

# The value of spatial analysis for tracking supply for family planning: the case of Kinshasa, DRC

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## Abstract

While geographic information systems (GIS) are frequently used to research accessibility issues for healthcare services around the world, sophisticated spatial analysis protocols and outputs often prove inappropriate and unsustainable to support evidence-based programme strategies in resource-constrained environments. This article examines how simple, open-source and interactive GIS tools have been used to locate family planning (FP) services delivery points in Kinshasa (Democratic Republic of Congo) and to identify underserved areas, determining the potential location of new service points, and to support advocacy for FP programmes. Using smartphone-based data collection applications (OpenDataKit), we conducted two surveys of FP facilities supported by partner organizations in 2012 and 2013 and used the results to assess gaps in FP services coverage, using both ratio of facilities per population and distance-based accessibility criteria. The cartographic outputs included both static analysis maps and interactive Google Earth displays, and sought to support advocacy and evidence-based planning for the placement of new service points. These maps, at the scale of Kinshasa or for each of the 35 health zones that cover the city, garnered a wide interest from the operational level of the health zones' Chief Medical Officers, who were consulted to contribute field knowledge on potential new service delivery points, to the FP programmes officers at the Ministry of Health, who could use the map to inform resources allocation decisions throughout the city.

**Key words:** Accessibility, Democratic Republic of the Congo, evidence-based programming, geographic information systems, family planning, Kinshasa

## Key Messages

- This article analyses the distribution of family planning services points throughout the Democratic Republic of Congo's capital city, Kinshasa.
- Based a geo-referenced surveys of all FP facilities supported by partner organizations, we assessed gaps in FP services coverage, using both ratio of facilities per population and distance-based accessibility criteria.
- The cartographic outputs integrate both static analysis maps and interactive Google Earth displays, and seek to support advocacy and evidence-based planning for the placement of new service points.
- In this perspective, this research explores the uses and value-added of open-source and user-friendly geographic information systems in order to adequately serve the programmatic needs of national and local health officers.

## Introduction

### The family planning supply environment in Kinshasa

Kinshasa, the capital city of the Democratic Republic of the Congo (DRC), has a population of approximately 10 million residents, distributed over a landmass almost twice of the size of the state of Rhode Island. The province of Kinshasa is divided into 35 health zones (HZs), with most of the population residing in about 32 densely populated HZs closest to the Congo River. The remaining three HZs, located in the eastern portion of the province, are primarily rural, with low population density, poor infrastructure and limited access to urban amenities. The DRC ties with Niger for lowest ranking on the Human Development Index (UNDP 2014), and 71% of the country's population lives below the poverty line (World Bank estimates 2006).

When this study began in 2012, the total fertility rate in Kinshasa was reported at 6.3 children per women and modern contraceptive prevalence was at 7.8% among married women of reproductive age [Demographic and Health Survey (DHS) 2013]. A number of governmental, non-governmental organizations (NGOs) and faith-based organizations (FBOs) had introduced family planning (FP) services in facilities throughout the city, but these groups worked in isolation and no central listing existed of sites providing contraception. The current study—aimed at mapping FP service delivery in Kinshasa—was an essential first step in a larger effort to systematically increase contraceptive access in this city (Bertrand *et al.* 2014). It provided a comprehensive and intuitively navigable database of all available FP services in Kinshasa as well as simple outputs tools supporting programmatic planning.

### Mapping as a resource in public health assessments

The literature on healthcare access studies in sub-Saharan Africa reveals a number of methodological challenges (e.g. Fassin and Brousselle 1991; Haddad and Fournier 1995; Manzambi *et al.* 2000). Underlying most of them are the complex interactions of supply and demand that determine the very notion of accessibility.

At the supply end, information regarding existing healthcare facilities in extremely low-income countries such as the DRC is often incomplete or inconsistent. Data on the type of structures, available human and technical resources, nature and quality of services provided tend to rely on outdated official registries, sometimes complemented by sample survey results from international organizations. The exact location of these facilities is often unknown, or limited to a broad health area, due to the absence of a reliable address system. As a result, a number of publications proposing to 'establish a cartography' of available healthcare services often end up listing tables of existing structures organized by administrative or health districts, or proposing data aggregated at a national or provincial level, which is inappropriate to accurately address programmatic needs (consider, e.g. that the province of Katanga in DRC is larger than the state of California; Noor *et al.* 2009; Witter 2010) Since physical proximity is a primary determinant of accessibility, a more accurate knowledge of the distribution of healthcare services appears essential to determining and improving the availability of services. Distance, including transportation time, is, however, not the only condition to adequate healthcare coverage: the nature and quality of services, including the presence of trained healthcare staff, are two of the strongest obstacles to healthcare accessibility in resource-constrained environments. Indeed, a recurring finding in research on healthcare accessibility is that even if adequate services exist in close proximity to potential users, the latter will not necessarily frequent said facilities. In other words, effective coverage does not guarantee effective accessibility.

Economic, social and cultural barriers to healthcare access exist, both in terms of direct and opportunity costs.

Geographic information systems (GIS) have been used for the past two decades to support feasibility assessments and pilot projects geared towards strengthening health information systems (McLafferty 2003; Nykiforuk and Flaman 2011; Nhavoto and Grönlund 2014). However, there have been notable shortcomings.

First, the use of GIS tools in developing countries has been limited. A literature review of the use of GIS to improve healthcare systems found that only 24.7% of all these applications were implemented in the developing world, and <10% of them in sub-Saharan Africa (Nykiforuk and Flaman 2011). Secondly, there have been even fewer studies on whether local health information systems were capable of effectively absorbing these technologies and routinely using them. Nhavoto and Grönlund, for example, reviewed a large number of small-scale tests that showed few or no attempts to integrate the new technologies into standard operations for national programmes (Nhavoto and Grönlund 2014).

Thirdly, the computing capacities and relative novelty of GIS tools often result in software-driven analysis rather than the production of outputs answering programmatic needs in field settings. The results can be sophisticated spatial regressions and multivariate cartographic displays that provide little practical information for local programming (Boelaert *et al.* 1998).

Geographical information on the location of FP services in Kinshasa was non-existent prior to this study. Thus, the most pressing need was to accurately map the distribution and quality of available FP services throughout the city as a basis for subsequent efforts to address the issue of coverage of these services. Using open-source and user-friendly mapping tools, we were able to provide FP programmes officers and managers with the information needed to assess the adequacy of the distribution of FP services throughout this city.

The objective of this work was to identify and geo-code every site in Kinshasa that provided FP services. This article represents one of the first published studies to apply GIS mapping to FP in the low-resource setting in sub-Saharan Africa. The interactive, user-friendly output from this work has met with great interest among government, donors and FP implementing agencies. As many sub-Saharan countries struggle to jump-start their FP programmes in response to new global initiatives (FP2020, the Global Financing Facility), the Kinshasa experience provides an excellent case study for the integrated uses of digital data collection and mapping to define the FP service delivery coverage.

## Materials and Methods

As of 2012, there were nine partner organizations supporting FP services in one or more HZ but no centralized database recording the number and localization of FP services in Kinshasa. The PNSR and each supporting partner provided the research team with a list of the structures they supported for FP services (either through training or contraceptive/technical resources provision) and each of the 35 Chief Medical Officers for the Health Zone (MCZ) were consulted to confirm that the listing provided matched the structures they knew to provide FP services in their HZs. In total, 220 structures were listed as offering FP services (out of the estimated 1570 health facilities operating in Kinshasa) and all of them were surveyed; 184 (83.6%) were found to actually offer FP services at the time (regardless of whether they had any contraceptive methods available or trained staff). The missing structures had either been erroneously listed as offering FP, had closed or changed their name, or could not be localized despite appearing on the partners' listings.

A follow-up survey was conducted in 2013 with the same set of objectives. Although it used the same questionnaire, it intensified efforts to produce a comprehensive list of these FP sites, including new sites that had been added since the baseline survey and other sites that had been missed in the baseline. Additionally, all data collection, including the geo-referencing of surveyed facilities, was completed on Android smartphones using the OpenDataKit (ODK) application. 444 structures were surveyed in 2013 after updated listings were provided by the supporting partners and verified by the MCZ. The data collected found that only 395 (89.0%) of these actually offered FP services at the time.

While there might be a few facilities in Kinshasa independently offering FP services without receiving support from any of the partner organizations, most governmental and non-governmental efforts to increase FP accessibility relies on the structures supported by members of the Kinshasa Family Planning Coalition. Thus, the 395 structures surveyed in 2013 constitute our baseline universe for all available FP services in Kinshasa.

Data mapping and analysis were conducted using Quantum GIS (QGIS 2.4 Chugiak), a free, open-source software compatible with a large number of geo-referenced layers (including the proprietary shapefiles of ArcGIS, but also Google Earth and OpenStreetMap files, thus expanding the pool of potential data sources for background and socio-demographic information layers). QGIS, in its latest versions (up to 2.12 Lyon released in October 2015), offers display and spatial

analysis capacities very similar to those of ArcGIS for evaluating the coverage and accessibility of healthcare services. Buffer tools, average nearest neighbour and nearest facility calculation, network analysis and site selection functionalities are all available in the QGIS toolbox. Based on the first author's experience with GIS training in other francophone African countries, programme managers have found QGIS to be user-friendly; its light architecture and inexpensive installation and maintenance made it appropriate for use in DRC.

Besides the technological appropriateness of the GIS software itself, the mapping and spatial analysis approaches were also implemented with a focus on the practical uses by local stakeholders of the information produced. Neither of these surveys was originally 'GIS-driven', that is, neither the data collection methodology nor the analysis objectives were designed in terms of GIS software capacities. Rather the aim of the maps presented below was to produce information that could be relevant to the most pressing programmatic needs: where were minimum FP services available? Which areas and populations were underserved? Within the highly constrained environment of Congo's health programmes, where would it make more sense to allocate the few additional resources available to maximize gains in FP accessibility?

The results section below details the value of putting FP data on the map as an effective tool to support programmatic evaluation and evidence-based planning, as well as advocacy and awareness-raising among FP stakeholders in the DRC.



Figure 1. Distribution of facilities offering minimum FP services in 2012 and capture of Google Earth deployment

### Ethical approvals

Studies were approved by the Tulane Institutional Review Board (#238734 and #493349, for 2012 and 2013, respectively), as well as by the Ethics Committee of the Kinshasa School of Public Health (ESP/CE/043/11 and ESP/CE/072/13).

### Results

The 2012 and 2013 surveys achieved the objective of creating and updating an inventory of all health facilities in Kinshasa that provided FP services, and GIS proved invaluable in determining the spatial distribution of FP services in Kinshasa, identifying underserved HZs, rationalizing site selection for additional FP service delivery points in underserved areas of Kinshasa, and serving as an advocacy tool that drew donor attention to programmatic needs in Kinshasa.

#### Determining the spatial distribution of FP facilities in Kinshasa

The 2012 survey represented a first attempt to identify and geo-code facilities that provided contraception throughout Kinshasa. It formed the basis of an initial set of static maps and interactive Google Earth deployments (shown in Figure 1). Data from the 2012 survey also served as a baseline to track improvements in access and quality, measured in the follow-up study in 2013.

The following 2013 survey created the opportunity to map out the entire universe of structures offering FP services based on lists of

supported facilities provided by all FP partners operating in Kinshasa (Figure 2)

#### Identifying underserved HZs

Displaying the location of health structures offering minimum FP services provided a preliminary visual identification of underserved areas in Kinshasa. The next steps of our analysis experimented with three different measures to further define areas of greatest needs for further programmatic intervention.

##### *Number of sites providing minimum FP services per HZ*

The National Strategic Plan for Family Planning in the DRC (Ministère de la Santé 2014) defines the standard of a minimum of five sites offering FP services per HZ. A total of 32 HZs in Kinshasa met the minimum number established in the Strategic Plan, whereas three were underserved by this definition: Lingwala (near the centre for Kinshasa), and the two constellations of small, non-contiguous areas comprehensively referred to as 'Kokolo' and 'Police', which are under the specific jurisdiction of Kinshasa's military and police forces (Figure 3).

##### *Number of sites providing minimum FP services per 100 000 population in the HZ*

Kinshasa presents stark contrasts in population concentrations, ranging from the densely populated neighbourhoods of Barumbu and N'Djili (nicknamed 'la Chine Populaire'), to the semi-rural HZs (such as Mont Ngafula), and rural areas of Maluku I and II, which

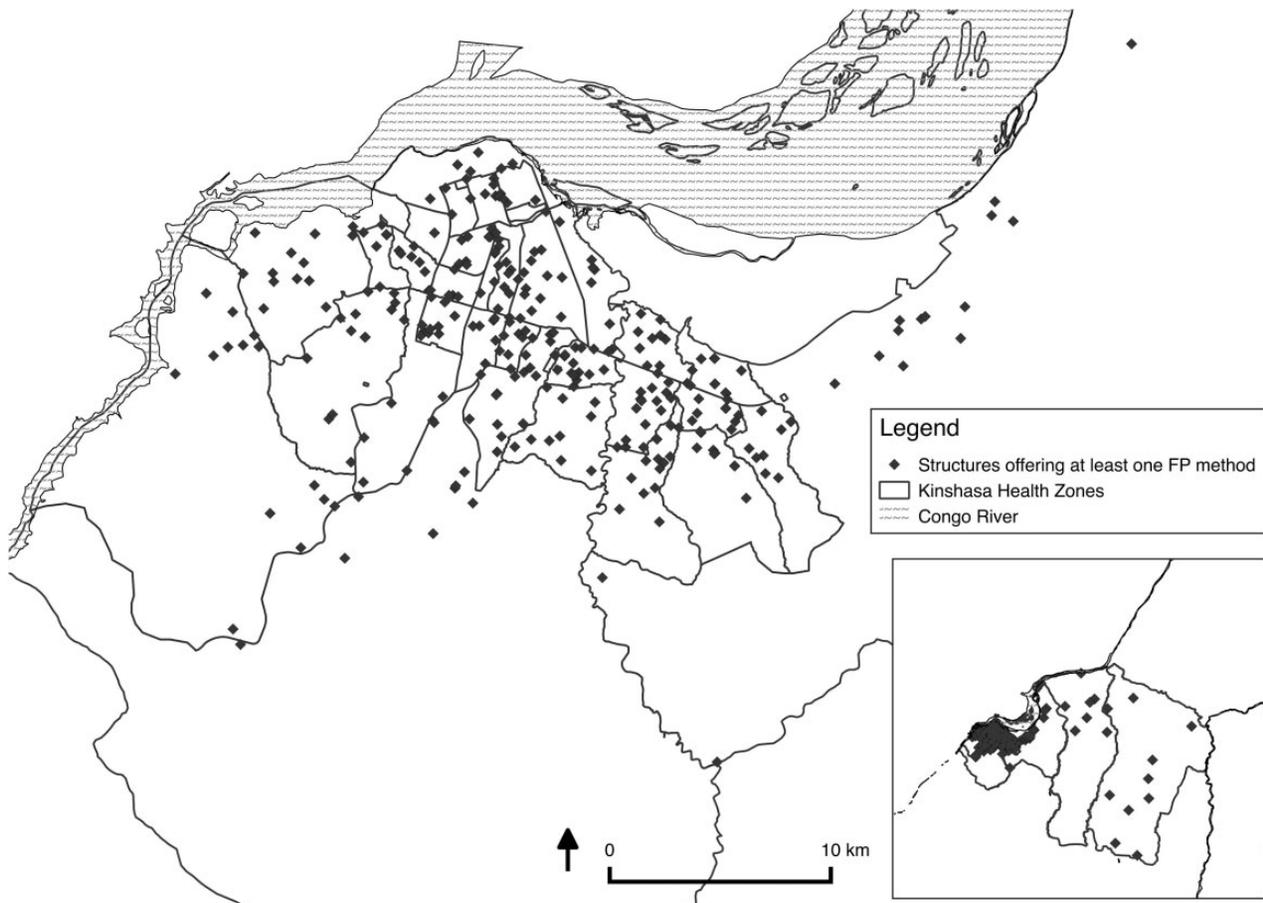
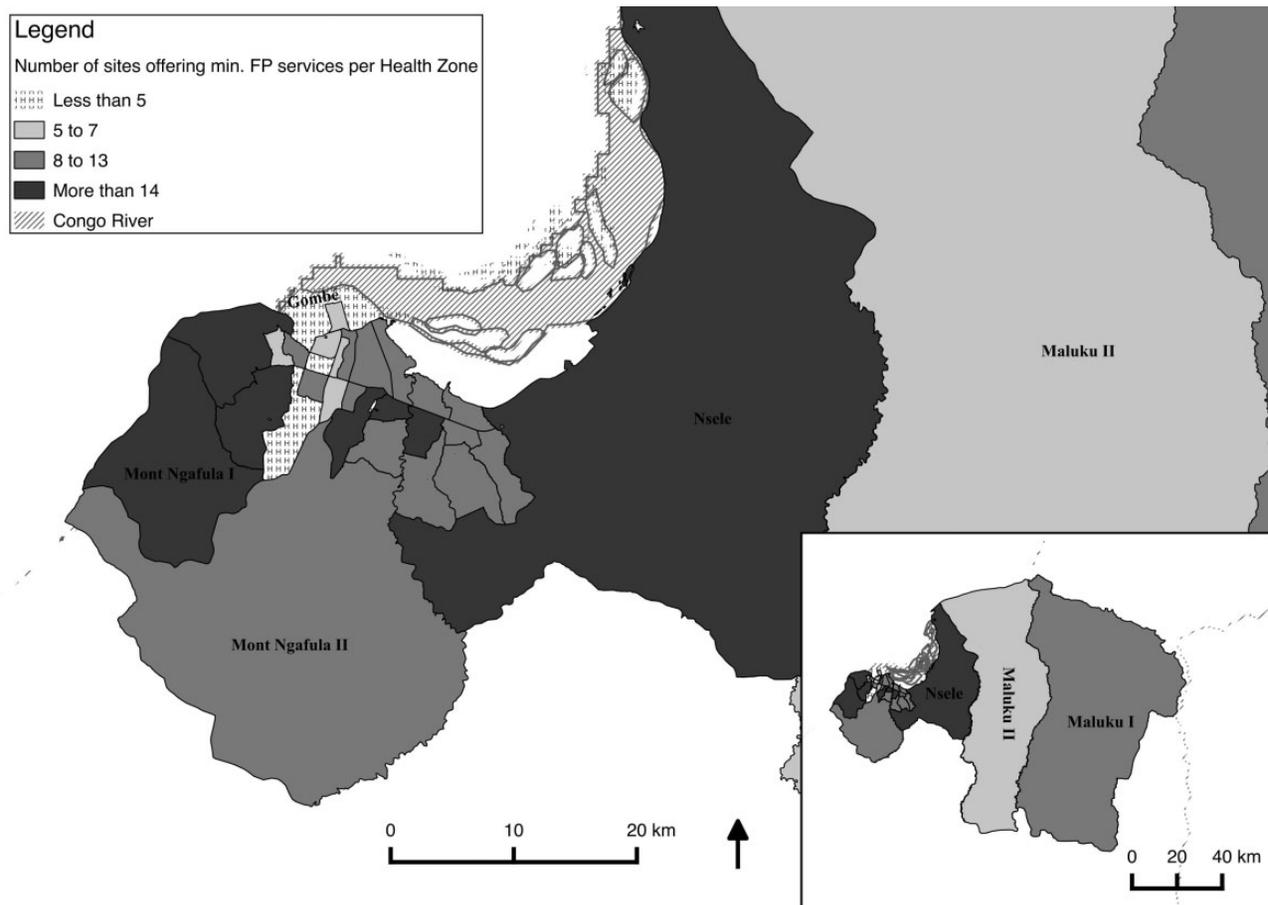


Figure 2. Distribution of facilities offering minimum FP services in 2013



**Figure 3.** Number of facilities offering minimum FP services per HZ

are >100 kilometres from downtown Kinshasa. Population censuses are notoriously limited in the DRC, with the last comprehensive one dating back to 1984. In addition, the general mobility of Kinshasa's residents accentuates the uncertainty of these estimates. However, the PNSR (Plan National pour la Santé de la Reproduction/National Plan for Reproductive Health) computed a table of 2012 population estimates per HZs, based on their own service data and a separate census conducted by UNICEF (UNICEF 2012). The first author then converted this information into a shapefile, recording the number of structures offering minimum FP services per 100 000 population.

Taking population density into account, the number of underserved HZs (<5 sites per 100 000 population that offer at least one method of contraception) increased to six: Kinsenso, Makala, Bumbu and Barumbu (in addition to Kokolo and Police); see Figure 4. The average number of FP sites dropped from 9 sites per HZ to <5 sites per 100 000 population.

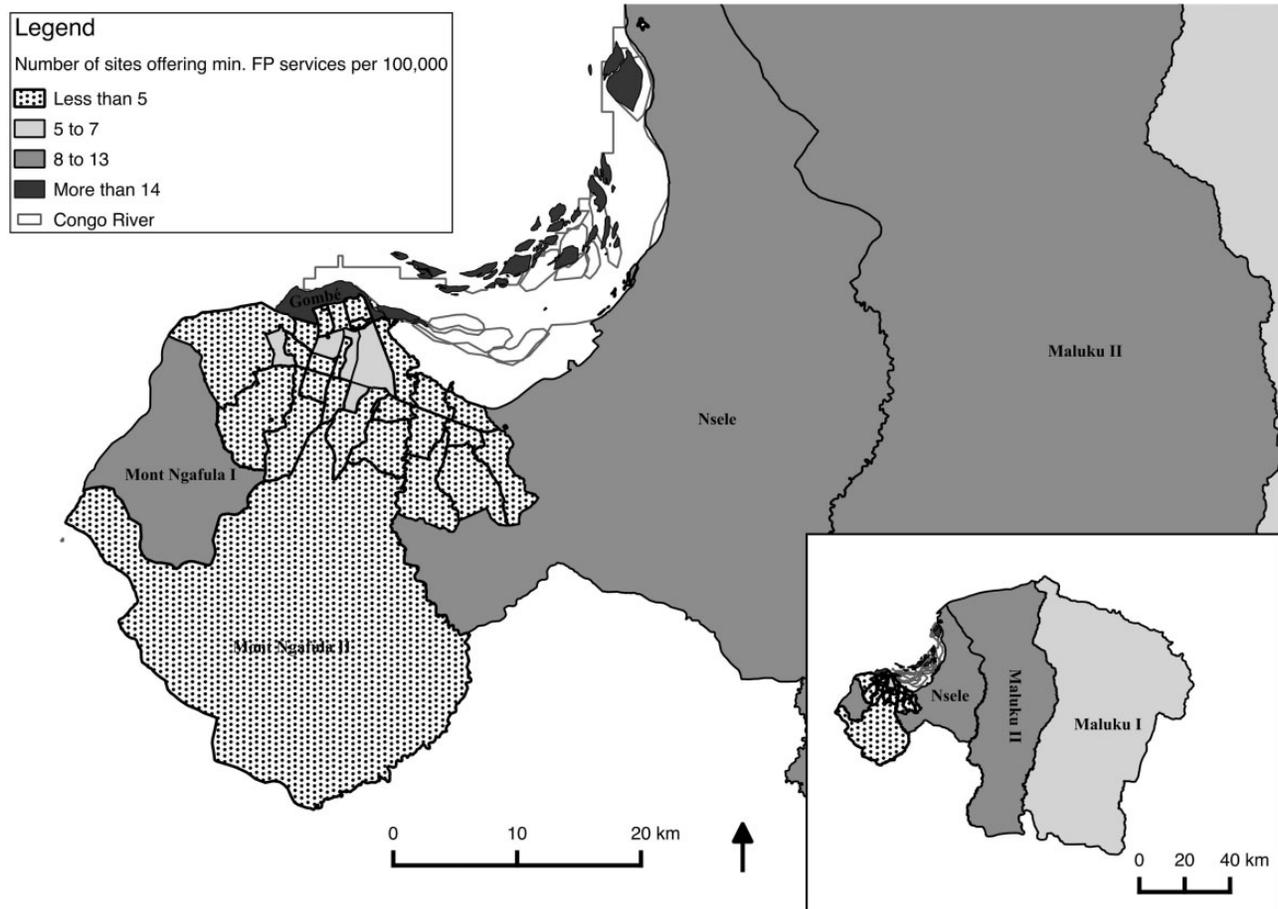
Interestingly, the HZs which appear well served in terms of FP structures were almost exclusively located in the semi-rural and rural peripheries of the city (with the exception of Gombé, the downtown area with many governmental, commercial and international organizations and relatively few residents). This measure of access fails to take into account the large size of certain HZs: Mont Ngafula is roughly the size of the metropolitan area of Philadelphia. Maluku I and II together cover an area larger than that of metropolitan Houston. Most of these HZs are comprised of small settlements, often accessible only by dirt roads. In such cases, having an adequate number of FP sites per 100 000 population does not

necessarily translate into actual proximity of a structure offering FP services.

#### *Percentage of the city within one kilometre of a FP site providing minimum services*

The initial count of FP sites per HZs, as well as per 100 000 population, could have been done without the use of GIS tools. However, the accurate geo-location of FP sites was essential to better evaluate the spatial accessibility of these facilities. Unlike some other types of services (e.g. 'food deserts'; see, e.g. Ver Ploeg 2010), there are no international standards for how distant one has to be located from an FP structure in order to be considered 'underserved'. Moreover, in a city where some residents are forced by necessity to walk over two hours to work, and where torrential rains can increase travel time exponentially, it is difficult to objectively determine what distance would constitute a barrier to seeking services. Research on healthcare seeking behaviours conducted in other sub-Saharan countries (e.g. Nigeria) has shown that the populations are sometimes capable of covering great distances to reach quality healthcare facilities (Stock 1983). In the absence of an international standard or other data, we arbitrarily established a baseline distance of 1 km as 'reasonable' proximity to FP services (estimated to take approximately 40 min on foot). We then created buffers beyond which populations and settlements were considered underserved, as shown in Figure 5.

As shown in Figure 5, almost all the centre of the city appears to be within <1 km from an FP structure. By contrast, residents of semi-rural and rural HZs are far removed from minimal services.



**Figure 4.** Number of facilities offering minimum FP services per 100 000 pop living in the HZ

Mont Ngafula I, which appears to offer adequate access to FP services based on the absolute number of sites (18) and sites per 100 000 (14.5), presents large portions of underserved areas, due to a clustering of all the FP structures in the northern part of the HZ. A similar situation occurred in Maluku I and II, where <1% of the area falls within 1 km of a facility providing even minimum FP.

These three measures used to identify 'underserved' HZs (absolute number of sites per HZ, as recommended by the National Strategic Plan; number of sites per HZ per 100 000 population; and total area of HZ covered by FP services) provided programme managers with different choices for deciding how to use their limited resources and prioritize activities. These approaches included strengthening existing, but underperforming, services points, increasing the absolute ratio of FP sites per population, or optimizing the distribution points in order to increase coverage.

#### Optimal placement of new service delivery points

Further GIS analysis provided evidence for the optimal placement of new service delivery points within underserved HZ. After the maps covering the entire city were created and analysed, the geocoded data were used to produce a detailed atlas showing the distribution of FP facilities in each HZ<sup>1</sup>. Two scenarios emerged from visual interpretation of these maps.

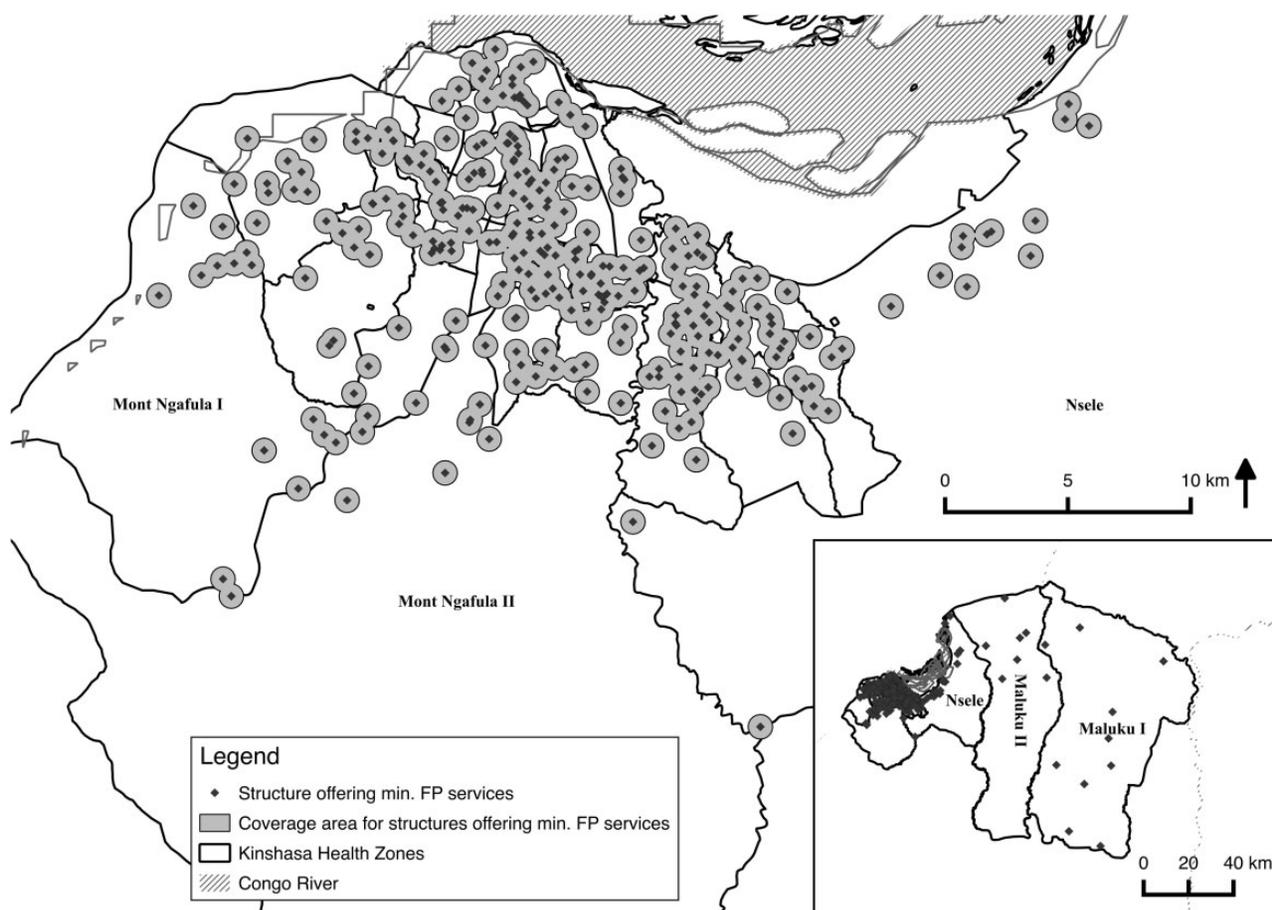
In some HZs, FP structures were well distributed but a number were under-performing ('no service or method available'); see Figure 6 of Barumbu HZ. In this case, the atlas provided visual evidence of which facilities could be further supported in order to

increase FP services coverage. Simple GIS queries could be used to identify the name of the structure as well as its supporting partners.

In the second scenario, existing facilities offered minimum FP services, but they were not evenly distributed throughout the HZs, leaving large underserved areas within the HZ. In some cases, both uneven distribution and poor quality of FP services combined to further decrease accessibility (see Figure 7 of Kinsenso)

In that case, GIS site selection functionalities could be mobilized to identify optimum new service delivery points that would maximize gains in terms of FP coverage. After the areas within 1 km from a facility offering minimum FP services were subtracted from the HZ area, the centroid of the remaining underserved portion was calculated to identify where a single new point of service would maximize additional coverage. In the case of large HZ, underserved areas were further divided into smaller sectors and several potential site locations were calculated for each of them.

One risk of this 'hypothetically optimal placement' is that the selected site may be uninhabited or used for another purpose (e.g. airport landing field). To address this concern, the maps containing the 'optimal placement of sites' were overlaid with satellite imagery, using Google Earth Viewer plug-in, to confirm that both the underserved areas and the proposed new sites were located in or near populated areas (see Figure 8 of the Kinsenso HZ). The resulting maps for seven HZs were then presented and discussed with the Médecin Chef de Zone who supplied local knowledge regarding the areas and facilities, as well as potential physical structures or individuals that could be used as new FP resources near the identified optimum location (Figure 8).



**Figure 5.** Areas with minimum FP services coverage (within 1 km) in the HZ of Kinsensu

Systematic follow-up visits with 12 out of 35 Médecins Chef de Zones in July and December 2014 led to updates of the maps for each HZ, which have replaced the hand-drawn paper maps posted on the walls of the health structures of reference for each HZ.

Finally, the GIS tools used to inform programmatic decision-making for FP in Kinshasa proved to have yet another benefit: advocacy.

### Advocacy

Maps are powerful tools for capturing the attention of audiences. The colour schemes of bright red HZs offering <5 FP sites per 100 000 population and the large beige FP ‘wastelands’ throughout much of the semi-urban and rural areas of Kinshasa have strongly illustrated the problem of access to FP in Kinshasa. For example, at the launch of the Strategic Plan in February 2013, national and international stakeholders were able to visualize the gaps in FP service delivery, which prior to then had been a virtual ‘black box’. In addition, the interactive Google Earth maps posted on the FP website for the DRC ([www.familyplanning-drc.net](http://www.familyplanning-drc.net) or [www.planificationfamiliale-rdc.net](http://www.planificationfamiliale-rdc.net)) allow users to click on specific sites to obtain a profile of what the site offers in terms of FP services. This information provides the evidence base that donor agencies in particular wish to have, prior to making major new investments in a country.

### Limitations

Limitations to this study are mostly a product of the extremely limited amount of spatial, socio-demographic and health information

available in Kinshasa. The growing international interest in the health outcomes of the third largest sub-Saharan population is an encouraging sign that data will soon be available to address health issues, and FP in particular, in a more comprehensive way. As of 2014, however, census data did not allow for precision in estimating the population for Kinshasa as a whole or for individual HZs. Rapid demographic growth and high levels of mobility in and out of the city still compound this problem. In this analysis, we used estimates of the population per HZ provided by the PNSR for 2011. These numbers are likely to underestimate the true population size, but are useful for comparative efforts (e.g. number of health centres per 100 000 population).

In addition, while the collection of GPS coordinates contributed greatly to the accurate visualization of FP services distribution, problems remain with the correct identification of all structures. In the absence of a standardized registry of public and private health facilities, the data collection team relied on lists of structures provided by the implementing agencies supporting FP services in Kinshasa, as well as consultations with the authorities in each HZ. Problems include duplicate structures sharing the same name, multiple names for the same structure, or closed structures unbeknownst to their partners.

Beyond these methodological issues, service coverage assessments have been criticized for focusing too much on supply to the exclusion of demand for the services. In the case of Kinshasa, the work described herein has been complemented by three population-based household surveys of contraceptive use: the DHS 2013–14, PMA/2013 and PMA/2014 (DHS 2013, PMA20/20 2014).



**Figure 6.** Barumbu—Weak coverage because of low performing facilities

However, because of differences in sampling methodologies and data collection scale, the correlations between service provision and demand/use have not yet been firmly established.

Such correlations will require a greater attention to the quality of FP services provided. A study conducted in Nigeria has shown that distance only factored in for 31.8% of health facilities choices versus 68.2% for socio-demographic elements and quality of care available at facility. (Egunjobi 1983), while Acharya and Cleland have compared the role of quality and distance health-seeking behaviours in Nepal and found that ‘basic improvements to health post quality is a more important priority than further increases in the number of health posts’ (Acharya and J Cleland 2000). The study presented here included a first attempt at creating a quality service readiness index, which included three variables. They were having: (1) at least three modern contraceptives available, (2) at least one person trained in FP in the last 3 years and (3) an information system that tracked distribution of products to clients. Dubbed ‘three star’ system, it represented a simple way to measure structural quality of services available, but did not necessarily include harder to capture aspects of ‘quality’ such as awareness and trust in the community.

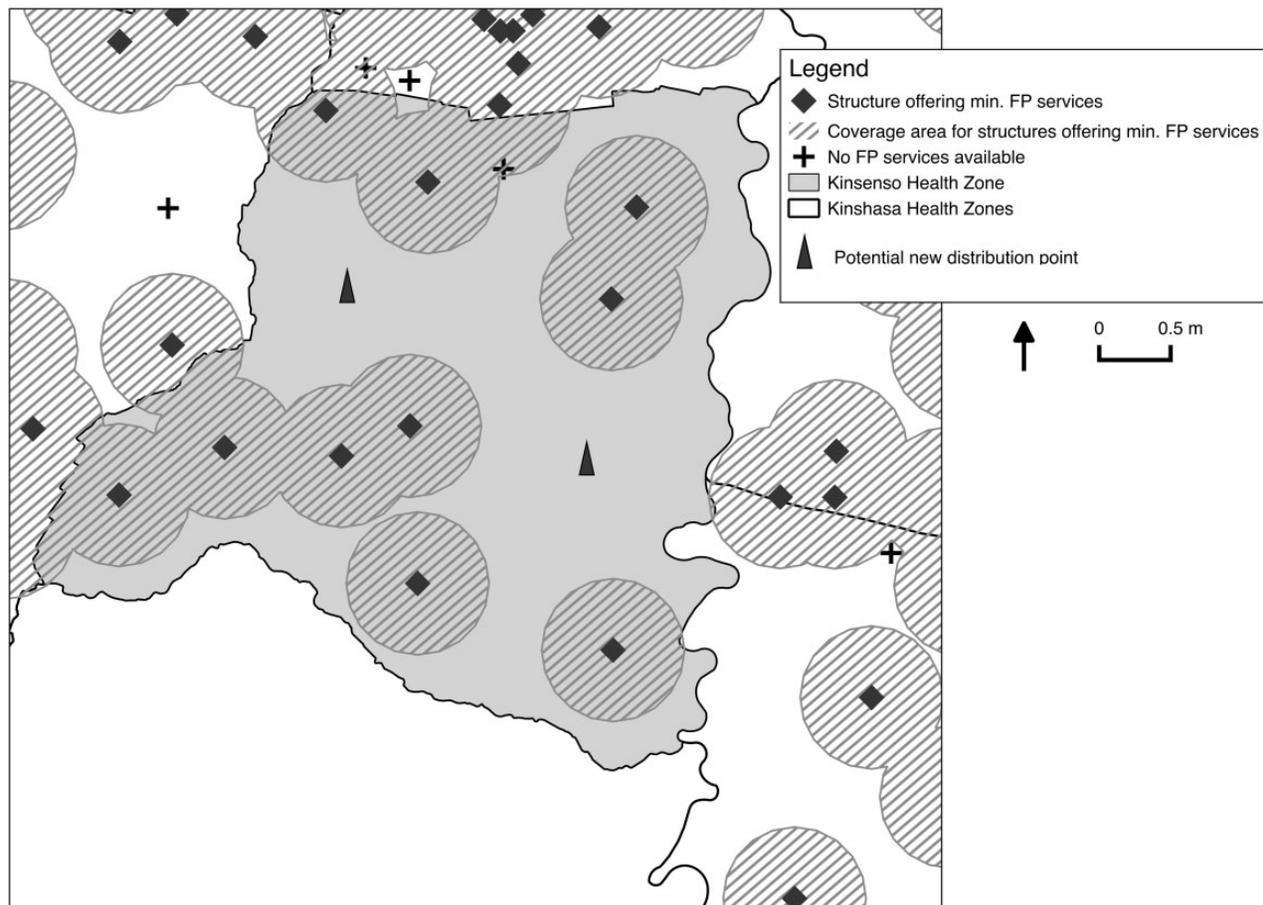
Limited analysis of supply and demand for selected HZs (based on the FP use data available from aforementioned surveys) suggests, however, that distance is far from being the main determinant of facility use: large numbers of women with unmet needs (per PMA2020 studies) live within one kilometre from minimum or even ‘three stars’ sites. Since the evidence-based planning solutions

discussed with FP programmes managers during this study often involved a choice between strengthening existing structures or creating new service delivery points, integrating more systematically all aspects of quality of care in future facilities survey will be crucial to understand how the quality can counterbalance the friction of distance in healthcare seeking behaviours in Kinshasa.

## Discussion

As a case study, the work conducted in Kinshasa demonstrates the utility of tools that are familiar to GIS specialists but underutilized in the domain of international FP programming. It underscores the feasibility of obtaining geo-coded data, despite the challenges of an extremely low-resource setting. And it identifies the types of research questions that can be addressed, as well as their programmatic implications.

The language of health information systems is replete with spatial metaphors: it is necessary to ‘put an issue on the map’, to offer all actors and stakeholders a ‘common ground’ for discussion so that they can eventually ‘draw a plan’ for effective and efficient resources allocation. But because GIS computing powers tend to be far more sophisticated than what is needed for programmatic purposes, the result can be a fascinating spatial regression highlighting the multi-dimension determinants of healthcare use that is impossible to scale-up or incorporate in routine programming (Dunn *et al.* 1997). The available geographic data for Kinshasa (and much of the



**Figure 7.** Kinshasa—Unequal distribution of facilities leaves gaps in FP coverage

developing world) are not sufficiently detailed or complete yet to warrant the use of more advanced spatial analysis of GIS tools. For example, time-distance, taking into account the network of paved and dirt roads in different parts of the city, would certainly be a more accurate way of measuring the exact area covered by each facility, but no such cadastral map or electronic shapefile exists for Kinshasa, despite progress made on platforms such as OpenStreetMap.

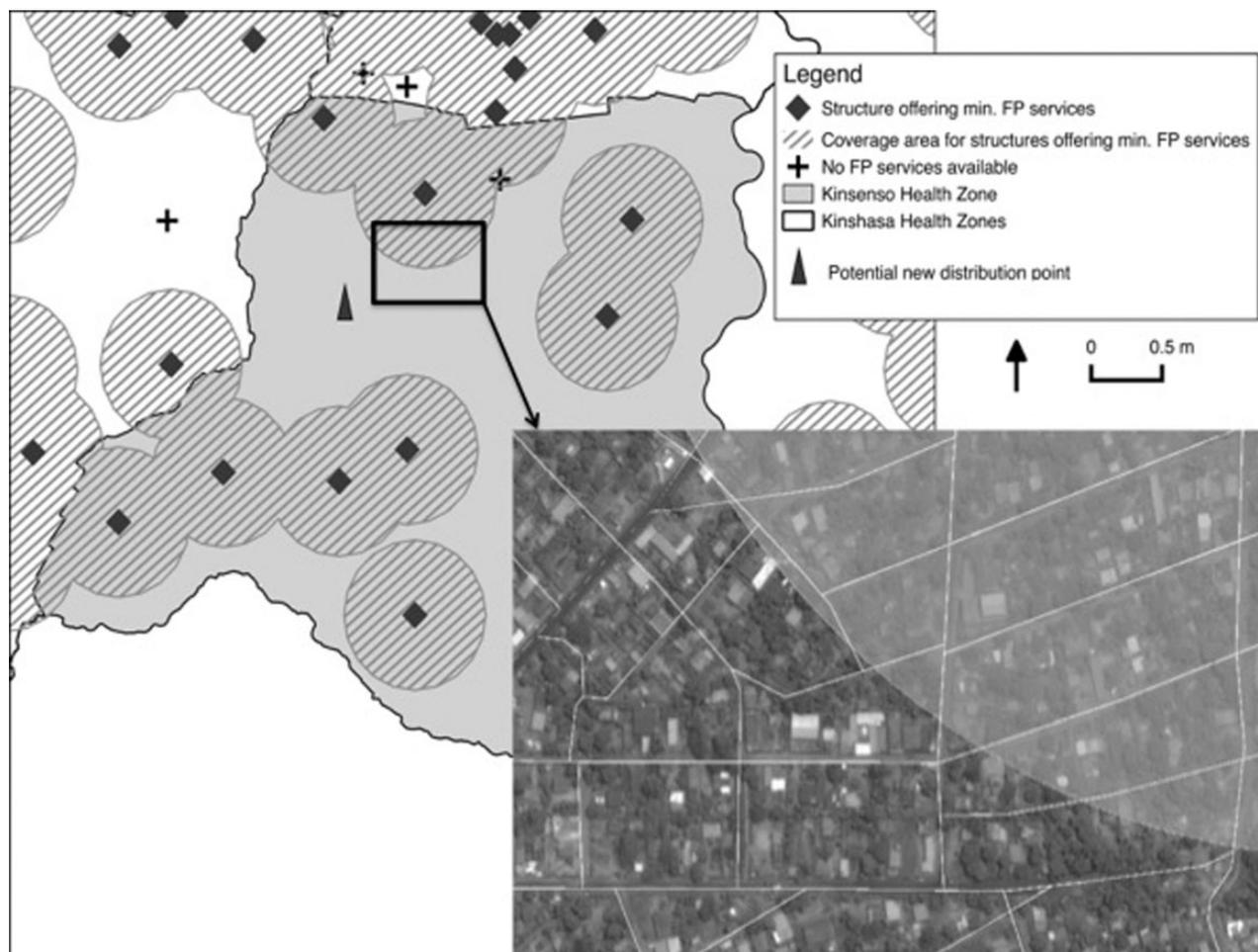
A major advantage of the non-software-driven approach presented in this article is the potential for sustainability, replicability and scalability, three characteristics that too often escape more intricate spatial analysis projects. The free and user-friendly nature of the tools used obviously lowers the financial and human cost of adoption and extension of these mapping resources to other parts of the country. But in addition, the selection and adaptation of those GIS functionalities that most relevantly serve programmatic needs and produce immediately actionable information may help bridge the gap existing between expert analysis and evidence-based decision-making at the policy level. In this example, the suite of digital tools provided effective support in focusing attention on the basic elements of FP services supply: distribution and definition of standards for minimum spatial accessibility, rapid identification of underserved areas and site selection for new points of services.

In this regard, two key developments in the field are encouraging: the replication of this mapping effort for Lubumbashi, completed in 2015 under the lead of a Congolese graduate student with support from the provincial branch of PNSR and Tulane University.

And the systematic integration of this activity within the *Comités Multisectoriels Techniques Provinciaux* (Provincial Multisectorial Technical Committees), the key programmes and policies agencies recently institutionalized at the regional level in DRC. Every effort is currently made to systematically associate members of these committees to the mapping protocol, with the authors of this article frequently travelling throughout the DRC to provide technical training in order to support local capacity building and sustainable technology transfer.

As new layers of spatial information regarding supply and demand for FP services become available, it will be possible to introduce new dimensions to the proposed analysis of service accessibility in Kinshasa and the DRC, including adequacy between FP services provision and specific healthcare seeking behaviours.

For example, the initial overlaying of the results from PMA20/20 (2014) at the household and women level have already highlighted some unexpected findings where clustering of unmet needs for contraception appeared in areas of Kinshasa adequately covered in terms of FP services provision. These findings highlight the needs to explore the concept of ‘accessibility’ beyond the simple notion of spatial proximity (Higgs 2014). Issues of costs, social and cultural acceptance and demographic characteristics are crucial to understand the use of FP services. This confirms the findings of earlier studies on healthcare seeking behaviours in the DRC. *Manzambi et al.* (2000) asked 1000 household representatives of Kinshasa’s population in 1997 which health structures they had visited the last time a family member was ill and why. Respondents were mostly women between the age of 25 and 41 years



**Figure 8.** Using Google Earth for better visualization of FP services coverage

old, which is relevant for insights into determinants of FP services' uses and among the factors determining facilities choice, geographic proximity ranked only number five (13.6% of respondents), behind the availability of quality care (28.8%), a personal relationship with healthcare staff (24%), the presence of a medical doctor at the facility (20.5%) and the existence of an insurance convention with the household (14.5%). These findings illustrate the role that well-distributed facilities, in conjunction with strengthened quality of services (especially in terms of) healthcare staff, can play in supporting better access to healthcare.

## Conclusion

The innovative combination of smartphone-based data collection, typical vector-based GIS analysis, and use of interactive tools such as Google Earth presented in this study opened the possibility for discussion and participation from officers and managers at all levels of the national health information system and their partners in the DRC.

The user-friendliness and attention grabbing quality of the interactive maps proved an unexpectedly effective tool for advocacy for a topic that had, so far, received little attention in DRC. The free, technologically unchallenging suite of tools and applications required to collect data also contributes to establish sustainable protocols for routine updating of the FP information.

As more sophisticated geo-referenced data emerge from the 'black box' of FP delivery in DRC, more advanced spatial analysis procedures will certainly be introduced to further strengthen the tracking of

supply and demand for these services in Kinshasa. But a continuous concern should remain for tailoring GIS tools and functionality to the existing technical skills and programmatic needs, so that, while trained GIS professionals might find these particular brands of spatial analysis rudimentary, FP managers in the DRC will find them useful.

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## Note

1. While we do recognize that health zones are arbitrary lines drawn for the purpose of managing the delivery of health care, and that individuals most likely do not factor these

divisions in their decision-making about which structure to patronize for FP services, the HZ remains the basic programmatic unit for resources allocation for the DRC Ministry of Health and its national and international partners.

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