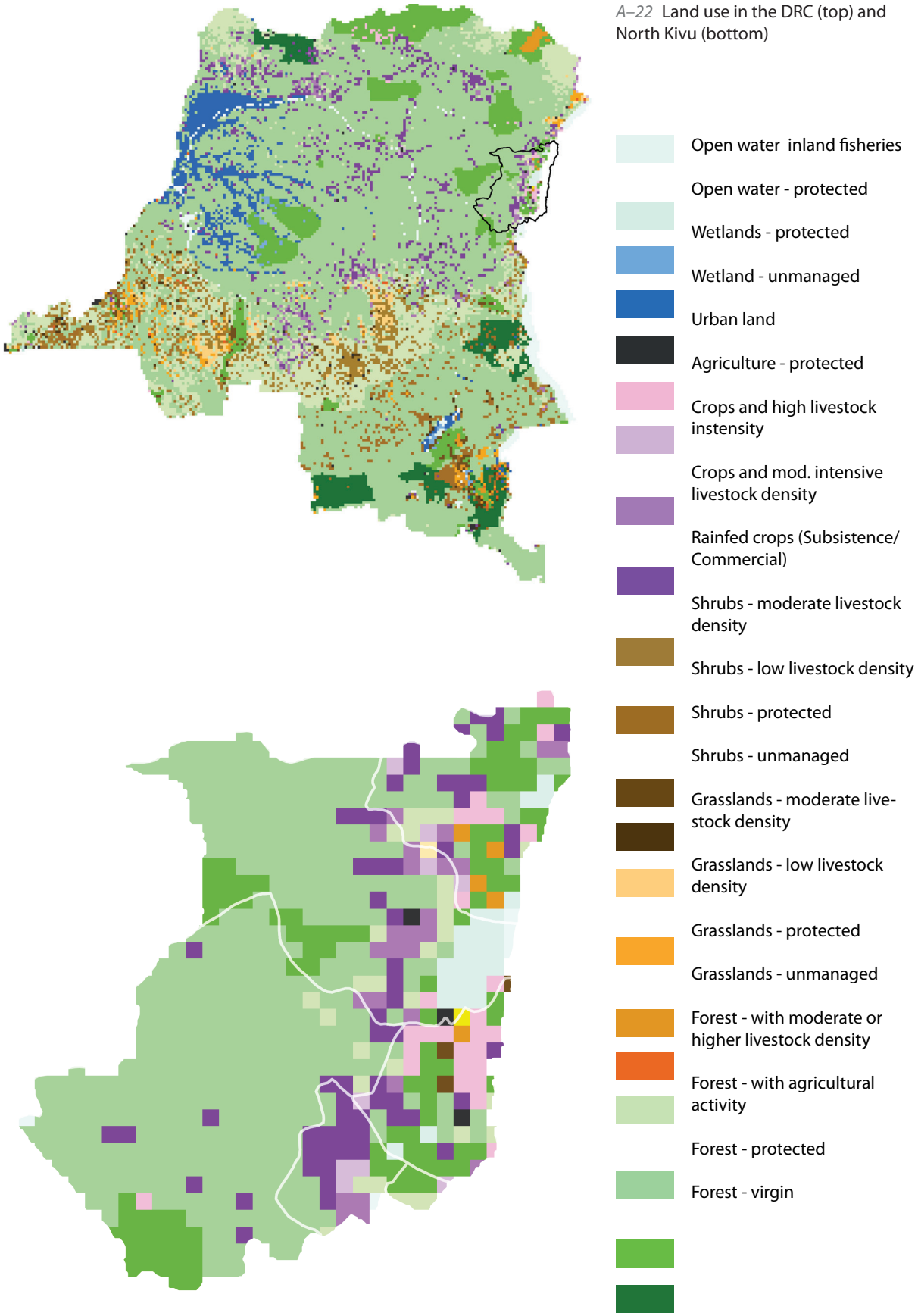
The region has a great potential to not only improve growing methods to produce more food per area of crops, but also to move into crops that were lost over the past thirty years but that grew well in the area. For example, coffee, a traditional export crop, shrank from 110,000 metric tons in the late 1980s to about 50,000 metric tons in 2009, according to the DRC's national coffee office (IRIN). Coffee has become a major export for neighboring Uganda and Rwanda, there is an increasing demand for coffee in middle-income countries, and the temperate climate in the region is thought to be protection against diseases affecting the plant. In seeing these benefits, NGOs have in recent, more peaceful years launched coffee projects in the Kivu provinces. NGOs are of the perspective that teaching efficient farming methods could be an effective way to provide good employment to excombatants, therefore reducing the desire for employment by military groups.



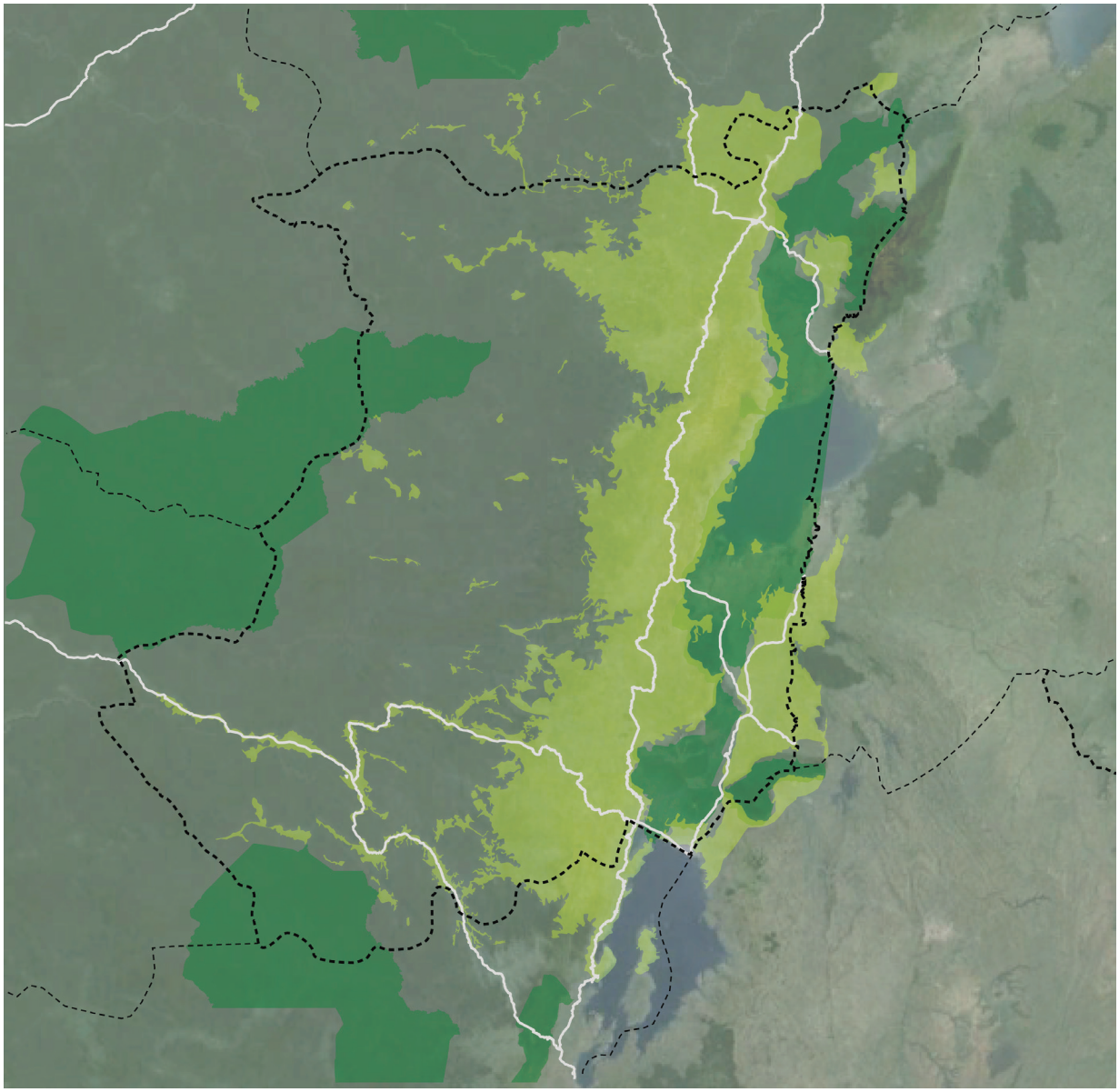
A–20 World Bank 2011 Agriculture Index



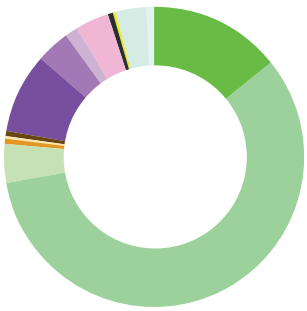
A–21 Land use map of Africa (see following page for legend)



A–22 Land use in the DRC (top) and North Kivu (bottom)



A–23 Agricultural land North Kivu (IPIS Research 2012).

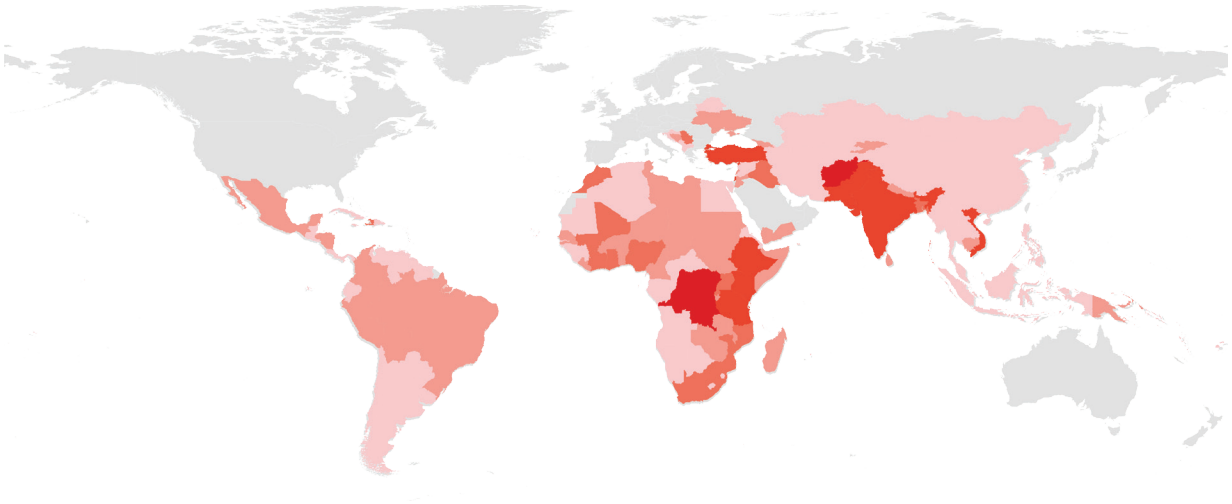


A–24 Graph showing percentage land use in North Kivu

A–25 Refugee camp

Aid

As described in many of the previous themes, aid has a major role to play in all parts of life in the Eastern Great Lakes region. The United Nations Organization Mission in the Democratic Republic of the Congo (MONUC) was established in 1999 following the Congo Wars. They helped organize the country's first free and fair elections in 46 years, held in 2006. In 2010 MONUC was renamed to the United Nations Organization Stabilization Mission (MUNISCO) to reflect the new phase reached in the country. MONUSCO has a very significant presence in the region, with almost 20,000 military personel. They extended their time in the country because of current unrest in the Kivu provinces. Beyond the United Nations, there are a substantial number of NGOs, both international and community-based. The International Council of Voluntary Agencies is an example of how organizations are seeing the need to work in cooperation.



A–26 World Bank 2011 Assistance and Official Aid Received (Current US$)

-660,900,000 – 424,210,000

424,210,001 – 1,122,810,000

1,122,810,001 – 2,070,790,000

2,070,790,001 – 3,595,160,000

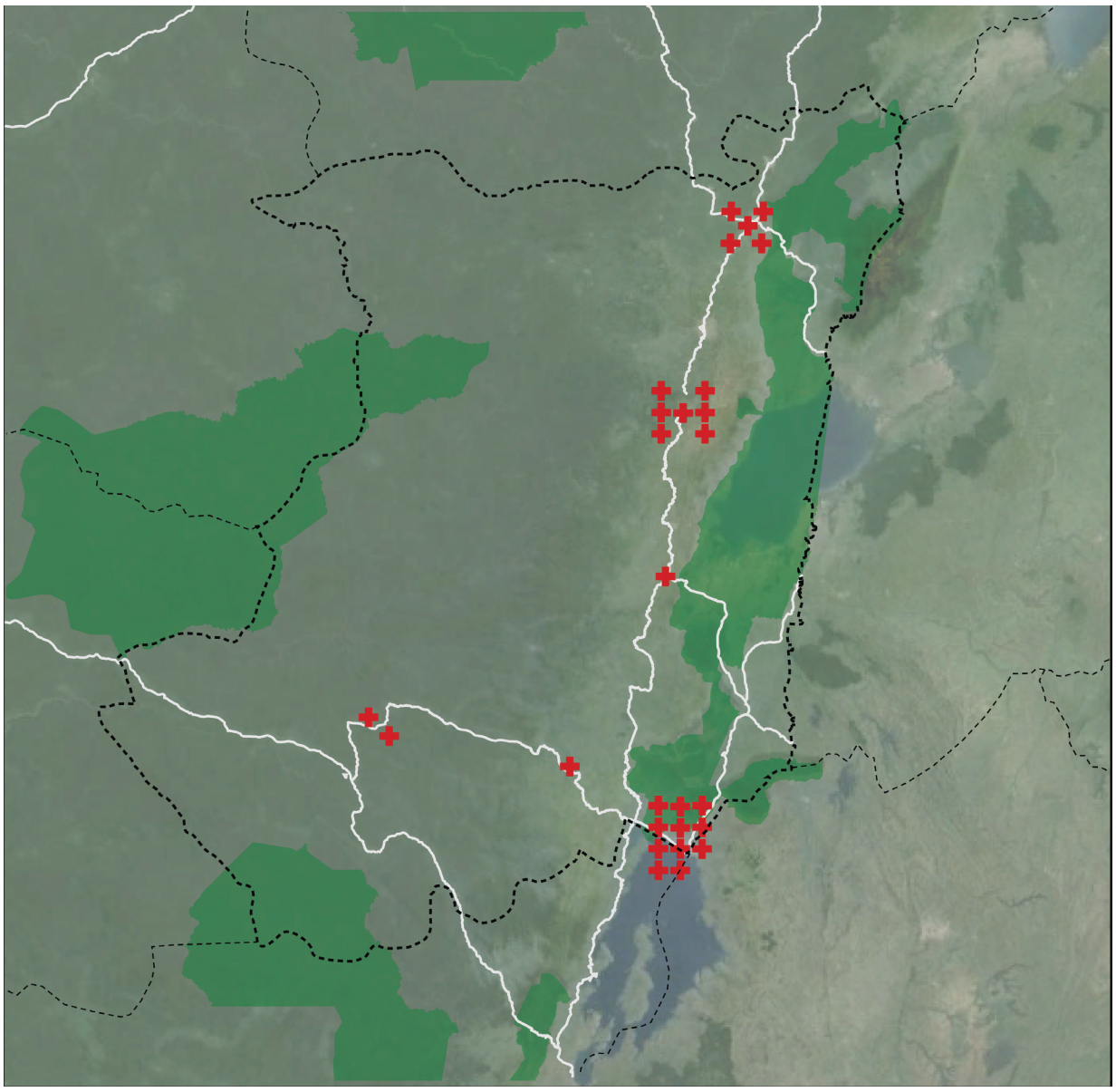
3,595,160,001 – 6,710,870,000

USAID	?	
17	?	
24	?	
19	?	
21	?	
24	?	
22	?	
21	?	
6	?	
12	?	
51	?	
29	?	

CBO's in Beni:

- Act for Gender (AFG)
- Responsible Reproductive Health Program in North Kivu (PRORENI)
- Concrete Actions for the Protection of Infancy (ACOPE)
- Community Hope Action Ministry (CHAM)
- Feminine Solidarity for Peace and Integral Development (SOFEPADI)

A–27 An attempt to find national data for aid in the country. I only found one organization – USAid – that publishes the locations of their nation-wide initiatives.



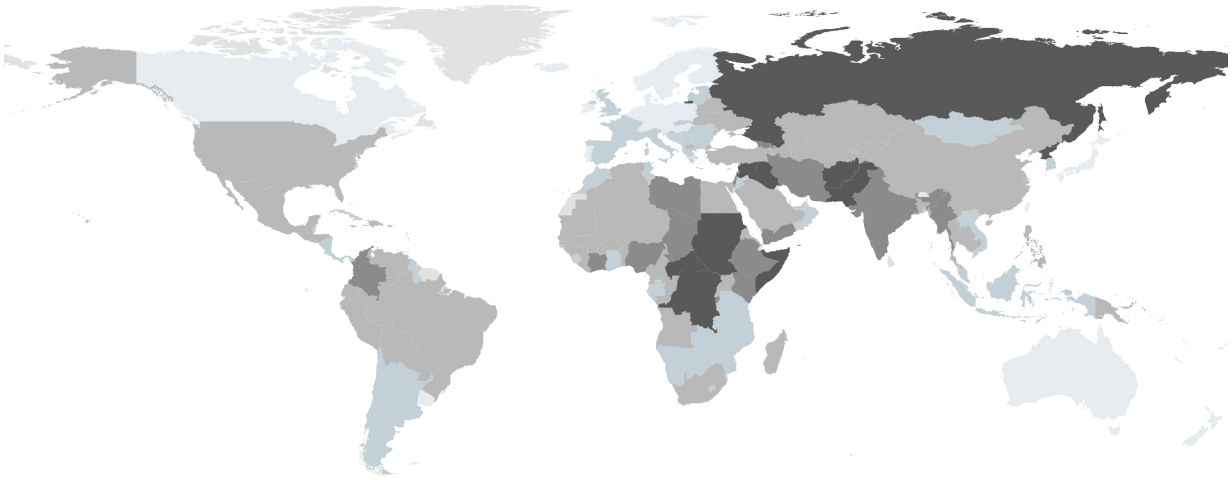
community-based organizations in North Kivu arranged by village/city as documented in the CBO Database created by Eastern Congo Initiative (Eastern Congo Initiative 2013).

A–28 Data for the Community-Based Organizations Database was gathered from a Landscape Analysis conducted in 2010 by USAID and the Eastern Congo Initiative (ECI) to identify Congolese-lead organizations that are improving outcomes in their communities.

A–29 Displacement camp

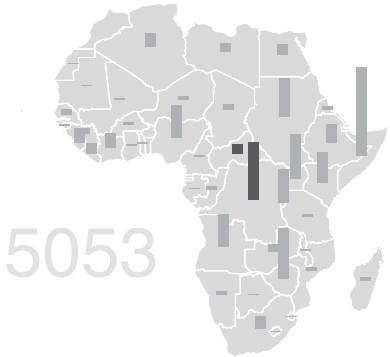
Conflict

The country has experienced a large amount of conflict, even since the last Congo War ended in 1999. In the past fifteen years an estimated total of four million people have died either from violence or the hunger and disease that ensue. Most of the deaths were civilian. Conflict stems from multiple sources, most of which are touched on in the six other themes of this chapter. The main bulk of conflict was initiated after the 1994 Rwandan genocide when Rwandan Hutu militian forces fled to eastern DRC and used refugee camps as a base for incursion against Rwanda. A coalition of Rwandan and Ugandan armies invaded the DRC to overthrough the government of Mobutu, and ultimately control the mineral resources of Zaire. This was the beginning of the First Congo War. This is only a small part of a whole history of the Congo that has been frought with corruption and exploitation, reaching all the way back to colonization by King Leopold II in the late 1800s. Rape of women and the enslavement of children as child soldiers are of common occurance.

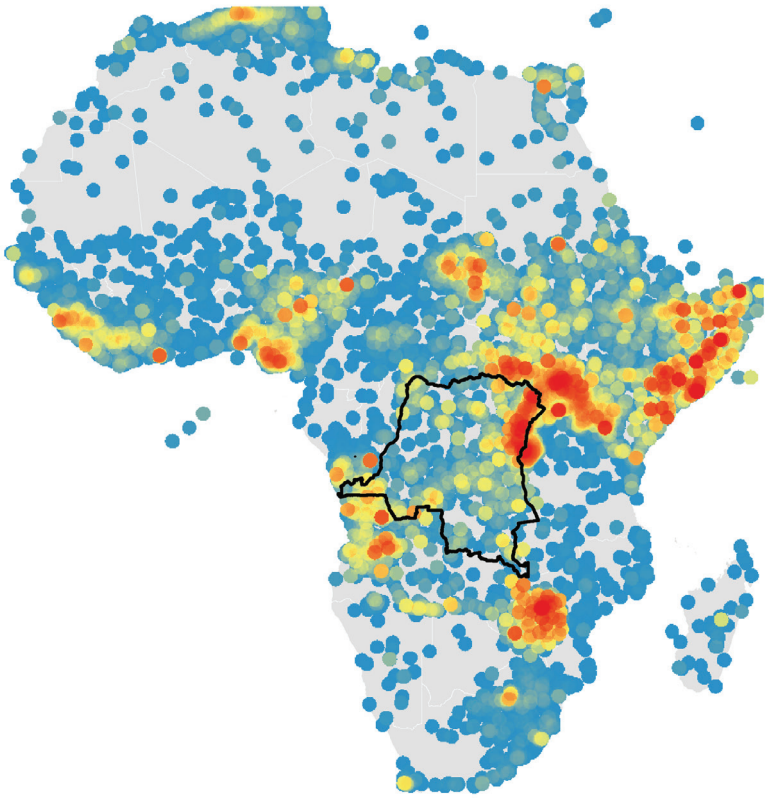


A–30 Vision of Humanity 2013 Global Peace Index

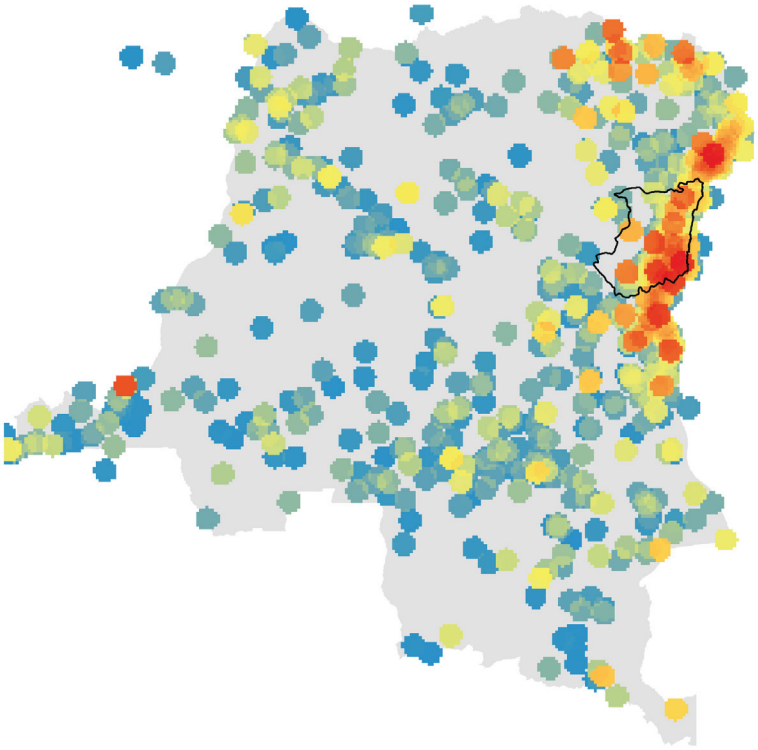
Very high
High
Medium
Low
Very low



A–31 (above) Numbers of conflicts by country 1997-2011 (ACLED 2013).



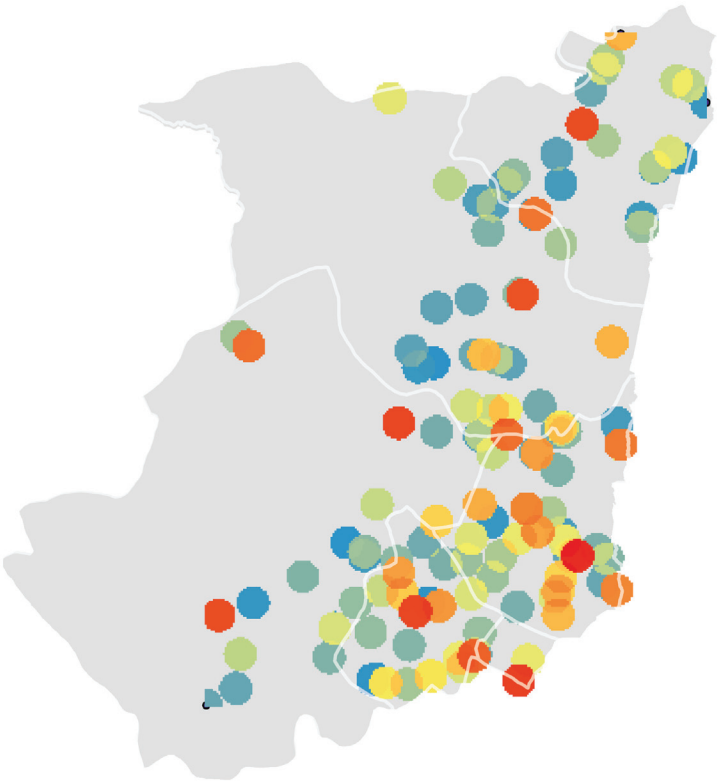
A–32 (right) Armed Conflict Location and Event Database (ACLED 2013).



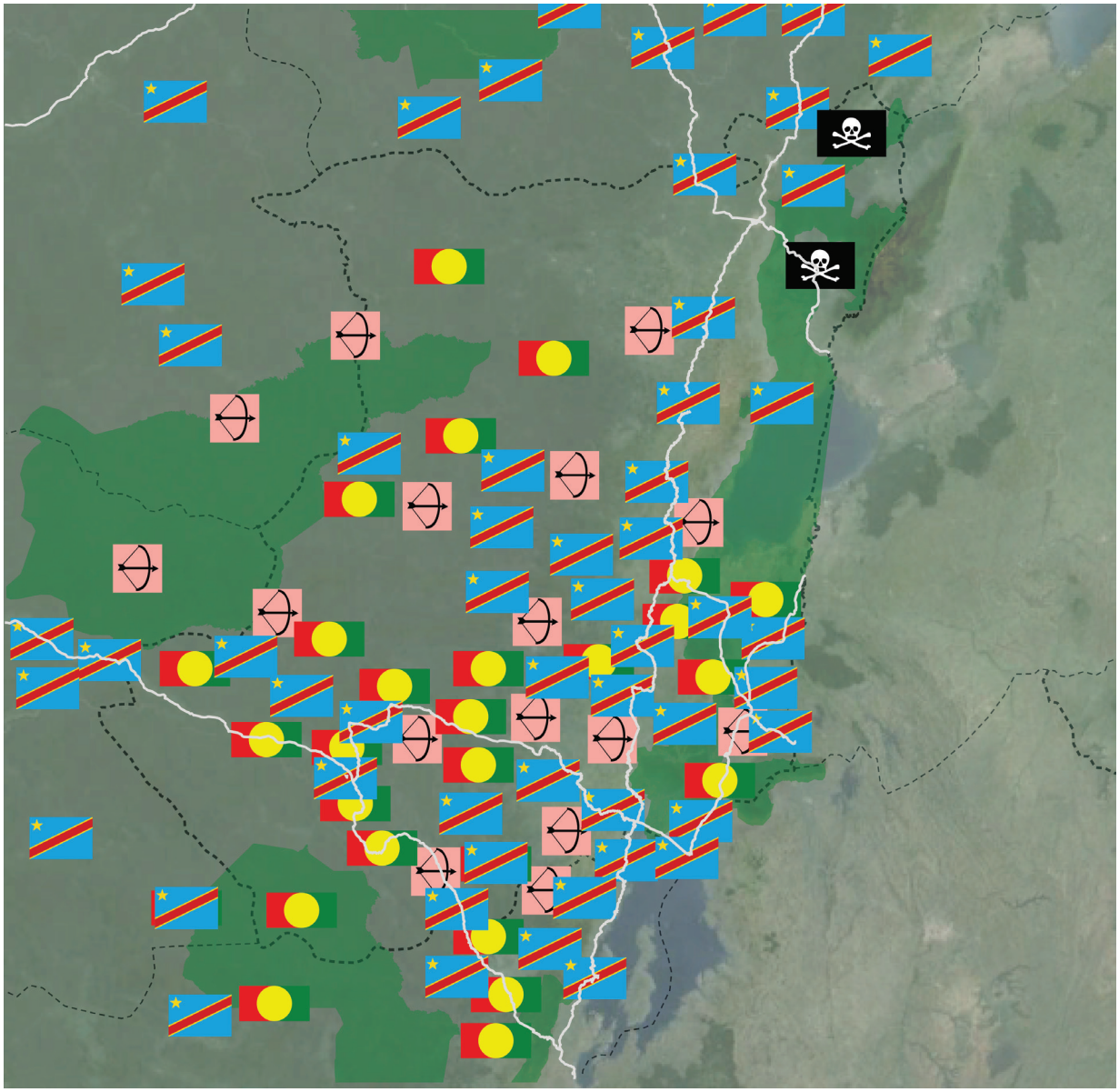
A–33 Armed Conflict Location and Event Database for DRC (top) and North Kivu (bottom) (ACLED 2013).

- Few conflicts
- Several conflicts
- Many conflicts
- Numerous conflicts
- Largest number of conflicts

A–34 % conflict type North Kivu



- Violence agains civilians
- Riots/Protests
- Non-violent transfer of territory
- Non-violent activity by a conflict actor
- Headquarters or base establishedf
- Battle - Rebels overtake territory
- Battle - No change of territory
- Battle - Government regains territory



A–35 Conflict actor locations overlaid onto Open Street Map and Google Earth image (IPIS Research 2013).

FARDC - Armed Forces of the Democratic Republic of the Congo

FDLR - Democratic Forces for the Liberation of Rwanda

PARECO (Mayi-Mayi) - Coalition of Congolese Patriotic Resistance

ADF/NALU - Allied Democratic Forces

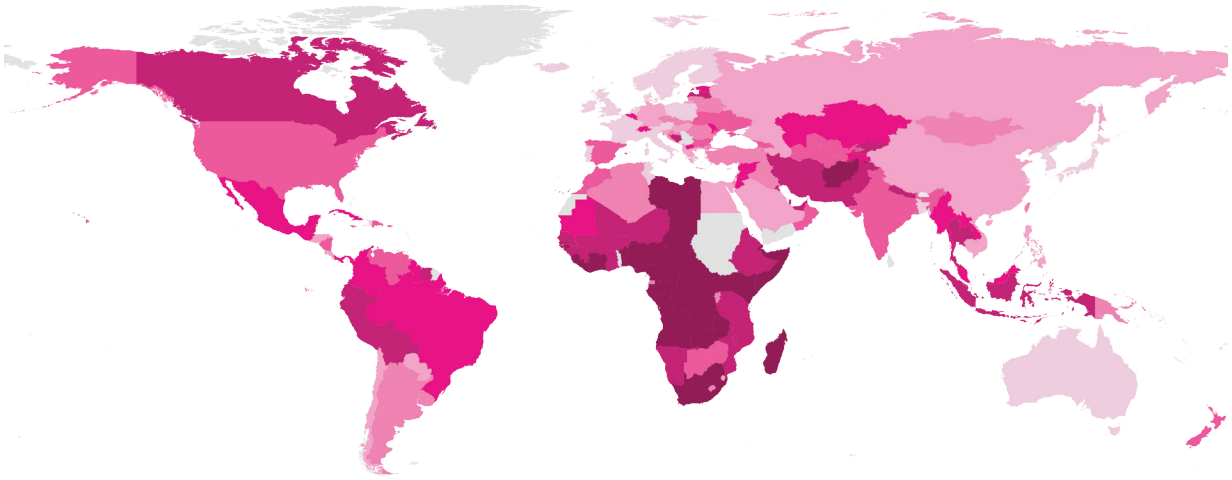
A–36 North Kivu % of all conflicts in DRC

A–37 Students at the university in Beni playing instruments at a graduation ceremony

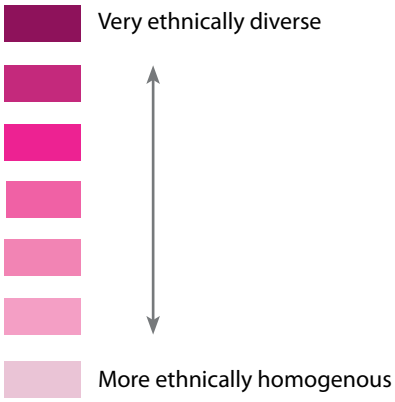
Culture

Often overlooked, ethnicity has a significant role to play in the instability of the region. The relationship of ethnicity with national dynamics, specifically its position compared with national citizenship, has allowed it to become an object of manipulation for political elites. It is often overlooked as a root cause of conflict because attention is focused on the symptoms of conflict rather than the source. A research initiative carried out by the International Refugee Rights Initiative and the Social Science Research Council ‚Who Belongs Where? Conflict, Displacement, Land and Identity in North Kivu, Democratic Republic of Congo, suggests that ongoing violence remains rooted in a lack of clarity over the critical question of citizenship in the region, and specifically over the relationship between national identity and ethnic allegiance. The war is seen as both an external confict that is being played out on Congolese soil, and one that draws upon pre-existing localised divisions. Both of these aspects relate to disagreements over the definition of who legitimately belongs as a citizen in the DRC, and are mostly expressed in ethnic terms. The fact that this dispute over citizenship has persisted throughout the recent fighting emphasises the fact that the cyclical forces that drive the conflict have not been broken.

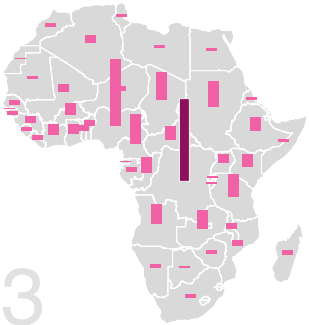
So how can ethnicity be accommodated within this highly charged environment? For many of those interviewed, the solution to ethnic-based fractures within communities, and therefore to violence, was to



A–38 Ethnic Diversity Index (Harvard Institute for Economic Research 2002).

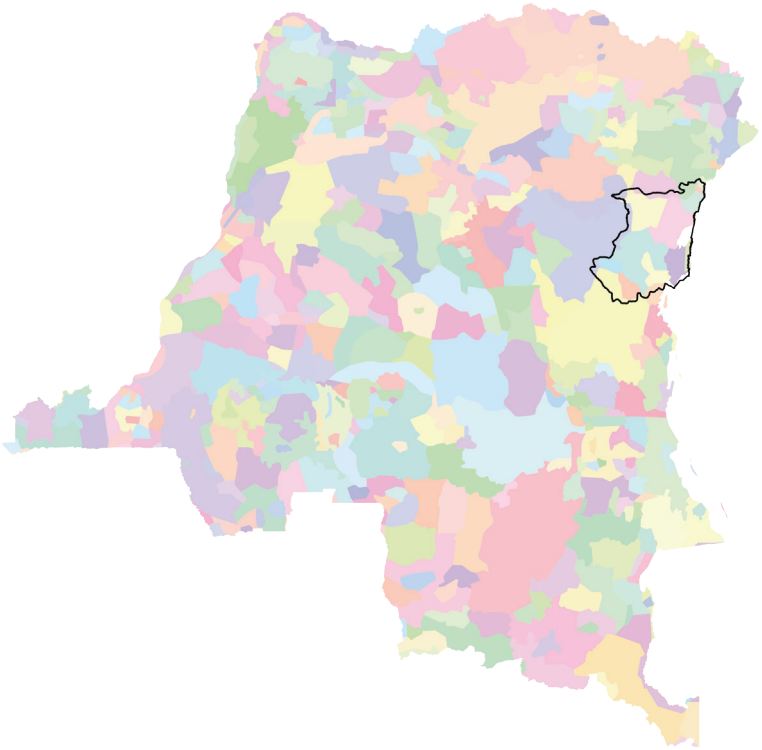


construct a Congolese national identity that could over-ride ethnicity. If properly realised, national identity would represent itself as political systems working in ethnically neutral ways. One displaced man in Rutshuru said, "This thing could be settled by making us feel that we are one people and are Congolese." However, there is something of a paradox because while there was a strongly anti-ethnic and pro-nationalistic emphasis, at the same time it was clear that the basis for national belonging was strongly tied to ethnicity. An example of this can be seen in the charged relationship between Congolese and Congolese with ties to cross-border ethnicities. Particularly the Hutu and Tutsi ethnicities have been blamed for exporting the conflict from the Rwandan Genocide in the 1990s (African Arguments 2010).

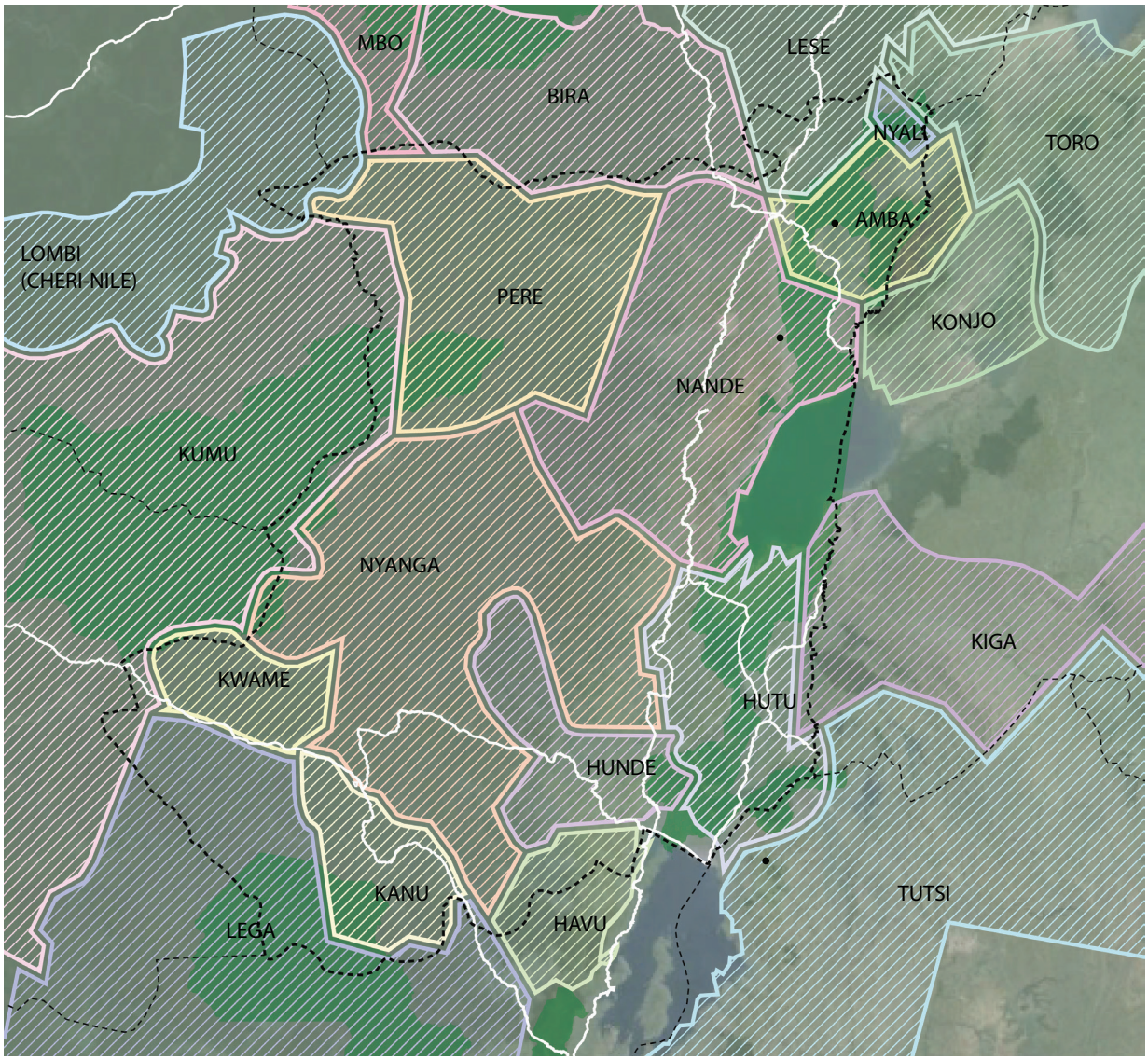


A–39 Numbers of Ethnicities by Country

A–40 Areas of ethnicity in Africa (Ethnicity 2001 Felix).



A–41 Areas of ethnicity in the DRC (Ethnicity 2001 Felix).



A–42 Areas of ethnicity in North Kivu. Data is taken from People's of Africa Atlas: An ethnolinguistic atlas of Africa edited by Marc Leo Felix, director of the Congo Basin Art History Research Center, Brussels (Ethnicty 2001 Felix).

Appendix B: Digital Mapping Tools Catalogue

The following are a selection of tools that I researched in my endeavour to become a master in GIS and to find the tools that were most appropriate for application in Beni. I have included a rating based on my own experience testing and using the tools and a short description of what the tools do. Tools with yellow stars are the ones that I chose to use in Beni and in the next section I include more detailed descriptions and procedures for a selection of those tools. If there is no rating then I discovered the tool but did not test it.

(a) Obtaining Map Data

OpenStreetMap

openstreetmap.org

OpenStreetMap (OSM) is an open-data map that is contributed to by a community of mappers around the world. It powers map data on hundreds of web-sites, mobile applications, and hardware devices. OSM uses ID Editor (online version) and JOSM Editor (offline version), tools that can edit data from various sources. The base map of Beni was traced in JOSM from satellite imagery and then added to OSM so that it would become available on other mapping applications that I selected that use OSM data including Garmin OpenStreetMap, OSMAnd, and Field Papers.

Weogeo

weogeo.com

Weogeo offers map data from around the world. It is possible to zoom in to different areas and search keywords to find specific types of data. Some datasets require payment and others like OpenStreetMap are free. Data from a specific area can be downloaded by drawing a box around the desired geographical region. I used the website to download citywide data of Beni in Shapefile format and it was also possible to select specific layers inside the dataset if I did not want to take everything. Weogeo takes some time to process the request and then e-mails the user a temporary download link.

(b) GPS Data Conversion

Mkgmap

mkgmap.org.uk

Mkgmap is a utility that converts OpenStreetMap data into vector maps that can be loaded onto a Garmen GPS device. It gives full control over which OSM data is integrated into the map and how POIs, streets and all other elements are displayed. The program runs out of the terminal or command-line.

Garmin OpenStreetMap

garmin.openstreetmap.nl

Garmin OpenStreetMap is a website that allows the user to select an area anywhere in the world using the OpenStreetMap (OSM) base map, and it converts it into files that can be used by Garmin software such as Basecamp, or downloaded directly to a Garmin device. Included in the package is the ìgmapsupp.imgî file needed as a basemap for the Garmin device. The request takes a few days and they send an e-mail with a link where the zipped package can be downloaded.

GPSBabel

www.gpsbabel.org

GPSBabel converts waypoints, tracks, and routes between popular GPS receivers and mapping programs. Hundreds of receivers and programs are supported. It can also perform actions such as filtering duplicate points or simplifying tracks. GPSBabel runs on all major platforms (PC/Mac) and is free to download or modify.

(c) GPS and Data Collection

Garmen Etrex 20

buy.garmin.com/en-CA/CA/on-the-trail/handheld/etrex-20/prod87771.html

GPS Etrex 20 has a world basemap, a colour sunlight-readable display, and a 25-hour battery life with 2 AA batteries. It has a microSD card slot and 1.7 GB of internal memory. It is possible to preload SD-cards with a custom map to use on the Garmin device. The device can be used to collect waypoints and tracks and see the user's geographical position.

Field Papers (five stars)

fieldpapers.org

Field Papers is a tool built by Stamen Design to create a multi-page atlas of any place in the world. A user can print it onto tiled sheets and then take it into the field and record notes on it. After it is all marked up, the user can either scan it or photograph it, and upload it into Field Papers. Field Papers will automatically locate the scans on top of the digital map where the information can then be inputted/traced into OSM. The tool was used in Beni as a back up to the devices for the field collection.

★★★★

OsmAnd

osmand.net

OSMAnd (OpenStreetMap Automated Navigation Directions) is a map and navigation application with access to OSM data. The application allows maps to be downloaded to the phone for offline use. Similar to the Garmin device, users can view their position and register tracks and waypoints. The free version of the application only offers 10 downloads for offline use.

EpiCollect.net

★★★

Epicollect

epicollect.net

EpiCollect is an open-source mobile application for creating forms, taking surveys with the forms, and hosting a management system for the data that is collected. A user can create a project website, design the forms, load the project onto the phone to collect data, and then view the resulting data on the project website after it has been uploaded. On the website the data can be viewed, charted, filtered and downloaded. EpiCollect was considered for use in Beni, but was too limited in the types of forms it could produce. EpiCollect uses a public profile and basic forms and EpiCollect+ is a beta version that provides a private page for the user and is working on introducing more complex forms.

fulcrum
mobile location leverage

Folcrum

fulcrumapp.com

Folcrum offers data collection services similar to EpiCollect but is a proprietary application that sells to businesses. The small package is $99 per month (3 apps).

XLSForm.org

★★★★

XLSForm

xlsform.org

XLSForm is a form standard that allows forms to be authored in Microsoft Excel and then converted into code to be read by mapping applications. The standard has been adopted by multiple data collection platforms including Formhub and OpenDataKit. The website provides full instructions on how to create the forms in Excel to make sure that the data is correctly translated. The learning curve is large, but there is a great amount of control in the resulting forms.

formhub
formhub

★★★

Formhub

formhub.org

Formhub is a website that provides a management system for data collection and analysis. It employs XLSForm to create the forms, and ODK Collect to collect the data. The Formhub website is currently experiencing technical difficulties due to being overcapacity.

OpenDataKit (ODK)

opendatakit.org

OpenDataKit is an open-source suite of tools that provide a full spectrum of support for mobile data collection. The tools in the suite are ODK Build, ODK Collect, and ODK Aggregate. ODK Build is a desktop application for building surveys using a graphic user interface instead of using Excel with the XLSForm standard. ODK Collect is the application for data collection on mobile phones. ODK Aggregate is a management system and data repository that provides the forms to the ODK Collect application, accepts the final forms, and visualizes and exports the data. Unlike Formhub that gathers the data on its own servers, ODK Aggregate is installed on a personal webservice that the user is responsible for (they recommend using Google's App Engine).

Cybertracker

cybertracker.org

Cybertracker is a first generation platform that was developed in 1995 for the original purpose of tracking wildlife using forms that display only images. Since then it has been employed around the world in the varied domains of scientific research, indigenous knowledge, environmental education, forestry, farming, education, health, crime prevention, and disaster relief. The platform includes Cybertracker desktop software that allows the user to custom design the survey for the phones and later aggregate, analyse and export the resulting data. The application is available for most mobile devices and has the ability to register tracks and waypoints.

(c) Crowd-sourcing Data Collection

FrontlineSMS/Cloud

frontlinesms.com

Frontline offers SMS management tools that can act as a reporting avenue using mobile technology for two-way communication. It needs either a PC or Mac computer, and either a compatible mobile phone or modem. The software is free and so only the messages need to be paid for. Another option is to have an internet connection and an account with one of Frontlineís web-based aggregators (SMS gateway services). Frontline SMS has support for Clickatell and IntelliSMS messaging services. Frontline Cloud is different tin that it has many ways to connec tto mobile networks, and the data is managed by the cloud. FrontlineCloud is currently in Beta and is $10 per month.

Ushahidi

ushahidi.com

Ushahidi is a platform for information collection, visualization and interactive mapping. It is free to download and use and has been used by crowd-sourced data collection initiatives around the world. It allows the user to collect information from the public via text messages, e-mail, twitter and web forms, offers mapping tools to visualize the information, and lets you filter your data by time.

(d) Computer Geographic Information System (GIS) Software

ArcGIS

esri.com/software/arcgis

Esri's ArcGIS is a geographic information system for working with maps and geographic information. It is used for creating and using maps, compiling geographic data, analyzing mapped information, using maps and geographic information in a range of applications, and managing geographic information in a database.

QGIS

qgis.org

QGIS is a free and open source geographic information system. It is used to create, edit, visualize, analyze, and publish geospatial information. It is compatiable with Windows, Mac, Linux, and BSD (Android coming soon). QGIS was a key tool in Beni because UCBC students could use it for free, and

(e) Map-editing Software

JOSM Editor

josm.openstreetmap.de/

JOSM is a free software that is used for offline editing of OpenStreetMap data. Once downloaded on your computer JOSM allows you to select an area that you want to download from OSM and then has the option to put a tiled Bing satellite image behind it. Then using editing tools it is possible to add to the map by tracing new elements such as roads, buildings, or waterbodies, or adjusting existing lines and information. After the edits are complete it is possible to upload the information onto OpenStreetMap or to save it as an OSM or geojson file. JOSM Is excellent for the preparation and clean-up of collected data before bringing it into QGIS.

TileMill

mapbox.com/tilemill/

TileMill is software created by Mapbox to create attractive interactive maps. It is compatible with data-sources that include ESRI Shapefile, KML, GeoJSON, GeoTIFF, PostGIS, CSV, and SQLite. You can layer data sources to build complex maps and write code that is similar to CSS that allows you to adjust and preview the styles for each element.

(f) Map Web Display Software

Mapbox (two stars)

www.mapbox.com

Mapbox is a mapping platform that allows developers to quickly build and style mobile and web apps that can be displayed on any website. The website code must refer to the Mapbox.js library and the map can be embedded by referred to a map ID that Mapbox provides. Map data can also be downloaded as geoJSON or KML.

(g) Programming Frameworks for Mapping

Leaflet (four stars)
www.leafletjs.com
Leaflet is an open-source JavaScript library for mobile-friendly interactive maps. It works across all major desktop and mobile platforms and can be extended with a large amount of plug-ins.

★★★

Modest Maps
www.modestmaps.com
Similar to Leaflet, Modest Maps is another JavaScript library. It is a simple base library that provides many hooks to build on.

OpenLayers (four stars)
www.openlayers.org
Open Layers is a completely open source JavaScript mapping library. It is possible to contribute to the OpenLayers community by sharing code. The library is big and cumbersome but has expansive capabilities.

★★★★

D3 Data-Driven Documents (four stars)
www.d3js.org
D3 is a JavaScript library for manipulating documents based on data. It uses html, SVG, and CSS to bring the data to life. D3 functions as a DOM framework, but unlike JQuery and Prototype it can specify functions of data and not just constants.

★★★★

Polymaps
www.polymaps.org
Polymaps is a Javascript library that uses SVG to create and manipulate maps on the web.

ArcGIS API for JavaScript
www.developers.arcgis.com/javascript/

(h) Dynamically Drawn Map Servers

Map Server
www.mapserver.org

QGIS Server
www.hub.qgis.org

GeoServer
www.geoserver.org

(i) Caches for Web Tiling

GeoWebCache
www.geowebcache.org

TileCache
www.tilecache.org
TileStache
www.tilestache.org

(j)Spatial Databases

PostGIS
www.postgis.net
PostGIS is an open source database that works with Post GRE SQL.

SpatiaLite
www.gaia-gis.it/fossil/libspatialite

Appendix C: Detailed Procedures for Selected Software

Garmin OpenStreetMap & Garmin Etrex 20

(a) Description

One way to collect geospatial data is to use a GPS unit. Although mobile phones now have the same, or perhaps even more capabilities as a GPS, the key qualities of a GPS device are durability and dependability. Not only are GPS waterproof and drop proof, they also take two AA batteries that you can get anywhere, and have a 24 hour battery life. They also donít require access to mobile internet. All of these qualities make it excellent for use in the developing context. Phones on the other hand are cheaper and more widely available, but are fragile, need to access internet, and have a shorter battery life. I have to think about all of these factors because Beni only has a few hours of electricity per day. The best action to take will be to bring a good amount of both technologies and bring extra things like portable battery chargers and extra batteries.

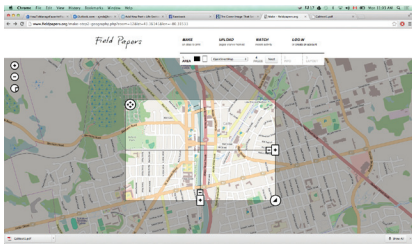
The first step in using the Garmin device was the most difficult. I had to determine how to create my own img file to serve as the background map for the Garmin device. From my research I determined that the best method would be to use JOSM to trace out a base map of the city that can be uploaded onto OSM, then retrieve it again using Garmin OpenStreetMap, a website that converts a chosen area selection of OSM and e-mails you a link to a downloadable zip file that includes the img file. It can take one or two days to receive the files and because it is a free service they ask for donations. The ìgmapsupp.imgî file can be downloaded onto the cards of several GPS devices that can then be enabled once the device is turned on. All of the Garmin devices will have the same base map for participants to navigate and work with. Because I canít really test this part of the process with the Beni map, I downloaded the OSM Garmin img file for Cambridge.

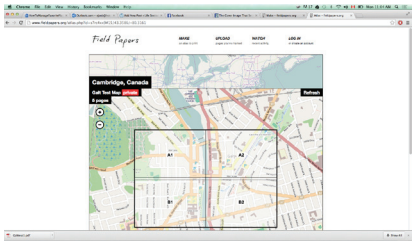
The next task was to learn how to use the device to collect data. I discovered that the Garmin device is quite limited in this respect. I thought I would be able to edit existing Points of Interest for example, or be able to rename existing streets. This is not the case; the only thing that the Garmin unit can do is log what are called “tracks” and

"waypoints". Tracks literally mark your journey with a connected trail of points over time that save the coordinates. Tracking can be enabled or disabled and there is an option to have it enabled while not being visible on the map. I will enable the tracking because anyone editing the map later will need to know where the groups of mappers went in the city to make sure there are no holes in the gathered information. Waypoints are points that can be logged at any time and can be used for the marking of any Points Of Interest (POIs). It can be marked by choosing to save a waypoint where you are standing, or you can toggle the mouse to select a nearby element such as a road or a building. A title can be given to a waypoint as well as a short note, and you can change the icon that represents the waypoint on the map to better express what it is. Originally I had planned for participants to input the POI and street names as the waypoint titles, and use the note category for descriptors such as type or condition, but I realized that it would take a long time to input the names, especially on devices that have to toggle across a keyboard to select individual letters. The best option will be to send out participants in groups that have a GPS user as well as a physical note-taker with a legend that shows what information to include. After the storage on the device is full or a task is complete, the data can be uploaded to the computer either by USB connection or removing and reading the MicroSD. After the points are transferred they can be cleared from the device to leave space to go out and collect more. The waypoints and tracks from the Garmin device are ìgpxî files that can be opened directly in JSOM or QGIS. A program called GPSBabel is handy if using a different brand device where conversion is required.

(b) User Instructions

1. Go in a team of three to your assigned neighbourhood, bringing with you the GPS unit and notebook. Use the GPS unit to identify location and information of all points of interest (POIs) and road names.
2. To change or add a road name or point of interest (POI) use the toggle to move the mouse over top of the road or building you want to rename and then click. A screen will come up that gives the name, elevation, distance, and location of the street.
3. Click the "menu" button on the left side of the device. A message will come up that says ìSave as Waypoint". Click to do this. A message will come up that says "This location was successfully saved as a waypoint. Click "OK".
4. Click the "back" button on the right side of the device. You donít want to go to this location. Click ìbackî two more times to get back to the main menu.
5. Click on "Where To?" button in the menu, and then click on "Find Another". Click on "Waypoints". Your most recent Waypoint additions should be exhibited in order. Click on the most recent street you created.
6. It will point it out on the map to confirm it is the right one. Then



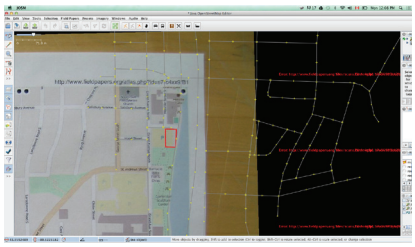


click the “menu” on the left side of the device. Then click on “Review Point”. Then click the “menu” button again and click the option “Edit Waypoint”.
7. All of the options can be edited except for the location. If you are editing a street chose the blue flag icon. For points of interest choose the red flag icon.
8. Use the toggle on the keyboard to click on the keys to rename the Waypoint as an ID that can be used to associate it with your notes. In your notebook fill in the following information:
If a street: ID, Name, Type (highway, major road, residential road, footpath), Condition (very good, good, average, bad, very bad), Paving (asphault, gravel, dirt)
If a POI: ID, Name, Type (commercial, recreational,, Address (if applicable)
9. When neighbourhood data collection is complete or your GPS is full, return to the hub to submit the GPS unit and notes to the map editors.

Field Papers

(a) Description

Field Papers is an excellent tool because it combines digital tools with the most raw form of data gathering: note-taking. In my discussions with experienced mappers, they all recommended to have a back-up to the digital devices because I will be in a place where mobile networks and electricity are not dependable. Field Papers was created by Stamen Design and its purpose is to make the note-taking process more efficient and accurate. The Field Papers website allows you to download a selected area of the OSM map of the world as a set of tiles that are print-ready on letter size paper. The papers can then be distributed to groups of participants to add notes to while exploring and mapping the city. When a certain neighbourhood is mapped, the sheets can then be scanned or photographed and uploaded back onto the field papers website. The barcodes that are on the tiles allow the program to geolocate the scanned image of the map so that all of the physical notes can be easily traced and made digital. Field Papers can be installed as a plug-in for JOSM where the traces can be made.



(b) Set-up Instructions

1. Go to Field Papers website and search your location.
2. Zoom in so that the maps will be a sufficient scale when printed.
3. Add as many tiles as you need to cover a neighbourhood.
4. Save the URL that is provided so that you can retrieve and share the map: http://www.fieldpapers.org/atlas.php?id=s7rc4xx9#15/43.3586/-80.3161
5. Print PDF to take into the field and mark up.
6. When you are done editing, scan or photograph the tiles and upload the images back to Field Papers.

7. Note down the URL of your page snapshot: http://www.fieldpapers.org/snapshot.php?id=5b4xxg3d#16/43.3562/-80.3224
8. Install the Field Papers plug-in for JOSM by going to "Edit - Preferences". You will have to restart the program.
9. Go to menu "Field Papers" and paste in the URL. The picture you took will be located in the correct location on your map.

OSMAnd

(a) Description

OSMAnd is an application on Android phones that works similar to a GPS unit in that it can save waypoints and track where you are going. Phones have a shorter battery life and are more fragile than GPS units, but the real advantage is that they are more widely available.

(b) Set-up Instructions

1. Download free application from Google Play and install on your phone.
2. Go to "Settings - Data Management - download or update offline data" to add maps (select "World Base Map" and "Congo-democratic-republic africa" for download).
3. Go to menu "Where am I" to locate yourself. Your position should show up as a blue dot.
4. Go to menu "Settings - Navigation - General" to select preferred language, language of names in maps, and unit of measure (kilometers/meters).
5. Go to menu "Settings - Plugins - Logging services & Sleep Mode" to activate tracking. Make sure to uncheck this setting after you are done your journey so that your phone isnít connecting to the internet more than it has to.
6. Go back one menu and configure the "Logging services" settings.
7. Select the pedestrian option and select "Log track to GPX file"
8. To see the track as you walk you can go to menu "Settings - Map layers - GPX tracks"
9. Tricks for extending battery life are to go to the home page before putting in sleep mode while tracking is set, and if in a remote area, turn on airplane mode so that the phone isnít continuously searching for signals. Airplane mode can be found under phone settings.
10. Upload the gpx files to the computer using a MicroSD adapter or plugging the phone into the computers USB port. Favourites are in the main folder as a single gpx file and the tracks are located in a "tracks" folder.
11. After uploaded onto the computer the waypoints can be deleted by going to the menu "favourites" folder and selecting the trash bin and then the items you want to delete. Tracks can similarly be removed.

ODK Collect

(b) User Instructions

1. To add a waypoint, tap the screen while still holding a finger on the screen (similar to a right click). A location box will come up with a Latitude and Longitude for the location you clicked. Click on the box and pick the "Add to favourites" option.
2. Fill in an ID (similar to GPS device) using the keyboard and click "Add". Note that the icon will locate itself at the center of the screen that you are at when you take the action of adding a favourite.
3. Another way to add a favourite is to go to menu "Use locations - Add to favourites". Using this method will locate the tag at the center of the screen.
4. In your notebook fill in the following information that must correspond with each ID number:
If a street: ID, Name, Type (highway, major road, residential road, footpath), Condition (very good, good, average, bad, very bad), Paving (asphault, gravel, dirt)
If a POI: ID, Name, Type (commercial, recreational,, Address (if applicable)
5. When you are done collecting data, return to the hub and submit the phone and your notes to the map editors.

JOSM

(a) Description

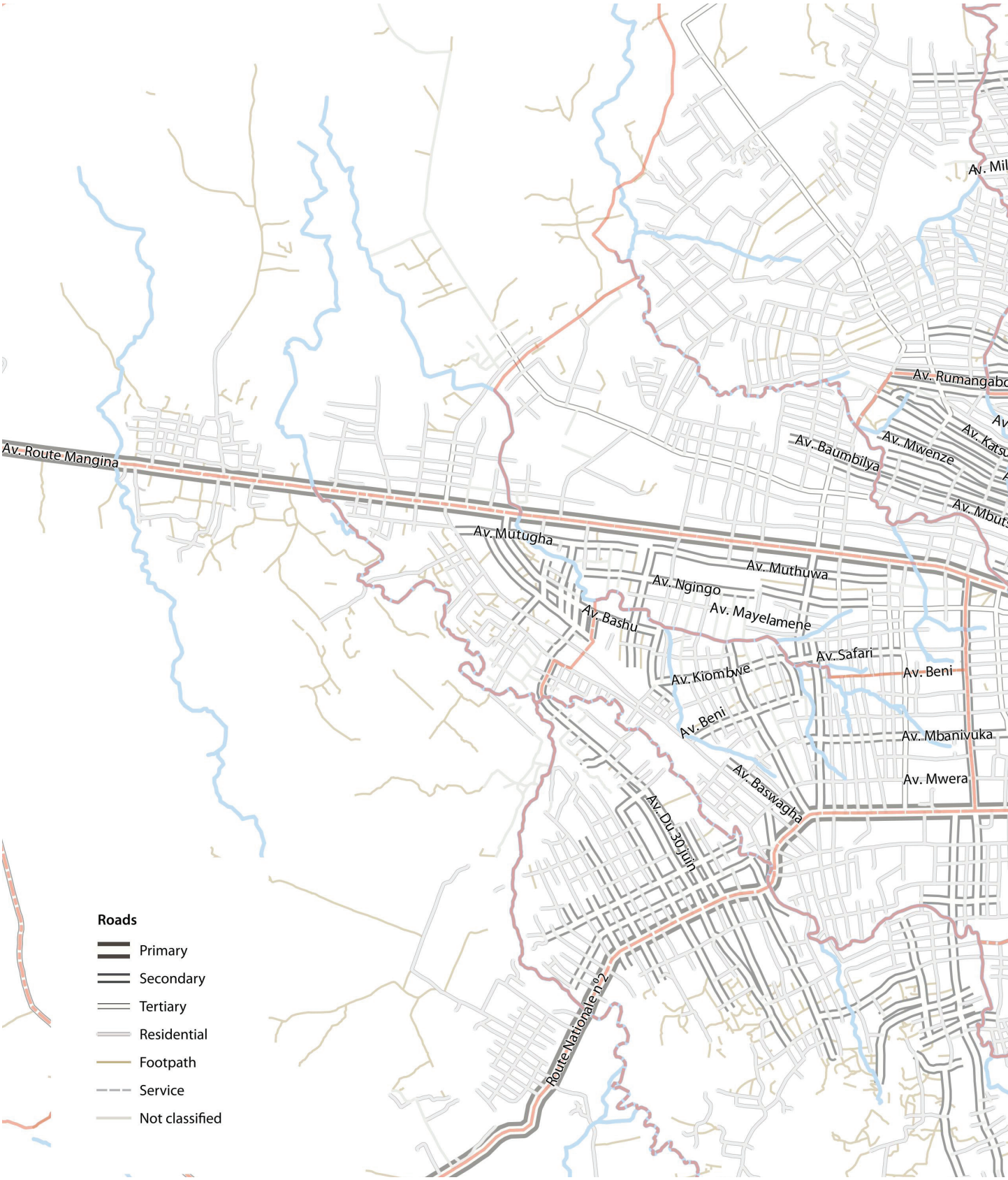
JOSM is a free software that is used for offline editing of OpenStreetMap (OSM). OpenStreetMap is an open source online map that can be edited or downloaded by any registered member. The easiest way to describe it is to call it the "Wikipedia" of mapping. There are now millions of people who contribute and I recently signed up because I learned it would be a valuable tool in generating a globally positioned map of Beni. JOSM allows you to select an area that you want to download from OSM and then has the option to put a tiled Bing satellite image behind it. Then using editing tools it is possible to add to the map by tracing new elements such as roads, buildings, or waterbodies, or adjusting existing lines and information. I am using JOSM to trace the roads and creeks to form a preliminary base map.
One might ask why I am tracing the roads of a place I have never been to and what if I make errors. The reason I am doing it is because I need to create a base map that I can add to once I go to Beni. If I do not create a base map, I would have nothing for the mapping participants to even follow or know where to go or what neighbourhoods to explore. They will use this information as a base but will then add to it and correct any errors by physically being there. That means that OSM will have errors for a small amount of time, but will soon be made accurate as we gallivant around Beni and document refinements and edits. The mapping participants will be able to collect informa-

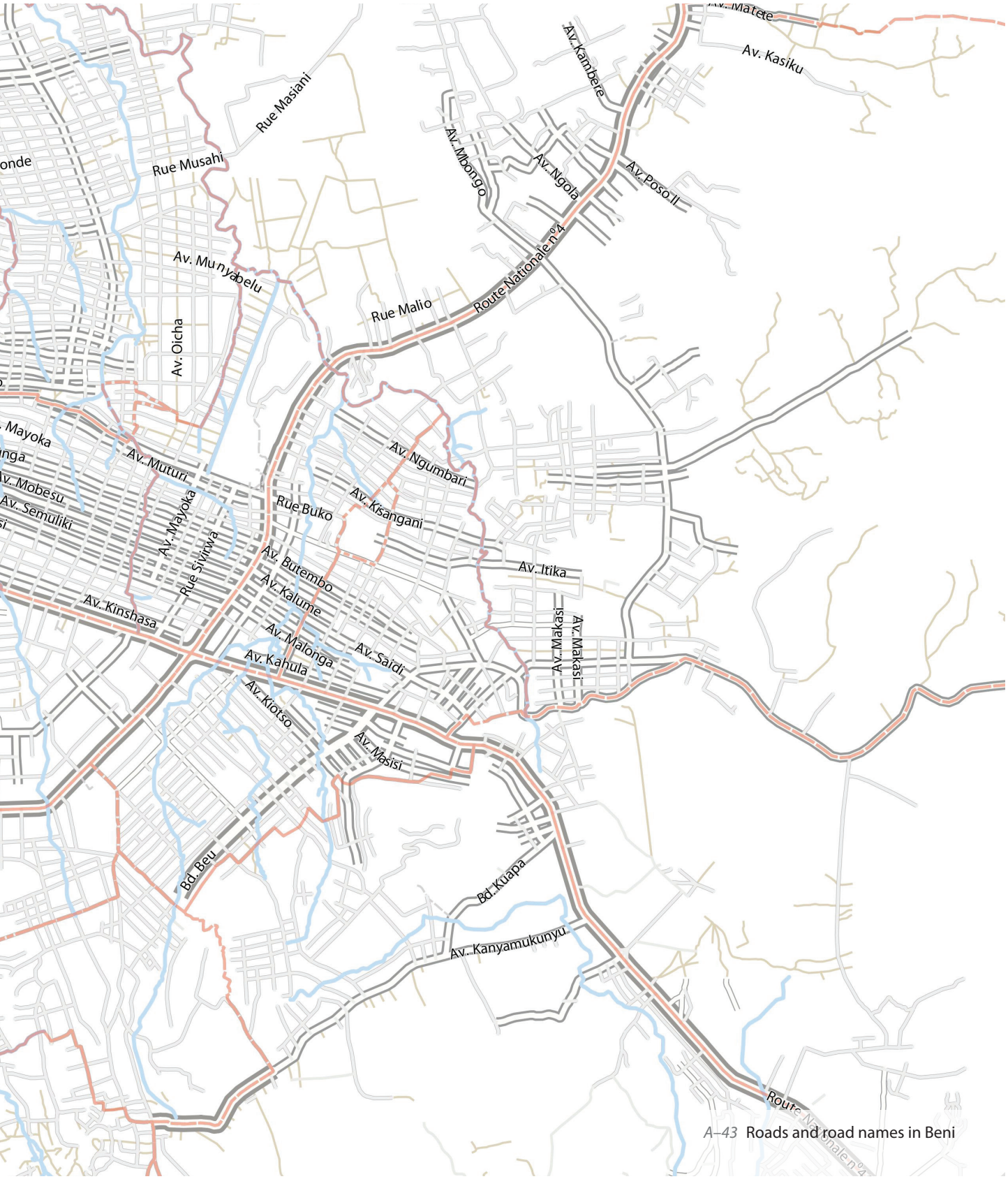
tion beyond just the tracings by documenting data such as road names, road types, paving types, and what condition they are in. They will also be mapping other things such as buildings and places that are Points Of Interest (POIs) for the community.

While the line information can be shared with OSM, we have the choice of whether or not to add the detailed information or keep it for our own use. JOSM always encourages people to upload the content back to OSM, but what is nice about the program is that you can always wait until the information is accurate before uploading, or choose to upload only the elements you want to contribute to the public map. Another great feature of JOSM is that it can export the information as gpx tracks that are compatible for download onto Garmin devices or GPS Android applications for use in the field. JOSM can also export as geoJson files that can be used in coding or to import the same elements with their data into QGIS, an open source Global Information System (GIS).

There is an online editor called iD that essentially does the same thing as JSOM, but it edits in OSM directly. I like JSOM for the ability to wait, its exporting capabilities, and also because work can be done offline, a key thing to think about when working with technology in a developing country where internet can be spotty and expensive. Iíll be bringing all of these programs over on a USB key to avoid any need for downloading big files from the web. One may also ask why I am not just editing this information in QGIS, a program that is capable of doing the same thing. The reason I have decided to use JSOM is because its connection with OSM allows me to use really helpful tools such as this website that formats base map img files of a specified area from OSM for Garmin devices. Editing in JSOM is also much faster than in QGIS just in the way the interface is designed. QGIS will come into the picture later on when it is time to manipulate the data that we collect to create our own custom maps and corresponding databases. Lastly, JSOM is great for preliminary work because it is valuable to contribute to OpenStreetMap, not only because I am benefiting so much from it as a tool and resource, but also because others will benefit from an open source base map of Beni.

Appendix D: Maps and Metadata of Beni


Av. Route Mangina
Av. Rumangabo
Av. Baumbilya
Av. Mwenze
Av. Mutugha
Av. Muthuwa
Av. Ngingo
Av. Mayelamene
Av. Bashu
Av. Safari
Av. Beni
Av. Kiombwe
Av. Beni
Av. Mbanivuka
Av. Mwera
Av. Baswagha
Av. Du 30 juin
Route Nationale n°2
Roads
Primary
Secondary
Tertiary
Residential
Footpath
Service
Not classified



A–43 Roads and road names in Beni

Table A–01 Road metadata

id_iri	id_osm	type	time	enumerator	name1	name2	surface	condition
1	298610435	route_secondaire	2013-01-01T02:48:12.324	stephen_salama	Av.	Mutugha	non-pave	mediocre
2	298610415	route_secondaire	2013-01-01T02:54:41.942	stephen_salama	Route	Braza	non-pave	mediocre
3	298610630	route_secondaire	2013-01-01T03:20:05.498	stephen_salama	Av.	Ngilinga	non-pave	mediocre
4	298610992	route_secondaire	2013-01-01T03:31:31.858	stephen_salama	Av.	Kamaka	non-pave	mediocre
5	298610894	route_secondaire	2013-01-01T03:46:55.557	stephen_salama	Av.	Maneno Kesho	non-pave	mediocre
6	298611146	route_secondaire	2013-01-01T04:05:42.126	stephen_salama	Av.	Lutswamba	non-pave	mediocre
7	298610356	route_secondaire	2013-01-01T04:21:05.069	stephen_salama	Av.	Kinsoir	non-pave	mediocre
8	311573686	route_secondaire	2013-01-01T04:31:03.921	stephen_salama	Av.	Mbonzo	non-pave	mediocre
9	298610716	route_secondaire	2013-01-01T04:36:58.669	stephen_salama	Av.	Mabakou	non-pave	mediocre
10	298610720	route_secondaire	2013-01-01T04:48:30.757	stephen_salama	Av.	Lubero	non-pave	mediocre
11	298610387	route_secondaire	2013-01-01T04:56:54.107	stephen_salama	Av.	Bashu	non-pave	mediocre
12	298610832	route_pieton	2013-01-01T05:02:37.663	stephen_salama	Av.	Ngombamoya	non-pave	mediocre
13	298611133	route_secondaire	2013-01-01T05:07:13.987	stephen_salama	Av.	Beni	non-pave	mediocre
14	298610929	route_pieton	2013-01-01T05:20:31.764	stephen_salama	Av.	Butembo	non-pave	mediocre
15	298610552	route_secondaire	2013-01-01T05:33:34.410	stephen_salama	Av.	Kiombwe	non-pave	mediocre
16	298610293	route_secondaire	2013-01-01T05:47:21.847	stephen_salama	Av.	Makasi	non-pave	mediocre
17	298610669	route_pieton	2013-01-01T06:05:56.055	stephen_salama	Av.	Kombamoya	non-pave	mediocre
18	298610559	route_secondaire	2013-01-01T06:28:56.426	stephen_salama	Av.	Ngingo	non-pave	bonne
19	298610438	route_secondaire	2013-01-04T00:51:48.947	archip_lobo		Mabakanga	non-pave	bonne
20	298610344	route_secondaire	2013-01-04T01:51:14.341	stephen_salama		Rue Anglican	non-pave	mediocre
21	298610295	route_secondaire	2013-01-04T01:58:23.192	stephen_salama	Av.	Kahula	non-pave	mediocre
22	207102548	route_secondaire	2013-01-04T02:56:45.675	stephen_salama	Av.	Saidi	non-pave	mediocre
23	312033477	route_pieton	2013-01-04T03:26:23.466	stephen_salama	Av.	Makwano	non-pave	mediocre
24	298610319	route_secondaire	2013-01-04T03:30:08.863	stephen_salama	Av.	Kalumendo	non-pave	mediocre
25	298611106	route_secondaire	2013-01-04T04:52:07.784	stephen_salama	Av.	Malonga	non-pave	mediocre
26	207102506	route_secondaire	2013-01-04T05:08:38.084	stephen_salama	Av.	Kalume	non-pave	mediocre
27	207102550	route_secondaire	2013-01-04T05:16:05.832	stephen_salama	Av.	Selemani	non-pave	mediocre
28	298610364	route_secondaire	2013-01-04T05:20:56.580	archip_lobo	Av.	Butembo	non-pave	mediocre
29		route_secondaire	2013-01-05T02:51:07.052	nadia_kavira	Av.	Kathetu	non-pave	mediocre
30		route_sentier	2013-01-05T03:10:03.481	nadia_kavira	Av.	Mali	non-pave	mauvaise
31		route_pieton	2013-01-05T03:14:38.104	stephen_salama	Av.	Lingongo	non-pave	mauvaise
32		route_sentier	2013-01-05T03:22:30.596	stephen_salama		Kasuki	non-pave	mauvaise
33		route_pieton	2013-01-05T03:31:41.298	stephen_salama	Av.	Mbonzo	non-pave	mediocre
34	313252610	route_secondaire	2013-01-05T03:38:44.893	stephen_salama	Av.	Kambere	non-pave	mediocre
35	313252776	route_sentier	2013-01-05T03:48:20.076	stephen_salama			non-pave	mediocre
36	313257697	route_secondaire	2013-01-05T04:24:54.647	nadia_kavira	Av.	Kighoma	non-pave	mediocre
37	298611033	route_secondaire	2013-01-05T04:31:24.746	stephen_salama	Av.	De la Réconciliation	non-pave	mediocre
38	298610891	route_secondaire	2013-01-05T04:50:29.944	stephen_salama	Av.	Ngola	non-pave	mediocre
39	312938129	route_secondaire	2013-01-05T05:25:06.531	nadia_kavira			non-pave	mediocre
40	312937824	route_secondaire	2013-01-05T05:32:37.595	stephen_salama	Av.	De l'école	non-pave	mediocre
41	298611184	route_secondaire	2013-01-05T05:56:28.334	stephen_salama	Av.	Mbongo	non-pave	mediocre
42	298610557	route_principale	2014-10-09T09:54:16.268	thierry_babonye	Bd.	Beu	non-pave	mediocre
43	298610299	route_secondaire	2014-10-09T10:01:44.554	nadia_kavira	Av.	Kiotso	non-pave	mauvaise
44		route_sentier	2014-10-09T10:12:03.164	elisabeth_vanoverbeeke			non-pave	mediocre
45	298611113	route_secondaire	2014-10-09T10:13:52.391	stephen_salama	Av.	Nzombia	non-pave	mauvaise

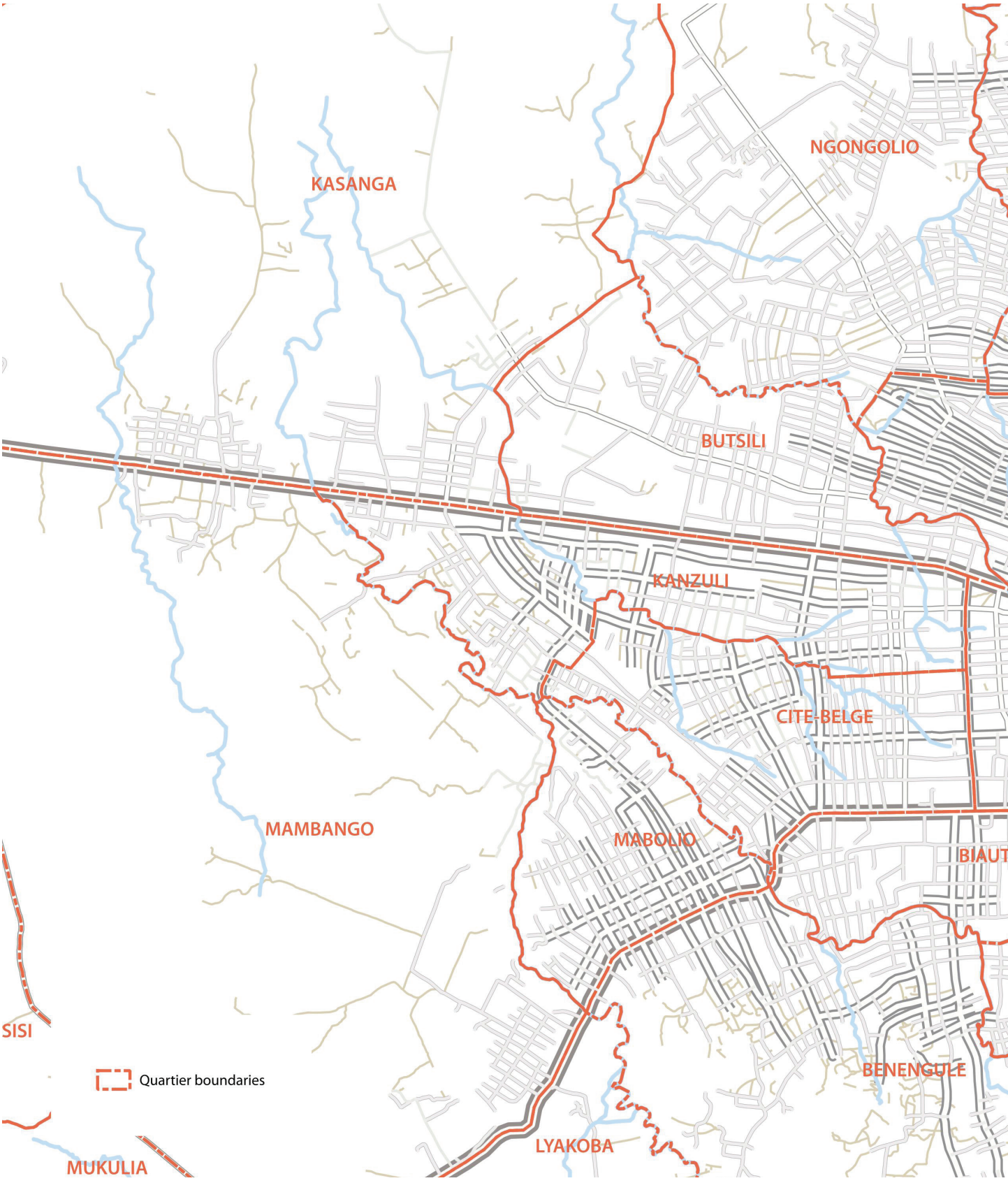
46		route_sentier	2014-10-09T10:15:15.020	elisabeth_vanoverbeeke			non-pave	mediocre
47		route_sentier	2014-10-09T10:18:29.726	elisabeth_vanoverbeeke			non-pave	mediocre
48		route_pieton	2014-10-09T10:24:55.386	elisabeth_vanoverbeeke			non-pave	mediocre
49	312559180	route_principale	2014-10-09T10:55:52.075	pascal_kazindu	Route	Nationale no.2	gravier	mediocre
50		route_pieton	2014-10-09T10:56:45.708	elisabeth_vanoverbeeke			non-pave	mediocre
51	298610279	route_sentier	2014-10-09T10:59:56.540	stephen_salama			non-pave	mauvaise
52	298610899	route_pieton	2014-10-09T11:01:14.311	elisabeth_vanoverbeeke		Vutyoka	non-pave	mediocre
53	298610736	route_secondaire	2014-10-09T11:06:22.650	nadia_kavira	Av.	C=Ceca 20 Mu-panda	non-pave	mediocre
54		route_pieton	2014-10-09T11:06:25.269	elisabeth_vanoverbeeke			non-pave	mauvaise
55		route_pieton	2014-10-09T11:15:17.733	elisabeth_vanoverbeeke			non-pave	mediocre
56	298610585	route_secondaire	2014-10-09T11:16:49.219	nadia_kavira	Av.	Kibombobombo	non-pave	mauvaise
57		route_pieton	2014-10-09T11:19:37.707	elisabeth_vanoverbeeke			non-pave	mediocre
58		route_pieton	2014-10-09T11:21:18.144	elisabeth_vanoverbeeke			non-pave	mediocre
59	298610336	route_secondaire	2014-10-09T11:25:11.992	nadia_kavira	Av.	Masisi	non-pave	mediocre
60	298611158	route_secondaire	2014-10-09T11:31:22.198	stephen_salama	Av.	Av. Kirongozi	non-pave	mauvaise
61		route_sentier	2014-10-09T11:32:17.290	elisabeth_vanoverbeeke			non-pave	mediocre
62		route_sentier	2014-10-09T11:35:26.600	elisabeth_vanoverbeeke			non-pave	mediocre
63	298610332	route_secondaire	2014-10-09T11:45:05.172	nadia_kavira	Av.	Kirongozi bis	non-pave	mediocre
64	298610396	route_secondaire	2014-10-09T11:46:25.847	puissance_mwendu		Mwenda	non-pave	mediocre
65		route_pieton	2014-10-09T11:47:03.009	elisabeth_vanoverbeeke			non-pave	mediocre
66	298611126	route_secondaire	2014-10-09T11:53:20.850	nadia_kavira	Av.	Masisi Bis	non-pave	mediocre
67		route_pieton	2014-10-09T11:57:08.901	elisabeth_vanoverbeeke			non-pave	mediocre
68	298611084	route_pieton	2014-10-09T12:01:28.876	puissance_mwendu		Brazza	non-pave	mediocre
69		route_pieton	2014-10-09T12:03:11.181	elisabeth_vanoverbeeke			non-pave	mediocre
70	298611027	route_secondaire	2014-10-09T12:07:48.994	micheline_nobikana		Rondpoint Vingazi	non-pave	mauvaise
71		route_sentier	2014-10-09T12:08:15.829	elisabeth_vanoverbeeke			non-pave	mediocre
72	298611025	route_principale	2014-10-09T12:10:16.191	thierry_babonye	Bd.	Rwangoma	non-pave	mediocre
73		route_pieton	2014-10-09T12:10:38.878	elisabeth_vanoverbeeke			non-pave	mediocre
74		route_sentier	2014-10-09T12:17:18.804	elisabeth_vanoverbeeke			non-pave	mediocre
75	298610563	route_pieton	2014-10-09T12:29:52.372	elisabeth_vanoverbeeke			non-pave	mediocre
76		route_pieton	2014-10-09T12:42:23.804	elisabeth_vanoverbeeke			non-pave	mediocre
77		route_pieton	2014-10-09T12:44:12.734	elisabeth_vanoverbeeke			non-pave	mediocre
78		route_pieton	2014-10-09T12:46:28.622	elisabeth_vanoverbeeke			non-pave	mediocre
79		route_pieton	2014-10-09T12:48:07.077	elisabeth_vanoverbeeke			non-pave	mediocre
80	298610526	route_secondaire	2014-10-09T12:49:38.718	nadia_kavira			non-pave	mediocre
81	298610837	route_pieton	2014-10-09T12:53:14.888	elisabeth_vanoverbeeke			non-pave	mediocre
82		route_pieton	2014-10-09T12:55:23.878	elisabeth_vanoverbeeke			non-pave	mediocre
83		route_pieton	2014-10-09T12:57:21.344	elisabeth_vanoverbeeke			non-pave	mediocre
84	315124779	route_pieton	2014-10-09T12:58:55.134	elisabeth_vanoverbeeke			non-pave	mauvaise
85	298610870	route_sentier	2014-10-09T13:02:12.545	elisabeth_vanoverbeeke			non-pave	mediocre
86	298610825	route_secondaire	2014-10-09T13:06:14.381	stephen_salama	Av.	Komanda	non-pave	mediocre
87	315124748	route_pieton	2014-10-09T13:11:17.784	elisabeth_vanoverbeeke			non-pave	mediocre
88	315124749	route_pieton	2014-10-09T13:13:03.314	elisabeth_vanoverbeeke			non-pave	mediocre
89	298610320	route_secondaire	2014-10-09T13:14:40.354	stephen_salama			non-pave	mauvaise
90	314876307	route_sentier	2014-10-09T13:15:57.288	elisabeth_vanoverbeeke			non-pave	mediocre
91	298611082	route_secondaire	2014-10-09T13:19:07.222	stephen_salama	Av.	Maliro	non-pave	mediocre

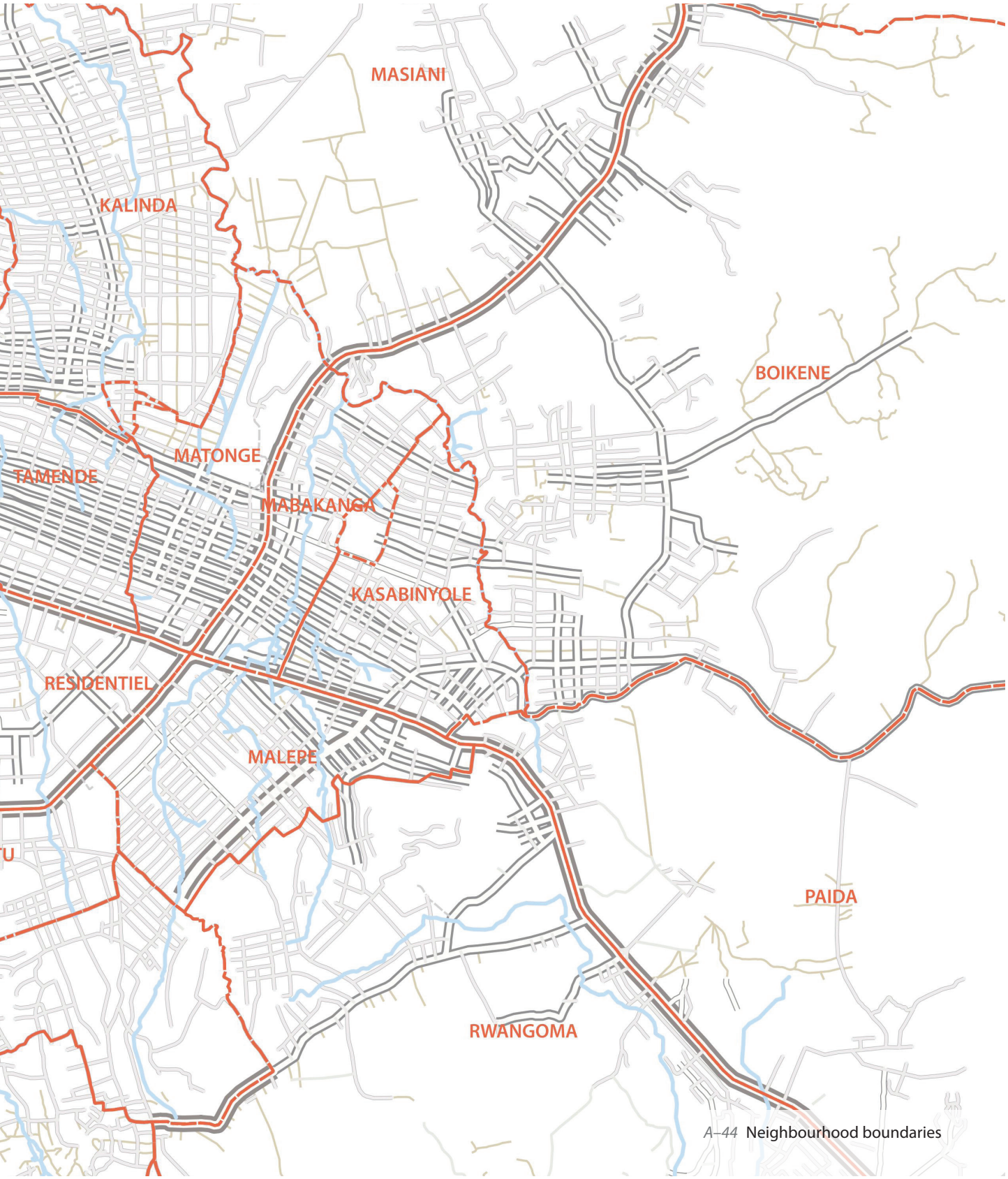
92	298610759	route_secondaire	2014-10-09T13:28:05.886	nadia_kavira	Av.	Sudan	non-pave	mediocre
93	298610655	route_sentier	2014-10-09T13:30:16.793	bora_mukovi	Av.	Saambili	non-pave	mauvaise
94	298610404	route_secondaire	2014-10-09T13:34:07.447	puissance_mwendu		Mbughulwa	non-pave	mediocre
95	298610604	route_sentier	2014-10-09T13:36:28.077	stephen_salama	Av.	Tsande	non-pave	mediocre
96	298610547	route_secondaire	2014-10-09T13:40:05.005	stephen_salama	Bd.	Kuapa	non-pave	mediocre
97		route_pieton	2014-10-09T13:51:12.701	elisabeth_vanoverbeeke			non-pave	mediocre
98	315124762	route_pieton	2014-10-09T13:52:32.909	elisabeth_vanoverbeeke			non-pave	mediocre
99	298611176	route_service	2014-10-09T13:58:55.780	stephen_salama			non-pave	mediocre
100	298610617	route_secondaire	2014-10-09T14:08:55.235	puissance_mwendu		Vulyongo	non-pave	mauvaise
101	298611095	route_secondaire	2014-10-09T14:11:58.905	puissance_mwendu		Kitatumba	non-pave	mediocre
102	298611078	route_sentier	2014-10-09T14:20:05.035	stephen_salama			non-pave	mauvaise
103	298610391	route_secondaire	2014-10-09T14:37:36.496	puissance_mwendu		Kabutunda1	non-pave	mauvaise
104	298610321	route_secondaire	2014-10-09T14:40:19.681	puissance_mwendu		Laho	non-pave	mauvaise
105	298611035	route_secondaire	2014-10-09T15:00:08.397	puissance_mwendu		Basele	non-pave	mauvaise
106	298610398	route_secondaire	2014-10-09T15:06:52.689	puissance_mwendu		Lubwasi	non-pave	mediocre
107	313288367	route_secondaire	2014-10-09T15:09:18.236	puissance_mwendu		Benin	non-pave	mediocre
108	298610869	route_secondaire	2014-10-09T15:36:09.548	puissance_mwendu		Prolongement Zrazza	non-pave	mediocre
109	298610744	route_secondaire	2014-10-09T15:49:47.509	micheline_nobikana	Av.	Lyangoma	non-pave	mauvaise
110	298610546	route_secondaire	2014-10-10T09:41:50.524	karl_tjongo_kamavu			non-pave	mediocre
111	298610322	route_secondaire	2014-10-10T09:48:19.589	jacques_ageno	Av.	Kinshasa	non-pave	bonne
112	298610558	route_secondaire	2014-10-10T09:49:28.588	junior_mukuka	Av.	Du 30 juin	non-pave	mauvaise
113	298610545	route_secondaire	2014-10-10T09:56:08.086	karl_tjongo_kamavu			non-pave	mediocre
114	298610744	route_secondaire	2014-10-10T10:00:03.258	karl_tjongo_kamavu			non-pave	mediocre
115	298611164	route_secondaire	2014-10-10T10:08:03.654	william_ungyertho_uuci		Kanzuli	non-pave	bonne
116	313610775	route_secondaire	2014-10-10T10:11:48.006	jacques_ageno	Av.	Mbutsi	non-pave	bonne
117	298610567	route_secondaire	2014-10-10T10:12:45.731	karl_tjongo_kamavu			non-pave	mediocre
118	298611018	route_pieton	2014-10-10T10:19:27.677	karl_tjongo_kamavu			non-pave	mauvaise
119	298610416	route_secondaire	2014-10-10T10:25:31.027	micheline_nobikana	Av.	Muthuwa	non-pave	bonne
120	207102499	route_secondaire	2014-10-10T10:26:34.775	jacques_ageno	Av.	Semuliki	non-pave	bonne
121	298610414	route_pieton	2014-10-10T10:32:38.208	william_ungyertho_uuci			non-pave	bonne
122	298610952	route_pieton	2014-10-10T10:35:22.723	karl_tjongo_kamavu			non-pave	mauvaise
123	298610559	route_secondaire	2014-10-10T10:36:42.224	william_ungyertho_uuci	Av.	Musema Kweli	non-pave	bonne
124	298610418	route_secondaire	2014-10-10T10:40:07.739	karl_tjongo_kamavu			non-pave	mauvaise
125	298610550	route_sentier	2014-10-10T10:50:01.682	micheline_nobikana	Av.	Mayelamene	non-pave	bonne
126	311573694	route_pieton	2014-10-10T10:52:30.848	karl_tjongo_kamavu			non-pave	mauvaise
127	315193986	route_secondaire	2014-10-10T10:56:37.685	karl_tjongo_kamavu			non-pave	mauvaise
128	201299316	route_sentier	2014-10-10T11:01:57.221	bora_mukovi	Av.	Kambilo	non-pave	mauvaise
129	311573681	route_sentier	2014-10-10T11:04:17.080	karl_tjongo_kamavu			non-pave	mauvaise
130	207102534	route_sentier	2014-10-10T11:05:52.300	sagesse_ndaliko	Av.	Mayoka	non-pave	mediocre
131	201299317	route_pieton	2014-10-10T11:10:41.409	bora_mukovi			non-pave	mauvaise
132	10357367	route_principale	2014-10-10T11:14:05.499	lewe_mobedra_netuta	Route	Nationale no.4	non-pave	bonne
133	201299324	route_sentier	2014-10-10T11:14:45.977	bora_mukovi		Butembo	non-pave	mediocre
134	201299346	route_pieton	2014-10-10T11:18:33.674	bora_mukovi	Av.	Shabani	non-pave	mauvaise
135	312379239	route_secondaire	2014-10-10T11:20:30.023	junior_mukuka	Route	Kitsanga	non-pave	mauvaise
136	314852622	route_secondaire	2014-10-10T11:20:52.181	william_ungyertho_uuci	Av.	Safari	non-pave	bonne
137	207102530	route_secondaire	2014-10-10T11:26:52.751	puissance_mwendu	Av.	Baumbilya	non-pave	mediocre

138	312675945	route_sentier	2014-10-10T11:33:11.726	ungale_kulesa			non-pave	mauvaise
139	311992541	route_secondaire	2014-10-10T11:41:37.713	puissance_mwendu	Av.	Mwenze	non-pave	mediocre
140	312675941	route_sentier	2014-10-10T11:47:24.132	ungale_kulesa			non-pave	mediocre
141	312380983	route_sentier	2014-10-10T11:52:04.390	karl_tjongo_kamavu			non-pave	mauvaise
142	298610577	route_pieton	2014-10-10T11:54:39.917	william_ungyertho_uuci	Av.	Beni	non-pave	mauvaise
143	298610577	route_pieton	2014-10-10T11:54:39.917	william_ungyertho_uuci	Av.	Beni	non-pave	mauvaise
144	298610790	route_secondaire	2014-10-10T11:54:44.341	pascal_kazindu	Rue	Kohobe	non-pave	mediocre
145	298610351	route_sentier	2014-10-10T11:56:14.861	karl_tjongo_kamavu			non-pave	mediocre
146	298610881	route_sentier	2014-10-10T12:00:25.436	karl_tjongo_kamavu			non-pave	mauvaise
147	298610642	route_sentier	2014-10-10T12:01:31.686	rebecca_eliane	Route	Stade	non-pave	mauvaise
148	312380427	route_sentier	2014-10-10T12:02:44.320	karl_tjongo_kamavu			non-pave	mediocre
149	201299376	route_sentier	2014-10-10T12:03:44.748	ungale_kulesa		Ferme	non-pave	mauvaise
150	298610565	route_secondaire	2014-10-10T12:04:56.161	pascal_kazindu			non-pave	mediocre
151	298610457	route_sentier	2014-10-10T12:07:04.873	pascal_kazindu			non-pave	mediocre
152	312380428	route_pieton	2014-10-10T12:09:09.881	karl_tjongo_kamavu			non-pave	mediocre
153	298610751	route_secondaire	2014-10-10T12:12:35.189	william_ungyertho_uuci	Av.	Mbanivuka	non-pave	mediocre
154	298610989	route_sentier	2014-10-10T12:13:38.394	karl_tjongo_kamavu			non-pave	mediocre
155	312312496	route_secondaire	2014-10-10T12:16:42.663	lewe_mobedra_netuta	Rue	Buko	non-pave	mediocre
156	298610989	route_secondaire	2014-10-10T12:18:36.724	karl_tjongo_kamavu	Av.	Luka	non-pave	mediocre
157	207102498	route_secondaire	2014-10-10T12:19:01.085	puissance_mwendu	Av.	Katsunga	non-pave	mauvaise
158	207102502	route_secondaire	2014-10-10T12:22:39.443	puissance_mwendu	Av.	Buko	non-pave	mediocre
159	298611182	route_sentier	2014-10-10T12:26:33.030	karl_tjongo_kamavu			non-pave	mediocre
160	195231365	route_secondaire	2014-10-10T12:27:30.422	puissance_mwendu	Av.	Rumangabo	non-pave	mediocre
161	298610399	route_secondaire	2014-10-10T12:28:25.973	william_ungyertho_uuci		Mayangose	non-pave	bonne
162	207102504	route_secondaire	2014-10-10T12:33:38.985	lewe_mobedra_netuta	Av.	Muturi	non-pave	mediocre
163	298610754	route_secondaire	2014-10-10T12:37:47.380	karl_tjongo_kamavu			non-pave	mediocre
164	207102514	route_secondaire	2014-10-10T12:42:36.183	lewe_mobedra_netuta	Rue	Sivirwa	non-pave	mediocre
165	298610933	route_sentier	2014-10-10T12:45:25.475	pascal_kazindu			gravier	mediocre
166	298610892	route_secondaire	2014-10-10T12:49:38.250	pascal_kazindu			non-pave	mediocre
167	298610281	route_secondaire	2014-10-10T12:53:38.947	karl_tjongo_kamavu			non-pave	mediocre
168	298610366	route_secondaire	2014-10-10T12:57:18.660	micheline_nobikana		Muloku	non-pave	bonne
169	298610807	route_secondaire	2014-10-10T13:08:40.044	william_ungyertho_uuci	Av.	Baswagha	gravier	bonne
170	312677983	route_principale	2014-10-10T13:22:25.347	puissance_mwendu	Av.	Route Mangina	gravier	bonne
171	298610745	route_sentier	2014-10-10T13:25:02.417	micheline_nobikana		Mungwana	non-pave	bonne
172	298610380	route_sentier	2014-10-10T13:42:35.950	micheline_nobikana	Av.	Mwera	non-pave	bonne
173	201299365	route_pieton	2014-10-10T13:50:09.609	bora_mukovi			non-pave	mauvaise
174		route_pieton	2014-10-10T13:58:10.759	bora_mukovi	Av.	Rukokota	non-pave	mediocre
175	201299323	route_sentier	2014-10-10T13:59:29.255	bora_mukovi	Rue	Didas	non-pave	mediocre
176	201299370	route_sentier	2014-10-10T14:05:00.234	bora_mukovi	Rue	17	non-pave	mediocre
177		route_pieton	2014-10-10T14:06:13.280	bora_mukovi	Av.	Kanyali	non-pave	mauvaise
178	201299325	route_pieton	2014-10-10T14:08:54.171	bora_mukovi	Av.	Mapendano	non-pave	mauvaise
179	298610976	route_sentier	2014-10-10T15:11:30.435	micheline_nobikana			non-pave	bonne
180	315464749	route_secondaire	2014-10-10T15:20:25.451	william_ungyertho_uuci		Manenokesho	gravier	bonne
181	298611145	route_pieton	2014-10-13T09:32:10.134	stephen_salama			non-pave	mediocre
182	298610815	route_pieton	2014-10-13T09:37:01.550	ungale_kulesa			non-pave	mediocre
183	298610810	route_pieton	2014-10-13T09:38:43.670	ungale_kulesa			non-pave	mediocre
184	207102513	route_secondaire	2014-10-13T09:47:43.730	karl_tjongo_kamavu			non-pave	mediocre

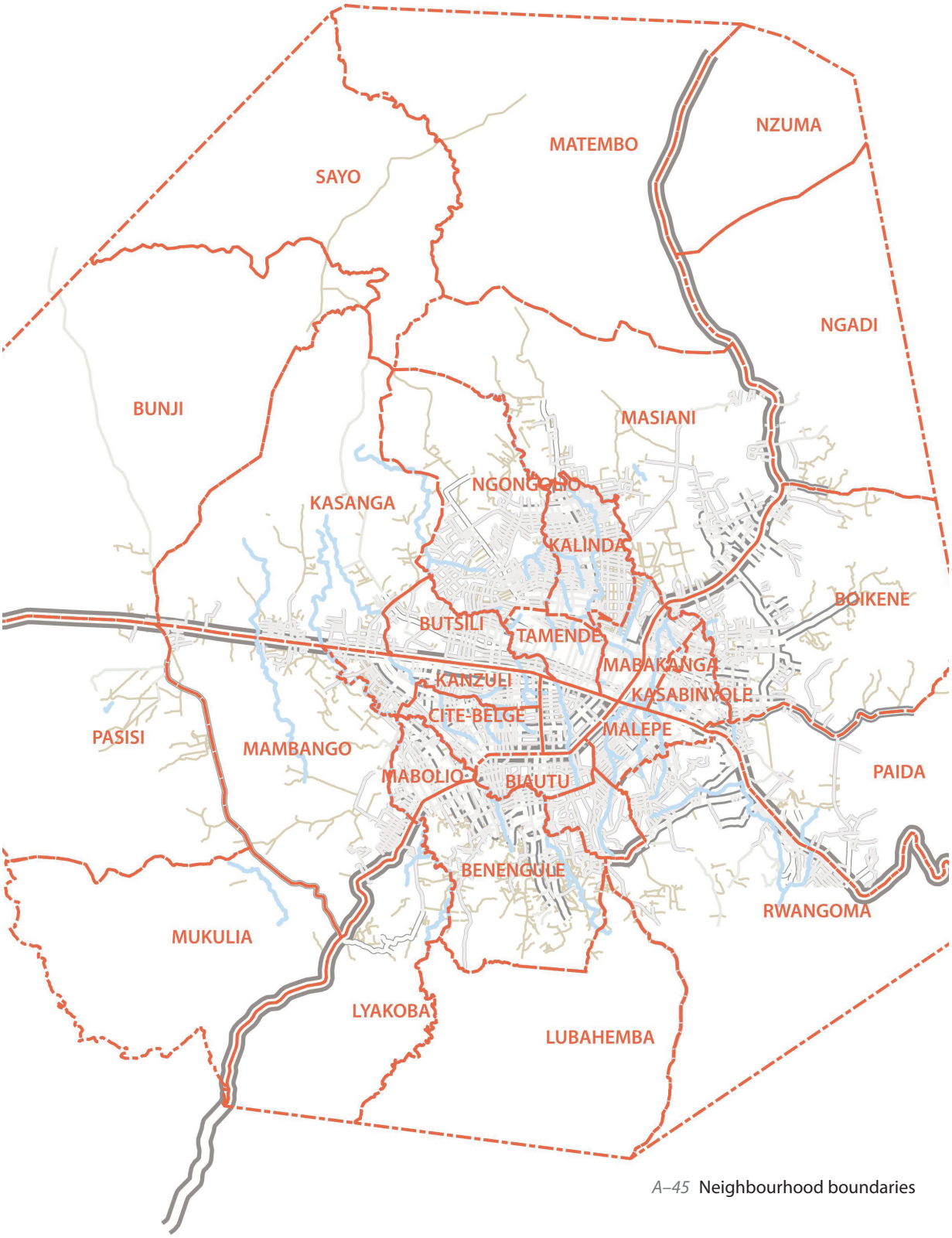
185	207102521	route_sentier	2014-10-13T09:50:23.932	karl_tjongo_kamavu			non-pave	mediocre
186	207102519	route_secondaire	2014-10-13T09:53:22.318	karl_tjongo_kamavu			non-pave	bonne
187	207102592	route_sentier	2014-10-13T09:55:13.087	karl_tjongo_kamavu			non-pave	mediocre
188	298610701	route_pieton	2014-10-13T09:58:42.419	ungale_kulesa			non-pave	mauvaise
189	207102583	route_secondaire	2014-10-13T10:00:21.362	karl_tjongo_kamavu			non-pave	mediocre
190	298610515	route_pieton	2014-10-13T10:03:39.744	ungale_kulesa			non-pave	mauvaise
200	313036411	route_sentier	2014-10-13T10:05:00.445	karl_tjongo_kamavu			non-pave	mediocre
201	298610315	route_sentier	2014-10-13T10:06:10.699	karl_tjongo_kamavu			non-pave	mediocre
202	298610452	route_pieton	2014-10-13T10:09:58.469	ungale_kulesa			non-pave	mauvaise
203	298610317	route_sentier	2014-10-13T10:11:57.139	karl_tjongo_kamavu			non-pave	mediocre
204	312448589	route_sentier	2014-10-13T10:12:53.699	karl_tjongo_kamavu			non-pave	mediocre
205	312273235	route_secondaire	2014-10-13T10:14:06.432	pascal_kazindu		Katoto	non-pave	bonne
206	298610732	route_pieton	2014-10-13T10:15:14.224	ungale_kulesa			non-pave	mauvaise
207	298610466	route_pieton	2014-10-13T10:18:01.284	ungale_kulesa			non-pave	mauvaise
208	298610928	route_sentier	2014-10-13T10:18:14.804	karl_tjongo_kamavu			non-pave	mediocre
209	298610411	route_pieton	2014-10-13T10:20:02.708	ungale_kulesa	Av.	Munyabelu	non-pave	mauvaise
210	207102601	route_sentier	2014-10-13T10:21:07.025	karl_tjongo_kamavu			non-pave	mediocre
211	311757806	route_secondaire	2014-10-13T10:31:24.056	karl_tjongo_kamavu			non-pave	mediocre
212	311757807	route_sentier	2014-10-13T10:33:26.846	karl_tjongo_kamavu			non-pave	mediocre
213	207102503	route_secondaire	2014-10-13T10:34:18.844	lewe_mobedra_netuta	Av.	Mobesu	non-pave	mediocre
214	207102550	route_secondaire	2014-10-13T10:46:59.578	lewe_mobedra_netuta	Av.	Lubero	non-pave	mediocre
215	298610323	route_sentier	2014-10-13T10:53:26.588	karl_tjongo_kamavu			non-pave	mediocre
216	298610335	route_sentier	2014-10-13T11:08:28.211	jacques_ageno	Av.	Milonde	non-pave	mediocre
217	207102512	route_secondaire	2014-10-13T11:17:30.011	thierry_babonye	Av.	Mayoka	non-pave	mediocre
218	298611121	route_secondaire	2014-10-13T12:01:38.828	muyisa_kombi			non-pave	mauvaise
219	298610797	route_secondaire	2014-10-13T12:20:55.106	muyisa_kombi			non-pave	mediocre
220	49332935	route_pieton	2014-10-13T12:47:42.137	ungale_kulesa	Av.	Oicha	non-pave	mediocre
221	207102579	route_sentier	2014-10-13T12:59:33.152	pascal_kazindu	Rue	Musahi	non-pave	mediocre
222	315023564	route_sentier	2014-10-13T13:03:09.302	karl_tjongo_kamavu			non-pave	mediocre
223	298610877	route_pieton	2014-10-13T13:06:29.259	ungale_kulesa	Av.	Landu	non-pave	mauvaise
224	207102579	route_sentier	2014-10-13T13:09:15.617	pascal_kazindu	Rue	Masiani	non-pave	mediocre
225	207102595	route_secondaire	2014-10-13T14:21:13.826	karl_tjongo_kamavu			non-pave	bonne
226	298610749	route_secondaire	2014-10-14T08:57:46.112	puissance_mwendu	Av.	Munyabelu	non-pave	mediocre
227	298610789	route_secondaire	2014-10-14T09:24:19.197	puissance_mwendu	Av.	Muchunga	non-pave	mediocre
228	298610893	route_sentier	2014-10-14T09:30:23.185	pascal_kazindu	Rue	Wamba	non-pave	mediocre
229	298610883	route_secondaire	2014-10-14T09:30:23.796	puissance_mwendu	Av.	Muyisa	non-pave	mauvaise
230	298611025	route_secondaire	2014-10-14T09:31:14.638	lewe_mobedra_netuta	Av.	Kanyamukunyu	non-pave	mediocre
231	312035604	route_sentier	2014-10-14T09:36:37.421	pascal_kazindu	Rue	Isale	non-pave	mediocre
232	298610722	route_secondaire	2014-10-14T09:37:40.566	puissance_mwendu	Av.	Odo	non-pave	mauvaise
233	298610846	route_sentier	2014-10-14T09:40:27.469	pascal_kazindu		Entre Rock Hôtel	non-pave	mediocre
234	298611184	route_secondaire	2014-10-14T09:45:49.852	william_ungyertho_uuci		Sobiede	gravier	bonne
235	312033474	route_secondaire	2014-10-14T09:49:56.952	puissance_mwendu	Av.	Mutoka Mbali	non-pave	mediocre
236	298610652	route_sentier	2014-10-14T09:55:52.180	pascal_kazindu	Rue	Kasongo	non-pave	mediocre
237	298610378	route_secondaire	2014-10-14T10:04:36.509	puissance_mwendu	Av.	Saidi	non-pave	mauvaise
238	298610286	route_pieton	2014-10-14T10:05:05.787	pascal_kazindu	Rue	Malio	non-pave	mediocre
239	298611096	route_secondaire	2014-10-14T10:10:12.006	puissance_mwendu	Av.	Makasi	non-pave	bonne
240	298610591	route_pieton	2014-10-14T10:10:53.066	pascal_kazindu	Rue	Kisandokiri	non-pave	mediocre

241	312382918	route_secondaire	2014-10-14T10:11:50.027	lewe_mobedra_netuta		Yoba	non-pave	mediocre
242	313276763	route_secondaire	2014-10-14T10:12:39.225	micheline_nobikana	Av.	Kambiro	non-pave	bonne
243	313605294	route_secondaire	2014-10-14T10:18:07.420	puissance_mwendu	Av.	Makasi	non-pave	mediocre
244	312381867	route_sentier	2014-10-14T10:20:56.745	karl_tjongo_kamavu			non-pave	mauvaise
245	298611036	route_pieton	2014-10-14T10:21:15.705	puissance_mwendu	Av.	Mabanga	non-pave	mauvaise
246	298610283	route_pieton	2014-10-14T10:24:59.528	elisabeth_vanoverbeeke			non-pave	mediocre
247	315023564	route_pieton	2014-10-14T10:26:59.953	elisabeth_vanoverbeeke			non-pave	mauvaise
248	298610729	route_secondaire	2014-10-14T10:27:06.999	william_ungyertho_uuci	Av.	Zandabo	non-pave	bonne
249	298611135	route_sentier	2014-10-14T10:31:19.304	elisabeth_vanoverbeeke			non-pave	mediocre
250	298611130	route_sentier	2014-10-14T10:33:22.193	karl_tjongo_kamavu			non-pave	mediocre
251	298610615	route_sentier	2014-10-14T10:35:55.195	karl_tjongo_kamavu			non-pave	mediocre
252	313276761	route_secondaire	2014-10-14T10:39:42.293	william_ungyertho_uuci	Av.	Sotexki	non-pave	bonne
253	312559183	route_principale	2014-10-14T10:40:34.441	lewe_mobedra_netuta	Route	Nationale no.44	non-pave	mediocre
254	298610597	route_sentier	2014-10-14T10:54:33.605	karl_tjongo_kamavu			non-pave	mediocre
255		route_sentier	2014-10-14T10:56:26.392	karl_tjongo_kamavu			non-pave	mediocre
256	298610726	route_sentier	2014-10-14T11:01:40.486	karl_tjongo_kamavu			non-pave	mediocre
257	298611183	route_secondaire	2014-10-14T11:08:00.335	karl_tjongo_kamavu			non-pave	mediocre
258	298610439	route_pieton	2014-10-14T11:09:05.888	puissance_mwendu		Mukosa Bei	non-pave	mauvaise
259	298610706	route_secondaire	2014-10-14T11:12:14.111	william_ungyertho_uuci	Av.	Ngobia	non-pave	bonne
260	298610373	route_secondaire	2014-10-14T11:16:21.956	karl_tjongo_kamavu			non-pave	mediocre
261	298610412	route_secondaire	2014-10-14T11:19:53.798	puissance_mwendu	Av.	Itika	non-pave	mediocre
262	298610668	route_secondaire	2014-10-14T11:21:42.969	micheline_nobikana	Av.	Nzelu	non-pave	bonne
263	298610402	route_secondaire	2014-10-14T11:22:51.454	karl_tjongo_kamavu			non-pave	bonne
264	313941856	route_secondaire	2014-10-14T11:28:10.990	william_ungyertho_uuci	Av.	Poso II	non-pave	bonne
265	298610436	route_secondaire	2014-10-14T11:30:59.332	jacques_ageno	Av.	Kisangani	non-pave	mediocre
266	207102574	route_sentier	2014-10-14T11:39:20.548	elisabeth_vanoverbeeke			non-pave	mediocre
267	312559184	route_secondaire	2014-10-14T11:40:48.539	jacques_ageno	Av.	Ngumbari	non-pave	bonne
268	313922194	route_sentier	2014-10-14T11:41:05.678	karl_tjongo_kamavu			non-pave	mediocre
269	207102586	route_pieton	2014-10-14T11:46:41.994	elisabeth_vanoverbeeke			non-pave	mauvaise
270	298610872	route_sentier	2014-10-14T11:49:35.821	puissance_mwendu	Av.	Maendeleo	non-pave	mauvaise
271	298610718	route_secondaire	2014-10-14T11:53:01.601	karl_tjongo_kamavu			non-pave	mediocre
272	298610718	route_secondaire	2014-10-14T11:53:01.601	karl_tjongo_kamavu			non-pave	mediocre
273	207102605	route_pieton	2014-10-14T11:53:21.054	elisabeth_vanoverbeeke			non-pave	mediocre
274	313605293	route_secondaire	2014-10-14T11:54:42.490	puissance_mwendu		Mapendo	non-pave	bonne
275	207102510	route_sentier	2014-10-14T11:56:11.255	elisabeth_vanoverbeeke			non-pave	mauvaise
276	313922199	route_sentier	2014-10-14T11:57:08.686	karl_tjongo_kamavu			non-pave	mediocre
277		route_secondaire	2014-10-14T12:16:04.796	william_ungyertho_uuci	Av.	Masiki	non-pave	bonne
278	298610354	route_sentier	2014-10-14T12:30:01.270	jacques_ageno	Av.	Bis ngumbare	non-pave	mauvaise
279	298610845	route_sentier	2014-10-14T12:56:20.653	william_ungyertho_uuci	Av.	Kikwaso	non-pave	bonne
280	298610316	route_sentier	2014-10-14T13:22:04.907	william_ungyertho_uuci	Av.	Kasiku	non-pave	bonne
281	298610998	route_pieton	2014-10-14T13:24:34.437	elisabeth_vanoverbeeke			non-pave	mauvaise
282	298610530	route_secondaire	2014-10-14T13:34:49.919	micheline_nobikana	Av.	De l'église	non-pave	bonne
283	298611169	route_secondaire	2014-10-14T14:10:13.930	micheline_nobikana	Av.	Matete	non-pave	bonne


KASANGA
NGONGOLIO
BUTSILI
KANZULI
CITE-BELGE
MAMBANGO
MABOLIO
BIAUT
SISI
Quartier boundaries
BENENGULE
LYAKOBA
MUKULIA



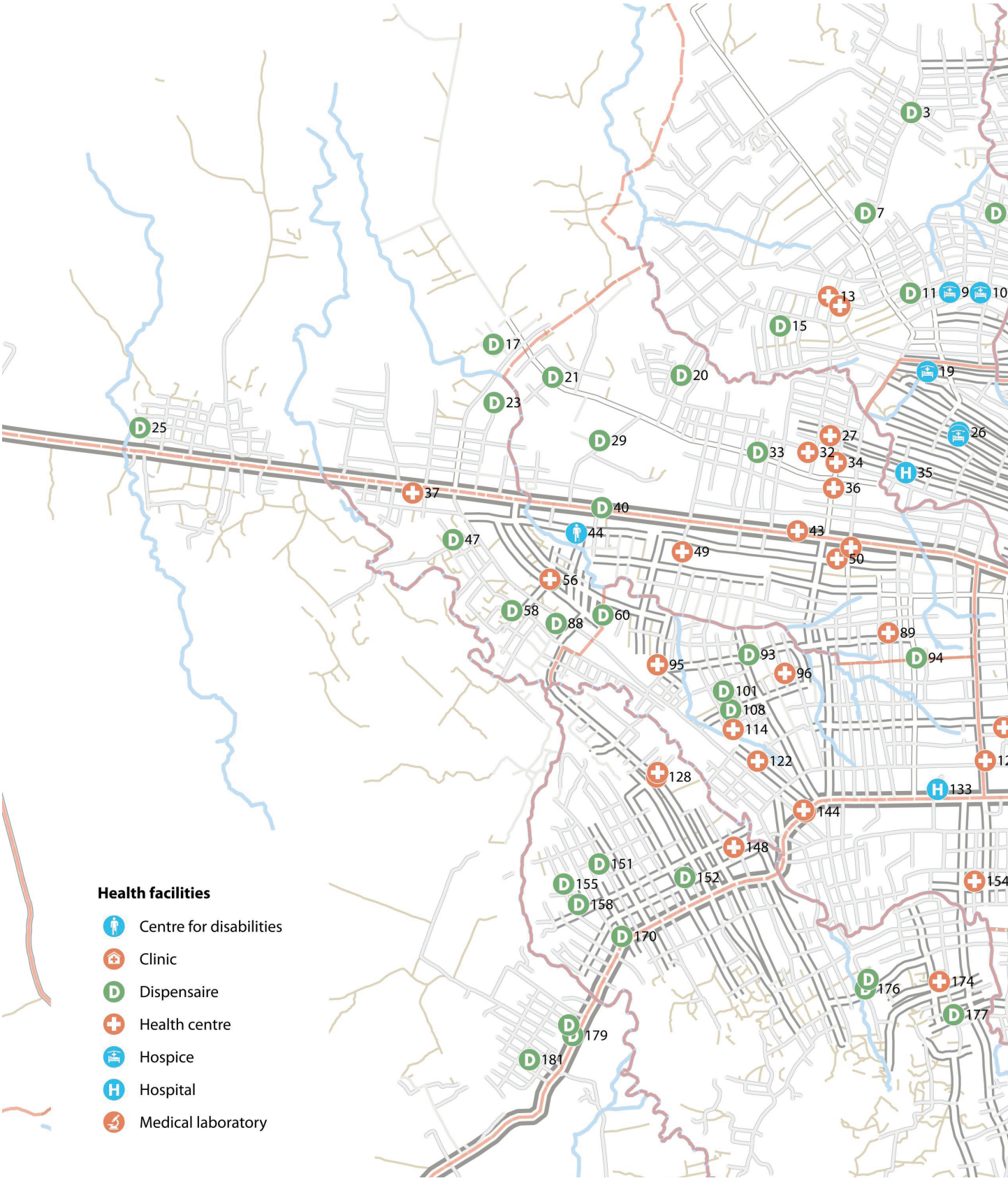
A–44 Neighbourhood boundaries

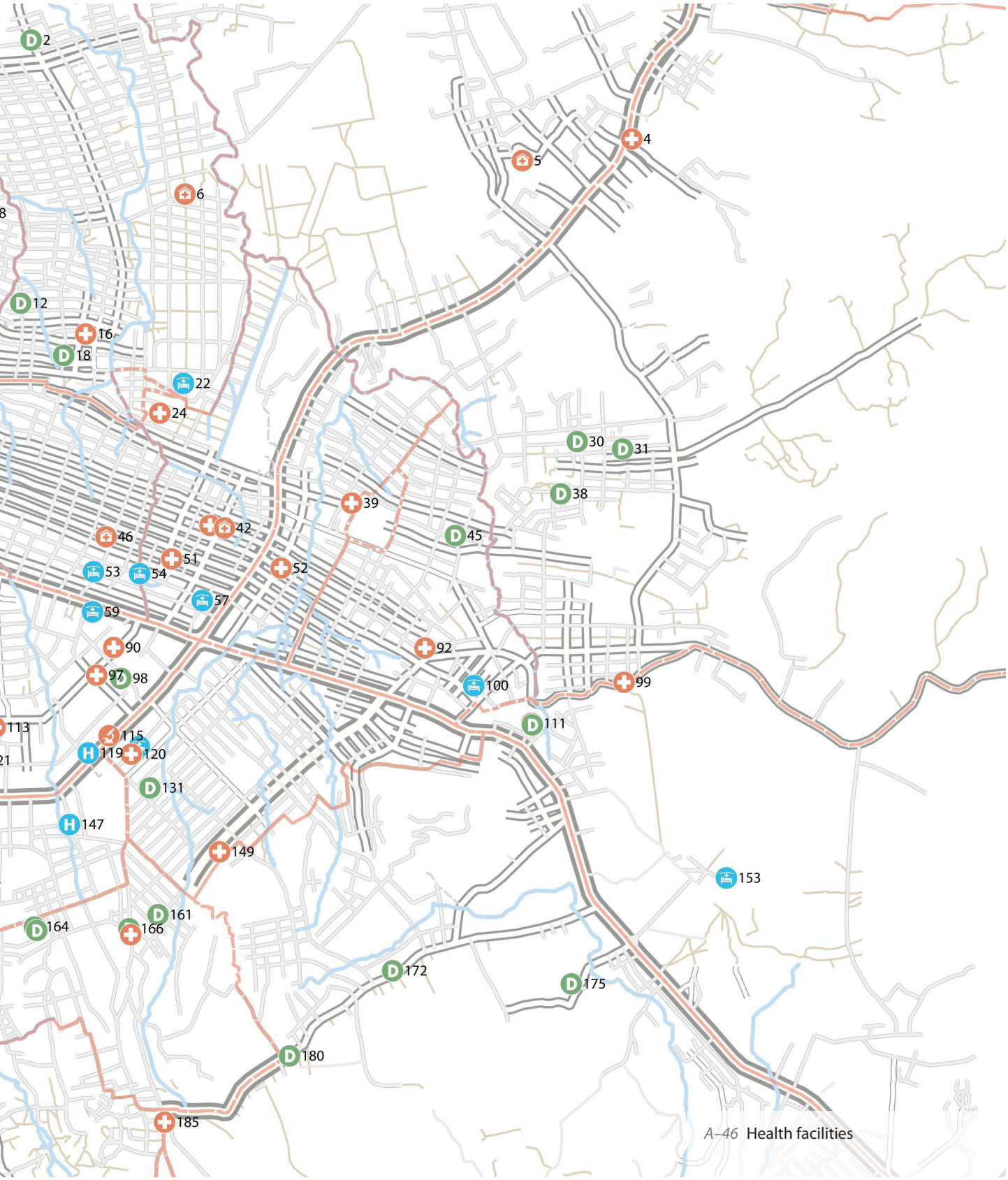


A–45 Neighbourhood boundaries

Table A–02 Neighbourhood boundary metadata

id	name	commune
1	NGADI	COMMUNE RWENZORI
2	LUBAHEMBA	COMMUNE BEU
3	LYAKOBA	COMMUNE BEU
4	BENENGULE	COMMUNE BEU
5	NGONGOLIO	COMMUNE MULEKERA
6	BIAUTU	COMMUNE BEU
7	BUTANUKA	COMMUNE BEU
8	KASANGA	COMMUNE MULEKERA
9	SAYO	COMMUNE MULEKERA
10	RWANGOMA	COMMUNE BEU
11	PAIDA	COMMUNE RWENZORI
12	NZUMA	COMMUNE RWENZORI
13	MATEMBO	COMMUNE MULEKERA
14	MASIANI	COMMUNE MULEKERA
15	KASABINYOLE	COMMUNE RWENZORI
16	KANZULI	COMMUNE BUNGULU
17	CITE-BELGE	COMMUNE BUNGULU
18	BUNJI	COMMUNE MULEKERA
19	BOIKENE	COMMUNE RWENZORI
20	TAMENDE	COMMUNE MULEKERA
21	MUKULIA	COMMUNE BUNGULU
22	PASISI	COMMUNE BUNGULU
23	RESIDENTIEL	COMMUNE BUNGULU
24	MABOLIO	COMMUNE BUNGULU
25	MAMBANGO	COMMUNE BUNGULU
26	MATONGE	COMMUNE MULEKERA
27	KALINDA	COMMUNE MULEKERA
28	BUTSILI	COMMUNE MULEKERA
29	MABAKANGA	COMMUNE RWENZORI
30	MALEPE	COMMUNE BEU


Health facilities
Centre for disabilities
Clinic
Dispensaire
Health centre
Hospice
Hospital
Medical laboratory



A–46 Health facilities

Table A–03 Health facility metadata

id	time	enumerator	name	type
1	2014-10-13T12:07:19.035	puissance_mwendu	Dispensaire Forever the Life	sante
2	2014-10-13T11:02:06.129	pascal_kazindu	M. Mandrandele	sante
3	2014-10-13T10:40:56.392	puissance_mwendu	Dispensaire Kavulivwa	sante
4	2014-10-14T11:34:46.557	william_ungyertho_uuci	Centre de Sante Boikene	sante
5	2013-01-05T05:11:09.285	nadia_kavira	Centre de Sante La Karmissionene	sante
6	2014-10-13T11:11:04.239	ungale_kulesa	Clinique Tumaini Letu	sante
7	2014-10-13T10:08:46.658	stephen_salama	Kiwanuka	sante
8	2014-10-13T11:16:51.068	karl_tjongo_kamavu	Dispensaire Somophar	sante
9	2014-10-13T13:17:27.962	karl_tjongo_kamavu	Centre Medico Chururgical Saint Vincent de Paul	sante
10	2014-10-13T13:25:22.283	karl_tjongo_kamavu	Centre de Sante Ngongolio	sante
11	2014-10-13T13:00:30.300	karl_tjongo_kamavu	Dispensaire Nouvel Espoir	sante
12	2014-10-13T13:38:44.405	karl_tjongo_kamavu	Dispensaire Muyisa	sante
13	2014-10-14T10:52:46.349	elisabeth_vanoverbeeke	Poste de Sante Afya	sante
14	2014-10-14T10:45:19.197	elisabeth_vanoverbeeke	Posted de Sante Plamedi	sante
15	2014-10-14T13:28:24.582	celestin_kasereka	Dispensaire Kuja Upesi Utaponeshwa	sante
16	2014-10-13T09:55:48.652	karl_tjongo_kamavu	Centre Medical Courriel International	sante
17	2014-10-13T13:32:56.859	william_ungyertho_uuci	Dispensaire A-V-O La sagesse de Dieu	sante
18	2014-10-13T14:13:18.270	karl_tjongo_kamavu	Dispensaire Mulamo	sante
19	2014-10-10T12:24:11.789	puissance_mwendu	Tulizeni	sante
20	2014-10-13T12:11:08		Dispensaire Imani Yako	sante
21	2014-10-13T12:40:00.658	william_ungyertho_uuci	Dispensaire Usalama Providence	sante
22	2014-10-13T13:51:41.301	ungale_kulesa	Centre Hospitalier	sante
23	2014-10-13T14:00:50.919	micheline_nobikana	Dispensaire Amani	sante
24	2014-10-13T14:25:10.572	gloria_najangusi_	Centre de Sante	sante
25	2014-10-10T13:47:22.195	bora_mukovi	Dispensaire Imani Ni Dawa	sante
26	2014-10-13T10:48:18.095	celestin_kasereka	Centre Hospitalier de Tamende	sante
27	2014-10-13T09:04:45		Poste de Sante Butsili	sante
28			Centre Hospitalier Tamende	sante
29	2014-10-13T11:04:34.614	william_ungyertho_uuci	Dispensaire Neuro-psychiatrique	sante
30	2014-10-14T10:29:59		Dispensaire La Floraison	sante
31	2014-10-14T09:52:33		Dispensaire La Colombe	sante
32	2014-10-13T10:15:31		Centre de Sante Butsili	sante
33	2014-10-13T11:50:29		Dispensaire Saint Thomas	sante
34	2014-10-13T08:49:47		Centre Medical Beauberceau	sante
35	2014-10-10T10:59:26.108	puissance_mwendu	Yakobi Bana Lisasa	sante
36	2014-10-13T08:30:51		Centre Medicale Mapendo	sante
37	2014-09-18T08:21:36		Maison Medicale De Ndindi	sante
38	2014-10-14T08:51:45		Dispensaire Le Rocher	sante
39	2014-10-14T09:27:40.155	jacques_ageno	Centre de Sante Anglicane Kasabinyole	sante
40	2014-10-13T09:59:50.313	william_ungyertho_uuci	Dispensaire Mungu Aponesha	sante

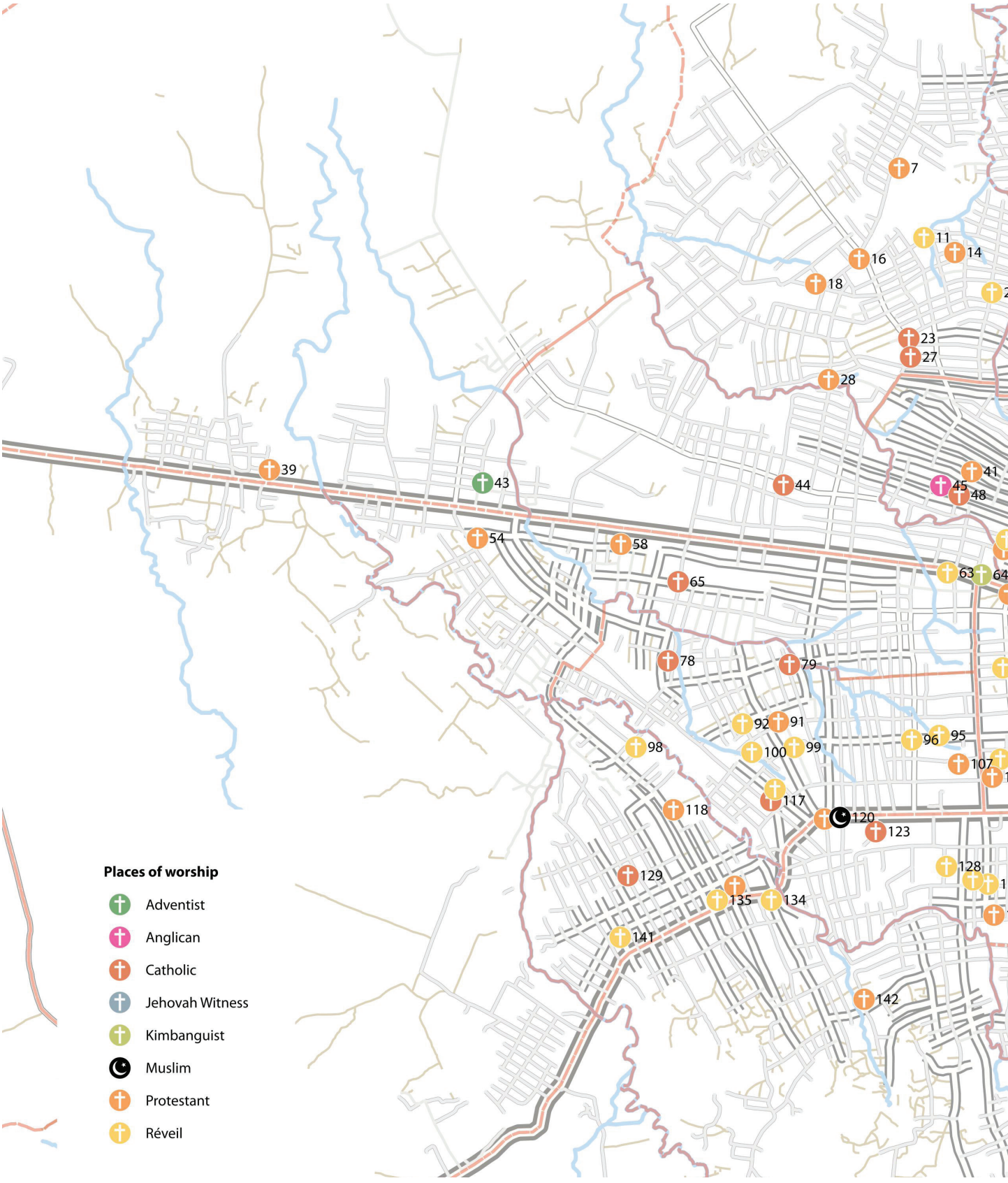
type_sante	other_sante	latitude	longitude	elevation	precision
dispensaire		0.5274433507	29.4555004101	1060.32180953	6
dispensaire		0.5224366254	29.4638516037	1085.6939943	4
dispensaire		0.5189576047	29.4576698948	1106.43882149	6
centre_de_sante		0.5176790488	29.492744025	1130.66554894	4
clinique		0.5166397521	29.48747962	1136.09807805	6
clinique		0.5150317267	29.4712504544	1074.78814421	6
dispensaire		0.5141224122	29.4554528493	1105.04593982	6
dispensaire		0.5141165722	29.4617279714	1093.23859363	4
centre_hospitalier		0.5103162182	29.4595158815	1110.96279504	6
centre_hospitalier		0.5102914502	29.4609955187	1109.29184443	4
dispensaire		0.5102728542	29.4576247862	1101.72170113	4
dispensaire		0.5097834753	29.4633467124	1098.32301776	4
centre_de_sante		0.5101114	29.45368874	1128	5
centre_de_sante		0.50965589	29.45423608	1123	5
dispensaire		0.5086944	29.4513673	1121	5
centre_de_sante		0.5083038251	29.4664752237	1115.29622614	4
dispensaire		0.5078127636	29.4375774989	1094.49269179	4
dispensaire		0.5072764576	29.4654174558	1116.75704241	4
centre_hospitalier		0.5065014963	29.4584444124	1109.8233838	4
dispensaire		0.506323	29.446606	1105.72229	
dispensaire		0.5062316668	29.4404304219	1087.79721577	4
centre_hospitalier		0.505929707	29.4711769109	1000.29535449	8
dispensaire		0.5050091539	29.4376095704	987.84347317	4
centre_de_sante		0.5045015087	29.4700414125	1124.0231165	4
dispensaire		0.503806042	29.4205776232	1071.78470785	4
centre_hospitalier		0.50357948	29.45996863	1120.90002441	4
centre_de_sante		0.503417	29.453769	1121.306641	
centre_hospitalier		0.5034027	29.4599318		
dispensaire		0.5031831692	29.44267976	1095.95392287	4
dispensaire		0.503132	29.490118	1165.24939	
dispensaire		0.502776	29.492304	1166.048828	
centre_de_sante		0.502619	29.452699	1120.305542	
dispensaire		0.502619	29.450279	1117.079712	
centre_de_sante		0.502129	29.454061	1125.793579	
hopital_general		0.501641674	29.4574091357	1113.87130121	6
centre_de_sante		0.500901	29.453935	1132.124023	
centre_de_sante		0.5006649	29.433695	1104.6	
dispensaire		0.500622	29.489326	1144.912964	
centre_de_sante		0.5001756795	29.4792654272	1136.06755587	4
dispensaire		0.4999620191	29.4427926344	1086.35222661	4

41	2014-10-13T10:39:47.431	lewe_mobedra_netuta	Centre de Sante Mabakanga	sante
42	2014-10-13T09:55:21.988	lewe_mobedra_netuta	Clinique Sante Plus1	sante
43	2014-10-13T13:19:50		Zone de Sante La Parite	sante
44	2014-09-18T09:03:50		Heri Lwetu	sante
45	2014-10-14T11:15:05.200	muyisa_kombi	Dispensaire Lwanzo	sante
46	2014-10-13T11:53:45.987	celestin_kasereka	Clinique Medicale La Siloe	sante
47	2014-09-18T08:05:29		Dispensaire Jean Marie Muzei Ndindi	sante
48	2014-09-18T10:03:38		Centre Medical Kuno	sante
49	2014-09-18T09:23:36		Centre De Sante Kanzulinzuli	sante
50	2014-09-18T10:06:24		Maison Pediatrique du Graben	sante
51	2014-10-13T12:31:37.360	lewe_mobedra_netuta	Cabinet medical Pilipili	sante
52	2013-01-04T05:12:48.794	stephen_salama	Centre Medical Gracia	sante
53	2014-10-13T13:12:33.086	lewe_mobedra_netuta	Centre de Sante Tamende CBCA	sante
54	2014-10-13T12:55:12.080	lewe_mobedra_netuta	Centre Pediatrique Saint Pierre Beni	sante
55	2014-09-18T07:35:18		Centre Medical Brazza	sante
56	2013-01-01T03:22:38.686	stephen_salama	Zone de Sante Braza	sante
57	2014-10-10T10:09:39.855	lewe_mobedra_netuta	Hopital la Breche	sante
58	2014-09-18T07:16:26		Dispensaire Mapendo	sante
59	2014-09-15T12:28:13		Centre Hospitalier Emanuel d'Alzon	sante
60	2014-09-18T07:42:50		Dispensaire Mbongo	sante
61	2014-09-18T07:24:52		Dispensaire De La Verite	sante
62	2014-10-10T09:50:34		Centre Medical C.E.FRO.M.T	sante
63	2014-09-15T12:37:42		Centre Medical de Beni	sante
64	2013-01-04T03:09:13.104	stephen_salama	Centre de Sante de la Sante	sante
65	2014-09-16T09:42:18		Dipsensaire Muloku Bon Berger	sante
66	2014-09-15T11:59:04		Dispensaire Tumaini Letu	sante
67	2014-09-16T08:51:15		Yesu Christu Ni Kuukushinda Yote	sante
68	2014-09-16T09:33:27		Centre Medical La Joie	sante
69	2014-09-15T12:41:21		Centre Medicale De Jourdain de Beni	sante
70	2014-09-15T13:36:49		Dispensaire ONC	sante
71	2014-10-14T12:05:50.641	puissance_mwendu	Maison Medicale Manza	sante
72	2014-10-14T09:39:08.413	puissance_mwendu	Maison Medicale Tuungane	sante
73	2014-09-16T09:05:11		Dispensaire E' Miyisa	sante
74	2014-10-10T15:07:40.129	william_ungyertho_uuci	Dispensaire E'miyisa	sante
75	2014-10-14T12:41:38.387	puissance_mwendu	Dispensaire Gloire a Dieu	sante
76			Dispensaire Gloire a Dieu	sante
77	2014-09-15T11:44:25		Croix Rouge	sante
78	2014-09-16T09:12:46		Tumaini Ya Afia	sante
79	2014-09-15T13:27:47		Laboratoire Medical Gradi	sante
80	2014-10-09T11:20:21.318	gloria_najangusi_	Labo Medical Specialise	sante
81	2014-09-15T12:52:45		Hopital Imagerie des Grands Lacs	sante
82	2014-10-09T11:28:33.115	bora_mukovi	Polyclinique et Recherche Santeplus	sante

centre_de_sante		0.4991032801	29.472453307	1140.0991399	6
clinique		0.4989813165	29.4731515634	1127.32927105	6
centre_de_sante		0.49884	29.4522	1135.427246	
sante_autre	centre_pour_handicape	0.49874187	29.441568	1092.2	
dispensaire		0.4986161078	29.4842625329	1153.47557467	6
clinique		0.4985547	29.46745027	1141.40002441	3
dispensaire		0.4984221	29.435637	1082.4	
centre_de_sante		0.49804822	29.45477	1134.5	
centre_de_sante		0.4978383	29.446661	1114.9	
centre_de_sante		0.49749655	29.4541	1135.3	
centre_de_sante		0.4974879214	29.470611857	1139.17106014	6
centre_de_sante		0.4970499226	29.4758746367	1139.80826479	6
centre_hospitalier		0.4968742836	29.4668478864	1138.46462036	6
centre_hospitalier		0.4967810536	29.4690703305	1125.81235608	6
centre_de_sante		0.49652064	29.440294	1111.8	
dispensaire		0.496473674	29.4403435268	1097.44939614	6
centre_hospitalier		0.4954897777	29.4720871619	1151.28787151	4
dispensaire		0.4950089	29.438465	1127.7	
centre_hospitalier		0.49494594	29.466805	1147.5	
dispensaire		0.4947986	29.442844	1110.9	
dispensaire		0.4943924	29.440594	1115.8	
centre_de_sante		0.49394	29.456566	1142.476807	
centre_de_sante		0.49323145	29.467823	1153.3	
centre_de_sante		0.4932063622	29.4827946995	1163.44049338	6
dispensaire		0.4928896	29.449858	1111.1	
dispensaire		0.49273887	29.457918	1143.4	
centre_de_sante		0.4924074	29.445465	1111.2	
centre_de_sante		0.4919966	29.451591	1128.3	
centre_de_sante		0.49190083	29.467	1161	
dispensaire		0.491746	29.468168	1166.6	
centre_de_sante		0.4915603962	29.4923732373	1158.74802888	6
centre_hospitalier		0.4913989908	29.4851449489	1161.56406836	6
dispensaire		0.49114177	29.44864	1124.9	
dispensaire		0.4902362685	29.4489847685	1130.48342803	4
clinique		0.4895802605	29.4879311553	1158.60685231	6
dispensaire		0.489512	29.4879626		
centre_de_sante		0.4893892	29.462118	1166.8	
centre_de_sante		0.48929772	29.449108	1126.2	
sante_autre	laboratoire_medicale	0.48899052	29.467598	1171	
centre_hospitalier		0.488465648	29.4690548211	1165.81566017	4
hopital_general		0.48815912	29.466599	1172.3	
centre_de_sante		0.488104239	29.4686661157	1195.25750857	12

83	2014-09-15T11:39:37		Poste De Sante PNC	sante
84	2014-09-16T08:22:19		Maison Medicale Jesus Ni Jibu	sante
85	2014-09-17T08:32:47		Centre De Sante Mabolio	sante
86	2014-10-10T10:27:57.481	junior_mukuka	Centre de Sante Mabolio	sante
87	2014-10-09T13:57:49.457	gloria_najangusi_	Dispensaire Kyangebeni	sante
88	2014-09-15T11:26:07		Hopital General de Reference	sante
89	2014-09-16T07:50:40		Centre Medical Imani Bora	sante
90	2014-10-10T13:12:29.830	micheline_nobikana	Imani Bora	sante
91	2014-10-09T14:50:35.415	karl_tjongo_kamavu	Hopital la Grace	sante
92	2014-09-17T09:43:40		Centre Medical Ekima	sante
93	2014-10-09T10:06:10.196	lewe_mobedra_netuta	Poste de Sante CECA 20 Malepe	sante
94	2014-09-17T08:12:00		Dispensaire Tulizeni	sante
95	2014-09-17T09:52:24		Dispensaire La Fraternite	sante
96	2014-10-14T11:34:35.655	lewe_mobedra_netuta	Centre Hospitalier de PAIDA	sante
97	2014-10-09T11:45:09.175	karl_tjongo_kamavu	Centre Medicale Coophyco	sante
98	2014-09-17T08:03:55		Dispensaire Sambili	sante
99	2014-09-17T07:55:27		Dispensaire Menamo Tumaini	sante
100	2014-10-09T16:11:56.756	bora_mukovi	Dispensaire La Victoire	sante
101	2014-10-09T11:50:06.656	jacques_ageno	Dispensaire horizon	sante
102	2014-10-09T11:05:01.191	sagesse_ndaliko	Dispensaire Saint Emannuel	sante
103			Centre de Sante	sante
104	2014-09-17T07:30:09		Dispensaire Salama	sante
105	2014-10-09T11:10:03.148	elisabeth_vanoverbeeke	Dispensaire Tumaini	sante
106			Dispensaire Tout Est Grace	sante
107	2014-10-09T13:00:59.508	puissance_mwendu	Sante Mentale CE SA ME	sante
108	2014-10-14T10:05:30.604	lewe_mobedra_netuta	Dispensaire Christ-Roi (Toba)	sante
109	2014-10-09T12:18:08.310	puissance_mwendu	Dispensaire Tout est Grace	sante
110	2014-10-09T14:14:42.255	puissance_mwendu	Dispensaire Baraka	sante
111	2014-10-09T13:06:27		Dispensaire La Patience	sante
112	2014-10-09T13:00:23		Dispensaire Ilonga	sante
113	2014-10-09T12:05:37.146	elisabeth_vanoverbeeke	Dispensaire Hewa Bora	sante
114	2014-10-09T11:32:31		Dispensaire La Guerison	sante
115	2014-10-09T13:06:32.830	elisabeth_vanoverbeeke	Poste de Sante Acoopadea	sante
116	2014-10-09T13:29:51.176	elisabeth_vanoverbeeke	Dispensaire Tumaini	sante
117			Dispensaire Baraka	sante

centre_de_sante		0.48779646	29.46123	1172.8	
centre_de_sante		0.4877747	29.45028	1130.5	
centre_de_sante		0.48722723	29.445478	1133.7	
centre_de_sante		0.48701539	29.44542086	1126	2
dispensaire		0.4864815814	29.469560961	1171.94675461	4
hopital_general		0.4864177	29.458933	1171.6	
centre_de_sante		0.485421	29.452494	1147.8	
centre_de_sante		0.4853385522	29.4525729861	1151.26418228	4
hopital_general		0.4847218029	29.4656938243	1169.0835248	4
centre_de_sante		0.48363376	29.449139	1136	
centre_de_sante		0.4834097078	29.4729130735	1184.87540861	6
dispensaire		0.48283145	29.442656	1138.6	
dispensaire		0.482182	29.446781	1141.6	
centre_hospitalier		0.4821522211	29.4972959418	1195.61688507	6
centre_de_sante		0.482001909	29.4607148867	1167.87013225	4
dispensaire		0.4818672	29.440956	1134.8	
dispensaire		0.48088357	29.441668	1139.1	
dispensaire		0.480382659	29.4699543669	1194.56276493	4
dispensaire		0.4798128816	29.4639977893	1199.34318685	6
dispensaire		0.4797111915	29.468554419	1211.05345396	4
centre_de_sante		0.4794261	29.4686407		
dispensaire		0.4793502	29.443754	1144.2	
dispensaire		0.47768913	29.4812416	1267	5
dispensaire		0.4772868	29.4555966		
centre_de_sante		0.477178362	29.4590206917	1188.05752561	4
dispensaire		0.4770596175	29.4898364289	1196.75375918	4
dispensaire		0.4768290298	29.4554606436	1166.00744565	4
dispensaire		0.4755860391	29.4597073592	1181.55793439	4
dispensaire		0.475092	29.441197	1139.835815	
dispensaire		0.474585	29.441398	1138.200562	
dispensaire		0.4735979	29.47628118	1286	3
dispensaire		0.473423	29.439309	1156.585449	
centre_de_sante		0.47040886	29.4702697	1267	3
dispensaire		0.46627864	29.47158123	1287	3
dispensaire		0.4650574	29.4601391		


Places of worship
Adventist
Anglican
Catholic
Jehovah Witness
Kimbanguist
Muslim
Protestant
Réveil
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16
18
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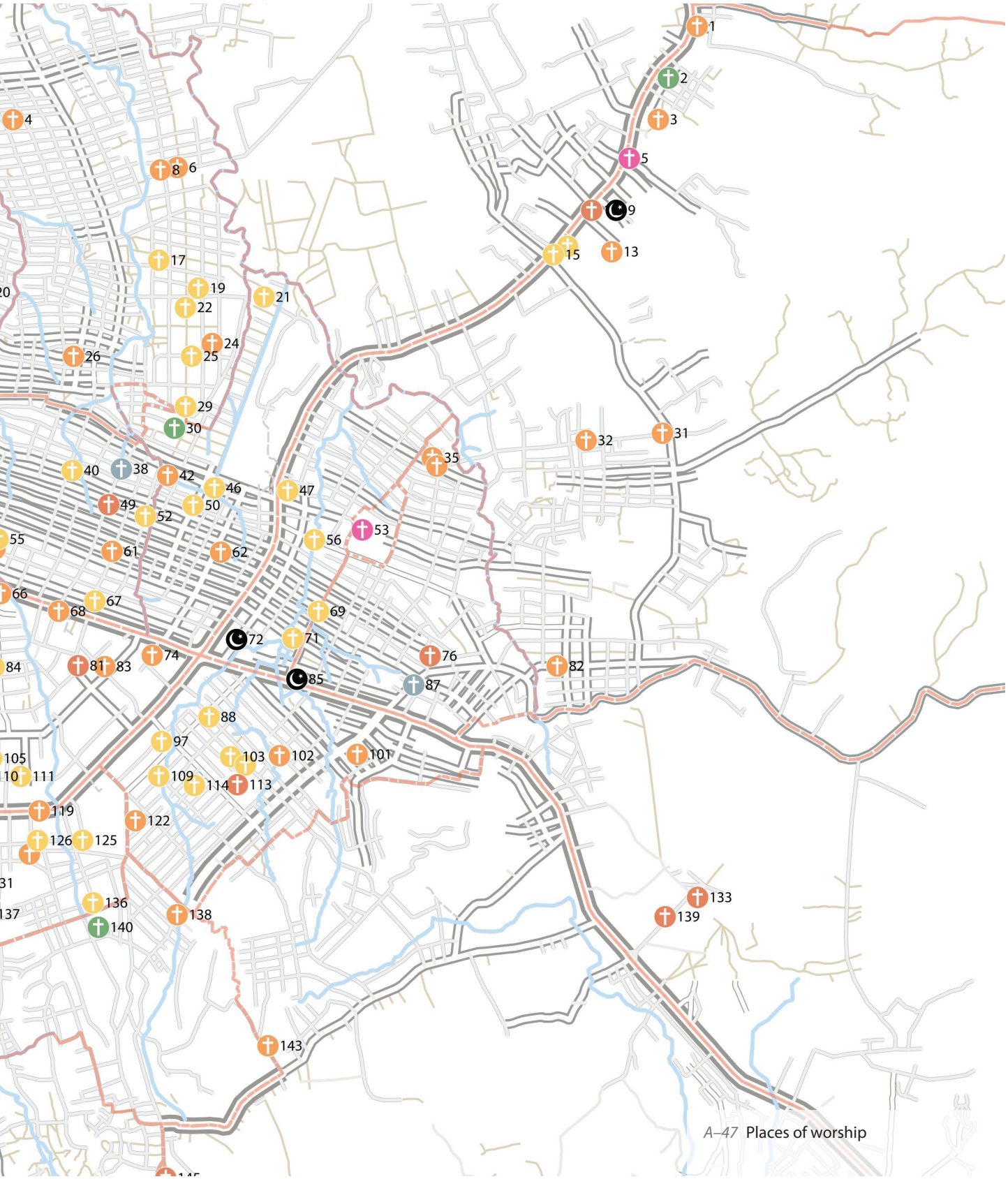


A–47 Places of worship

Table A–04 Places of worship metadata

id	start	enumerator	name	type
	2014-10-14T13:36:34.779	william_ungyertho_uuci	Église CBCA	eglise
2	2014-10-14T12:51:02.145	micheline_nobikana	Église Adventiste	eglise
3	2014-10-14T12:10:43.071	micheline_nobikana	CECA 20 Boikene	eglise
4	2014-10-13T11:29:24.110	jacques_ageno	Église CBCA Macampage	eglise
5	2014-10-14T11:26:12.425	william_ungyertho_uuci	Église Anglicane	eglise
6	2014-10-13T12:53:58.401	pascal_kazindu	Église Uzima Tele	eglise
7	2014-10-13T10:33:31.826	puissance_mwendu	Ceca 20 Kangaembi	eglise
8	2014-10-13T10:01:20.503	pascal_kazindu	Celvie	eglise
9	2014-10-14T10:44:16.993	william_ungyertho_uuci	Mosquet Boikene	eglise
10	2014-10-14T10:28:50.283	micheline_nobikana	Église catholique de Boikene Par-oisse Saint Gustave	eglise
11	2014-10-13T12:09:59.939	karl_tjongo_kamavu	Église	eglise
12	2014-10-14T09:58:21.701	william_ungyertho_uuci	Streams of Life Church	eglise
13	2014-10-14T10:19:22.964	william_ungyertho_uuci	Église CEPAC	eglise
14	2014-10-13T11:43:08.636	karl_tjongo_kamavu	Église Adventiste	eglise
15	2014-10-14T09:47:27.115	micheline_nobikana	Église Miel	eglise
16	2014-10-14T11:28:39.868	elisabeth_vanoverbeeke	Église de Fraternité	eglise
17	2014-10-13T12:33:50.739	ungale_kulesa	Communaute Pentecotiste	eglise
18	2014-10-14T13:50:14.697	celestin_kasereka	Église CBCA Paroisse de Ngongolio	eglise
19	2014-10-13T12:51:47.285	ungale_kulesa	FEPACO	eglise
20	2014-10-13T13:29:14.208	karl_tjongo_kamavu	Église du Dieu Vivant	eglise
21	2014-10-13T10:29:06.317	ungale_kulesa	Église Israel	eglise
22	2014-10-13T12:58:48.177	ungale_kulesa	Église Adventiste	eglise
23	2014-10-13T13:09:04.433	karl_tjongo_kamavu	Église catholique ngongolio	eglise
24	2014-10-13T13:18:07.372	ungale_kulesa	CECA 20	eglise
25	2014-10-13T13:33:37.253	ungale_kulesa	Église JLV	eglise
26	2014-10-13T14:19:09.618	karl_tjongo_kamavu	Église 8e Cepac Kalinda	eglise
27	2014-10-10T12:42:48.076	puissance_mwendu	Église catholique tamende kati	eglise
28	2014-10-14T14:16:19.200	celestin_kasereka	Eglise Pentecotiste du Congo la Puissance de Dieu	eglise
29	2014-10-13T13:57:06.466	ungale_kulesa	Temple du Grand Roi	eglise
30	2014-10-13T14:13:30.756	gloria_najangusi_	Église Adventiste	eglise
31	2014-10-14T10:48:43.925	pascal_kazindu	Église Chrisco	eglise
32	2014-10-14T11:05:14.149	pascal_kazindu	École Primaire Mabambila	eglise
33	2014-10-13T12:00:00		Église Chrisco	eglise
34	2014-10-14T10:22:46		Maison de Prière	eglise
35	2014-10-14T12:03:39.117	muyisa_kombi	Ceca Kasabi	eglise
36	2014-10-13T10:06:38		Église Adventiste	eglise
37	2014-10-14T11:59:10.064	jacques_ageno	Église Evangelique des Rachetes du Seigneur	eglise
38	2014-10-13T11:38:15.768	lewe_mobedra_netuta	Jehova witness Room	eglise

type_eglise	other_eglise	latitude	longitude	elevation	precision
protestant		0.5238345229	29.4959122686	1104.82563853	4
eglise_autre	adventiste	0.5213366361	29.4945286742	1105.50648834	4
protestant		0.5193444186	29.4940420962	1132.45474735	4
protestant		0.5193365395	29.4629769148	1101.58874223	6
eglise_autre	anglicane	0.5174778857	29.49264644	1125.00134247	4
protestant		0.5170382276	29.4708873647	1094.68532066	6
protestant		0.5170132885	29.4570852251	1102.14613306	6
protestant		0.5169200707	29.4700779146	1098.68841241	6
musulam		0.5149771297	29.4920146982	1141.79604666	4
catholique		0.5149755424	29.4908327967	1153.28360884	4
reveil		0.5136713647	29.458278296	1082.84109119	4
reveil		0.5132446206	29.4896762469	1151.61615581	4
protestant		0.5129828867	29.4918024818	1134.62391917	4
protestant		0.5129604881	29.4597638077	1088.84778391	4
reveil		0.5128395067	29.4889904911	1142.00030883	4
protestant		0.51265381	29.45516319	1128	5
reveil		0.5125758969	29.4699968093	915.129142394	4
protestant		0.51144974	29.45307738	1089	5
reveil		0.5112314805	29.4718980122	1123.48762123	6
reveil		0.5110341774	29.4615488522	1103.99464729	4
reveil		0.510803268	29.4750600167	1106.86980486	4
reveil		0.5103018709	29.4712774239	1104.9764075	4
catholique		0.5088326429	29.4575526187	1106.4492932	4
protestant		0.5085656991	29.472565685	1053.14351317	4
reveil		0.5079569448	29.4715750584	1129.14186206	4
protestant		0.5079518782	29.4658942255	1118.90011916	4
catholique		0.5079339725	29.4576350603	1114.28965063	6
protestant		0.5068465	29.4536966	1090	4
reveil		0.5055316065	29.4712858608	1112.1951869	4
eglise_autre	adventiste	0.50449314	29.4707505476	1116.061968	4
protestant		0.5042512572	29.4942413403	1160.03296288	6
protestant		0.5039035759	29.4905652906	1152.70139827	6
		0.503546	29.449145	1116.59436	
		0.503456	29.490563	1165.918213	
protestant		0.5030674351	29.4831645859	1141.00780259	6
eglise_autre	adventiste	0.502995	29.452682	1119.1073	
protestant		0.5026687	29.4833844728	1146.17235234	4
eglise_autre	temoins_de_jehovah	0.5025284453	29.4681930041	1115.18645444	6

39	2014-10-10T12:17:09.827	ungale_kulesa	CECA 20	eglise
40	2014-10-10T11:55:07.177	jacques_ageno	Assemblee Chrétienne Maranatha	eglise
41	2014-10-13T10:53:42.025	junior_mukuka	Eglise CECA Tamende	eglise
42	2014-10-13T11:25:23.549	lewe_mobedra_netuta	Église 8e CEPAC Hermon Beni	eglise
43	2014-10-13T15:50:47.213	william_ungyertho_uuci	Eglise Adventiste Tambere	eglise
44	2014-10-13T11:01:35		Église Catholique de Kanzuli	eglise
45	2014-10-13T10:36:17.080	celestin_kasereka	Église Anglicaine du Congo Paroise Tamende	eglise
46	2014-10-13T11:06:34.278	lewe_mobedra_netuta	Église Bima	eglise
47	2014-10-14T13:26:42.932	sagesse_ndaliko	La Manne du Ciel	eglise
48	2014-10-10T13:08:37.356	jacques_ageno	Église Catholique Butsili	eglise
49	2014-10-13T11:44:21.588	lewe_mobedra_netuta	Église Catholique de Tamende	eglise
50	2014-10-13T11:14:39.808	lewe_mobedra_netuta	Église Combat Spirituel	eglise
51	2014-10-10T13:05:08.202	puissance_mwendu	NULL	eglise
52	2014-10-13T11:56:31.092	lewe_mobedra_netuta	Église Jesus Christ le Seul Sauveur	eglise
53	2014-10-14T09:17:03.797	jacques_ageno	Église Anglicane Kasabi	eglise
54	2014-09-18T07:34:33		SEPAC	eglise
55	2014-10-13T10:07:55.031	junior_mukuka	Church of God World Mission	eglise
56	2013-01-04T05:38:19.144	stephen_salama	Aglise Assemblee des Saints	eglise
57	2014-09-18T07:28:09		Shirika Ndindi	eglise
58	2014-09-18T08:22:48		CECA 20	eglise
59	2014-09-18T07:23:04		Maisonde Royaume Temoin De Jehovah	eglise
60	2014-10-13T10:05:20.422	junior_mukuka	Assemblee Evangelique des Pentecotistes Unis	eglise
61	2014-10-13T11:50:20.076	celestin_kasereka	Église CBCA Tamende	eglise
62	2014-10-13T10:11:23.343	lewe_mobedra_netuta	Church CECA 20 Mabakanga Matonge	eglise
63	2014-09-15T12:52:42		Bethlehem Church	eglise
64	2014-10-10T12:33:04.188	jacques_ageno	Eglise Kimbanguiste	eglise
65	2014-09-18T08:14:02		Shirika Catolique De Mabako	eglise
66	2014-09-15T13:40:29		Église Missionnaire De Pentecote Bethlehem Emipebe	eglise
67	2014-10-13T13:30:08.677	lewe_mobedra_netuta	Mission Evangelique pour le Sauvetage	eglise
68	2014-09-15T13:48:54		Église Francophone CBCA	eglise
69	2013-01-04T04:30:56.399	stephen_salama	Église des Freres	eglise
70	2014-09-15T12:33:36		45e CEP Communauté Evangelique De Pentecote	eglise
71	2013-01-04T04:41:15.018	archip_lobo	Église JCSS Yesu ni Jibu	eglise
72	2013-01-04T00:54:11.802	archip_lobo	Mosque	eglise
73	2014-09-16T10:52:25		Full Gospel Church	eglise
74	2014-10-10T09:28:38.271	rebecca_eliane	Gospel Beni	eglise
75	2014-09-15T13:29:59		Église des Frères	eglise

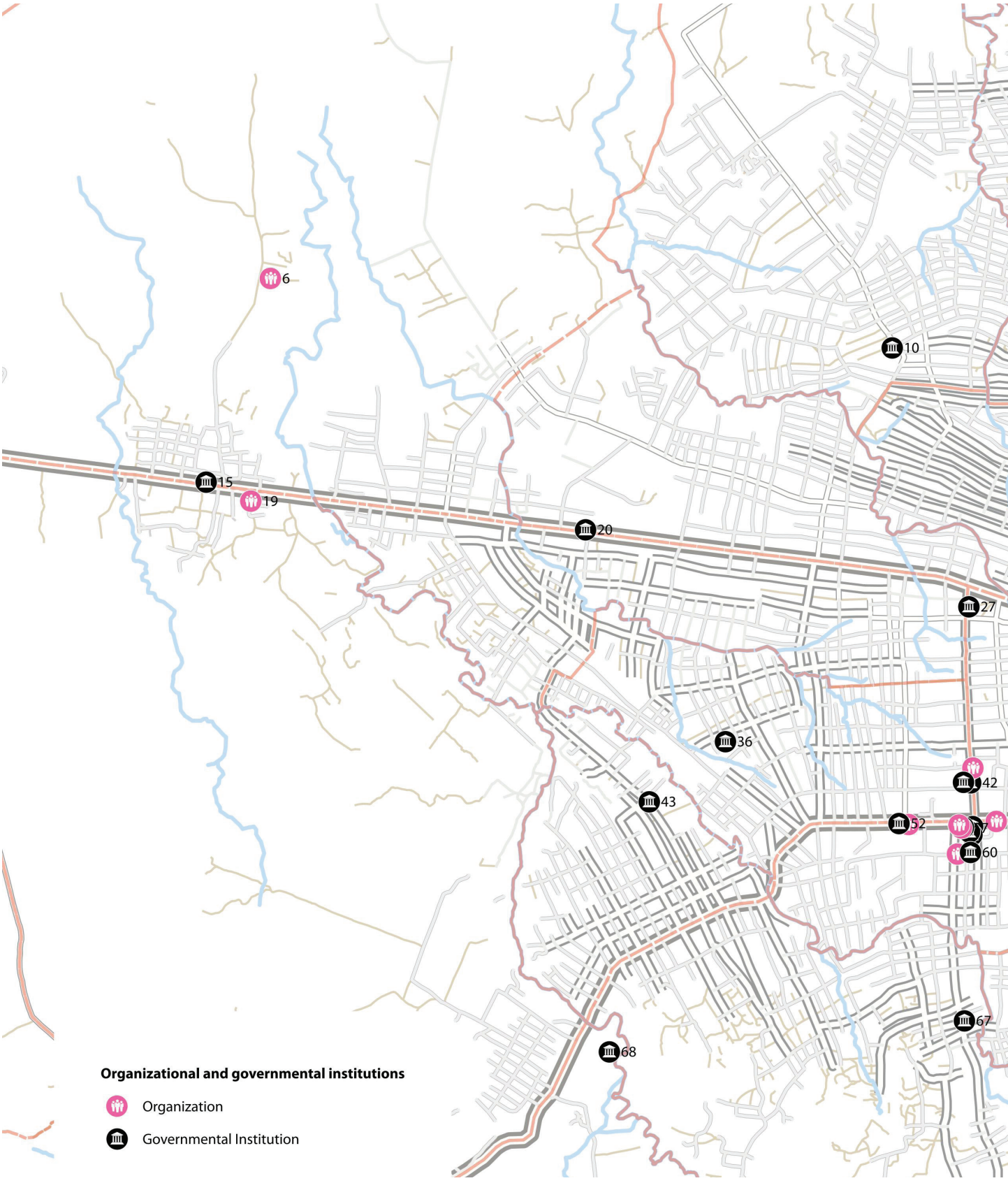
protestant		0.5025168875	29.4268047327	1083.58430682	4
reveil		0.50245505	29.4658287011	1119.10348361	6
protestant		0.50242454	29.46058274	1123.19995117	5
protestant		0.5022165457	29.4704245392	1118.41180471	6
eglise_autre	adventiste	0.501882347	29.437061078	1084.7309752	4
catholique		0.501781	29.451527	1122.589722	
eglise_autre	anglicane	0.50175215	29.45909124	1125.5	5
reveil		0.5016174317	29.4726757562	1128.79794702	6
reveil		0.5014881035	29.4762037715	1088.5443352	24
catholique		0.5013038816	29.4599756219	1125.06671196	6
catholique		0.5008106006	29.4675842765	1126.8924187	6
reveil		0.5007848708	29.4716502989	1130.30458592	6
NULL		0.500598303	29.4549461021	1116.61340995	6
reveil		0.5002542074	29.469353468	1128.75417553	6
eglise_autre	anglicane	0.4995990681	29.4797959285	1096.17239414	4
protestant		0.49922645	29.43681	1108.6	
reveil		0.49915106	29.46225184	1132.59997559	3
reveil		0.4991206199	29.4774899843	1122.38027782	4
NULL		0.49910668	29.434776	1106	
protestant		0.49893746	29.443707	1114.3	
eglise_autre		0.49891222	29.436026	1103.5	
protestant		0.49868738	29.46210867	1128	2
protestant		0.4985662	29.46774561	1146.40002441	5
protestant		0.4985275845	29.4729757894	1137.26041146	4
reveil		0.4975634	29.459414	1134.6	
kimbanguiste		0.4974654248	29.4610428451	1129.02579645	6
catholique		0.49713188	29.446463	1116.4	
protestant		0.49653286	29.46238	1132.2	
reveil		0.4961752972	29.4669184125	1141.36529724	4
protestant		0.49568403	29.46518	1142.2	
reveil		0.495678179	29.477681391	1134.69018108	4
NULL		0.49495828	29.461807	1141.3	
reveil		0.4943835843	29.4764540689	1139.68184089	4
musulam		0.494324629	29.4737418746	1147.60314383	8
NULL		0.49359685	29.469702	1155.1	
protestant		0.4935643282	29.4696801506	1148.38479542	4
NULL		0.49354285	29.460815	1135.4	

76	2013-01-04T03:06:23.096	stephen_salama	Église Calvari	eglise
77	2014-09-18T07:48:19		CBCA	eglise
78	2013-01-01T05:43:32.613	stephen_salama	Église Catholique Mulokou	eglise
79	2014-09-16T09:40:18		Église Catholique	eglise
80	2014-09-16T09:40:18		Église Catholique	eglise
81	2014-09-15T14:07:53		Église Unite Chretienne	eglise
82	2014-10-14T10:05:46.877	puissance_mwendu	CECA 20	eglise
83	2014-09-15T14:10:30		Église Francophone CECA 20	eglise
84	2014-09-15T12:22:55		Église Chretienne Evangelique Au Congo	eglise
85	2013-01-04T02:01:54.410	stephen_salama	Mosquee Al Djaamia	eglise
86	2014-09-15T14:12:57		Fepaco Nzambe Malamu	eglise
87	2014-10-14T09:00:52.589	puissance_mwendu	Salle du Royaume des Temoins de Jehovah	eglise
88	2014-10-09T11:34:22.329	junior_mukuka	Église Chrisco Malepe	eglise
89	2014-10-10T09:02:55		Église CELPA Paroise Baraka Beni	eglise
89	2014-09-16T10:43:27		Église Foi Audacieuse Internation-ale	eglise
90			Église Sanctification	eglise
91	2014-09-16T09:46:49		Église CECA 20	eglise
92	2014-10-10T14:47:23.100	william_ungyertho_uuci	8-ième CEPAC Église Locale Baraka	eglise
93			Eglise Fepaco Malepe	eglise
94			Chrisco Malepe	eglise
95	2014-09-15T11:58:41		JSS	eglise
96	2014-09-16T10:16:33		Église Armée Spirituelle	eglise
97	2014-10-09T09:41:23.932	bora_mukovi	Église de la Vision de Rehoboth	eglise
98	2014-10-10T10:55:14.789	junior_mukuka	Église Mebei	eglise
99	2014-09-16T09:50:17		Église de Reveil au Congo	eglise
100	2014-09-16T09:13:25		Église Ceresh	eglise
101	2014-10-08T10:27:36.167	nadia_kavira	Église CECA 20 Mupanda	eglise
102	2014-10-09T12:14:20.178	junior_mukuka	Église CEPAC Centre Sayuni Malepe	eglise
103	2014-10-09T11:21:05.827	junior_mukuka	Église Corps de Christ Malepe	eglise
104			Eglise Corps du Christ Malepe	eglise
105	2014-09-15T11:34:34		Église Fepaco Nzambe Malamu	eglise
106	2014-09-15T11:34:34		Église Fepaco Nzambe Malamu	eglise
107	2014-09-15T11:43:48		Église Des Assemlees De Dieu Arche De L'alliance	eglise
108	2014-10-09T11:01:06.612	celestin_kasereka	Cellule Makedonia Malepe	eglise
109	2014-10-09T13:35:15.010	ungale_kulesa	Assemblee des Mesagers de Jesus	eglise
110	2014-09-15T11:29:02		Aumonerie Protestante	eglise
111	2014-09-16T10:32:06		Streams Of Life Church	eglise
112	2014-09-16T10:06:38		Église Neoapostolique	eglise
113	2014-10-09T10:25:48.143	celestin_kasereka	Cathedrale de Malepe	eglise

catholique		0.4935347943	29.483057593	1175.06687144	4
NULL		0.49349728	29.438967	1114.8	
catholique		0.493329518	29.4459751787	1110.981522	4
catholique		0.4931489	29.451813	1117.7	
catholique		0.4931489	29.451813	1117.7	
catholique		0.49306393	29.466112	1147	
protestant		0.4930469822	29.4891759862	1157.691963	6
protestant		0.4930225	29.46739	1152.4	
reveil		0.49299362	29.462072	1153.1	
musulam		0.4924136381	29.4766454177	1147.7005666	4
NULL		0.49222958	29.467245	1150.6	
eglise_autre	temoins_de_jehovah	0.4921363925	29.4822692859	1169.2590105	6
reveil		0.49059742	29.47241678	1160.90002441	5
NULL		0.490547	29.459967	1162.716797	
NULL		0.49052778	29.467981	1170.8	
NULL		0.4904491	29.4773674		
protestant		0.49039912	29.45128	1124.9	
reveil		0.4903005981	29.4495558447	1123.55127365	4
		0.4899994	29.4735765		
		0.4898817	29.4724159		
reveil		0.48974174	29.459011	1156.1	
reveil		0.48953292	29.457695	1157.5	
reveil		0.4894166255	29.4701334808	1165.72606618	4
reveil		0.48918214	29.44443093	1119.40002441	4
reveil		0.48917073	29.452038	1131.7	
reveil		0.48893464	29.450005	1125.4	
protestant		0.4887962732	29.4795514091	1182.1604089	6
protestant		0.48873247	29.47580524	1173	4
reveil		0.48868638	29.47344847	1166.30004883	4
		0.4886832	29.4734492		
reveil		0.48860228	29.461956	1171.6	
reveil		0.48860228	29.461956	1171.6	
protestant		0.4883698	29.459946	1167	
reveil		0.48828284	29.47416145	1174.80004883	4
reveil		0.487750523	29.4699972809	1161.77981353	4
protestant		0.48773944	29.461565	1171.8	
reveil		0.48773742	29.463346	1170.2	
NULL		0.48757643	29.454708	1147.5	
catholique		0.4873377	29.47378122	1190.90002441	10

114	2014-10-09T14:56:37.478	gloria_najangusi_	Église La Louange	eglise
115	2014-09-16T10:36:16		Église Chrisco	eglise
116	2014-09-16T10:00:20		EEPD	eglise
117	2014-09-16T08:05:07		Église Catholique	eglise
118	2014-10-10T10:30:45.845	karl_tjongo_kamavu	Église Adventiste de Mabolio	eglise
119	2014-10-09T14:33:07.074	karl_tjongo_kamavu	Centre de Diffusion de la Bible Beni	eglise
120	2014-10-09T15:01:31.175	william_ungyertho_uuci	Mosquet An-nuur	eglise
121	2014-10-09T15:16:30.120	micheline_nobikana	CEPC Paroisse Jerusalem	eglise
122	2014-10-09T13:49:35.457	bora_mukovi	39 Communauté Emmanuel	eglise
123	2014-10-09T14:31:41.537	william_ungyertho_uuci	Église Catholique Beni-cité	eglise
124	2014-09-16T08:00:48		Église Sayuni	eglise
125	2014-10-09T10:05:07.078	karl_tjongo_kamavu	Église Jesus de Toute Suffisance	eglise
126	2014-10-09T13:38:25.298	karl_tjongo_kamavu	Église de la Restauration	eglise
127	2014-10-09T13:57:45.356	karl_tjongo_kamavu	Église Francophone 8e CEPAC	eglise
128	2014-10-09T12:57:01.802	micheline_nobikana	Église de Maman Sarah	eglise
129	2014-10-10T12:59:12.042	karl_tjongo_kamavu	Eglise Catholique de Mabolio	eglise
130	2014-10-09T11:54:20.782	karl_tjongo_kamavu	Ministere International d'Evangelisation Commandos de Jesus Christ	eglise
131	2014-10-09T11:49:27.579	karl_tjongo_kamavu	Salle de Royaume des Temoins de Jehovah	eglise
132	2014-10-10T09:35:29.810	junior_mukuka	CECA 20 Mabolio	eglise
133	2014-10-14T11:18:31.128	lewe_mobedra_netuta	Église Catholique Saint Gustave Beni PAIDA	eglise
134	2014-10-09T16:13:21.452	william_ungyertho_uuci	Église Safina	eglise
135	2014-10-10T10:02:30.800	karl_tjongo_kamavu	Église Mont Golgotha	eglise
136	2014-10-09T10:51:42.732	karl_tjongo_kamavu	ACG	eglise
137	2014-10-09T11:13:34.771	karl_tjongo_kamavu	CBCA Vingazi	eglise
138	2014-10-09T15:57:22.658	bora_mukovi	Communaute Baptiste au Congo-Est	eglise
139	2014-10-14T12:35:37.575	lewe_mobedra_netuta	Bureau de Coordination Diocesaine Convatione Catholique	eglise
140	2014-10-09T11:18:35.567	jacques_ageno	Église Assemblee Chretienne	eglise
141	2014-10-10T12:39:51.403	karl_tjongo_kamavu	Assemblee Chrétienne Jesus Christ est Vivant	eglise
142	2014-10-09T12:10:30.231	puissance_mwendu	Assemble des Messagers de Jesus Christ	eglise
143	2014-10-09T12:25:41.206	thierry_babonye	CBCA Rwangoma	eglise
144	2014-10-09T11:58:34.651	elisabeth_vanoverbeeke	Salle du Royaume des Temoins de Jehovah	eglise
145	2014-10-09T13:18:09.840	elisabeth_vanoverbeeke	Église Kimbwa	eglise
146	2014-10-09T13:25:58.184	elisabeth_vanoverbeeke	Église Advantiste Kalongo	eglise

reveil		0.4873035861	29.4717093487	1172.33517372	4
NULL		0.48724163	29.464994	1163.3	
reveil		0.48715577	29.451118	1133.7	
catholique		0.48661116	29.450914	1132.5	
protestant		0.4861688967	29.4462346244	1120.52572599	4
protestant		0.4860747354	29.4642440036	1172.57396813	4
musulam		0.4857999675	29.4542407822	1154.02852748	4
protestant		0.4857294957	29.4534955142	1147.94160001	4
protestant		0.485603067	29.4688724679	1182.22445292	4
catholique		0.4851207827	29.4559607107	1157.76803789	4
NULL		0.48510462	29.450861	1136.2	
reveil		0.4846624667	29.4663291713	1178.27366439	4
reveil		0.4846532274	29.4641630446	1175.8722238	4
protestant		0.4839996282	29.4637678048	1175.98618214	4
reveil		0.4834462879	29.4593607514	1165.10541597	4
catholique		0.4830067923	29.4440472502	1139.22971505	4
reveil		0.4828048581	29.4606339982	1168.96452196	4
reveil		0.4825974132	29.4613658231	1170.3352422	4
protestant		0.4824916	29.44918242	1132.40002441	5
catholique		0.4819139712	29.4959337566	1203.26274484	6
reveil		0.4818304724	29.4509418396	1138.09987291	4
reveil		0.4818258761	29.4483415252	1139.80278324	4
reveil		0.4816546536	29.4668285219	1170.49692912	4
protestant		0.4811081486	29.4616463609	1171.20540873	4
protestant		0.4810789157	29.4708800701	1185.2176569	6
catholique		0.4809844934	29.4943698577	1193.73603767	6
eglise_autre	adventiste	0.4804765598	29.4670888957	1209.96082184	6
reveil		0.480042489	29.4436737482	1133.3765812	4
protestant		0.4770629881	29.4553989935	1168.13759657	4
protestant		0.4747752245	29.4752504375	1297.58703849	6
eglise_autre		0.474004	29.47723628	1279	3
catholique		0.46840662	29.47033132	1271	4
protestant		0.46675858	29.4711995	1284	3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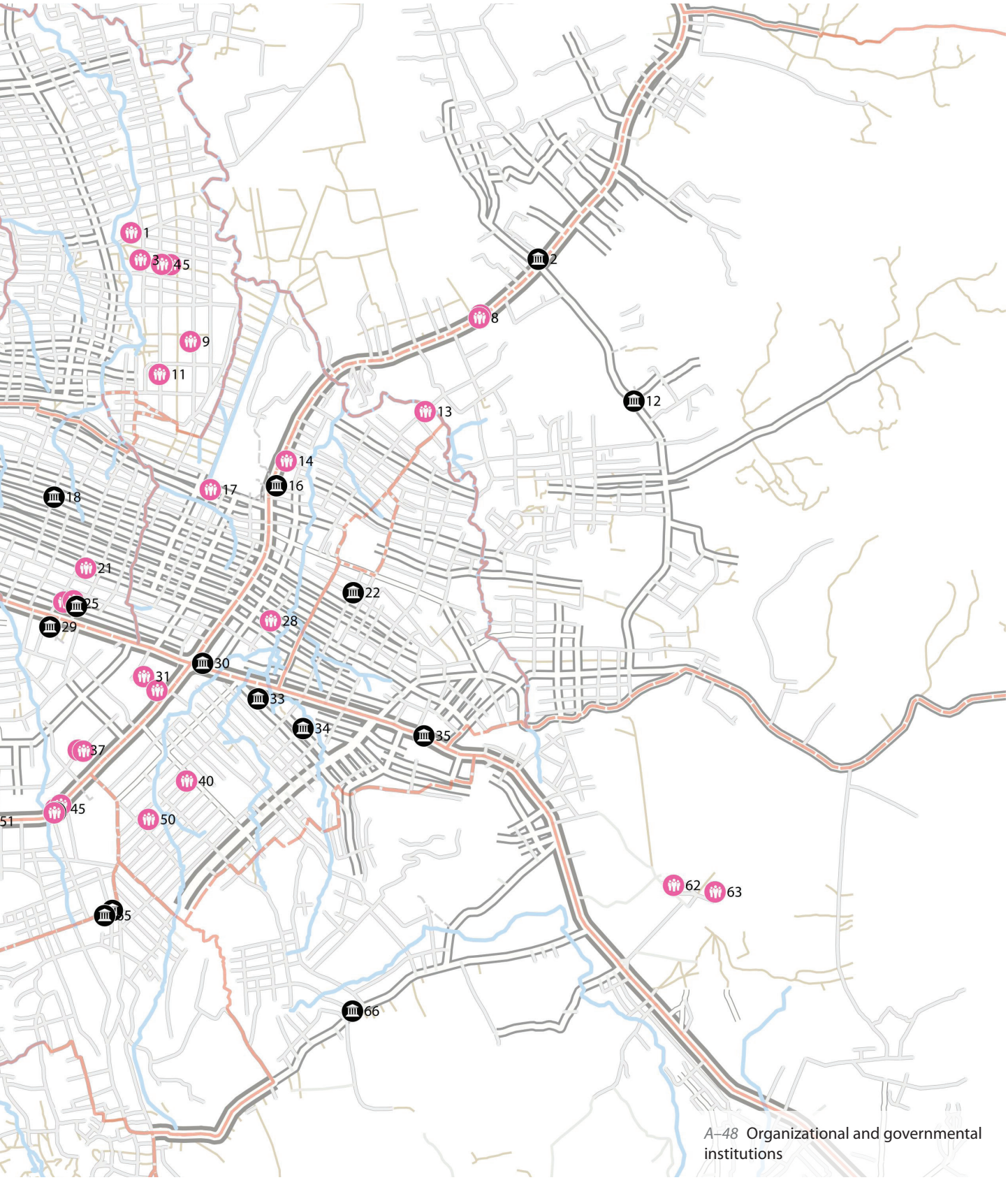
Organizational and governmental institutions
Organization
Governmental Institution



A–48 Organizational and governmental institutions

Table A–05 Organizational and governmental institutions metadata

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1	2014-10-13T12:00:03.447	ungale_kulesa	ONG Misere Sors	organisation
2	2013-01-05T05:45:52.466	stephen_salama	Bureau du quartier Masiani	gouvernementale
3	2014-10-13T12:25:25.718	ungale_kulesa	Sonetrans	organisation
4	2014-10-13T12:30:52.010	ungale_kulesa	Kami HSS	organisation
5	2014-10-13T12:39:18.180	ungale_kulesa	OEIL	organisation
6	2014-10-10T13:08:49.159	bora_mukovi	ACODEA	organisation
7	2014-10-14T10:14:23.336	pascal_kazindu	NEP BATT Monusco	organisation
8	2014-10-14T10:12:45.131	pascal_kazindu	Sinohydro	organisation
9	2014-10-13T13:27:52.609	ungale_kulesa	ESADER	organisation
10	2014-10-14T10:07:40.376	elisabeth_vanoverbeeke	Bureau du Quarter Ngongolio	gouvernementale
11	2014-10-13T13:43:27.876	ungale_kulesa	CEPAC	organisation
12	2014-10-14T11:51:01.633	karl_tjongo_kamavu	Bureau Quartier Boikene	gouvernementale
13	2014-10-14T12:15:42.206	jacques_ageno	Top Sig-Beni	organisation
14	2014-10-14T13:17:38.902	muyisa_kombi	PAP-RDC	organisation
15	2014-10-10T14:11:22.103	bora_mukovi	Bureau de la Population	gouvernementale
16	2014-10-14T13:21:46.676	jacques_ageno	Gmi-Beni	gouvernementale
17	2014-10-13T11:00:29.887	lewe_mobedra_netuta	Marche des Bois	organisation
18	2014-10-13T11:26:47.810	celestin_kasereka	Bureau Starec	gouvernementale
19	2014-10-10T12:06:32.921	ungale_kulesa	Tout Jeune	organisation
20	2014-10-13T10:08:10.906	micheline_nobikana	Bureau de Quatier Butsili	gouvernementale
21	2014-10-10T10:09:54.035	jacques_ageno	Comunity Hope Action Ministry	organisation
22	2013-01-04T04:06:14.496	stephen_salama	Bureau Quartier Kasabinyole	gouvernementale
23	2014-10-10T09:44:34.692	jacques_ageno	Bureau Peace and Development: Public Recreation Center	organisation
24	2014-10-13T09:50:55.028	junior_mukuka	Bureau Parlement Enfant	organisation
25	2014-10-13T13:25:42.621	lewe_mobedra_netuta	Bureau du quartier Tamende	gouvernementale
26	2014-10-13T09:29:05.919	junior_mukuka	Affaire Sociale Fardc	gouvernementale
27	2014-09-15T13:17:33		Bureau Quartier Residentiel	gouvernementale
28	2013-01-04T04:57:05.494	archip_lobo	Comite International Geneve	organisation
29	2014-10-10T10:09:36.359	pascal_kazindu	Bureau Commune Bungulu	gouvernementale
30	2013-01-04T00:46:11.124	stephen_salama	Institut National de Securite Social	gouvernementale
31	2014-10-10T09:24:19.152	rachel_muvuya	LWF	organisation
32	2014-10-10T09:16:53.814	pascal_kazindu	BCDC	organisation
33	2014-10-09T13:11:35.184	junior_mukuka	Bureau Quartier Malepe	gouvernementale
34	2014-10-14T10:34:15		Bureau Quartier Malepe	gouvernementale
35	2014-10-14T13:16:25.604	puissance_mwendu	Direction Generale de Douane et Assise	gouvernementale
36	2014-09-16T08:06:57		Bureau Quartier Cite Belge	gouvernementale

type_org	type_gov	latitude	longitude	elevation	precision
ong		0.5142804178	29.4691000464	1091.34319384	6
	administration_publique	0.5130155268	29.4886776771	1142.61263844	6
ong		0.5129709196	29.4695401474	1112.74395311	6
ong		0.5127608868	29.4705762499	1103.92976169	6
ong		0.5127447412	29.4710059171	1102.01415444	6
ong		0.5120873599	29.4272977001	1079.65321402	6
ong		0.5103254778	29.4859185488	1142.09003319	4
ong		0.5101895013	29.4858481317	1138.4775809	8
ong		0.5090486874	29.471951645	1103.41825279	6
	administration_publique	0.50875248	29.45719061	1115	5
ong		0.5074720925	29.4704595215	1117.08727852	4
	administration_publique	0.506193	29.4932867789	1153.90605237	4
entreprise		0.5056840438	29.4832499366	1150.29061544	4
ong		0.503304437	29.4765654782	1148.89497047	8
	administration_publique	0.5023011094	29.4241989907	1081.23310039	6
	bureau_de_police	0.5021222781	29.4760884747	1073.19410043	16
entreprise		0.5019301916	29.4729132782	1134.95232257	6
	administration_publique	0.50157695	29.46538978	1131.80004883	5
entreprise		0.5013843618	29.4263560031	1082.93876503	6
	administration_publique	0.5000088538	29.4424431171	1094.77140011	4
ong		0.4981543826	29.4669208012	1143.33944418	4
	administration_publique	0.4969801395	29.4797819112	1146.82795975	4
ong		0.4965862072	29.4663301495	1146.25364091	4
ong		0.49652252	29.46586839	1147.59997559	5
	administration_publique	0.4964593811	29.4662531378	1137.8994806	6
	administration_publique	0.49632255	29.46647303	1151.5	4
	administration_publique	0.49630877	29.460876	1140.5	
ong		0.4956216886	29.4758120296	1142.44792979	4
	judiciaire	0.495334418	29.4651881559	1168.66726827	8
	administration_publique	0.4935846004	29.4725382391	1151.85468352	4
ong		0.492943541	29.4697068301	1148.58039947	4
entreprise		0.4922706778	29.4703515372	1155.39935664	6
	administration_publique	0.49187646	29.47520491	1157	4
	administration_publique	0.4904491	29.4773674	1159.485962	
	administration_publique	0.4900956216	29.4831838419	1204.54755924	6
	administration_publique	0.48982462	29.44917	1129.6	

37	2014-09-15T13:19:52		Programme D'action Le Dev. Soutenable Et Bureau Humanitas Afrique	organisation
38	2014-09-15T13:21:31		Oxfam	organisation
39	2014-09-15T12:40:14		Police Speciale pour la Protection de l'Enfant et de la Femme	organisation
40	2014-10-09T14:12:05.777	ungale_kulesa	Slfav	organisation
41	2014-09-15T11:39:24		Prison Pour Enfants Et Femmes	gouvernementale
42	2014-09-15T12:37:57		Prison Pour Mineurs	gouvernementale
43	2014-10-10T10:21:19.320	junior_mukuka	Bureau Quartier Mabolio	gouvernementale
44	2014-10-09T09:40:57.429	karl_tjongo_kamavu	Bureau Fenapec	organisation
45	2014-10-09T09:47:48.817	archip_lobo	Bureau Societé Civile	organisation
46	2014-10-09T15:04:56.482	karl_tjongo_kamavu	Galerie des Beaux Arts	organisation
47	2014-10-09T14:55:50.321	karl_tjongo_kamavu	Bureau Inspection Urbain du Travail	gouvernementale
48	2014-10-09T16:33:57.951	bora_mukovi	Min de l'emploi et Prevoyance Sociale	gouvernementale
49	2014-10-09T16:31:31.814	bora_mukovi	ASADHO	organisation
50	2014-10-09T14:21:19.797	gloria_najangusi_	ONG Medair	organisation
51	2014-10-09T13:06:54.936	karl_tjongo_kamavu	Régis de Distribution d'Eaux	organisation
52	2014-10-09T14:13:01.711	micheline_nobikana	Cabinet de Consultance	gouvernementale
53	2014-10-09T13:37:20.835	william_ungyertho_uuci	Heshima Letu ASBL	organisation
54	2014-10-09T12:34:16.474	karl_tjongo_kamavu	Garage Lwanzo Service	organisation
55	2014-10-09T12:57:40.370	karl_tjongo_kamavu	Hotel de Ville de Beni	gouvernementale
56	2014-10-09T12:40:00.442	karl_tjongo_kamavu	Bureau des Postes et Télécommunications	gouvernementale
57	2014-10-09T12:36:50.903	karl_tjongo_kamavu	Bureau Syndicale des Medecins	organisation
58	2014-10-09T12:46:47.084	karl_tjongo_kamavu	Service Urbain de Budjet	gouvernementale
59	2014-10-09T12:52:06.161	karl_tjongo_kamavu	Bureau Urbain de L'office Nationale de l'Emploie	gouvernementale
60	2014-10-09T12:13:37.974	karl_tjongo_kamavu	Direction Générale des Migrations	gouvernementale
61	2014-10-09T12:06:18.122	karl_tjongo_kamavu	Bureau Atamovobe	organisation
62	2014-10-14T12:01:24.309	lewe_mobedra_netuta	Couvant Priere PAIDA	organisation
63	2014-10-14T11:57:18.591	lewe_mobedra_netuta	Orfelinant Paida	organisation
64	2014-10-09T10:20:52.305	jacques_ageno	Bureau de Police	gouvernementale
65			Bureau Quartier Butanuka	gouvernementale
66	2014-10-09T11:26:50.926	elisabeth_vanoverbeeke	Bureau Quarter Rwangoma	gouvernementale
67	2014-10-09T13:54:32.960	puissance_mwendu	Bureau du Quartier	gouvernementale
68			Institution Bureau Commune	gouvernementale

NULL		0.48940426	29.466562	1165.5	
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	securitaire_renseignement	0.4878714	29.460617	1169.4	
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	administration_publique	0.48693388	29.44550742	1132.69995117	5
entreprise		0.4867678711	29.465718455	1152.43400696	8
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entreprise		0.4865778278	29.4654618709	1168.8726082	4
	administration_publique	0.4864403612	29.4654675692	1162.45151631	4
	administration_publique	0.4864227873	29.4654613292	1164.78427149	6
ong		0.4863907381	29.4654017876	1168.67312937	4
ong		0.4860755851	29.4699345276	1174.38634586	4
entreprise		0.485985866	29.462202508	1178.97132112	4
	judiciaire	0.4858892599	29.457515571	1171.68688326	4
asbl		0.4858377244	29.4579864722	1167.65946662	4
entreprise		0.4858117009	29.4604095357	1173.30329986	4
	hôtel_de_ville	0.4857437523	29.461057224	1179.56920451	4
	administration_publique	0.485704611	29.4606139547	1171.56110835	4
asbl		0.4856722294	29.4605285331	1169.57710497	4
	administration_publique	0.4854830438	29.4609047178	1185.35776179	4
	administration_publique	0.48534411	29.4610244894	1179.13591376	4
	administration_publique	0.4845020851	29.4609556107	1168.49572086	4
asbl		0.4844173346	29.4603352099	1164.46203533	4
asbl		0.4829071879	29.4952013676	1195.88217035	6
asbl		0.4825897876	29.4971976488	1199.49473395	6
	bureau_de_police	0.4817051429	29.4681955295	1195.61295385	4
	administration_publique	0.4814558	29.4678221		
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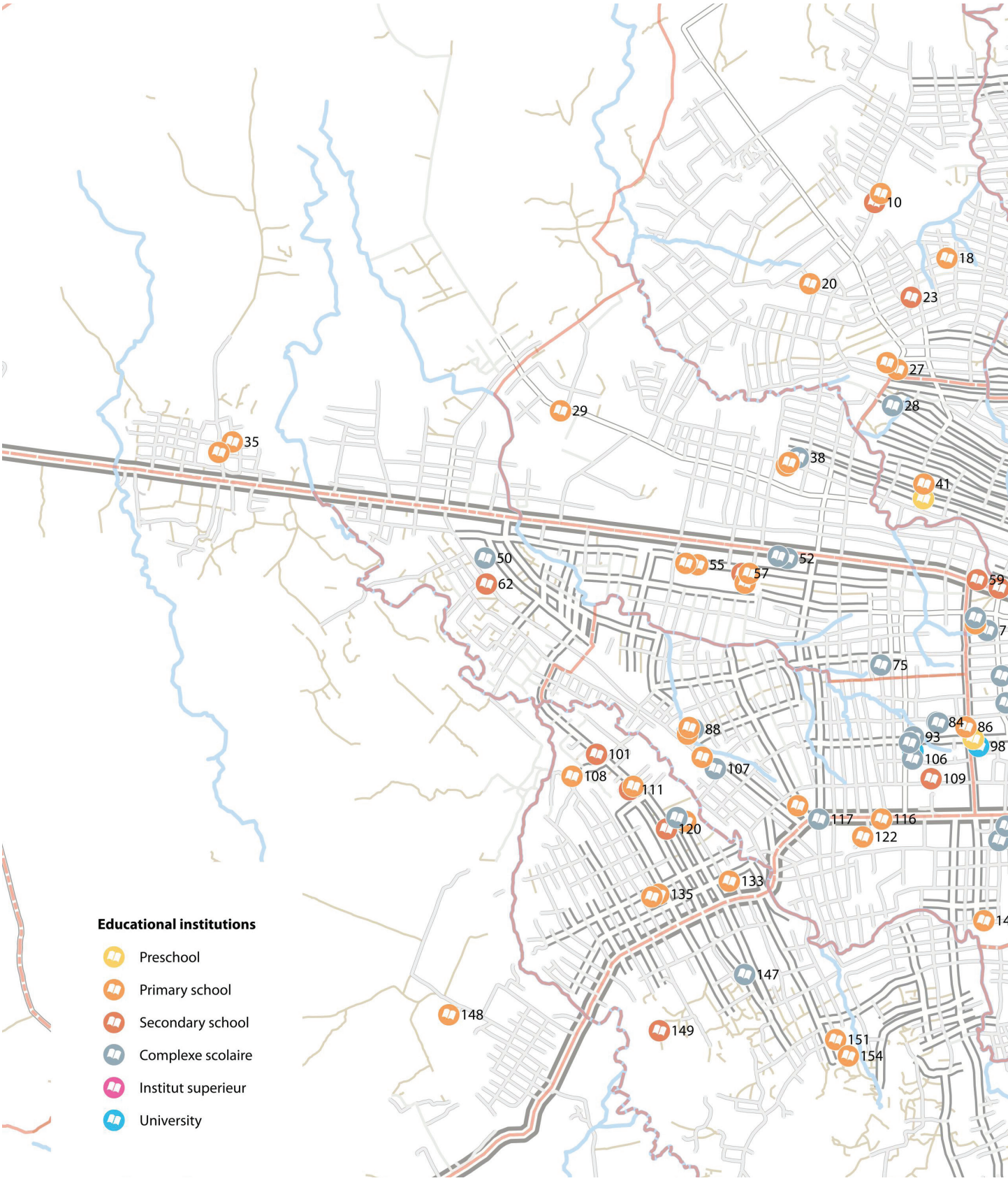
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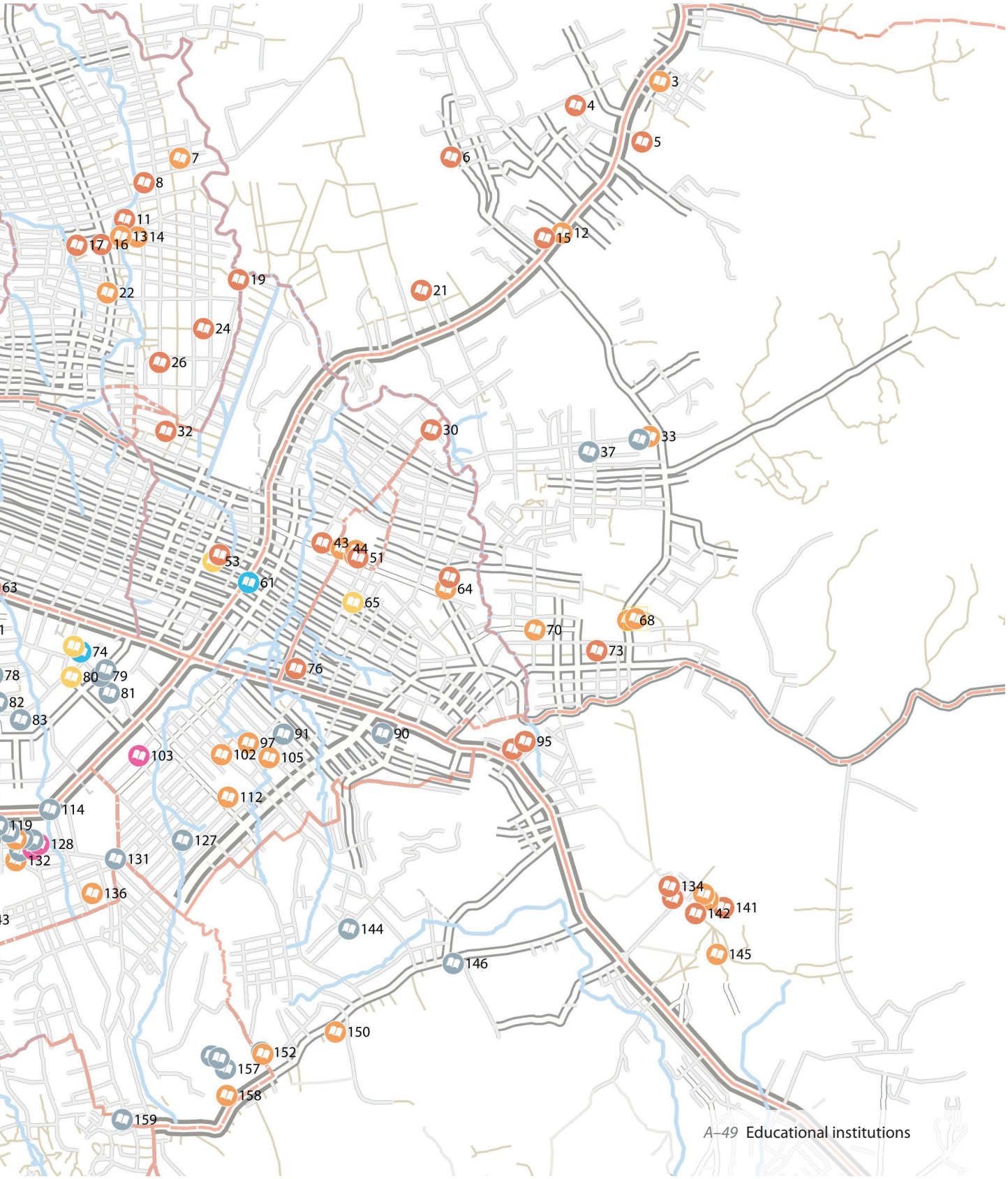
Educational institutions
Preschool
Primary school
Secondary school
Complexe scolaire
Institut superieur
University



A–49 Educational institutions

Table A–06 Educational institutions metadata

id	time	enumerator	name	type
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2			École Primaire Elimu	ecole
3	2014-10-14T12:48:37.846	william_ungyertho_uuci	École Primaire Tujenge	ecole
4	2013-01-05T04:11:41.670	nadia_kavira	Institut Tuha Utala	ecole
5	2014-10-14T11:53:49.364	micheline_nobikana	Institut Mabakanga	ecole
6	2013-01-05T06:08:39.811	stephen_salama	Complexe Scolaire JPN School	ecole
7	2014-10-13T12:50:53.971	pascal_kazindu	École Kolongo	ecole
8	2014-10-13T11:31:41.667	ungale_kulesa	Complexe Scolaire Musayi	ecole
9			École Primaire Kangaimbi	ecole
10	2014-10-13T10:16:11.248	puissance_mwendu	Institut Kangaimbi	ecole
11	2014-10-13T11:54:17.269	ungale_kulesa	École le Berceau	ecole
12	2014-10-14T10:07:54.524	william_ungyertho_uuci	Ecole Primaire de l'UCBC	ecole
13	2014-10-13T12:17:01.588	ungale_kulesa	École Primaire Nuria	ecole
14	2014-10-13T12:04:57.482	ungale_kulesa	Complexe scolaire Mathe	ecole
15	2013-01-05T05:50:32.276	stephen_salama	Institut Boikene	ecole
16	2014-10-13T10:22:43.895	karl_tjongo_kamavu	École Primaire Mapambazuko	ecole
17	2014-10-13T10:40:08.812	karl_tjongo_kamavu	Institut Mapambazuko	ecole
18	2014-10-13T11:47:15.315	karl_tjongo_kamavu	École Primaire Uwezo	ecole
19	2014-10-13T10:42:58.418	ungale_kulesa	Complexe Scolaire sauvetage	ecole
20	2014-10-14T13:52:56.222	elisabeth_vanoverbeeke	École Primaire Makampagne	ecole
21	2014-10-14T09:58:30.407	pascal_kazindu	Jardin de fleur	ecole
22	2014-10-13T10:13:40.939	karl_tjongo_kamavu	Complexe Scolaire Maadibisho Kalema	ecole
23	2014-10-13T12:51:54.192	karl_tjongo_kamavu	Complexe Scolaire Ndjoke	ecole
24	2014-10-13T13:12:02.735	ungale_kulesa	Complexe l'Avenir	ecole
25	2014-10-09T14:16:45.280	elisabeth_vanoverbeeke	École Primaire Kabalaka	ecole
26	2014-10-13T13:39:09.297	ungale_kulesa	Complexe Scolaire Patmos	ecole
27	2014-10-10T12:29:55.079	puissance_mwendu	École Primaire Kabalaka	ecole
28			Ecole CEPAC	ecole
29	2014-10-13T12:25:25.933	william_ungyertho_uuci	École Primaire Ntoni	ecole
30	2014-10-14T12:09:16.155	jacques_ageno	Complexe Scolaire Amkeni	ecole
31	2014-10-14T11:30:45.016	pascal_kazindu	École Primaire Kim	ecole
32	2014-10-13T14:16:32.561	gloria_najangusi_	Institut Ujasiri	ecole
33	2014-10-14T10:50:41.877	pascal_kazindu	École Primaire Mabathonzi	ecole
34	2014-10-14T10:03:39		Institut Malere	ecole
35	2014-10-10T12:23:38.778	ungale_kulesa	Sahuni	ecole
36	2014-10-10T12:31:16.585	ungale_kulesa	Kasanga	ecole
37	2014-10-14T10:16:55		Institut Mabambilia	ecole
38	2014-10-13T10:02:19		Institut Bahati	ecole
39	2014-10-13T10:40:10		École Primaire Tusonge Mbele	ecole
40	2014-10-13T10:20:43		École Primaire Butsili	ecole

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secondaire	0.5201181061	29.490494639	1125.78401379	4
secondaire	0.5183703891	29.4936959113	1129.22045761	4
secondaire	0.5176376864	29.484500021	1132.29115115	4
primaire	0.5175836424	29.4714488547	1095.55533804	6
secondaire	0.5164079644	29.4697236591	1080.00931218	6
primaire	0.5158956	29.4566367		
secondaire	0.5154677901	29.4563467655	1101.9592897	6
secondaire	0.514642071	29.4687864232	1088.46346472	4
primaire	0.5139874245	29.4898403212	1134.93765056	4
primaire	0.5138202476	29.4686014162	1104.47791487	4
primaire	0.5137980857	29.4694007793	1071.98797083	6
secondaire	0.5137490219	29.4889918611	1151.97553892	4
secondaire	0.5134323911	29.4676686385	1101.00361506	4
secondaire	0.5133948853	29.46648914	1093.56111811	4
primaire	0.5127891248	29.4598223136	1090.40361002	4
secondaire	0.511743071	29.4742701528	1108.94722176	4
primaire	0.51155739	29.45322841	1105	5
secondaire	0.5112230408	29.4830737211	1133.57981132	4
primaire	0.5111088029	29.4679588447	1112.363349	4
secondaire	0.5109084227	29.4580992795	1106.80350444	4
secondaire	0.5093846215	29.4725868309	1108.39780931	4
primaire	0.507767	29.45693918	1119	5
secondaire	0.5077621964	29.4704751633	1115.04584927	4
primaire	0.5074380432	29.4574434179	1110.28927881	6
complexe_scolaire	0.5056928	29.4572076		
primaire	0.5054531318	29.44123785	1156.16505047	4
secondaire	0.50451385	29.4835524147	1115.4645809	6
secondaire	0.5044993082	29.4835312391	1125.97097612	6
secondaire	0.5044460105	29.4707713003	1123.99911385	4
primaire	0.5042017392	29.4940526387	1160.88552252	6
complexe_scolaire	0.504048	29.493555	1167.337402	
primaire	0.5039579055	29.4254556588	1085.31832891	6
primaire	0.5034559599	29.4248089435	1084.7330674	6
complexe_scolaire	0.50345	29.491135	1164.414429	
complexe_scolaire	0.503193	29.452674	1120.714966	
primaire	0.502967	29.452224	1117.983398	
primaire	0.502809	29.452098	1124.016602	

41	2014-10-13T10:41:15.439	celestin_kasereka	École Primaire Mbongo Sima	ecole
42	2014-10-10T10:31:34.826	puissance_mwendu	École Maternelle de l'ISP Oicha Beni	ecole
43	2014-10-14T09:44:19.216	jacques_ageno	Institut Kalemire	ecole
44	2014-10-14T09:01:34.999	jacques_ageno	École Primaire Kasabinyole	ecole
45	2014-10-14T09:09:57.553	jacques_ageno	École Primaire Tamende	ecole
46	2014-10-13T10:16:18.091	lewe_mobedra_netuta	Institut Hodari	ecole
47	2014-10-13T10:19:26.644	lewe_mobedra_netuta	École Primaire Mabakanga	ecole
48	2014-10-14T09:03:25.282	jacques_ageno	École Primaire Munzenda	ecole
49	2014-09-18T09:17:37		Complexe Scolaire Les Bernardins	ecole
50	2014-09-18T07:25:31		École pour Sourds Muets	ecole
51	2013-01-04T04:16:49.814	stephen_salama	École Conventionnee Anglicane	ecole
52	2014-09-18T09:11:06		Complexe Scolaire Savana School International	ecole
53	2014-10-13T10:23:38.164	lewe_mobedra_netuta	École Martenelle CECA 20 Mabakanga	ecole
54	2014-09-18T08:20:25		École Primaire á Kisungu	ecole
55	2014-09-18T08:18:10		École Primaire Maadibisho	ecole
56	2014-09-18T08:29:27		École Primaire Mapendano	ecole
57	2014-09-18T08:31:53		Institut Mukulia	ecole
58	2014-10-14T10:28:10.378	jacques_ageno	Institut Technique Industriel de Kasabinyole	ecole
59	2014-10-10T12:30:32.268	jacques_ageno	Institut Mbanza	ecole
60	2014-09-18T08:35:48		École Primaire Kanzulinzuli	ecole
61	2013-01-04T05:55:01.277	stephen_salama	Centre inscription ucbc	ecole
62	2014-09-18T07:21:36		Institut Shutshe	ecole
63	2014-10-10T12:25:42.283	jacques_ageno	Institut Kisolokele	ecole
64	2014-10-14T10:24:19.154	muyisa_kombi	École Primaire Kisenge	ecole
65	2013-01-04T04:02:09.717	stephen_salama	École Maternelle Olive	ecole
66	2014-10-10T11:02:20		Institut Kilokwa	ecole
67	2014-10-14T10:41:23.654	puissance_mwendu	Parapanda	ecole
68	2014-10-14T10:38:46.133	karl_tjongo_kamavu	École Primaire Parapanda	ecole
69	2014-10-10T11:00:20		École Primaire Kilokwa	ecole
70	2014-10-14T11:30:11.061	puissance_mwendu	École Primaire Sekemu	ecole
71	2014-10-10T07:50:01		Centre de Recuperation Scolaire TODA	ecole
72	2014-09-15T13:38:17		Ecole Maternelle Les Moissonneurs	ecole
73	2014-10-14T10:23:37.737	puissance_mwendu	Emausi	ecole
74	2014-09-15T13:39:04		Universite Officielle De Semuliki	ecole
75	2014-10-10T09:46:29		Complexe Scolaire Goshene	ecole
76	2013-01-04T01:55:08.754	stephen_salama	Institut Islamique	ecole

primaire	0.50193735	29.45871525	1117.40002441	5
maternelle	0.5012291771	29.4586902954	1122.16370266	4
secondaire	0.499081535	29.4782944588	1129.23596627	6
primaire	0.4987968033	29.479212543	1129.92272787	4
primaire	0.4987078086	29.4799230599	1147.09288497	4
secondaire	0.498511722	29.473358159	1137.00122503	4
primaire	0.4984683219	29.473362228	1136.64376369	6
primaire	0.4984633494	29.4798525272	1071.19421764	8
complexe_scolaire	0.49845904	29.45171	1131.6	
complexe_scolaire	0.49836847	29.437607	1110.9	
secondaire	0.4983632089	29.4800159565	1141.06948129	4
complexe_scolaire	0.49835	29.452154	1123.1	
maternelle	0.4981871915	29.4730448534	1138.09999579	4
primaire	0.49812168	29.447262	1115.3	
primaire	0.4980551	29.447834	1116.2	
primaire	0.49763834	29.450315	1124.6	
secondaire	0.49763617	29.449965	1123.9	
secondaire	0.4974239269	29.4844217264	1149.0170033	6
secondaire	0.4973315483	29.4612781452	1128.02884195	6
primaire	0.49717274	29.450117	1123.4	
universite	0.4971638077	29.4747557425	1144.96007537	8
secondaire	0.49713042	29.437677	1114.2	
secondaire	0.4969332711	29.4623368948	1122.60161751	4
primaire	0.49686501	29.4842437783	1158.08636695	4
maternelle	0.4962094595	29.4797845545	1147.36927376	4
complexe_scolaire	0.495502	29.461191	1146.661499	
primaire	0.4954327499	29.493389429	1177.86891683	8
primaire	0.4953498173	29.493011374	1173.86199698	4
primaire	0.49522	29.461189	1147.43811	
primaire	0.494891753	29.4885391508	1135.37573396	4
complexe_scolaire	0.494891	29.461763	1137.266479	
maternelle	0.4941033	29.466337	1153.4	
secondaire	0.4938918446	29.4915186267	1174.85744457	4
universite	0.49383456	29.466671	1155.4	
complexe_scolaire	0.493227	29.456646	1137.910156	
secondaire	0.4930284086	29.4770306318	1151.16487436	4

77	2014-09-15T13:44:39		Complexe Scolaire Marie Corasson	ecole
78	2014-09-15T13:09:01		College Technique De Beni	ecole
79	2014-09-15 T13:42:24		Institut De L'avenir De Beni	ecole
80	2014-09-15T13:32:46		Ecole Maternelle Du Complexe Scolaire I. A. B	ecole
81	2014-09-15T13:47:26		Lycee Mwandu	ecole
82	2014-09-15T13:16:25		Complexe Scolaire Espoir De Joseph	ecole
83	2014-09-15T13:25:32		Complexe Scolaire Amani	ecole
84	2014-09-15T12:40:08		Institut De Langue U. C. B. C	ecole
85	2014-10-10T09:06:15		Complexe Scolaire La Charité Bilingue de l'UCBC	ecole
86	2014-10-10T08:55:02		École Primaire Savana School	ecole
87	2014-09-16T08:30:43		École Primaire El Salem	ecole
88	2014-09-16T08:26:07		Institut Ingieni	ecole
89	2014-09-16T08:23:04		École Primaire Tabi	ecole
90	2014-10-09T11:34:06.916	stephen_salama	Complexe Scolaire Virunga	ecole
91	2014-10-09T12:25:47.496	junior_mukuka	Groupe Scolaire Waben Chirac	ecole
92			Groupe Scolaire Waben Chirac	ecole
93	2014-09-15T12:51:21		Group Scolaire Imara	ecole
94	2014-09-15T11:45:37		Ecole Maternelle Savana	ecole
95	2014-10-14T12:39:07.008	puissance_mwendu	Institut de l'Independance	ecole
96	2014-10-10T09:20:04		Complexe Scolaire Beni International School	ecole
97			École Primaire Safinatinnajah	ecole
98	2014-09-15T11:40:36		Universite Evangelique De Beni	ecole
99	2014-10-14T12:48:29.596	puissance_mwendu	Mont Sinai	ecole
100	2014-09-15T12:07:37		U. Fra. G. L	ecole
101	2014-10-10T11:00:00.456	karl_tjongo_kamavu	Institut Kitumaini	ecole
102	2014-10-09T11:14:10.948	celestin_kasereka	École Primaire Safinatinnajah	ecole
103	2014-10-09T11:09:44.381	bora_mukovi	Institut Superieur Pedagogique Beni	ecole
104	2014-09-16T08:15:32		École Primaire Bundji	ecole
105	2014-10-09T12:07:14.287	junior_mukuka	École Primaire Basayi Vusayi	ecole
106	2014-09-15T12:02:43		Beni International School	ecole
107	2014-09-16T08:10:44		Institut Wasingya	ecole
108	2014-10-10T11:40:00.601	karl_tjongo_kamavu	École Primaire ACG	ecole
109	2014-09-15T12:19:32		Complexe Scolaire Musafa	ecole
110	2014-09-17T08:14:57		École Primaire Disalu	ecole
111	2014-10-10T10:44:30.943	karl_tjongo_kamavu	Institut Esele	ecole
112	2014-10-09T10:20:33.101	celestin_kasereka	École Primaire Malepe	ecole
113	2014-09-16T09:32:33		École Primaire Malabo	ecole

complexe_scolaire	0.49296072	29.467882	1159.1	
complexe_scolaire	0.49270573	29.462439	1150.2	
complexe_scolaire	0.49266043	29.467628	1159.7	
maternelle	0.49262455	29.466223	1157	
complexe_scolaire	0.49184555	29.468048	1159.8	
complexe_scolaire	0.49140912	29.462664	1157.9	
complexe_scolaire	0.49055898	29.463778	1157.7	
complexe_scolaire	0.490487	29.459335	1162.1	
complexe_scolaire	0.490441	29.459406	1162.696533	
primaire	0.490258	29.460735	1171.089478	
primaire	0.49023318	29.447424	1125.9	
complexe_scolaire	0.49014497	29.447634	1125.3	
primaire	0.4899152	29.447348	1122.7	
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maternelle	0.4896893	29.461086	1162	
secondaire	0.4895233725	29.4880655298	1156.34139004	4
complexe_scolaire	0.489496	29.458016	1156.172119	
primaire	0.4894557	29.4747433		
universite	0.48932356	29.46134	1150.8	
secondaire	0.4891582706	29.487465745	1164.64261533	4
universite	0.4890904	29.458185	1160.4	
secondaire	0.488946617	29.4429702746	1112.49163687	4
primaire	0.48889071	29.47345291	1163.59997559	2
institut_superieur	0.4888375386	29.4694753193	1171.91838852	8
primaire	0.48880762	29.448051	1125.5	
primaire	0.48874893	29.47574272	1169.69995117	5
complexe_scolaire	0.48871168	29.458166	1157.1	
complexe_scolaire	0.4882448	29.448683	1124.9	
primaire	0.4878914008	29.4417912806	1102.37611401	4
secondaire	0.48777145	29.45906	1167.5	
primaire	0.48740578	29.444738	1133.5	
secondaire	0.4872450938	29.4445549094	1121.34852011	4
primaire	0.48684341	29.47376237	1186.90002441	6
primaire	0.48647243	29.452648	1141.6	

114	2014-10-09T14:42:47.501	karl_tjongo_kamavu	Université Patmos de l'Afrique Centrale	ecole
115	2014-09-17T08:05:18		Institut Tusonge Mbele	ecole
116	2014-10-09T14:26:43.616	micheline_nobikana	École Primaire Mbene	ecole
117	2014-10-09T15:11:40.740	micheline_nobikana	Complexe Scolaire Saint Edmond	ecole
118	2014-10-10T10:06:30.020	junior_mukuka	École Primaire Maarifa	ecole
119	2014-10-09T13:20:11.601	karl_tjongo_kamavu	Inspection Générale de l'EPSP	ecole
120	2014-10-10T10:26:30.501	karl_tjongo_kamavu	Complexe Scolaire la Rochebelle	ecole
121	2014-10-09T13:30:39.216	karl_tjongo_kamavu	Institut Bungulu	ecole
122	2014-10-09T14:39:08.585	william_ungyertho_uuci	École Primaire Kilewe	ecole
123	2014-10-09T13:35:48.029	karl_tjongo_kamavu	Institut de Bundji	ecole
124	2014-10-09T13:33:34.698	karl_tjongo_kamavu	École Primaire d'Application de Beni	ecole
125	2014-10-09T13:25:56.854	karl_tjongo_kamavu	Institut de Beni	ecole
126	2014-10-09T13:40:48.980	karl_tjongo_kamavu	Complexe Scolaire Vughumba Lucia	ecole
127	2014-10-09T15:26:50.347	gloria_najangusi_	Complexe Scolaire La Politesse	ecole
128	2014-10-09T13:43:27.701	karl_tjongo_kamavu	Institut Superieur de Commerce Beni	ecole
129	2014-10-09T13:49:57.985	karl_tjongo_kamavu	Institut Superieur Pedagogique d'Oicha	ecole
130	2014-10-09T13:54:05.943	karl_tjongo_kamavu	Institut Basayi Vusayi	ecole
131	2014-10-09T14:29:55.359	bora_mukovi	Complexe Scolaire Mont Rwen-zori	ecole
132	2014-10-09T14:00:48.825	karl_tjongo_kamavu	École Primaire Hekima	ecole
133	2014-09-17T10:04:33		École Primaire Mabolio	ecole
134	2014-10-14T12:07:42.445	lewe_mobedra_netuta	Institut Professionel de PAIDA	ecole
135	2014-10-10T13:23:11.202	karl_tjongo_kamavu	École Primaire Tuha	ecole
136	2014-10-09T10:29:19.914	karl_tjongo_kamavu	École Primaire Butanuka	ecole
137	2014-10-14T11:30:04.713	lewe_mobedra_netuta	École Primaire d'Application PAIDA	ecole
138	2014-09-17T07:47:43		École Primaire Manziko	ecole
139	2014-10-14T12:27:44.334	lewe_mobedra_netuta	Atelier MENUIPA (Menuiserie Industrielle de Paida)	ecole
140	2014-10-14T11:25:22.017	lewe_mobedra_netuta	École Primaire Munyabelu	ecole
141	2014-10-14T11:41:23.219	lewe_mobedra_netuta	Lycée Muhani	ecole
142	2014-10-14T11:14:35.984	lewe_mobedra_netuta	Institut Lwanzururu	ecole
143	2014-10-09T11:16:16.977	karl_tjongo_kamavu	École Primaire Vingazi	ecole
144	2014-10-09T13:37:34.954	thierry_babonye	ISDR	ecole
145	2014-10-14T11:08:43.695	lewe_mobedra_netuta	École Primaire Beu	ecole
146	2014-10-09T10:39:23.155	elisabeth_vanoverbeeke	Institute Mupanda	ecole
147	2014-10-09T11:56:31.737	rebecca_eliane	École Jardin Bene	ecole
148	2014-10-09T12:33:00		École Primaire Murongani	ecole
149			École Bene Secondaire	ecole

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primaire	0.4858332086	29.4566780094	1164.53738491	4
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primaire	0.48572117	29.44725917	1126.40002441	4
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secondaire	0.485354518	29.4463365758	1129.88407479	4
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primaire	0.4849759832	29.4557716449	1157.34071837	4
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institut_superieur	0.4845845013	29.4646593224	1176.14567298	4
institut_superieur	0.4843340934	29.4643801568	1181.99751934	4
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secondaire	0.4825563252	29.4950014017	1195.03756367	6
primaire	0.4822209619	29.445963961	1136.27425926	4
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primaire	0.4821839449	29.4966656146	1197.70065922	4
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primaire	0.4819249066	29.4968745799	1195.18203193	6
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primaire	0.4809496586	29.4615938767	1166.71229658	4
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complexe_scolaire	0.4783567779	29.4500920087	1154.14739695	6
primaire	0.476427	29.435868	1154.756226	
secondaire	0.475662	29.4459915		

150	2014-10-09T11:41:49.716	elisabeth_vanoverbeeke	École Primaire Kaliva	ecole
151	2014-10-09T11:34:12.762	puissance_mwendu	École Primaire Kisolokele	ecole
152	2014-10-09T12:27:30.254	thierry_babonye	Institut Rwangoma	ecole
153	2014-10-09T12:22:15.490	thierry_babonye	École Primaire Musiyiro	ecole
154			École Primaire Kisolokele	ecole
155	2014-10-09T11:49:27.607	thierry_babonye	Institut Wokovu	ecole
156	2014-10-09T11:47:12.971	thierry_babonye	EPA Rwangoma	ecole
157	2014-10-09T11:53:06.284	thierry_babonye	Institut Technique Michel Kwapa	ecole
158	2014-10-09T12:00:22.990	thierry_babonye	École Primaire Kimbya	ecole
159	2014-10-09T13:49:45.871	elisabeth_vanoverbeeke	Complexe Scolaire Malihi	ecole
160	2014-10-09T13:24:19.681	elisabeth_vanoverbeeke	École Primaire Arifa	ecole

primaire	0.47555169	29.47893703	1259	3
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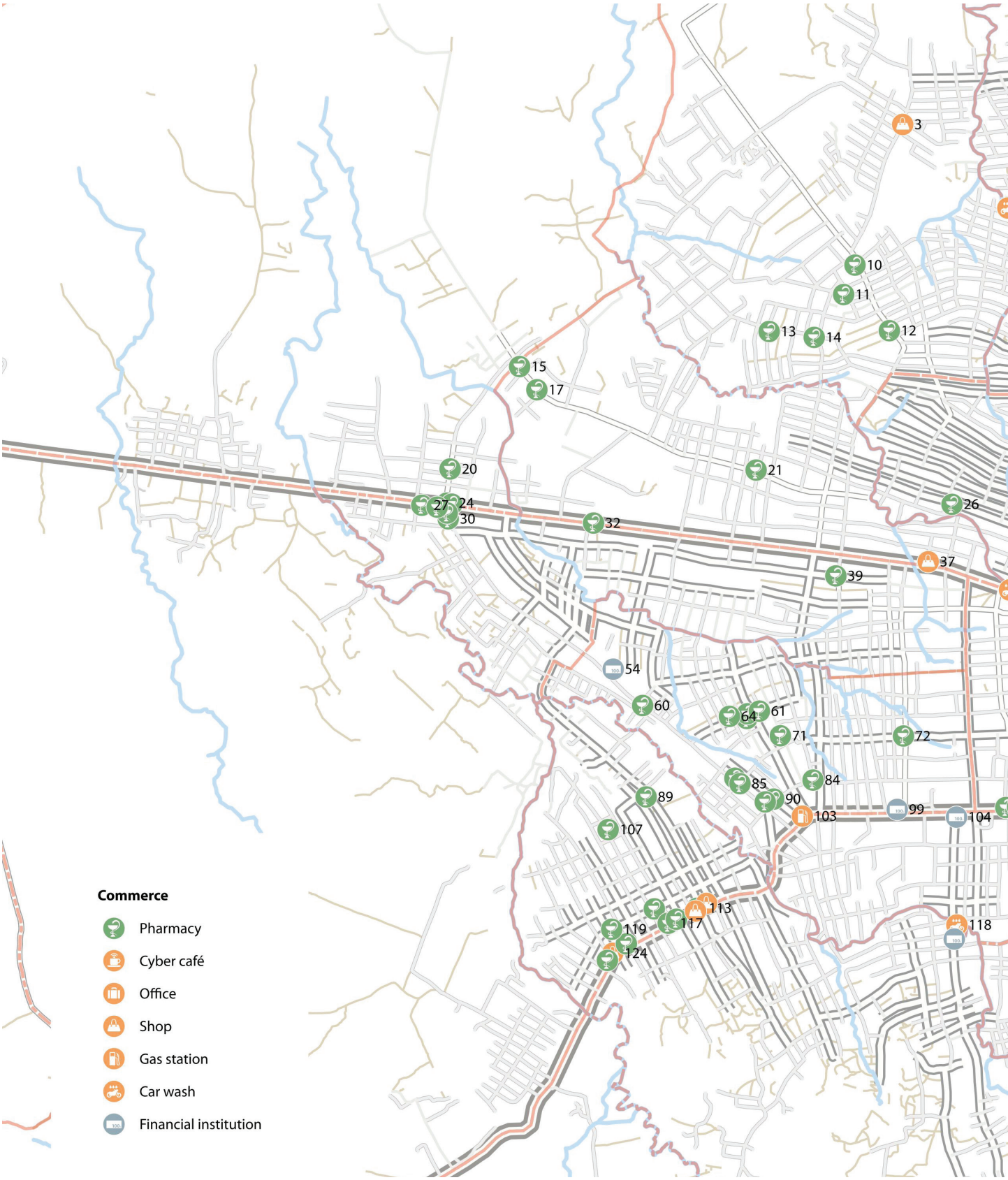
complexe_scolaire	0.4737712554	29.4736437666	1300.2399966	4
primaire	0.4724932538	29.4737089927	1300.10195018	4
complexe_scolaire	0.47132691	29.46867389	1272	3
primaire	0.46678567	29.47119595	1283	3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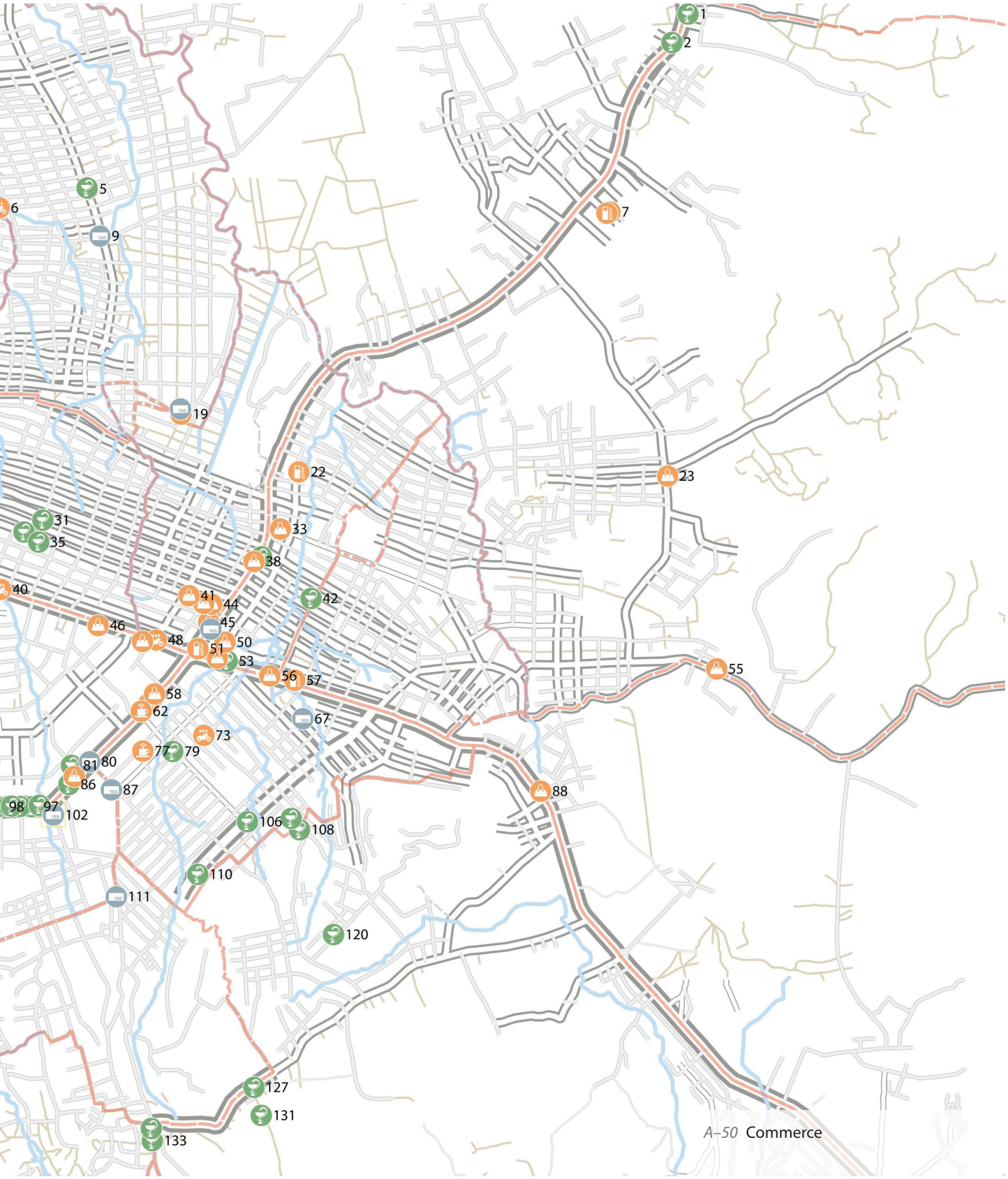
Pharmacy
Cyber café
Office
Shop
Gas station
Car wash
Financial institution



A–50 Commerce

Table A–07 Commerce metadata

id	time	enumerator	name	type
1	2014-10-14T14:02:28.185	william_ungyertho_uuci	Familia	sante
2	2013-01-05T02:56:29.717	nadia_kavira	Pharmacie Kakuhiphar	sante
3	2014-10-13T11:04:54.811	puissance_mwendu	Centre Comerciale Kan-gaembi	commerciale
4	2014-10-13T10:19:30.630	pascal_kazindu	Pharmacie Jacquephar	sante
5	2014-10-13T10:15:38.688	pascal_kazindu	Pharmacie Vuhinga	sante
6	2014-10-13T10:39:22.767	jacques_ageno	Lavage Picine	commerciale
7	2014-10-14T11:02:39.162	micheline_nobikana	Trans-gaz	commerciale
8	2014-10-14T10:50:45.388	william_ungyertho_uuci	Station Carburant TG	commerciale
9	2014-10-13T10:27:29.780	karl_tjongo_kamavu	Cash-point Airtel	financiere
10	2014-10-14T11:24:48.453	elisabeth_vanoverbeeke	Pharmacie la Guerison	sante
11	2014-10-14T11:12:38.463	elisabeth_vanoverbeeke	Avophar	sante
12	2014-10-14T10:17:53.682	elisabeth_vanoverbeeke	Dawaphar	sante
13	2014-10-14T13:20:27.879	elisabeth_vanoverbeeke	Sivaphar	sante
14	2014-10-14T14:05:39.805	celestin_kasereka	Kasaphar	sante
15	2014-10-13T13:15:43.512	william_ungyertho_uuci	Kathuphar	sante
16	2014-10-14T09:35:23.410	elisabeth_vanoverbeeke	Center Commerciale	commerciale
17	2014-10-13T13:03:06.777	william_ungyertho_uuci	Kasophar	sante
18	2014-10-13T14:07:24.577	gloria_najangusi_	Shop Vodacom	financiere
19	2014-10-13T14:03:32.035	gloria_najangusi_	Petit Marche	commerciale
20	2014-10-13T14:51:47.246	william_ungyertho_uuci	Kasiviphar	sante
21	2014-10-13T11:47:18		Pharmacie Jeacksonphar	sante
22	2014-10-14T13:12:26.173	sagesse_ndaliko	Station Vihum	commerciale
23	2014-10-14T11:17:34.456	karl_tjongo_kamavu	Kasoko Munzambai	commerciale
24	2014-10-13T15:18:57.913	william_ungyertho_uuci	Pharmacie Sondiphar	sante
25	2014-10-13T15:25:01.365	william_ungyertho_uuci	Tiens	sante
26	2014-10-13T10:25:27.525	celestin_kasereka	Batuphar	sante
27	2014-09-18T08:19:09		Lwayiphar	sante
28	2014-09-18T08:16:48		JDS Pharma	sante
29	2014-09-18T08:12:48		Kapaphar	sante
30	2014-09-18T07:57:52		Nzanzuphar	sante
31	2014-10-13T11:21:05.057	celestin_kasereka	Pharmacie Tamende	sante
32	2014-10-13T09:48:18.409	micheline_nobikana	Kathephar	sante
33	2013-01-04T05:43:02.280	stephen_salama	Depot Planches	commerciale
34	2014-10-13T11:10:49.637	celestin_kasereka	Pharmacie la Providence	sante
35	2014-10-10T12:09:43.272	jacques_ageno	Pharmacie Maya	sante
36	2013-01-04T05:49:18.756	stephen_salama	De la Charite	sante
37	2014-10-10T12:47:37.483	jacques_ageno	Moulin Huilerie Evariste	commerciale
38	2014-10-10T11:56:15.228	lewe_mobedra_netuta	Etablissement Palos	commerciale
39	2014-09-18T10:01:22		Sedriphar	sante
40	2014-10-10T10:25:09.362	pascal_kazindu	Lavage Kibangu	commerciale

type_comm	latitude	longitude	elevation	precision
pharmacie	0.5243529582	29.4959087015	1120.74867854	4
pharmacie	0.5229806151	29.4951374329	1106.57553549	4
alimentaire	0.5190431857	29.4576932965	1093.23511195	4
pharmacie	0.5159828553	29.4669804481	1096.27547346	6
pharmacie	0.5159357093	29.4670095415	1093.76302699	8
lavage_automobile	0.515026471	29.4627513927	1077.62120874	4
bureau	0.5148285692	29.4921509999	1149.70823533	4
station_de_carburant	0.5147668024	29.4920014248	1147.84044879	4
	0.5136686657	29.4676016589	1100.18085897	6
pharmacie	0.51228544	29.45540049	1110	5
pharmacie	0.51086974	29.45485567	1115	5
pharmacie	0.50913125	29.45705282	1108	5
pharmacie	0.50909274	29.45127245	1119	5
pharmacie	0.50881057	29.45344023	1122	5
pharmacie	0.5074058855	29.439273622	1095.72969401	4
	0.50740048	29.45720265	1114	5
pharmacie	0.506290818	29.4401035932	1094.05372695	4
	0.5053520066	29.4714740945	1071.52394195	8
alimentaire	0.5051058387	29.4715032825	1132.82860838	4
pharmacie	0.5024837855	29.4359306969	1086.38234603	4
pharmacie	0.502431	29.450645	1118.622803	
station_de_carburant	0.5023248799	29.4771762841	1065.22384056	4
alimentaire	0.5021242074	29.4949309278	1163.71972036	4
pharmacie	0.5008440483	29.4357746505	1108.64318359	4
pharmacie	0.5007941238	29.4360144764	1100.09266081	4
pharmacie	0.50078601	29.4600669	1126.40002441	5
pharmacie	0.5007401	29.43457	1108	
pharmacie	0.5006511	29.435308	1107	
pharmacie	0.5003684	29.435791	1103.7	
pharmacie	0.500086	29.435839	1103.7	
pharmacie	0.50000014	29.46485376	1139.30004883	5
pharmacie	0.4998844384	29.4428296032	1102.69700663	4
magasin	0.4995730707	29.476286164	1137.95727927	4
pharmacie	0.49943244	29.46394877	1135.59997559	3
pharmacie	0.4989480842	29.4646534819	1134.91360348	8
pharmacie	0.4982432034	29.47538042	1142.15831878	6
alimentaire	0.4980264662	29.4589217353	1123.00405748	4
magasin	0.4980145838	29.4750228235	1140.50119407	6
pharmacie	0.4973451	29.454481	1135.8	
lavage_automobile	0.4966682944	29.4628314651	1125.22798328	6

41	2014-10-10T10:40:45.985	lewe_mobedra_netuta	Galerie Masyolo Beni (GMB)	commerciale
42	2013-01-04T04:26:40.376	stephen_salama	Kamuphar	sante
43	2014-10-10T10:48:33.593	lewe_mobedra_netuta	Boutique Elegance	commerciale
44	2014-10-10T10:59:19.472	lewe_mobedra_netuta	Boutique Kin Soir	commerciale
45	2014-10-10T11:09:38.770	lewe_mobedra_netuta	Speranza Galeria	commerciale
46	2014-10-10T09:57:53.442	pascal_kazindu	Ujecode	commerciale
47	2013-01-04T06:01:53.407	stephen_salama	Solidaire Transfert	financiere
48	2014-10-13T13:49:37.411	lewe_mobedra_netuta	Lavage Auto	commerciale
49	2014-10-10T09:39:11.268	pascal_kazindu	Maban Service	commerciale
50	2013-01-04T00:58:19.369	stephen_salama	Restaurant Boyoma	commerciale
51	2013-01-04T00:43:24.739	stephen_salama	Station Vihum	commerciale
52	2013-01-04T01:17:42.417	stephen_salama	Pieces de Rechange	commerciale
53	2013-01-04T01:28:42.178	stephen_salama	Pharmacie Kyoghero	sante
54	2014-09-16T08:55:50		Concession Tmk De Cite Belge	financiere
55	2014-10-14T10:09:31.876	karl_tjongo_kamavu	Kasoko Belle Air	commerciale
56	2013-01-04T01:46:16.843	stephen_salama	Depot Umoja	commerciale
57	2013-01-04T02:04:36.235	stephen_salama	Station Kivu Petrolium	commerciale
58	2014-09-15T12:27:53		Alimentation Alpha	commerciale
59	2014-09-15T12:23:20		Secretariat Public Pendacel Computer Office	commerciale
60	2014-09-16T08:42:34		Kariphar	sante
61	2014-09-16T09:25:36		Kitumiphar	sante
62	2014-09-15T12:19:22		Cybercafe Bakat	commerciale
64	2014-09-16T09:17:03		Ekera Yetu Ni Simba	sante
65	2014-09-15T12:45:59		Lunetterie Belle Vue	sante
66	2014-09-16T09:24:25		Rebephar	sante
67			Casa Nova Super Market	commerciale
68			Station de Carburant Kal-mango	commerciale
69			La Semence Banque	financiere
70	2014-10-09T16:57:02.909	bora_mukovi	Shop Airtel	commerciale
71	2014-09-16T10:01:37		VinoII	sante
72	2014-09-16T10:45:04		Pharmacie Mont Carmel	sante
73			Lavage Mulasa	commerciale
74	2014-10-09T16:54:49.005	bora_mukovi	Globale Market Moviers	commerciale
75	2014-10-09T16:51:01.056	bora_mukovi	Librairie Horizon	commerciale
76	2014-10-09T16:49:07.857	bora_mukovi	Shop Vodacom	commerciale
77	2014-10-09T10:45:41.426	gloria_najangusi_	Cyber Cafe et Secretariat La Reference	commerciale
78	2014-10-09T16:45:51.921	bora_mukovi	Custom and Trading Agency	commerciale
79	2014-10-09T13:20:14.877	gloria_najangusi_	Pharmacie Kamuphar	sante
80	2014-09-15T13:36:52		Rawbank	financiere

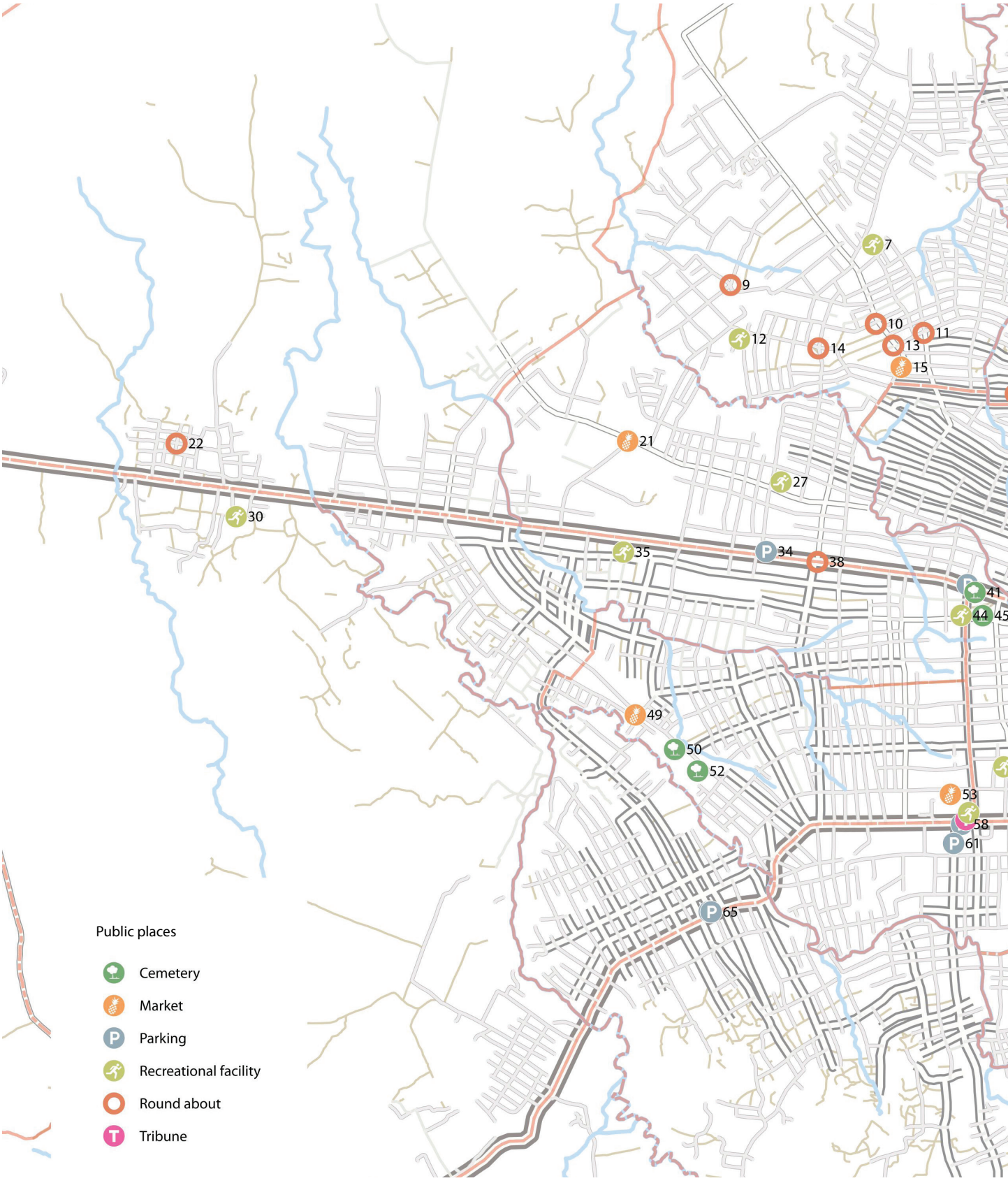
magasin	0.4963719253	29.4718875341	1145.97279874	4
pharmacie	0.4962357725	29.4777674074	1137.86819709	6
magasin	0.496001134	29.4725934985	1149.16730758	4
magasin	0.4959582963	29.4729774738	1147.94914948	6
magasin	0.4950900516	29.4728326936	1154.4432676	6
super_marche	0.4949343121	29.4675153902	1141.54015052	6
	0.4947588669	29.4729387029	1151.41719122	6
lavage_automobile	0.4942350911	29.4703139763	1140.22174505	6
magasin	0.4941702514	29.4696481638	1139.01928814	4
alimentaire	0.4941291663	29.4736193801	1145.61142852	8
station_de_carburant	0.4938183807	29.472320561	1148.38942314	4
magasin	0.4933621117	29.4732541656	1146.56824219	6
pharmacie	0.4932206067	29.4737229173	1148.90453141	6
	0.49286374	29.443773	1103.6	
alimentaire	0.4928467986	29.4972914205	1174.92632839	4
magasin	0.4925141233	29.4757817757	1143.89545333	6
station_de_carburant	0.4923001429	29.4769724892	1150.76913759	4
alimentaire	0.49164054	29.470232	1169.1	
bureau	0.4911757	29.469957	1176.6	
pharmacie	0.49111402	29.44519	1116.8	
pharmacie	0.49084634	29.450802	1130.3	
cyber_cafe	0.49081028	29.469587	1172	
pharmacie	0.49059284	29.449362	1130.7	
sante_autre	0.49053866	29.465492	1160.6	
pharmacie	0.49049005	29.450201	1128.9	
super_marche	0.4904491	29.4773674		
station_de_carburant	0.4904491	29.4773674		
	0.4904491	29.4773674		
magasin	0.4896961479	29.4686726125	1175.32585149	4
pharmacie	0.48965994	29.451813	1131	
pharmacie	0.48965013	29.457733	1155.8	
lavage_automobile	0.4896479	29.4726005		
magasin	0.4894377244	29.4684409319	1168.15394115	6
magasin	0.4891297982	29.4681197946	1167.9227524	6
magasin	0.4889670792	29.4679175951	1161.58256713	4
cyber_cafe	0.4888960264	29.4696653466	1171.78925605	8
magasin	0.4888906514	29.4679205684	1173.75967428	6
pharmacie	0.4888736251	29.471103891	1176.86081997	4
	0.4883799	29.467106	1173.5	

81	2014-09-15T12:50:39		Pharmacie Muhatikani	sante
82	2014-09-16T10:09:56		Supermarche Angel's Super-market	commerciale
83	2014-09-16T08:26:05		Shayiphar	sante
84	2014-09-16T10:31:02		Ornelaphar	sante
85	2014-09-16T08:20:36		Jodaniphar	sante
86	2014-09-15T12:56:21		Rwenzorie Pharmacie	sante
87	2014-10-09T12:18:21.429	gloria_najangusi_	Codefi Beni	financiere
88	2014-10-14T13:02:48.536	puissance_mwendu	March ├┼Kasanga	commerciale
89	2014-09-17T08:30:11		Kaziphar	sante
90	2014-09-16T08:13:20		Secouphar	sante
91	2014-09-16T08:15:00		Mutaphar	sante
92	2014-09-15T13:00:03		Miraphar	sante
93	2014-09-15T13:07:37		Ndalphar	sante
94	2014-09-15T13:06:12		Kavulophar	sante
95	2014-09-15T13:03:35		Santephar	sante
96	2014-09-15T13:04:35		Musaphar	sante
97	2014-09-15T13:02:08		Nziraphar	sante
98	2014-09-15T13:09:07		Salamaphar	sante
99	2014-09-16T07:42:10		Station Mico	financiere
100	2014-10-09T13:12:19.875	karl_tjongo_kamavu	Galerie Tsongo de Beni	commerciale
101	2014-10-09T10:37:38.578	william_ungyertho_uuci	Galerie GTB	commerciale
102	2014-10-09T14:46:21.464	karl_tjongo_kamavu	Paidek	financiere
103	2014-09-16T07:51:59		Station Kihydro	commerciale
104	2014-10-09T12:29:57.992	karl_tjongo_kamavu	Cash Point Airtel Money La Conscience	financiere
105	2014-10-09T14:00:28.076	thierry_babonye	Harlephar	sante
106	2014-10-09T14:09:18.641	thierry_babonye	Luzaphar	sante
107	2014-09-17T08:21:02		Kiviphar	sante
108	2014-10-09T13:57:17.438	thierry_babonye	Wikophar	sante
109	2014-10-09T12:41:54.228	micheline_nobikana	Depot-boutique Cafetariat Alimentaire	commerciale
110	2014-10-09T10:20:17.176	thierry_babonye	Pharmacie A.COO.PA.DE.A	sante
111	2014-10-09T10:41:03.671	karl_tjongo_kamavu	Cash-point Airtel Money	financiere
112	2014-09-17T10:03:39		Salon Nike	commerciale
113	2014-09-17T10:02:17		Maciphar	sante
114	2014-09-17T09:55:23		Makephar	sante
115	2014-09-17T10:02:06		Salon De Coiffure Nevia	commerciale
116	2014-09-17 09:59:21		Crisophar	sante
117	2014-09-17T09:58:26		Kaliphar	sante
118	2014-10-09T11:37:37.943	karl_tjongo_kamavu	Lavage Nouvelle Amiti ├┼	commerciale
119	2014-09-17T07:23:36		Kaluphar	sante
120	2014-10-09T13:33:25.569	thierry_babonye	Dispensaire Hodari	sante

pharmacie	0.48820603	29.46623	1167	
super_marche	0.48766795	29.46637	1173.1	
pharmacie	0.48762068	29.449627	1113.6	
pharmacie	0.4875324	29.453384	1143.2	
pharmacie	0.48735943	29.449871	1129.7	
pharmacie	0.48728865	29.466108	1171.2	
	0.4870274444	29.46814974	1177.17970924	4
alimentaire	0.4869603237	29.4888191893	1170.90952757	6
pharmacie	0.48672202	29.445356	1132.9	
pharmacie	0.48661816	29.451492	1141.8	
pharmacie	0.48648092	29.451086	1136.9	
pharmacie	0.4862841	29.46468	1169.1	
pharmacie	0.48624703	29.463219	1173.1	
pharmacie	0.486242	29.463346	1170.8	
pharmacie	0.4862347	29.46403	1173.8	
pharmacie	0.48622864	29.46375	1175.6	
pharmacie	0.48621827	29.464315	1167.6	
pharmacie	0.48621187	29.462654	1172.1	
	0.48611942	29.45743	1173.9	
magasin	0.4859991966	29.4623861068	1178.6779284	4
magasin	0.4859809055	29.4625614019	1176.44342643	16
	0.4858205191	29.4653616068	1162.27587674	4
station_de_carburant	0.48579863	29.452868	1150	
	0.4857529579	29.4602806907	1171.22545434	4
pharmacie	0.4856530919	29.4768117172	1199.07802297	6
pharmacie	0.4854971786	29.4747027334	1188.28651516	8
pharmacie	0.48515007	29.44353	1136.3	
pharmacie	0.4851124083	29.4772114768	1205.93851786	6
alimentaire	0.4831166499	29.4600419207	1163.75959886	4
pharmacie	0.4829631351	29.4723083563	1187.01861439	6
	0.4818878603	29.4683871116	1200.31954506	4
magasin	0.48160297	29.44826	1148.3	
pharmacie	0.4813706	29.447805	1152.2	
pharmacie	0.481341	29.44575	1148.3	
magasin	0.48123583	29.447731	1150.6	
pharmacie	0.4808439	29.446812	1148	
pharmacie	0.48064938	29.44642	1148	
lavage_automobile	0.4805653453	29.4602998556	1160.7313651	4
pharmacie	0.4803615	29.443703	1149.4	
pharmacie	0.4800670472	29.4788479953	1255.3801527	8

121	2014-10-09T12:04:30.038	rachel_muvuya	Limanga Mabolio	commerciale
122	2014-10-09T11:31:03.980	karl_tjongo_kamavu	Cash-point Airtel Money Mwanaweka	financiere
123	2014-09-17T07:33:44		Mambophar	sante
124	2014-10-10T12:34:21.657	karl_tjongo_kamavu	Cafeteria Paradis Terrestre	commerciale
125	2014-09-17T07:36:53		Sirikaphar	sante
126	2014-10-09T10:53:36.625	elisabeth_vanoverbeeke	Alimentation Kalemberwa	commerciale
127	2014-10-09T12:13:15.305	elisabeth_vanoverbeeke	Pharmacie Acoopadea	sante
128	2014-10-09T12:36:17.227	elisabeth_vanoverbeeke	Boucherie Jenga Mwili	commerciale
129	2014-10-09T12:32:45.258	elisabeth_vanoverbeeke	Alimentation Hotel	commerciale
130	2014-10-09T12:34:20.973	elisabeth_vanoverbeeke	Alimentation de l'Espoir	commerciale
131	2014-10-09T12:27:17.755	elisabeth_vanoverbeeke	Pharmacie Romephar	sante
132	2014-10-09T13:03:45.059	elisabeth_vanoverbeeke	Pharmacie Matuphar	sante
133	2014-10-09T13:09:02.451	elisabeth_vanoverbeeke	Pharmacie Vutale-phar	sante

magasin	0.4800574603	29.448593303	1146.95539308	6
	0.4798903229	29.4601727463	1164.05625477	4
pharmacie	0.47965685	29.444408	1145.7	
alimentaire	0.4792055636	29.4437508162	1127.72806449	4
pharmacie	0.47886324	29.443493	1143.8	
alimentaire	0.47873691	29.48329505	1223	5
pharmacie	0.47271587	29.47501302	1298	3
alimentaire	0.47154066	29.47526622	1296	3
alimentaire	0.47142754	29.47532533	1302	3
alimentaire	0.47137153	29.47538062	1299	3
pharmacie	0.47136739	29.47536581	1299	4
pharmacie	0.47073635	29.47007529	1266	3
pharmacie	0.470154	29.47012151	1264	5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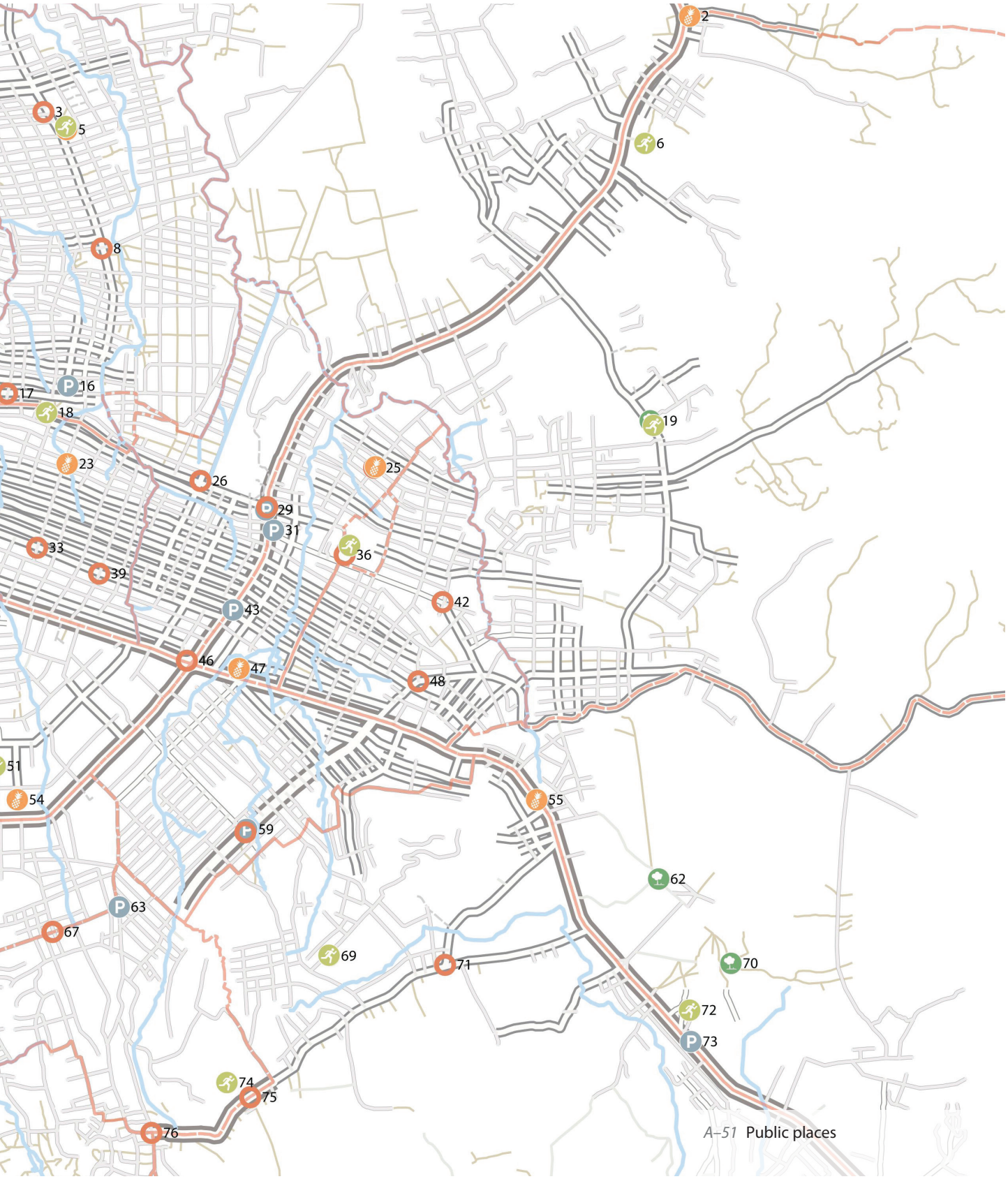
Public places
Cemetery
Market
Parking
Recreational facility
Round about
Tribune



A–51 Public places

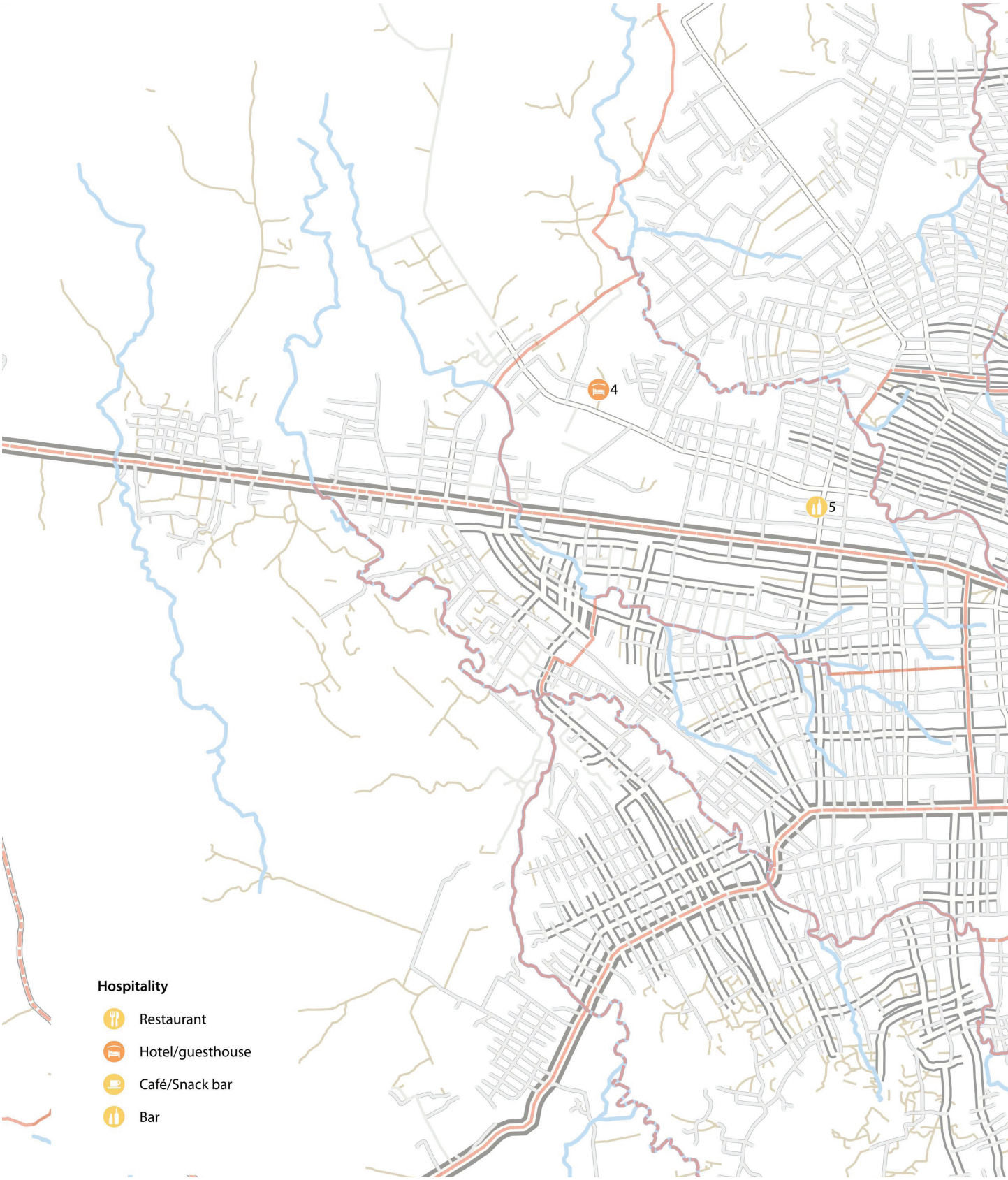
Table A–08 Public places metadata

id	time	enumerator	name	type
1	2014-10-13T13:42:39.949	pascal_kazindu	Cimetier Masiyani	public
2	2014-10-14T13:53:11.158	william_ungyertho_uuci	Mayangose	public
3	2014-10-13T11:48:27.945	muyisa_kombi	Rond-point du Marche	public
4	2014-10-13T10:47:23.725	pascal_kazindu	Stade Makapagne	recreation
5	2014-10-13T10:44:10.666	pascal_kazindu	Marche Makapagne	public
6	2014-10-14T11:48:21.244	william_ungyertho_uuci	Terrain de Football Mabakanga	recreation
7	2014-10-13T12:21:58.62	karl_tjongo_kamavu	Stade Footbool Kangaimbi	recreation
8	2014-10-13T10:24:57.179	karl_tjongo_kamavu	Rond-point Katoto	public
9	2014-10-14T12:25:30.829	elisabeth_vanoverbeeke	Rond-point Ngongolio	public
10	2014-10-14T10:29:43.078	elisabeth_vanoverbeeke	Rond-point le Meridien	public
11	2014-10-13T13:13:57.814	karl_tjongo_kamavu	Rond-point Muyala	public
12	2014-10-14T13:09:17.934	elisabeth_vanoverbeeke	NULL	recreation
13	2014-10-13T13:07:40.383	karl_tjongo_kamavu	Rond-point Karoro	public
14	2014-10-14T14:01:36.868	elisabeth_vanoverbeeke	Rond-point la Race de Vainqueur	public
15	2014-10-10T12:45:19.535	puissance_mwendu	Petit Marche Kabalaka	public
16	2014-10-13T14:25:31.065	karl_tjongo_kamavu	Parking Kalinda	public
17	2014-10-10T13:35:00.689	sagesse_ndaliko	Rond-point Ndaliko	public
18	2014-10-10T13:45:56.021	jacques_ageno	Terrain de Football Kalinda	recreation
19	2014-10-14T11:46:44.571	karl_tjongo_kamavu	Cymetiere Bugagala	public
20	2014-10-14T11:43:24.383	karl_tjongo_kamavu	Stade Munzambai	recreation
21	2014-10-13T11:26:11.363	william_ungyertho_uuci	Petit Marche Concession des Eveques	public
22	2014-10-10T13:39:28.204	bora_mukovi	Rond-point Canana	public
23	2014-10-10T11:48:04.313	jacques_ageno	Kasoko Kalinda	public
24	2014-10-14T12:37:08.141	jacques_ageno	Kasoko Kasabi	public
25	2014-10-14T12:39:26.668	jacques_ageno	Rond-point Mupanda	public
26	2014-10-13T14:54:11.115	gloria_najangusi_	Monument	public
27	2014-10-13T10:58:00		Terrain de Football de Catholique	recreation
28	2014-10-10T12:12:23.886	lewe_mobedra_netuta	Rond-point ENRA	public
29	2014-10-10T12:14:37.538	lewe_mobedra_netuta	Parking ENRA	public
30	2014-10-10T11:51:25.944	ungale_kulesa	Terrain Foot	recreation
31	2014-10-14T13:35:12.674	jacques_ageno	Parking Nyabia	public
32	2014-10-14T09:12:37.284	jacques_ageno	Terrain de Foot Kasabinyole	recreation
33	2014-10-13T11:16:55.785	celestin_kasereka	Rond-point Yamba Yamba	public
34	2014-10-13T13:16:32		Parking Mangina	public
35	2014-09-18T08:08:53		Terrain De Football	recreation
36	2014-10-14T10:03:21.082	jacques_ageno	Rond-point Anglicane	public
37	2014-10-13T07:52:20		Petit Marche Kanzuli	public
38	2014-09-18T09:06:08		Rond-point Kanzuli	public
39	2014-10-13T11:56:46.073	celestin_kasereka	Rond-point Germanto	public
40	2014-10-10T12:37:40.484	jacques_ageno	Parking Kimbangu	public

type_public	latitude	longitude	elevation	precision
cimetiere	0.5327672408	29.4805323147	1086.38941638	8
marche	0.5247418317	29.4959919179	1125.39120568	4
rondpoint	0.5201239434	29.4648833564	1077.18668983	8
terrain_foot	0.519429066	29.465953637	1091.11888168	4
marche	0.5192786268	29.465992287	1088.11941494	8
terrain_foot	0.5186150839	29.4938360701	1127.5080612	4
terrain_foot	0.5137558398	29.4562619652	1100.98312857	4
rondpoint	0.5135574149	29.4676850499	1099.69053539	4
rondpoint	0.51181392	29.44941185	1094	5
rondpoint	0.50994577	29.45640036	1095	4
rondpoint	0.509513263	29.4586993968	1112.31321701	4
terrain_foot	0.50922237	29.44984343	1097	5
rondpoint	0.5089074326	29.4572391773	1103.31491094	4
rondpoint	0.50876893	29.4536373	1107	4
marche	0.5078610847	29.4576198792	1111.94444284	4
parking	0.5069429128	29.46605982	1115.54487686	4
rondpoint	0.5065826853	29.4631285507	1120.80262117	6
terrain_foot	0.5056594625	29.4650295492	1123.14296876	4
cimetiere	0.5052645056	29.4940947323	1159.54633961	4
terrain_foot	0.5050457826	29.494251368	1156.1850041	4
marche	0.5043107378	29.4444677205	1099.83605382	4
rondpoint	0.504192158	29.4227747655	1081.66753169	4
marche	0.503194236	29.4660224162	1118.29665594	4
marche	0.5030529528	29.4808671855	1139.23229904	6
rondpoint	0.5030051994	29.4807986888	1130.74908859	4
rondpoint	0.5023738636	29.4724386168	1138.36117297	4
terrain_foot	0.502345	29.451845	1122.014282	
rondpoint	0.5011071718	29.4756509348	1138.45508134	4
parking	0.5009791321	29.4755837194	1137.1945925	6
terrain_foot	0.5006784113	29.4256408416	1085.02294176	6
parking	0.5000007252	29.475953425	1054.86333194	12
terrain_foot	0.4992687123	29.4796178549	1147.82689629	6
rondpoint	0.49915961	29.46457654	1140.19995117	2
parking	0.499001	29.451126	1129.882446	
terrain_foot	0.4989758	29.444262	1119.6	
rondpoint	0.4988131607	29.4793774539	826.689812099	8
marche	0.498797	29.454888	1135.992554	
rondpoint	0.49850166	29.453594	1133.1	
rondpoint	0.49791202	29.46756156	1137.09997559	2
parking	0.4974101237	29.460806354	1127.90786726	4

41	2014-10-10T11:11:25		Cimetiere de Kanzuli	public
42	2014-10-14T10:22:20.134	jacques_ageno	Rond-point ITK	public
43	2013-01-04T05:58:01.297	stephen_salama	Parking Oicha	public
44	2014-10-10T11:07:00		Stade Football Beni Sport	recreation
45	2014-09-15T13:37:20		Cimetiere Kilokwa	public
46	2014-10-13T13:53:32.622	lewe_mobedra_netuta	Grand Rond-point	public
47	2013-01-04T01:33:38.310	stephen_salama	Marche Mabakanga	public
48	2013-01-04T03:02:58.759	stephen_salama	Rond-point Calvaire	public
49	2014-09-16T08:49:12		Petit marche de Cite Belge	public
50	2014-09-16T08:37:06		Cimetiere De Cite Belge	public
51	2014-09-15T11:58:29		Stade Municipal De Beni	recreation
52	2014-10-10T11:13:01.180	junior_mukuka	Cimetiere de Mabolio	public
53	2014-09-15T11:34:44		Marche De Mayangose	public
54	2014-09-15T11:51:40		Marchee Central De Kilokwa	public
55			Petit Marche	public
56	2014-10-10T08:41:24		Stade Basketball de Beni	recreation
57	2014-09-15T11:25:20		Tribune Du 08 Mars	public
58	2014-10-09T12:42:48.873	karl_tjongo_kamavu	Parking Moto Endebe	public
59	2014-10-09T14:05:22.999	thierry_babonye	Parking Catego	public
60	2014-10-09T10:35:38.380	celestin_kasereka	Rond-point Mandela	public
61	2014-10-09T13:14:28.861	micheline_nobikana	Parking de Butembo	public
62	2014-10-14T12:13:01.643	lewe_mobedra_netuta	Lourde Statut Marie	public
63	2014-10-09T10:45:09.840	karl_tjongo_kamavu	Parking Moto Butanuka	public
64	2014-10-10T10:09:44.197	karl_tjongo_kamavu	Parking Auto Courses de Ville Mabolio	public
65	2014-10-10T10:05:57.450	karl_tjongo_kamavu	Parking Moto Zimamoto	public
66	2014-10-09T11:36:27.661	jacques_ageno	Rond-point Rali	public
67	2014-10-09T10:59:48.454	karl_tjongo_kamavu	Rond-point Rally	public
68	2014-10-09T13:29:47.563	thierry_babonye	Terrain foot ISDR	recreation
69	2014-10-09T13:27:09.712	thierry_babonye	Terrain foot ISDR	recreation
70	2014-10-14T11:01:48.507	lewe_mobedra_netuta	Cimetiere	public
71	2014-10-09T10:48:09.673	elisabeth_vanoverbeeke	Rond-point	public
72	2014-10-14T10:49:33.372	lewe_mobedra_netuta	Terrain de Football	recreation
73	2014-10-14T10:35:00.399	lewe_mobedra_netuta	Entrepot vehicule Petrolier	public
74	2014-10-09T11:55:32.045	thierry_babonye	Terrain Foot Rwangoma	recreation
75	2014-10-09T12:13:28.154	thierry_babonye	Rond-point Rwangoma	public
76	2014-10-09T13:41:15.543	elisabeth_vanoverbeeke	Rond-point kalongo	public

cimetiere	0.497037	29.461173	1139.765137	
rondpoint	0.4965448169	29.4840926925	1161.66862606	4
parking	0.4961677588	29.4740047849	1145.74044863	4
terrain_foot	0.495931	29.460503	1143.213501	
cimetiere	0.4959203	29.461542	1139.3	
rondpoint	0.493721671	29.4717848848	1150.25726334	6
marche	0.4933461282	29.4742934467	1147.84990465	4
rondpoint	0.4927292035	29.4829259914	1169.77973839	6
marche	0.4911491	29.444836	1105.9	
cimetiere	0.48948926	29.446733	1122.6	
terrain_foot	0.48865443	29.462557	1172.9	
cimetiere	0.48844998	29.44783847	1123.80004883	2
marche	0.48732895	29.459991	1173.2	
marche	0.48703384	29.463621	1169.2	
marche	0.487028	29.4886234		
terrain_basket	0.486448	29.460869	1175.579834	
tribune	0.48611236	29.460733	1165.5	
parking	0.4858905013	29.4605295648	1172.25626286	4
parking	0.4856034732	29.4746612642	1183.7368758	4
rondpoint	0.48546698	29.47460012	1180.59997559	3
parking	0.4849708969	29.4601413106	1171.06237028	4
cimetiere	0.4832170011	29.494502117	1192.09733933	6
parking	0.4818714941	29.4685276525	1198.53325945	4
parking	0.4816901849	29.448389871	1144.43830739	4
parking	0.4816798796	29.4484801211	1140.1214242	4
rondpoint	0.4806776158	29.4653272231	1195.44105176	4
rondpoint	0.4806701895	29.4653128312	1163.26240175	4
terrain_foot	0.4795487325	29.4786268251	1260.297731	4
terrain_foot	0.4795172686	29.4786477729	1256.23435322	6
cimetiere	0.4791584607	29.4979798126	1205.50240156	4
rondpoint	0.4790869	29.48421381	1224	5
terrain_foot	0.4769071149	29.4959864728	1212.50529353	4
parking	0.4753953674	29.4960465587	1210.08518177	6
terrain_foot	0.4734234442	29.4737115726	1303.65922573	4
rondpoint	0.4727189562	29.4748334586	1304.1649447	4
rondpoint	0.47100241	29.47007655	1270	3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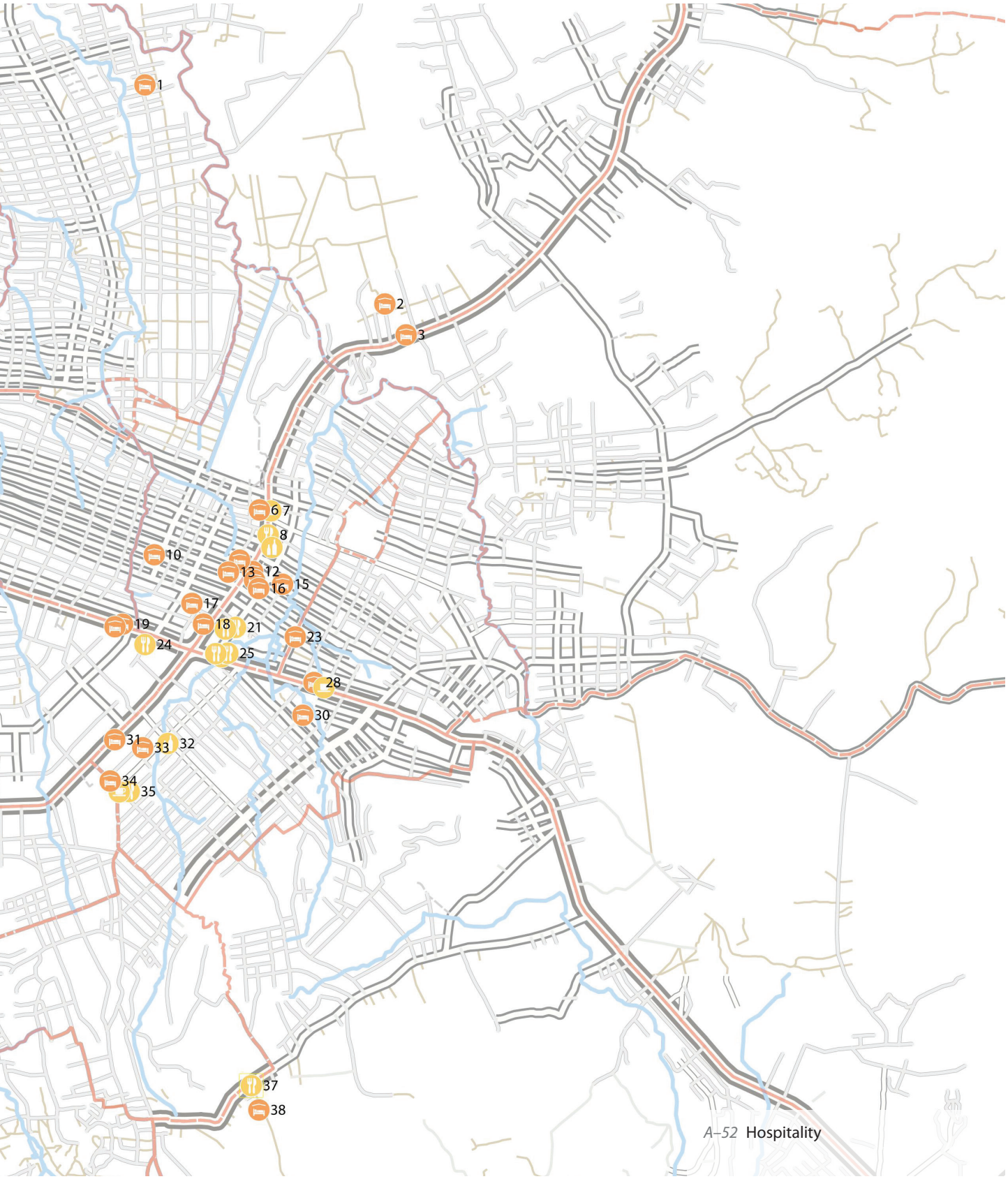
5
Hospitality
Restaurant
Hotel/guesthouse
Café/Snack bar
Bar

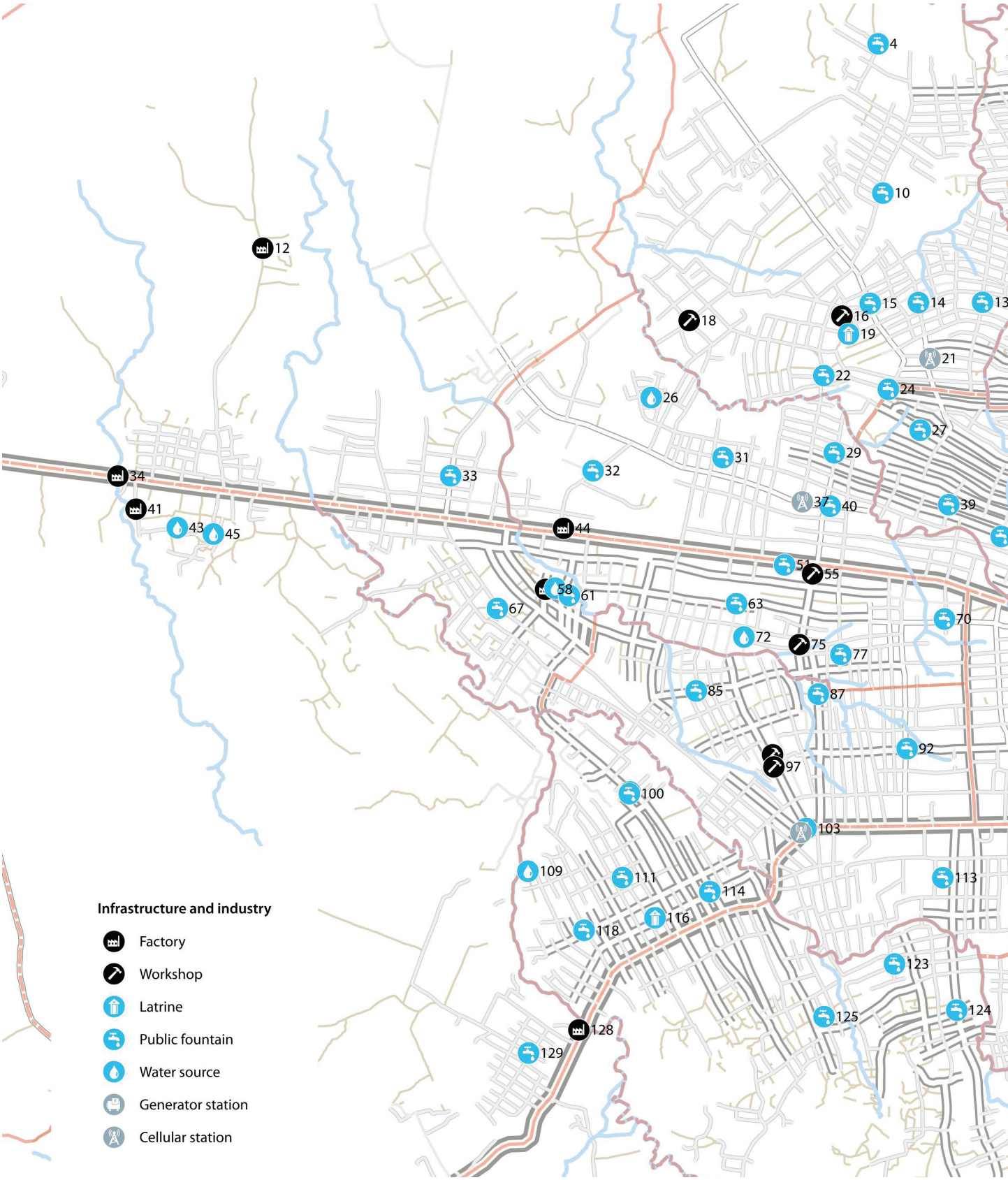


A–52 Hospitality

Table A–09 Hospitality metadata

id	time	enumerator	name	type
1	2014-10-13T12:25:06.630	pascal_kazindu	Hotel Pergola	hotellerie
2	2014-10-14T09:41:35.107	pascal_kazindu	Rock hotel	hotellerie
3	2014-10-14T09:48:11.862	pascal_kazindu	Albertine hotel	hotellerie
4	2014-10-13T12:30:34		Hotel Hewa Bora	hotellerie
5	2014-10-13T08:23:03		Bar Grande Bruxelles	hotellerie
6	2014-10-10T12:07:42.688	thierry_babonye	Guesthouse Amis Clients	hotellerie
7	2014-10-14T13:31:24.929	jacques_ageno	Snack Bar Chelsea	hotellerie
8	2013-01-04T05:46:59.232	stephen_salama	FrAtela	hotellerie
9	2013-01-04T05:24:10.500	stephen_salama	Super Aubene	hotellerie
10	2014-10-13T12:21:01.476	lewe_mobedra_netuta	Irongi Centre d'Accueil	hotellerie
11	2014-10-13T09:48:04.719	lewe_mobedra_netuta	Hotel du Pic Marguerite	hotellerie
12	2013-01-04T05:51:54.514	stephen_salama	Hotel Vihum	hotellerie
13	2014-10-10T11:27:05.296	lewe_mobedra_netuta	Hotel Pakap	hotellerie
14	2013-01-04T05:04:32.601	stephen_salama	Centre d'Accueil LAIC	hotellerie
15	2013-01-04T05:09:21.497	stephen_salama	Maison Lola	hotellerie
16	2013-01-04T05:02:23.866	stephen_salama	Dolce Vitae	hotellerie
17	2014-10-10T10:23:06.528	lewe_mobedra_netuta	Nouveau Centre d'Acceuil Laic	hotellerie
18	2014-10-10T09:36:30.102	lewe_mobedra_netuta	Maison Beni	hotellerie
19	2014-10-13T13:41:50.513	lewe_mobedra_netuta	Centre d'Accueil Protestante	hotellerie
20	2014-10-10T09:49:21.155	pascal_kazindu	Hotel Beu	hotellerie
21	2013-01-04T01:10:55.136	stephen_salama	Restaurant Tuonane	hotellerie
22	2013-01-04T01:06:50.192	stephen_salama	Snack Restaurant Gomez	hotellerie
23	2013-01-04T04:35:10.324	stephen_salama	Hotel Umbrella	hotellerie
24	2014-10-10T09:31:26.664	pascal_kazindu	Restaurant Bar Sous le Palmier	hotellerie
25	2013-01-04T01:27:07.384	stephen_salama	Restaurant Trois Tentes	hotellerie
26	2013-01-04T01:15:33.574	stephen_salama	Restaurant Shanga	hotellerie
27	2013-01-04T01:20:46.128	stephen_salama	Bar Rwakuna	hotellerie
28	2013-01-04T02:13:35.114	stephen_salama	Hotel au Retruvaille	hotellerie
29	2013-01-04T02:16:06.333	stephen_salama	Snack Bar Epasola	hotellerie
30			Pic Nic Hotel	hotellerie
31	2014-10-09T16:52:36.499	bora_mukovi	Africa Vyaka Hotel	hotellerie
32	2014-10-09T13:16:45.444	gloria_najangusi_	Bar C le moment	hotellerie
33	2014-10-09T10:17:49.593	gloria_najangusi_	Hotel	hotellerie
34	2014-10-09T12:07:19.320	gloria_najangusi_	Hotel Royal	hotellerie
35	2014-10-09T13:40:41.103	ungale_kulesa	Kifaruwnei	hotellerie
36	2014-10-09T12:46:59.912	bora_mukovi	Snak Bar Horizon 2020	hotellerie
37	2014-10-09T12:39:57.538	elisabeth_vanoverbeeke	Restaurant Maisha no ya Mungu	hotellerie
38	2014-10-09T12:23:42.270	elisabeth_vanoverbeeke	Hotel Kasone	hotellerie

type_hotellerie	latitude	longitude	elevation	precision
hotel_de_camping	0.5207691605	29.4697615719	1078.28873265	8
hotel_de_camping	0.5102334974	29.4813104341	1126.459258	6
hotel_de_camping	0.5087452626	29.4823352049	1128.37685109	4
hotel_de_residence	0.506128	29.443067	1107.778198	
bar	0.500482	29.453561	1130.967163	
guest_house	0.500324213	29.4752741647	1138.74883759	6
cafe	0.5002779319	29.4758308858	1136.48152537	6
restaurant	0.4991191493	29.4756919504	1138.12368856	8
bar	0.4985160533	29.4758783972	1136.7992586	4
guest_house	0.4981674271	29.4702124794	1130.55766913	6
hotel_de_residence	0.497909593	29.4743175458	1008.46888292	6
hotel_de_camping	0.497360503	29.4749490177	1148.63613362	8
hotel_de_residence	0.4973338072	29.4737795605	1141.16120915	6
hotel_de_residence	0.4969408726	29.4750384441	1141.68771622	6
hotel_de_residence	0.496749951	29.4763868505	1141.32987112	4
hotel_de_camping	0.4965460492	29.475235755	1138.62782263	4
hotel_de_residence	0.4958276999	29.4720236768	1139.84220075	4
guest_house	0.4948313231	29.472577221	1158.42359954	4
hotel_de_residence	0.4948310301	29.4686872158	1135.17938038	6
guest_house	0.4947061089	29.4683189425	1140.07098807	12
restaurant	0.4946732074	29.4741218626	1148.96190767	4
restaurant	0.4945937148	29.4736345335	1150.0502841	4
hotel_de_camping	0.4942144532	29.4769983447	1139.19590768	6
restaurant	0.4938473528	29.4697644973	1141.62582628	6
restaurant	0.4934283176	29.4737500974	1148.28769693	4
restaurant	0.4934095971	29.4731720309	1144.0580006	6
bar	0.4932547491	29.4734541746	1146.66010574	6
hotel_de_camping	0.4920220271	29.4778987932	1155.96612834	4
cafe	0.4917722961	29.4783835482	1156.46602853	6
hotel_de_residence	0.4904491	29.4773674		
hotel_de_residence	0.4892704583	29.468306865	1170.83874563	6
bar	0.4890829582	29.4708715341	1173.41210077	4
hotel_de_residence	0.4888838965	29.469654694	1163.3181458	4
hotel_de_residence	0.4872834672	29.4680881913	1166.18510201	4
restaurant	0.4867784273	29.4690017756	1171.68457951	4
cafe	0.4867605381	29.4685280597	1178.69362439	6
restaurant	0.47262998	29.47488356	1297	3
hotel_de_residence	0.47145716	29.47524733	1299	3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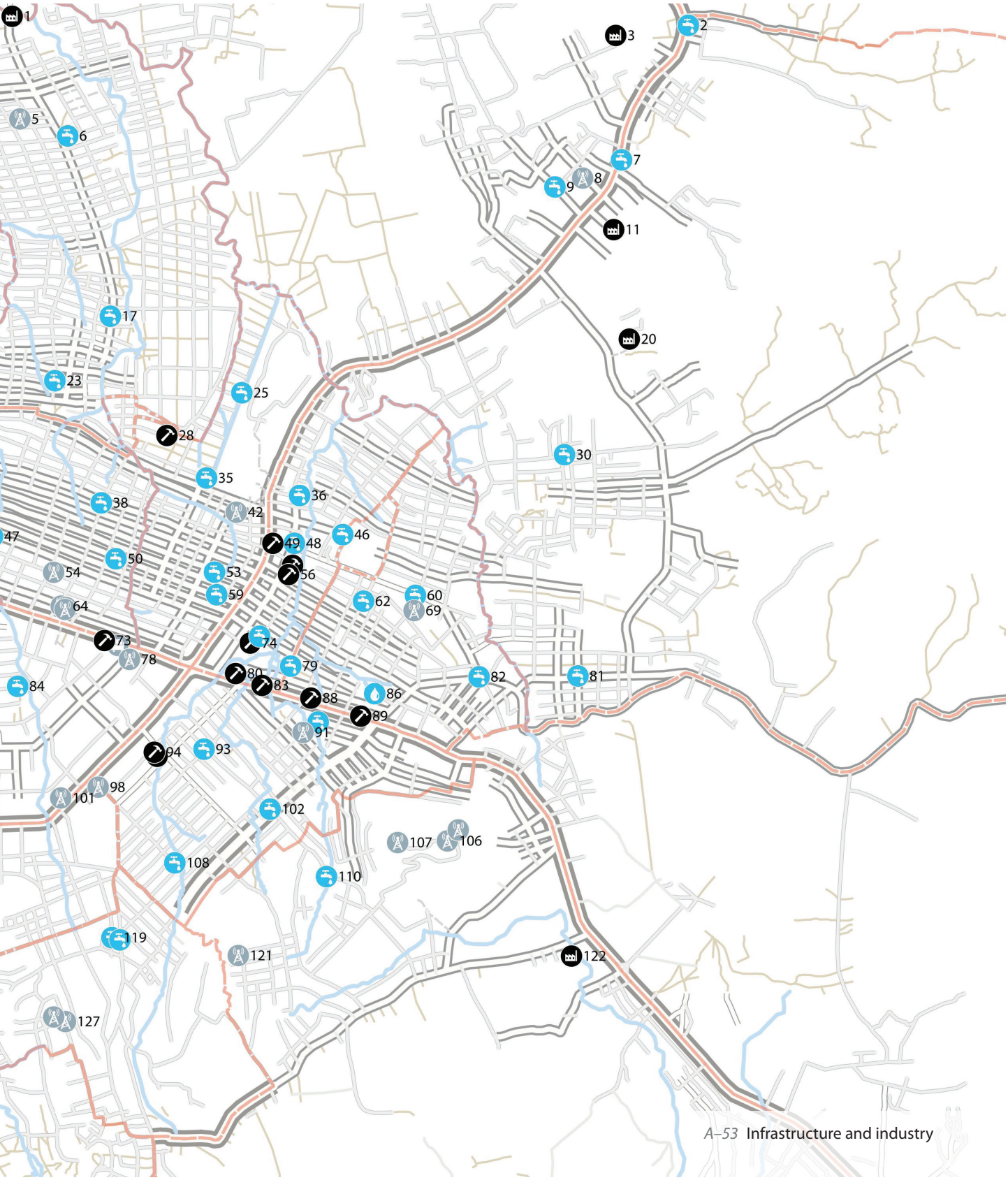
Infrastructure and industry
Factory
Workshop
Latrine
Public fountain
Water source
Generator station
Cellular station



A–53 Infrastructure and industry

A–54 Infrastructure and industry metadata

id	time	enumerator	name	type
1	2014-10-13T11:12:27.355	pascal_kazindu	Huile de Palme	industrie
2	2014-10-14T13:57:08.169	william_ungyertho_uuci	Solidarites	infrastructure
3	2013-01-05T03:55:58.580	stephen_salama	Abatoire Central de Beni	industrie
4	2014-10-13T12:22:22.373	puissance_mwendu	Borne Fontaine no.103	infrastructure
5	2014-10-13T11:38:25.554	jacques_ageno	Antenne Vodacom	infrastructure
6	2014-10-13T10:42:36.506	pascal_kazindu	Borne Fontaine	infrastructure
7	2014-10-14T11:42:02.859	william_ungyertho_uuci	Solidarites	infrastructure
8	2013-01-05T04:33:26.660	stephen_salama	Antene de Telecommunication Airtel	infrastructure
9	2013-01-05T04:53:17.946	stephen_salama	Borne Fontaine	infrastructure
10	2014-10-13T10:27:33.114	puissance_mwendu	Borne Fontaine no.97	infrastructure
11	2014-10-14T10:55:23.549	william_ungyertho_uuci	Entreprise Okapi Afia	industrie
12	2014-10-10T12:55:03.828	ungale_kulesa	Kal Mango	industrie
13	2014-10-13T13:31:12.988	karl_tjongo_kamavu	Borne Fontaine no.9	infrastructure
14	2014-10-13T12:55:20.095	karl_tjongo_kamavu	Borne Fontaine no.25	infrastructure
15	2014-10-14T11:16:09.883	elisabeth_vanoverbeeke	Borne Fontaine no.24	infrastructure
16	2014-10-14T11:06:04.822	elisabeth_vanoverbeeke	Garage Pied á Coulisse	industrie
17	2014-10-13T10:07:38.898	karl_tjongo_kamavu	Borne Fontaine no.33	infrastructure
18	2014-10-14T12:36:58.372	celestin_kasereka	Atelier de Couture Dieu Merci	industrie
19	2014-10-14T10:38:37.332	elisabeth_vanoverbeeke	Latrines	infrastructure
20	2014-10-14T12:14:19.957	karl_tjongo_kamavu	Usine Scak Sprl	industrie
21	2014-10-13T13:52:36.606	karl_tjongo_kamavu	Cash-point Muyala	infrastructure
22	2014-10-14T14:10:55.362	elisabeth_vanoverbeeke	Borne Fontaine no.33	infrastructure
23	2014-10-13T14:12:04.502	karl_tjongo_kamavu	Borne Fontaine no.15	infrastructure
24	2014-10-14T09:31:37.829	elisabeth_vanoverbeeke	Borne Fontaine no.22	infrastructure
25	2014-10-13T09:54:48.549	stephen_salama	Borne Fontaine no.2	infrastructure
26	2014-10-13T12:16:13		Puit Butsili	infrastructure
27	2014-10-10T12:06:35.122	puissance_mwendu	Borne Fontaine	infrastructure
28	2014-10-13T14:18:58.739	gloria_najangusi_	Atelier Venez Voir	industrie
29	2014-10-13T09:15:40		Borne Fontaine no.28	infrastructure
30	2014-10-14T11:10:02.618	pascal_kazindu	Borne Fontaine	infrastructure
31	2014/10/13 11:58:34		Borne Fontaine	infrastructure
32	2014-10-13T11:17:12.924	micheline_nobikana	Borne Fontaine no.36	infrastructure
33	2014-10-13T14:42:22.857	william_ungyertho_uuci	Borne Fontaine Solidarite	infrastructure
34	2014-10-10T10:54:23.170	bora_mukovi	Usine de la Regideso Kasanga	industrie
35	2014-10-13T09:23:27.742	ungale_kulesa	Borne Fontaine	infrastructure
36	2014-10-14T13:05:35.603	jacques_ageno	Borne Fontaine no.82	infrastructure
37	2014-10-13T11:06:49		Antenne Improuvement	infrastructure
38	2014-10-10T10:48:20.969	sagesse_ndaliko	Borne Fontaine no.10	infrastructure
39	2014-10-13T10:32:25.452	junior_mukuka	Borne Fontaine no.13	infrastructure
40	2014-10-13T08:39:24		Borne Fontaine no.20	infrastructure

type_infrastructure	type_industry	latitude	longitude	elevation	precision
	usine	0.5248835423	29.4633745998	1064.93036908	6
borne_de_fontaine		0.5244472815	29.4958976936	1122.11133644	4
	usine	0.5239628028	29.4924088896	1109.29192985	6
borne_de_fontaine		0.5235596075	29.456507773	1072.98837564	6
station_de_base		0.5199461425	29.463741337	1084.20763456	4
borne_de_fontaine		0.5191319033	29.4660433226	1093.54602839	6
borne_de_fontaine		0.5179816569	29.4926867883	1128.78667664	4
station_de_base		0.5171054327	29.4908190061	1138.14570048	4
borne_de_fontaine		0.5166780828	29.4894786349	1139.25912382	6
borne_de_fontaine		0.5163859009	29.4567380706	1101.75141603	6
	usine	0.5146268872	29.4923120298	1143.33980672	4
	usine	0.5137324994	29.4269224313	1073.28837332	4
borne_de_fontaine		0.5111322626	29.4615323232	1102.74262215	4
borne_de_fontaine		0.5111176524	29.4584481409	1108.19659174	4
borne_de_fontaine		0.51107977	29.45613041	1102	4
	atelier	0.51047048	29.45477249	1124	5
borne_de_fontaine		0.5104653923	29.4680943153	1112.06447492	4
	atelier	0.51025581	29.44742482	1083	5
latrines		0.50960602	29.45508558	1103	5
	usine	0.5093640212	29.4930620598	1145.08927366	4
station_de_base		0.5084298271	29.4590056877	1117.56223695	4
borne_de_fontaine		0.50761023	29.45389528	1111	5
borne_de_fontaine		0.5073643151	29.4654247042	1115.6320601	4
borne_de_fontaine		0.50694984	29.45699928	1108	5
borne_de_fontaine		0.506783251	29.4744197057	1119.1057086	12
puit		0.506551	29.4456	1108.497681	
borne_de_fontaine		0.5049841812	29.4585312565	1105.58052267	8
	atelier	0.5047295191	29.4708186102	1111.71876951	4
borne_de_fontaine		0.503897	29.454403	1119.401611	
borne_de_fontaine		0.5038067811	29.4899415307	1152.17232287	6
borne_de_fontaine		0.503669	29.44905	1117.603638	
borne_de_fontaine		0.5030346113	29.4428029499	1089.0577535	4
borne_de_fontaine		0.5027883413	29.4359531539	1098.56507098	4
	usine	0.5027792471	29.4199552459	1064.27608353	6
borne_de_fontaine		0.5026872312	29.4727224684	1135.32828339	4
borne_de_fontaine		0.501843474	29.4772003357	1124.7399591	4
station_de_base		0.501539	29.452866	1126.416748	
borne_de_fontaine		0.5014892611	29.4676572508	1131.25103777	4
borne_de_fontaine		0.5014023	29.45990607	1128.09997559	5
borne_de_fontaine		0.501327	29.454204	1132.446289	

41	2014-10-10T11:07:33.428	bora_mukovi	Chateau d'Eau de la Brasimba	industrie
42	2014-10-10T12:27:59.099	lewe_mobedra_netuta	Antenne Telecommunication	infrastructure
43	2014-10-10T11:21:35.314	ungale_kulesa	Non-potable	infrastructure
44	2014-10-13T10:20:29.350	william_ungyertho_uuci	Riserie	industrie
45	2014-10-10T11:39:20.821	ungale_kulesa	Source	infrastructure
46	2014-10-14T09:22:02.480	jacques_ageno	Borne Fontaine no.80	infrastructure
47	2014-10-13T10:12:17.725	junior_mukuka	Borne Fontaine	infrastructure
48	2014-10-14T12:58:11.475	sagesse_ndaliko	Borne Fontaine	infrastructure
49	2013-01-04T05:44:41.736	stephen_salama	Garage ATDB	industrie
50	2014-10-13T12:07:13.819	lewe_mobedra_netuta	Borne Fontaine no.14	infrastructure
51	2014-09-18T09:02:24		Borne Fontaine no.69	infrastructure
52	2013-01-04T05:28:51.829	stephen_salama	Garage Atedeaut	industrie
53	2014-10-13T10:27:06.095	thierry_babonye	Borne Fontaine no.2	infrastructure
54	2014-10-13T12:04:36.788	celestin_kasereka	Antenne de Tigo	infrastructure
55	2014-10-10T10:12:19.308	micheline_nobikana	Atelier de Reparation Bendarar	industrie
56	2013-01-04T05:21:53.583	stephen_salama	Garage Automibile	industrie
57	2014-09-18T07:53:43		Puit D'eau	infrastructure
58	2013-01-01T04:12:38.292	stephen_salama	Moulin Vimba Na Sante	industrie
59	2014-10-10T11:37:55.174	thierry_babonye	Borne Fontaine no.5	infrastructure
60	2013-01-04T03:44:26.696	stephen_salama	Borne Fontaine no.65	infrastructure
61	2014-09-18T07:58:02		Borne Fontaine no.32	infrastructure
62	2013-01-04T03:59:15.135	stephen_salama	Borne Fontaine no.70	infrastructure
64	2014-10-13T13:18:35.256	lewe_mobedra_netuta	Antenne airtel	infrastructure
65	2014-10-13T13:21:47.468	lewe_mobedra_netuta	Antenne CCT	infrastructure
66	2014-09-18T07:14:46		Borne Fontaine no.100	infrastructure
67	2014-09-18T07:13:31		Borne Fontaine no.100	infrastructure
68	2014-10-13T09:41:14.006	junior_mukuka	Antenne orange	infrastructure
69	2013-01-04T03:41:39.018	stephen_salama	BTS Airtel	infrastructure
70	2014-09-18T09:50:53		Borne Fontaine no.27	infrastructure
71	2013-01-04T04:46:34.965	stephen_salama	Borne Fontaine	infrastructure
72	2014-09-18T08:41:49		Source D'eau Kahodokyo	infrastructure
73	2014-10-10T09:52:57.247	pascal_kazindu	Atelier Soudure	industrie
74	2013-01-04T04:49:28.401	stephen_salama	Garage Auto	industrie
75	2014-10-10T10:54:17.470	william_ungyertho_uuci	Atelier de Couture Tupendane	industrie
76	2014-10-10T09:45:40.676	archip_lobo	Station Garage	infrastructure
77	2014-10-10T10:07:34		Borne Fontaine no.28	infrastructure
78	2014-09-16T10:36:46		Antenne Airtel	infrastructure
79	2013-01-04T04:38:10.219	stephen_salama	Borne Fontaine no.75	infrastructure
80	2013-01-04T01:31:00.698	stephen_salama	Atelier de Menuiserie	industrie
81	2014-10-14T10:14:56.850	puissance_mwendu	Borne Fontaine	infrastructure
82	2014-10-14T09:27:52.836	puissance_mwendu	Borne Fontaine no.73	infrastructure

	usine	0.5011885659	29.4208246084	1069.34771542	4
station_de_base		0.5010399903	29.474153022	1134.97612669	6
source_deau		0.5002969115	29.422809916	1071.81134867	8
	usine	0.5002648587	29.4413845072	1086.18700608	4
source_deau		0.499992487	29.4245466953	1077.4462681	6
borne_de_fontaine		0.49996402	29.4792724024	1143.44580943	4
borne_de_fontaine		0.4998745	29.46243024	1133.69995117	2
borne_de_fontaine		0.4995452049	29.4769472865	1107.90056368	8
	atelier	0.4995450124	29.4759159148	1137.25528967	6
borne_de_fontaine		0.4988014692	29.4683633918	1128.68256003	6
borne_de_fontaine		0.49850672	29.45201	1126.9	
	atelier	0.4984880678	29.4768643368	1138.96199279	4
borne_de_fontaine		0.498161099	29.4731059271	1139.90688382	6
station_de_base		0.49814991	29.46536914	1140.40002441	2
	atelier	0.4980746531	29.4533605361	1134.55788212	4
	atelier	0.4980433609	29.4766676419	1133.96892153	4
puit		0.49738887	29.44098	1101.9	
	usine	0.4973319775	29.4405189048	1094.38957054	4
borne_de_fontaine		0.4970720726	29.4732083776	1133.84096005	6
borne_de_fontaine		0.4970415399	29.4827722846	1145.86668719	6
borne_de_fontaine		0.49703607	29.441656	1107.8	
borne_de_fontaine		0.4967639229	29.4802762385	1146.55038469	4
station_de_base		0.4965303182	29.4657318004	1143.32247341	6
station_de_base		0.4964631519	29.46595928	1143.80995915	6
borne_de_fontaine		0.49641344	29.438202	1111.8	
borne_de_fontaine		0.49640933	29.438196	1112	
station_de_base		0.49636659	29.46591589	1150.30004883	2
station_de_base		0.4963110356	29.4827068037	1153.10971695	4
borne_de_fontaine		0.49590307	29.459698	1138	
borne_de_fontaine		0.4950767556	29.4752776733	1138.36897381	4
source_deau		0.49504203	29.45006	1111.7	
	atelier	0.4948727058	29.4678123987	1142.27737313	6
	atelier	0.4947489395	29.4748255827	1146.28080153	4
	atelier	0.4946770005	29.4527181185	1109.91984474	4
station_de_genera-teur		0.4946369011	29.4684560946	1140.85142673	6
borne_de_fontaine		0.494204	29.45472	1133.394897	
station_de_base		0.49396405	29.469017	1152.6	
borne_de_fontaine		0.493641414	29.4767711274	1132.66694385	4
	atelier	0.4932839465	29.4741206076	1150.5237904	4
borne_de_fontaine		0.4931673751	29.4905865513	1166.78998635	6
borne_de_fontaine		0.4931223378	29.4858307945	1159.48489862	6

83	2013-01-04T01:43:06.185	stephen_salama	Atelier Menuiserie	industrie
84	2014-10-10T11:09:42.262	pascal_kazindu	Borne Fontaine	infrastructure
85	2014-09-18T08:32:00		Borne Fontaine Solidarites	infrastructure
86	2013-01-04T02:48:36.284	stephen_salama	Source Kawaya	infrastructure
87	2014-10-10T10:23:59		Borne Fontaine no.1	infrastructure
88	2013-01-04T02:10:59.437	stephen_salama	Garage Automobile	industrie
89	2013-01-04T02:27:47.098	stephen_salama	Garage Auto Nairobi	industrie
90	2014-10-09T12:45:05.218	junior_mukuka	Borne Fontaine no.21	infrastructure
91			Antenne Airtel	infrastructure
92	2014-10-10T09:17:04		Borne Fontaine no.41	infrastructure
93			Borne Fontaine no.53	infrastructure
94	2014-10-09T09:30:03.898	bora_mukovi	Atelier de Menuiserie CAEPA	industrie
95	2014-10-10T14:16:59.784	micheline_nobikana	Atelier de Couture Chalom	industrie
96	2014-10-09T13:06:26.577	bora_mukovi	Garage	industrie
97	2014-10-10T14:02:30.622	micheline_nobikana	C'est Dieu Qui Donne	industrie
98	2014-10-09T16:42:50.457	bora_mukovi	Vodacom	infrastructure
99	2014-10-10T10:47:40.717	karl_tjongo_kamavu	Borne Fontaine no.101	infrastructure
100	2014-09-17T08:29:33		Borne Fontaine Solidarites	infrastructure
101	2014-09-16T10:14:45		Antenne Airtel	infrastructure
102	2014-10-09T10:47:44.721	celestin_kasereka	Borne Fontaine no.51	infrastructure
103	2014-10-10T13:00:27.903	william_ungyertho_uuci	Regideso	infrastructure
104	2014-10-09T14:57:47.383	stephen_salama	Antenne Tigo	infrastructure
105	2014-10-10T13:03:00.644	william_ungyertho_uuci	Kihydro	infrastructure
106	2014-10-09T15:02:55.367	stephen_salama	Antenne Orange	infrastructure
107	2014-10-09T15:20:13.244	nadia_kavira	Antenne Airtel	infrastructure
108	2014-10-09T15:33:55.337	bora_mukovi	Borne Fontaine	infrastructure
109	2014-09-17T07:28:38		Source d'Eau Kamusonge	infrastructure
110	2014-10-09T13:51:08.068	thierry_babonye	Borne Fontaine no.72	infrastructure
111	2014-09-17T08:44:00		Borne Fontaine no.45	infrastructure
112	2014-10-10T13:13:43.961	karl_tjongo_kamavu	Borne Fontaine no.45	infrastructure
113	2014-10-09T12:54:09.279	william_ungyertho_uuci	Borne Fontaine	infrastructure
114	2014-10-10T09:46:27.157	karl_tjongo_kamavu	Borne Fontaine no.43	infrastructure
115	2014-09-17T09:40:59		Borne Fontaine no.43	infrastructure
116	2014-09-17T09:55:23		Lattrines Publiques	infrastructure
117	2014-09-17T09:27:29		Borne Fontaine no.44	infrastructure
118	2014-10-10T12:45:15.147	karl_tjongo_kamavu	Borne Fontaine no.44	infrastructure
119	2014-10-09T11:07:54.568	muyisa_kombi	Borne fontaine no.61	infrastructure
120			Borne Fontaine	infrastructure
121	2014-10-09T12:46:50.548	thierry_babonye	Antenne	infrastructure
122	2014-10-14T09:42:22.361	lewe_mobedra_netuta	Usine de Savonnerie Yonayo	industrie
123			Borne Fontaine no.66	infrastructure
124	2014-10-09T13:28:22.817	puissance_mwendu	Solidarite 67	infrastructure

	atelier	0.4927160513	29.4753943556	1144.6868128	6
borne_de_fontaine		0.4926698522	29.4636354187	1137.85834099	8
borne_de_fontaine		0.4924488	29.447762	1120.6	
source_deau		0.4923154349	29.4808134587	1151.8008632	6
borne_de_fontaine		0.492294	29.453634	1127.392334	
	atelier	0.4921031851	29.4777408035	1154.18834366	4
	atelier	0.4912374442	29.4801424711	1165.54756428	4
borne_de_fontaine		0.49095732	29.47809135	1163.09997559	3
station_de_base		0.4904491	29.4773674		
borne_de_fontaine		0.489673	29.457905	1153.588501	
borne_de_fontaine		0.489648	29.4726009		
	atelier	0.4895011041	29.4702094669	1166.42357529	6
	atelier	0.4893799982	29.4514361115	1136.48314174	4
	atelier	0.489305994	29.4703459312	1174.03005012	4
	atelier	0.4887975219	29.4514994603	1127.13085713	4
station_de_base		0.4878224206	29.4675118983	1177.43073497	4
borne_de_fontaine		0.4875893997	29.4445774758	1121.31892875	4
borne_de_fontaine		0.48750737	29.444546	1131.3	
station_de_base		0.4873005	29.46571	1172.7	
borne_de_fontaine		0.48676339	29.47577654	1186.40002441	3
borne_de_fontaine		0.4858302612	29.4530404029	1149.50264112	4
station_de_base		0.4857675828	29.4848322679	1297.19805976	6
station_de_base		0.4856360994	29.4527984749	1140.37927979	4
station_de_base		0.4852378086	29.4843103268	1306.51037463	6
station_de_base		0.4851580485	29.4819162833	1308.62156619	6
borne_de_fontaine		0.4841834907	29.4711958826	1175.33750141	4
source_deau		0.48378056	29.43967	1118.5	
borne_de_fontaine		0.4835203713	29.4784922333	1210.85970313	6
borne_de_fontaine		0.48347306	29.444216	1135.8	
borne_de_fontaine		0.4834702054	29.4442273787	1134.85255745	4
borne_de_fontaine		0.4834657606	29.4596188177	1164.88619663	4
borne_de_fontaine		0.48281748	29.4484527411	1137.4773511	4
borne_de_fontaine		0.48279712	29.448418	1143.5	
latrines		0.48153993	29.445778	1145.8	
borne_de_fontaine		0.48094055	29.442368	1139.6	
borne_de_fontaine		0.4809175195	29.4423885201	1129.87156121	4
borne_de_fontaine		0.4805853635	29.4681691487	1208.10117639	4
borne_de_fontaine		0.4804823	29.4685546		
station_de_base		0.4797261791	29.4742494959	1287.79622024	4
	usine	0.4797012927	29.4902808153	1179.18912262	4
borne_de_fontaine		0.4793204	29.4572974		
borne_de_fontaine		0.4770976888	29.4602874859	1175.73366866	4

125	2014-10-09T11:17:52.094	puissance_mwendu	Solidarite	infrastructure
126			Antenne Airtel	infrastructure
127	2014-10-09T12:58:31.055	jacques_ageno	Antenne Airtel	infrastructure
128	2014-10-09T13:11:54		Usine ESCO Kivu	industrie
129	2014-10-09T12:20:51		Borne Fontaine no.102	infrastructure

borne_de_fontaine		0.4767864909	29.4539081862	1163.23489178	4
station_de_base		0.4767738	29.465371		
station_de_base		0.4765522307	29.4659384871	1264.56100812	6
	usine	0.476149	29.442121	1133.710815	
borne_de_fontaine		0.475037	29.439699	1145.295776	

Appendix E: Code for Beta Application

The following section includes the code that was developed for the beta mapping application. The website uses Jquery (https://jquery.com/), and Openlayers3 (http://openlayers.org/) API's. The code includes HTML, CSS, and Javascript.

HTML

```
<!DOCTYPE html PUBLIC “-//W3C//DTD XHTML 1.0 Transitional//EN”>

<html lang=’en’>
    <head>
        <title>Beni Atlas</title>
        <link rel=”stylesheet” href=”stylesheets/ol.css” type=”text/css”>
        <link rel=”stylesheet” href=”stylesheets/beniatlas.css”>
        <script type=”text/javascript” src=”javascript/jquery.min.js”></script>
        <script type=”text/javascript” src=”javascript/ol.js”></script>
    </head>
    <body>
        <script type=”text/javascript” src=”javascript/beniatlas.js”></script>
        <script type=”text/javascript” src=”javascript/layerfunctions.js”></script>
        <script type=”text/javascript” src=”javascript/buttonfunctionality.js”></script>
        <div id=”header”>
            <p>
                <a href=”index.html”>
                    <img src=”images/logo_beniatlas.png” alt=”BeniAtlas” style=”top:80px; left: 30px;
position:absolute”>
                </a>
            </p>
            <p>
                <ul class=”nobullet” class=”hnav”>
                    <li class=”hnav-about”><a class=”hnav-menu” href=”about.html”>[About]</a></li>
                    <li class=”hnav-map”><a class=”hnav-menu” href=”maps.html”>[Maps]</a></li>
                    <li class=”hnav-blog”><a class=”hnav-menu” href=”blog.html”>[Blog]</a></li>
                    <li class=”hnav-partners”><a class=”hnav-menu” href=”partners.html”>[Partners]</a></li>
                    <li class=”hnav-en”><a class=”hnav-menu” href=”english.html”>[EN]</a>/</li>
                    <li class=”hnav-fr”><a class=”hnav-menu” href=”french.html”>[FR]</a></li>
                    </ul>
            </p>
        </div>

        <div id=”mapcolumn”>
            <div id=”map” class=”map”></div>
            <img class=”northarrow” src=”images/northarrow.png” alt=”North Arrow” width=”30px”>

            <div id=”infocolumn1”>
                <h2 class=”title”></h2>
                <p class=”source”></p>
                <p class=”description”></p>
                <!--<svg width=”20” height=”10”><rect fill=”red” stroke=”#000000” stroke-miterlimit=”10”
width=”20” height=”10”/></svg>-->
                <div id=”legend”>
                    <div id=”legendicons”></div>
                    <p class=”legend”></p>
                </div>
            </div>
```

```
            <div id="infocolumn2">
                <h3 class="subtitle"></h3>
                <p class="description"></p>
                <p class="instructions"></p>
                <div class="geolocate"></div>
                <div class="report"></div>
                <div id="chart"></div>
                <div id="contribute"></div>
        <script type="text/javascript" src="javascript/graphs.js"></script>
            </div>
        </div>

        <div id="buttoncolumn">
            <p class="buttons">SELECT AN ACTIVITY</p>
            <div class="method_group">
                <input type="image" id="method_aggregate" class="toggle" src="images/method_aggregate_off.
svg"/>
                <input type="image" id="method_collect" class="toggle"src="images/method_collect_off.svg"/>
               <!--<input type="image" id="method_network" src="images/method_network.png">-->
                <input type="image" id="method_play" class="toggle"src="images/method_play_off.svg"/>
                <div id="method" class="namebutton"></div>
            </div>
            <p class="buttons">SELECT A PLACE</p>
            <div class="place_group">
                <input id="place_world" class="toggle" type="image" src="images/place_world_off.svg"/>
                <input id="place_drc" class="toggle" type="image" src="images/place_drc_off.svg"/>
                <input id="place_nkivu" class="toggle" type="image" src="images/place_nkivu_off.svg"/>
                <input id="place_beni_r" class="toggle" type="image" src="images/place_beni_r_off.svg"/>
                <input id="place_beni_c" class="toggle" type="image" src="images/place_beni_c_off.svg"/>
                <input id="place_beni_q" class="toggle" type="image" src="images/place_beni_q_off.svg"/>
                <div id="place" class="namebutton"></div>
            </div>
            <p class="buttons">SELECT A THEME</p>
            <div class="layer_group">
                <input id="layer_in" class="layer_button" type="image" src="images/layer_in_off.png"
style="display:none"/>
                <input id="layer_fo" class="layer_button" type="image" src="images/layer_fo_off.png"
style="display:none"/>
                <input id="layer_ag" class="layer_button" type="image" src="images/layer_ag_off.png"
style="display:none"/>
                <input id="layer_mi" class="layer_button" type="image" src="images/layer_mi_off.png"
style="display:none"/>
                <input id="layer_co" class="layer_button" type="image" src="images/layer_co_off.png"
style="display:none"/>
                <input id="layer_ai" class="layer_button" type="image" src="images/layer_ai_off.png"
style="display:none"/>
                <input id="layer_cu" class="layer_button" type="image" src="images/layer_cu_off.png"
style="display:none"/>
                <input id="layer_po" class="layer_button" type="image" src="images/layer_po_off.png"
style="display:none"/>
                <div id="layer" class="namebutton"></div>
            </div>
        </div>

        <script type="text/javascript">
        //map
        var map = new ol.Map({
            target: 'map',
            controls: [
               new ol.control.Zoom({
                    duration: 250,
                    className: 'ol-zoom',
                    zoomInLabel: '+',
                    zoomOutLabel: '-',
                    })
                ],
            layers: [],
            view: beni_c
            });
            aggregateFunction();
            beni_cFunction();
            beni_c_noneFunction();
        </script>
    </body>
</html>
```

CSS

```
/*-------------------------------------*\
        GENERAL
\*-------------------------------------*/

body {
    padding: 0;
    font-family: “Helvetica Neue”, Arial, Helvetica, sans-serif;
    color: #333333;
    font-size: 75%;
    background: white;
    color: #666;
    }

#header {
    height: 160px;
    width: 100%;
    }

#mapcolumn {
    width: 700px;
    float: left;
    }

#map {
    height: 500px;
    width: 100%;
    background:white;
    top: 155px;
    left: 0px;
    z-index: -1;
    float:left;
    }

#buttoncolumn {
    width: 140px;
    height: auto;
    padding: 50px;
    background-color: white;
    z-index: 2;
    float:left;
    clear:right;
    }

#infocolumn1 {
    width: 300px;
    height: auto;
    padding-left: 50px;
    float: left;
    z-index: -1;
    }

#infocolumn2 {
    width: 300px;
    height: auto;
    padding-left: 50px;
    float: left;
    }


/*-------------------------------------*\
        BUTTONS
\*-------------------------------------*/

/*negative margin around layer buttons to bring closer together*/
input.layer_button {
    margin-right: -4px;
    margin-top: -4px;
    bottom: -10px;
    }

div.method_group {
    padding-left: 10px;
```

```
    }

div.place_group {
    padding-left: 10px;
    }

div.layer_group {
    padding-left: 10px;
    }

div.namebutton {
    height: 30px;
    }

#legend {
    padding-left: 15px;
    }

#legendicons {
    width: 30px;
    float: left;
    }

.icon {
    width:30px;
    height:15px;
    margin-bottom: 5px;
    }


/*-------------------------------------*\
        CONTROLS
\*-------------------------------------*/

img.northarrow {
    position:absolute;
    top:620px;
    left:38px;
    z-index:2;
    }

#menu {
    top:500px;
    left:28px;
    position: absolute;
    }


/*-------------------------------------*\
        OL3 OVERRIDE
\*-------------------------------------*/

.ol-control button{
    display:block;
    margin:1px;
    padding:0;
    color:black;
    font-size:1.5em;
    font-weight:700;
    text-decoration:none;
    text-align:center;
    height:30px;
    width:30px;
    line-height:.4em;
    background-color:white;
    border-style:solid;
    border-width:2px;
    border-color: black;
    border-radius:4px
    }

.ol-control button:focus,.ol-control button:hover{
    text-decoration:none;
    color:black;
    background-color:white;
```

```
    border-style:solid;
    border-width:2px;
    border-color:red;
    }

.ol-zoom .ol-zoom-in{
    border-radius:4px 4px 0 0
    }
.ol-zoom .ol-zoom-out{
    border-radius:0 0 4px 4px
    }


/*-------------------------------------*\
        TEXT
\*-------------------------------------*/

p.buttons {
    font-family: “Myriad Pro”;
    font-size: 110%;
    font-weight: bold;
    color: black;
    z-index: 1;
    }

p.legend {
    padding-left: 35px;
    padding-bottom: 10px;
    line-height: 170%;
    }

p.copyright {
    position:absolute;
    top:1750px;
    left:460px;
    }

p.white {
    color:white;
    }

ul.nobullet {
    list-style-type:none;
    margin:0;
    padding:0;
    }

ul.hnav {
    list-style-type:none;
    margin:0;
    padding:0;
    overflow: hidden;
    z-index: 1;
    }

li.hnav-about {
    position: absolute;
    top:180px;
    left:94px;
    z-index: 1;
    }

li.hnav-map {
    position: absolute;
    top:180px;
    left:245px;
    z-index: 1;
    }

li.hnav-blog {
    position: absolute;
    top:180px;
    left:389px;
    z-index: 1;
    }
```

```
li.hnav-partners {
    position: absolute;
    top:180px;
    left:526px;
    z-index: 1;
    }

li.hnav-en {
    position: absolute;
    top:180px;
    left:850px;
    z-index: 1;
    }

li.hnav-fr {
    position: absolute;
    top:180px;
    left:880px;
    z-index: 1;
    }

li.hnav-menu {
    font-family: “Myriad Pro”;
    font-size: 110%;
    font-weight: bold;
    color: black;
    z-index: 1;
    }

a.button hover{
    }

a.hnav-menu {
    font-family: “Myriad Pro”;
    font-size: 110%;
    font-weight: bold;
    color: black;
    background-color:white;
    z-index: 1;
    }

body a:hover {
    color: red;
    }

a:link {text-decoration:none;}    /* unvisited link */
a:visited {text-decoration:none;} /* visited link */
a:hover {text-decoration:none;}   /* mouse over link */
a:active {text-decoration:none;}
```

Javascript

```
////////////////////////////////////////////////
                    //VIEWS//
////////////////////////////////////////////////

var world = new ol.View({//WORLD VIEW
    projection: 'EPSG:4326',
    center: [0, 0],
    zoom: 1.5,
    minZoom: 1.5,
    maxZoom: 1.5
    });

var drc = new ol.View({//DRC VIEW
    projection: 'EPSG:4326',
    center: [23.65, -3.02],
    zoom: 5,
    minZoom: 5,
    maxZoom: 5
    });

var nkivu = new ol.View({//NORTH KIVU VIEW
    projection: 'EPSG:4326',
    center: [28.69, -0.60],
    zoom: 7.4,
    minZoom: 7.4,
    maxZoom: 7.4
    });

var beni_r = new ol.View({//BENI REGION VIEW
    projection: 'EPSG:4326',
    center: [29.53, 0.42],
    zoom: 9,
    minZoom: 9,
    maxZoom: 9
    });

var beni_c = new ol.View({//BENI CITY VIEW
    projection: 'EPSG:4326',
    center: [29.46, 0.50],
    zoom: 13,
    minZoom: 13,
    maxZoom: 16
    });

var beni_q = new ol.View({//BENI CITY VIEW
    projection: 'EPSG:4326',
    center: [29.46, 0.50],
    zoom: 13,
    minZoom: 13,
    maxZoom: 16
    });

////////////////////////////////////////////////
                    //SOURCES//
////////////////////////////////////////////////

var worldSource = new ol.source.GeoJSON({//WORLD ADMIN SOURCE
    url: 'data/admin_world.geojson',
    projection: 'EPSG:4326'
    });

var drcSource = new ol.source.GeoJSON({//DRC ADMIN SOURCE
    url: 'data/admin_drc.geojson',
    projection: 'EPSG:4326'
    });

var drcdivSource = new ol.source.GeoJSON({//DRC DIVIDED ADMIN SOURCE
    url: 'data/admin_drc_div.geojson',
    projection: 'EPSG:4326'
    });

var nkivuSource = new ol.source.GeoJSON({//NORTH KIVU ADMIN SOURCE
```

```
    url: 'data/admin_nkivu.geojson',
    projection: 'EPSG:4326'
    });

var nkivudivSource = new ol.source.GeoJSON({//NORTH KIVU DIVIDED ADMIN SOURCE
    url: 'data/admin_nkivu_div.geojson',
    projection: 'EPSG:4326'
    });

var beni_rSource = new ol.source.GeoJSON({//BENI REGION ADMIN SOURCE
    url: 'data/admin_beni_r.geojson',
    projection: 'EPSG:4326'
    });

var beni_c_roadsSource = new ol.source.GeoJSON({//BENI ROADS SOURCE
    url: 'data/roads_test.geojson',
    projection: 'EPSG:4326'
    });

var beni_c_roadspSource = new ol.source.GeoJSON({//BENI PRIMARY ROADS SOURCE
    url: 'data/roads_primary.json',
    projection: 'EPSG:4326'
    });

var drc_coSource = new ol.source.GeoJSON({//DRC CONFLICT SOURCE
    url: 'data/conflict_drc.geojson',
    projection: 'EPSG:4326'
    });

var drc_cuSource = new ol.source.GeoJSON({//DRC CONFLICT SOURCE
    url: 'data/culture_drc.geojson',
    projection: 'EPSG:4326'
    });

var beni_c_cuSource = new ol.source.GeoJSON({//BENICITY CULTURE SOURCE
    url: 'data/culture_test.geojson',
    projection: 'EPSG:4326'
    });

var beni_qSource = new ol.source.GeoJSON({//BENI QUARTIER BOUNDARIES SOURCE
    url: 'data/quartiers_test.geojson',
    projection: 'EPSG:4326'
    });


////////////////////////////////////////////////
                //STYLES//
////////////////////////////////////////////////

//GREY FILL STYLE
var greyStyle = new ol.style.Style({
    fill: new ol.style.Fill({
        color: '#D8DAD9',
        }),
    stroke: new ol.style.Stroke({
        color: 'white',
        width: 0.5
        })
    });

//BLACK OUTLINE STYLE
var outlineStyle = new ol.style.Style({
    stroke: new ol.style.Stroke({
        color: 'black',
        width: 1
        })
    });

//BLACK OUTLINE 2 STYLE
var outline2Style = new ol.style.Style({
    stroke: new ol.style.Stroke({
        color: 'black',
        width: 2
        })
    });
```

```
//POINT STYLE CONFLICT
var drc_coStyle = new ol.style.Style({
    image: new ol.style.Circle({
        radius: 4,
        fill: new ol.style.Fill({
            color: '#94ABB7',
            }),
        stroke: new ol.style.Stroke({
            color: 'rgba(20,130,150,0.8)',
            width: 1
            })
        })
    });

//culture drc style
var drc_cuStyle = new ol.style.Style({
    stroke: new ol.style.Stroke({
        color: '#F062A4',
        width: 1
        })
    });

//POINT STYLE CULTURE

var beni_c_cuStyle = new ol.style.Style({
    image: new ol.style.Circle({
        radius: 4,
        fill: new ol.style.Fill({
            color: '#F768A1',
            }),
        stroke: new ol.style.Stroke({
            color: 'rgba(20,130,150,0.8)',
            width: 1
            })
        })
    });

////////////////////////////////////////////////////
                    //FONT STYLE FUNCTIONS//
////////////////////////////////////////////////////

var quartiertextStyleFunction = function(feature, resolution) {
    var fontSize = '18';
    if(resolution>=39134) {
        fontSize = '10';
        } else if(resolution>=9782) {
        fontSize = '14';
        } else if(resolution>=2444) {
        fontSize = '16';
        }
    return [new ol.style.Style({
        text: new ol.style.Text({
            font: '14px sans-serif,helvetica',
            text: feature.get('name'),
            fill: new ol.style.Fill({
                color: 'black'
                }),
            stroke: new ol.style.Stroke({
                color: 'white',
                width: 1.5
                })
            }),
        stroke: new ol.style.Stroke({
            color: 'red',
            width: 2
            }),
        })];
    };


////////////////////////////////////////////////////
                    //LAYERS//
////////////////////////////////////////////////////
```

```
var worldLayer = new ol.layer.Vector({//WORLD ADMIN LAYER
    source: worldSource,
    style: greyStyle
    });

var drcLayer = new ol.layer.Vector({//DRC ADMIN LAYER
    source: drcSource,
    style: outlineStyle
    });

var drcdivLayer = new ol.layer.Vector({//DRC DIVIDED ADMIN LAYER
    source: drcdivSource,
    style: greyStyle
    });

var nkivuLayer = new ol.layer.Vector({//NORTHKIVU ADMIN LAYER
    source: nkivuSource,
    style: outlineStyle
    });

var nkivudivLayer = new ol.layer.Vector({//NORTHKIVU DIVIDED ADMIN LAYER
    source: nkivudivSource,
    style: greyStyle
    });

var beni_rLayer = new ol.layer.Vector({//BENIREGION ADMIN LAYER
    source: beni_rSource,
    style: outlineStyle
    });

var beni_rdivLayer = new ol.layer.Vector({//BENIREGION ADMIN LAYER
    source: beni_rSource,
    style: greyStyle
    });

//ADMINISTRATIVE BENI POINT LAYER

//quartier boundaries layer
var beni_qLayer = new ol.layer.Vector({
    source: beni_qSource,
    style: quartiertextStyleFunction
    });

//roads layer
var roadsLayer = new ol.layer.Vector({
    source: beni_c_roadsSource,
    style: (function() {
        var route_principale = [new ol.style.Style({
            stroke: new ol.style.Stroke({
                color: 'black',
                width: 6
                })
            })];
        var route_secondaire = [new ol.style.Style({
            stroke: new ol.style.Stroke({
                color: 'grey',
                width: 4
                })
            })];
        var route_tertiare = [new ol.style.Style({
            stroke: new ol.style.Stroke({
                color: 'grey',
                width: 2.5
                })
            })];
        var route_sentier = [new ol.style.Style({
            stroke: new ol.style.Stroke({
                color: '#D8DAD9',
                width: 1.5
                })
            })];
        var route_service = [new ol.style.Style({
            stroke: new ol.style.Stroke({
                color: '#D8DAD9',
                width: 2
```

```
                })
            })];
        var route_pieton = [new ol.style.Style({
            stroke: new ol.style.Stroke({
                color: '#938B6A',
                width: 1
                })
            })];
        var route_default = [new ol.style.Style({
            stroke: new ol.style.Stroke({
                color: '#D8DAD9',
                width: 1.5
                })
            })];
        return function(feature) {
            if (feature.get('type') == 'route_principale') {
                return route_principale;
            } else if (feature.get('type') == 'route_secondaire') {
                return route_secondaire;
            } else if (feature.get('type') == 'route_tertiare') {
                return route_tertiaire;
            } else if (feature.get('type') == 'route_sentier') {
                return route_sentier;
            } else if (feature.get('type') == 'route_service') {
                return route_service;
            } else if (feature.get('type') == 'route_pieton') {
                return route_pieton;
            } else {
                return route_default;
                }
            };
        })()
    });

//inner roads layer
var roadsLayer2 = new ol.layer.Vector({
    source: beni_c_roadsSource,
    style: (function() {
        var route_principale2 = [new ol.style.Style({
            stroke: new ol.style.Stroke({
                color: 'white',
                width: 3
                })
            })];
        var route_secondaire2 = [new ol.style.Style({
            stroke: new ol.style.Stroke({
                color: 'white',
                width: 1.5
                })
            })];
        var route_tertiare2 = [new ol.style.Style({
            stroke: new ol.style.Stroke({
                color: 'white',
                width: 0.5
                })
            })];
        var route_default2 = [new ol.style.Style({
            stroke: new ol.style.Stroke({
                width: 0
                })
            })];
        return function(feature) {
            if (feature.get('type') == 'route_principale') {
                return route_principale2;
            } else if (feature.get('type') == 'route_secondaire') {
                return route_secondaire2;
            } else if (feature.get('type') == 'route_tertiare') {
                return route_tertiaire2;
                }
            };
        })()
    });

//primary roads layer
var roads_primaryLayer = new ol.layer.Vector({
```

```
        source: beni_c_roadspSource,
        style: new ol.style.Style({
            stroke: new ol.style.Stroke({
                color: 'grey',
                width: 3
                })
            })
        });

    //roads infrastructure layer
    var beni_c_inLayer = new ol.layer.Vector({
        source: beni_c_roadsSource,
        style: (function() {
            var condition_bonne = [new ol.style.Style({
                stroke: new ol.style.Stroke({
                    color: 'blue',
                    width: 2
                    })
                })];
            var condition_mediocre = [new ol.style.Style({
                stroke: new ol.style.Stroke({
                    color: 'yellow',
                    width: 2
                    })
                })];
            var condition_mauvaise = [new ol.style.Style({
                stroke: new ol.style.Stroke({
                    color: 'red',
                    width: 2
                    })
                })];
            var condition_default = [new ol.style.Style({
                stroke: new ol.style.Stroke({
                    color: '#D8DAD9',
                    width: 1
                    })
                })];
            return function(feature) {
                if (feature.get('condition') == 'condition_bonne') {
                    return condition_bonne;
                } else if (feature.get('condition') == 'condition_mediocre') {
                    return condition_mediocre;
                } else if (feature.get('condition') == 'condition_mauvaise') {
                    return condition_mauvaise;
                } else {
                    return condition_default;
                    }
                };
            })()
        });


    // conflict drc layer
    var drc_coLayer = new ol.layer.Vector({
        source: drc_coSource,
        style: drc_coStyle
        });

    // conflict world layer
    var world_coLayer = new ol.layer.Vector({
        source: worldSource,
        style: (function () {
            var defaultStyle = [new ol.style.Style({
                fill: new ol.style.Fill({
                    color: '#D8DAD9',
                    }),
                stroke: new ol.style.Stroke({
                    color: 'white',
                    width: 0.5
                    })
                })];
            var veryhighStyle = [new ol.style.Style({
                fill: new ol.style.Fill({
                    color: '#D1D1D1',
                    }),
```

```
            stroke: new ol.style.Stroke({
                color: 'white',
                width: 0.5
                })
            })];
        var highStyle = [new ol.style.Style({
            fill: new ol.style.Fill({
                color: '#A8A8A8',
                }),
            stroke: new ol.style.Stroke({
                color: 'white',
                width: 0.5
                })
            })];
        var mediumStyle = [new ol.style.Style({
            fill: new ol.style.Fill({
                color: '#7F7F7F',
                }),
            stroke: new ol.style.Stroke({
                color: 'white',
                width: 0.5
                })
            })];
        var lowStyle = [new ol.style.Style({
            fill: new ol.style.Fill({
                color: '#565656',
                }),
            stroke: new ol.style.Stroke({
                color: 'white',
                width: 0.5
                })
            })];
        var verylowStyle = [new ol.style.Style({
            fill: new ol.style.Fill({
                color: '#2D2D2D',
                }),
            stroke: new ol.style.Stroke({
                color: 'white',
                width: 0.5
                })
            })];
        return function(feature) {
            if (feature.get('p2013rate') == 'veryhigh') {
                return veryhighStyle;
            } else if (feature.get('p2013rate') == 'high') {
                return highStyle;
            } else if (feature.get('p2013rate') == 'medium') {
                return mediumStyle;
            } else if (feature.get('p2013rate') == 'low') {
                return lowStyle;
            } else if (feature.get('p2013rate') == 'verylow') {
                return verylowStyle;
            } else {
                return defaultStyle;
                }
            };
        })()
    });

// culture world layer
var world_cuLayer = new ol.layer.Vector({
    source: worldSource,
    style: (function () {
        var defaultStyle = [new ol.style.Style({
            fill: new ol.style.Fill({
                color: '#D8DAD9',
                }),
            stroke: new ol.style.Stroke({
                color: 'white',
                width: 0.5
                })
            })];
        var veryhighStyle = [new ol.style.Style({
            fill: new ol.style.Fill({
                color: '#AC1283',
```

```
                }),
            stroke: new ol.style.Stroke({
                color: 'white',
                width: 0.5
                })
            })];
        var highStyle = [new ol.style.Style({
            fill: new ol.style.Fill({
                color: '#D53491',
                }),
            stroke: new ol.style.Stroke({
                color: 'white',
                width: 0.5
                })
            })];
        var mediumStyle = [new ol.style.Style({
            fill: new ol.style.Fill({
                color: '#F768A1',
                }),
            stroke: new ol.style.Stroke({
                color: 'white',
                width: 0.5
                })
            })];
        var lowStyle = [new ol.style.Style({
            fill: new ol.style.Fill({
                color: '#F99AB1',
                }),
            stroke: new ol.style.Stroke({
                color: 'white',
                width: 0.5
                })
            })];
        var verylowStyle = [new ol.style.Style({
            fill: new ol.style.Fill({
                color: '#FCC6C6',
                }),
            stroke: new ol.style.Stroke({
                color: 'white',
                width: 0.5
                })
            })];
        return function(feature) {
            if (feature.get('cu_rating') == 'veryhigh') {
                return veryhighStyle;
            } else if (feature.get('cu_rating') == 'high') {
                return highStyle;
            } else if (feature.get('cu_rating') == 'medium') {
                return mediumStyle;
            } else if (feature.get('cu_rating') == 'low') {
                return lowStyle;
            } else if (feature.get('cu_rating') == 'verylow') {
                return verylowStyle;
            } else {
                return defaultStyle;
                }
            };
        })()
    });

// culture drc layer
var drc_cuLayer = new ol.layer.Vector({
    source: drc_cuSource,
    style: drc_cuStyle
    });

var beni_c_cuLayer = new ol.layer.Vector({
    source: beni_c_cuSource,
    style: beni_c_cuStyle
    });


/////////////////////////////////////////////////
                  //LAYER GROUPS//
/////////////////////////////////////////////////
```

```
var worldGroup = new ol.layer.Group({
    layers: [worldLayer, drcLayer]
    });

var world_coGroup = new ol.layer.Group({
    layers: [world_coLayer, drcLayer]
    });

var world_cuGroup = new ol.layer.Group({
    layers: [world_cuLayer, drcLayer]
    });

var drcGroup = new ol.layer.Group({
    layers: [drcdivLayer, nkivuLayer]
    });

var drc_coGroup = new ol.layer.Group({
    layers: [drcdivLayer, drc_coLayer, nkivuLayer]
    });

var drc_cuGroup = new ol.layer.Group({
    layers: [drcdivLayer, drc_cuLayer, nkivuLayer]
    });

var nkivuGroup = new ol.layer.Group({
    layers: [nkivudivLayer, beni_rLayer]
    });

var beni_rGroup = new ol.layer.Group({
    layers: [beni_rdivLayer]
    });

var beni_cGroup = new ol.layer.Group({
    layers: [roadsLayer, roadsLayer2]
    });

var beni_c_inGroup = new ol.layer.Group({
    layers: [beni_c_inLayer]
    });

var beni_c_cuGroup = new ol.layer.Group({
    layers: [roadsLayer, roadsLayer2, beni_c_cuLayer]
    });

var beni_qGroup = new ol.layer.Group({
    layers: [roadsLayer, roadsLayer2, beni_qLayer]
    });

var beni_q_inGroup = new ol.layer.Group({
    layers: [beni_c_inLayer, beni_qLayer]
    });

var beni_q_cuGroup = new ol.layer.Group({
    layers: [roadsLayer, roadsLayer2, beni_c_cuLayer, beni_qLayer]
    });


////////////////////////////////////////////////
                  //INTERACTIONS//
////////////////////////////////////////////////

//change to red when click
var selectInteraction = new ol.interaction.Select({
    layers: [beni_qLayer, drcLayer, nkivuLayer],
    style: new ol.style.Style({
        stroke: new ol.style.Stroke({
            color: 'blue',
            width: 3,
            }),
        fill: new ol.style.Fill({
            color: 'rgba(0,0,255,0.1)',
            })
        }),
    });
```

```
//change to blue when hover
var selectPointerMove = new ol.interaction.Select({
    layers: [beni_qLayer, drcLayer, nkivuLayer],
    style: new ol.style.Style({
        stroke: new ol.style.Stroke({
            color: 'red',
            width: 3,
            }),
        fill: new ol.style.Fill({
            color: 'rgba(255,0,0,0.1)',
            })
        }),
    });


////////////////////////////////////////////////////
                    //MENU BUTTON FUNCTIONS//
////////////////////////////////////////////////////

$(document).ready(function() {

   map.addEventListener('click', function() {
        var featuresExtent = ol.extent.createEmpty();
        selectInteraction.getFeatures().forEach(function(feature) {
            ol.extent.extend(featuresExtent, feature.getGeometry().getExtent());
        });
        map.getView().fitExtent(featuresExtent, map.getSize());
    });
});
```

Javascript: Button Functionality

```
$(document).ready(function() {

    var method = ‘aggregate’//sets aggregate as default method
    var scale = ‘beni_c’ //sets beni city as default place
    var layer = ‘none’ //sets no default layer

    document.getElementById(“method_aggregate”).src = “images/method_aggregate_on.svg”; //turns aggregate
button on as default
    document.getElementById(“place_beni_c”).src = “images/place_beni_c_on.svg”; //turns beni city button on
as default

    $(‘div.method_group’).on(‘click’, function(event) {
        document.getElementById(“method_aggregate”).src = “images/method_aggregate_off.svg”; //turns aggre-
gate button off if it was on
        document.getElementById(“method_collect”).src = “images/method_collect_off.svg”; //turns collect
button off if it was on
        document.getElementById(“method_play”).src = “images/method_play_off.svg”; //turns play putton off if
it was on
        switch(event.target.id) {
            case “method_aggregate”:
                document.getElementById(“method_aggregate”).src = “images/method_aggregate_on.svg”; //turns
aggregate button on
                method = ‘aggregate’ //sets aggregate as method
                aggregateFunction();
                if (scale == ‘world’) {
                    worldFunction();
                    if (layer == ‘layer_co’) {
                        world_coFunction();
                    } else if (layer == ‘layer_cu’) {
                        world_cuFunction();
                    } else {
                        world_noneFunction();
                    }
                } else if (scale == ‘drc’) {
                    drcFunction();
                    if (layer == ‘layer_co’) {
                        drc_coFunction();
                    } else if (layer == ‘layer_cu’) {
                        drc_cuFunction();
                    } else {
                        drc_noneFunction();
                    }
                } else if (scale == ‘nkivu’) {
                    nkivuFunction();
                    nkivu_noneFunction();
                } else if (scale == ‘beni_r’) {
                    beni_rFunction();
                    beni_r_noneFunction();
                } else if (scale == ‘beni_c’) {
                    beni_cFunction();
                    if (layer == ‘layer_in’) {
                        beni_c_inFunction();
                    } else if (layer == ‘layer_cu’) {
                        beni_c_cuFunction();
                    } else {
                        beni_c_noneFunction();
                    }
                } else if (scale == ‘beni_q’) {
                    beni_qFunction();
                    if (layer == ‘layer_in’) {
                        beni_q_inFunction();
                    } else if (layer == ‘layer_cu’) {
                        beni_q_cuFunction();
                    } else {
                    beni_q_noneFunction();
                    }
                }
                break;
            case “method_collect”:
                document.getElementById(“method_collect”).src = “images/method_collect_on.svg”;
                method = ‘collect’
                collectFunction();
```

```
                if (scale == 'world') {
                    worldFunction();
                    world_noneFunction();
                } else if (scale == 'drc') {
                    drcFunction();
                    drc_noneFunction();
                } else if (scale == 'nkivu') {
                    nkivuFunction();
                    nkivu_noneFunction();
                } else if (scale == 'beni_r') {
                    beni_rFunction();
                    beni_r_noneFunction();
                } else if (scale == 'beni_c') {
                    beni_cFunction();
                    if (layer == 'layer_in') {
                        beni_c_inFunction();
                    } else if (layer == 'layer_cu') {
                        beni_c_cuFunction();
                    } else {
                        beni_c_noneFunction();
                    }
                } else if (scale == 'beni_q') {
                    beni_qFunction();
                    if (layer == 'layer_in') {
                        beni_q_inFunction();
                    } else if (layer == 'layer_cu') {
                        beni_q_cuFunction();
                    } else {
                        beni_q_noneFunction();
                    }
                }
                break;
            case "method_play":
                document.getElementById("method_play").src = "images/method_play_on.svg";
                method = 'play'
                playFunction();
                if (scale == 'world') {
                    worldFunction();
                    world_noneFunction();
                } else if (scale == 'drc') {
                    drcFunction();
                    drc_noneFunction();
                } else if (scale == 'nkivu') {
                    nkivuFunction();
                    if (layer == 'layer_fo') {
                        nkivu_foFunction();
                    } else {
                        nkivu_noneFunction();
                    }
                } else if (scale == 'beni_r') {
                    beni_rFunction();
                    if (layer == 'layer_fo') {
                        beni_r_foFunction();
                    } else {
                        beni_r_noneFunction();
                    }
                } else if (scale == 'beni_c') {
                    beni_cFunction();
                    beni_c_noneFunction();
                } else if (scale == 'beni_q') {
                    beni_qFunction();
                    beni_q_noneFunction();
                }
                break;
            default:
                break;
            }
        });

    $('div.place_group').on('click', function(event) {
        document.getElementById("place_world").src = "images/place_world_off.svg";
        document.getElementById("place_drc").src = "images/place_drc_off.svg";
        document.getElementById("place_nkivu").src = "images/place_nkivu_off.svg";
        document.getElementById("place_beni_r").src = "images/place_beni_r_off.svg";
        document.getElementById("place_beni_c").src = "images/place_beni_c_off.svg";
```

```
document.getElementById(“place_beni_q”).src = “images/place_beni_q_off.svg”;
switch(event.target.id) {
    case “place_world”:
        document.getElementById(“place_world”).src = “images/place_world_on.svg”;
        scale = ‘world’;
        worldFunction();
        if (method == ‘aggregate’) {
            aggregateFunction();
            if (layer == ‘layer_co’) {
                world_coFunction();
            } else if (layer == ‘layer_cu’) {
                world_cuFunction();
            } else {
                world_noneFunction();
            }
        } else {
            world_noneFunction();
        }
        break;
    case “place_drc”:
        document.getElementById(“place_drc”).src = “images/place_drc_on.svg”;
        scale = ‘drc’;
        drcFunction();
        if (method == ‘aggregate’) {
            aggregateFunction();
            if (layer == ‘layer_co’) {
                drc_coFunction();
            } else if (layer == ‘layer_cu’) {
                drc_cuFunction();
            } else {
                drc_noneFunction();
            }
        } else {
            drc_noneFunction();
        }
        break;
    case “place_nkivu”:
        document.getElementById(“place_nkivu”).src = “images/place_nkivu_on.svg”;
        scale = ‘nkivu’;
        nkivuFunction();
        if (method == ‘play’) {
            playFunction();
            if (layer == ‘layer_fo’) {
                nkivu_foFunction();
            } else {
                nkivu_noneFunction();
            }
        } else {
            nkivu_noneFunction();
        }
        break;
    case “place_beni_r”:
        document.getElementById(“place_beni_r”).src = “images/place_beni_r_on.svg”;
        scale = ‘beni_r’;
        beni_rFunction();
        if (method == ‘play’) {
            playFunction();
            if (layer == ‘layer_fo’) {
                beni_r_foFunction();
            } else {
                beni_r_noneFunction();
            }
        } else {
            beni_r_noneFunction();
        }
        break;
    case “place_beni_c”:
        document.getElementById(“place_beni_c”).src = “images/place_beni_c_on.svg”;
        scale = ‘beni_c’;
        beni_cFunction();
        map.addInteraction(selectInteraction);
        if (method == ‘aggregate’) {
            aggregateFunction();
            if (layer == ‘layer_in’) {
                beni_c_inFunction();
```

```
                    } else if (layer == 'layer_cu') {
                        beni_c_cuFunction();
                    } else {
                        beni_c_noneFunction();
                    }
                } else if (method == 'collect') {
                    collectFunction();
                    if (layer == 'layer_in') {
                        beni_c_inFunction();
                    } else if (layer == 'layer_cu') {
                        beni_c_cuFunction();
                    } else {
                        beni_c_noneFunction();
                    }
                } else {
                    beni_c_noneFunction();
                }
                break;
            case "place_beni_q":
                document.getElementById("place_beni_q").src = "images/place_beni_q_on.svg";
                scale = 'beni_q';
                beni_qFunction();
                map.addInteraction(selectInteraction);
                if (method == 'aggregate') {
                    aggregateFunction();
                    if (layer == 'layer_in') {
                        beni_q_inFunction();
                    } else if (layer == 'layer_cu') {
                        beni_q_cuFunction();
                    } else {
                        beni_q_noneFunction();
                    }
                } else if (method == 'collect') {
                    collectFunction();
                    if (layer == 'layer_in') {
                        beni_q_inFunction();
                    } else if (layer == 'layer_cu') {
                        beni_q_cuFunction();
                    } else {
                        beni_q_noneFunction();
                    }
                } else {
                    beni_q_noneFunction();
                }
                break;
            default:
                break;
            }
        });

    $('div.layer_group').on('click', function(event) {
        document.getElementById("layer_in").src = "images/layer_in_off.png";
        document.getElementById("layer_fo").src = "images/layer_fo_off.png";
        document.getElementById("layer_co").src = "images/layer_co_off.png";
        document.getElementById("layer_cu").src = "images/layer_cu_off.png";
        switch(event.target.id) {
            case "layer_in":
                if (layer !== 'layer_in') {
                    document.getElementById("layer_in").src = "images/layer_in_on.png";
                    layer = 'layer_in';
                    if (method == 'aggregate') {
                        aggregateFunction();
                        if (scale == 'beni_c') {
                            beni_cFunction();
                            beni_c_inFunction();
                        } else if (scale == 'beni_q') {
                            beni_qFunction();
                            beni_q_inFunction();
                        }
                    } else if (method == 'collect') {
                        collectFunction();
                        if (scale == 'beni_c') {
                            beni_cFunction();
                            beni_c_inFunction();
                        } else if (scale == 'beni_q') {
```

```
                beni_qFunction();
                beni_q_inFunction();
            }
        }
    } else if (layer == 'layer_in') {
        document.getElementById("layer_in").src = "images/layer_in_off.png";
        layer = 'none';
        if (method == 'aggregate') {
            aggregateFunction();
            if (scale == 'beni_c') {
                beni_cFunction();
                beni_c_noneFunction();
            } else if (scale == 'beni_q') {
                beni_qFunction();
                beni_q_noneFunction();
            }
        } else if (method == 'collect') {
            collectFunction();
            if (scale == 'beni_c') {
                beni_cFunction();
                beni_c_noneFunction();
            } else if (scale == 'beni_q') {
                beni_qFunction();
                beni_q_noneFunction();
            }
        }
    }
    break;
case "layer_fo":
    if (layer !== 'layer_fo') {
        document.getElementById("layer_fo").src = "images/layer_fo_on.png";
        layer = 'layer_fo';
        if (method == 'play') {
            playFunction();
            if (scale == 'nkivu') {
                nkivuFunction();
                nkivu_foFunction();
            } else if (scale == 'beni_r') {
                beni_rFunction();
                beni_r_foFunction();
            }
        }
    } else if (layer == 'layer_fo') {
        document.getElementById("layer_fo").src = "images/layer_fo_off.png";
        layer = 'none';
        if (method == 'play') {
            playFunction();
            if (scale == 'nkivu') {
                nkivuFunction();
                nkivu_noneFunction();
            } else if (scale == 'beni_r') {
                beni_rFunction();
                beni_r_noneFunction();
            }
        }
    }
    break;
case "layer_co":
    if (layer !== 'layer_co') {
        document.getElementById("layer_co").src = "images/layer_co_on.png";
        layer = 'layer_co';
        if (method == 'aggregate') {
            aggregateFunction();
            if (scale == 'world') {
                worldFunction();
                world_coFunction();
            } else if (scale == 'drc') {
                drcFunction();
                drc_coFunction();
            }
        }
    } else if (layer == 'layer_co') {
        document.getElementById("layer_co").src = "images/layer_co_off.png";
        layer = 'none';
        if (method == 'aggregate') {
```

```
                aggregateFunction();
                if (scale == 'world') {
                    worldFunction();
                    world_noneFunction();
                } else if (scale == 'drc') {
                    drcFunction();
                    drc_noneFunction();
                }
            }
        }
        break;
    case "layer_cu":
        if (layer !== 'layer_cu') { //confirming that layer has not been previously clicked
            document.getElementById("layer_cu").src = "images/layer_cu_on.png"; //turn button on
            layer = 'layer_cu'; //change layer variable to culture
            if (method == 'aggregate') {
                aggregateFunction();
                if (scale == 'world') {
                    worldFunction();
                    world_cuFunction();
                } else if (scale == 'drc') {
                    drcFunction();
                    drc_cuFunction();
                } else if (scale == 'beni_c') {
                    beni_cFunction();
                    beni_c_cuFunction();
                } else if (scale == 'beni_q') {
                    beni_qFunction();
                    beni_q_cuFunction();
                }
            } else if (method == 'collect') {
                collectFunction();
                if (scale == 'beni_c') {
                    beni_cFunction();
                    beni_c_cuFunction();
                } else if (scale == 'beni_q') {
                    beni_qFunction();
                    beni_q_cuFunction();
                }
            }
        } else if (layer == 'layer_cu') { //allows layer to toggle off if has already been clicked
            document.getElementById("layer_cu").src = "images/layer_cu_off.png"; //turn button off
            layer = 'none'; //change layer variable to none
            if (method == 'aggregate') {
                aggregateFunction();
                if (scale == 'world') {
                    worldFunction();
                    world_noneFunction();
                } else if (scale == 'drc') {
                    drcFunction();
                    drc_noneFunction();
                } else if (scale == 'beni_c') {
                    beni_cFunction();
                    beni_c_noneFunction();
                } else if (scale == 'beni_q') {
                    beni_qFunction();
                    beni_q_noneFunction();
                }
            } else if (method == 'collect') {
                collectFunction();
                if (scale == 'beni_c') {
                    beni_cFunction();
                    beni_c_noneFunction();
                } else if (scale == 'beni_q') {
                    beni_qFunction();
                    beni_q_noneFunction();
                }
            }
        }
        break;
    default:
        layer = 'none'
            if (scale == 'world') {
                worldFunction();
                world_noneFunction();
```

```
                } else if (scale == 'drc') {
                    drcFunction();
                    drc_noneFunction();
                } else if (scale == 'nkivu') {
                    nkivuFunction();
                    nkivu_noneFunction();
                } else if (scale == 'beni_r') {
                    beni_rFunction();
                    beni_r_noneFunction();
                } else if (scale == 'beni_c') {
                    beni_cFunction();
                    beni_c_noneFunction();
                } else if (scale == 'beni_q') {
                    beni_qFunction();
                    beni_q_noneFunction();
                }
            break;
        }
    });
});
```