

**Spatial Distribution of
Publicly Funded Telecommunications Infrastructure
in Kenya (2007)**

April 7, 2008

**Report Prepared by
Warigia Bowman
Doctoral Candidate in Public Policy
John F. Kennedy School of Government**

I. Key Findings and Recommendations

The maps I have created indicate that public communications infrastructure, as represented by the Kenyan Posta facilities, has not been distributed evenly throughout the country. Some rural areas have received significantly more infrastructure than their population or mileage would justify. In general, post offices with Internet are more fairly distributed than post offices with electricity.

A. Key Findings

- Consistent with reports from the ITU and other bodies, my GIS maps make it clear that there is a concentration of communication facilities in urban areas.
- Northeastern province has been systematically neglected in terms of public communications facilities.
- In general, post office facilities with Internet seem to be distributed quite equitably between all provinces.
- By contrast, post office facilities with electricity do not seem to be distributed equitably.
- The province with the largest number of post offices, in terms of absolute numbers, is Rift Valley province. In addition, Central and Coast provinces seem to be generally underserved by public post offices.
- Eastern, Nyanza and Western all received reasonable amounts of infrastructure.
- The trend is that infrastructure distribution in Kenya became more equitable and less politicized under the NARC government of President Mwai Kibaki, in terms of raw numbers of post offices with Internet.
- Nonetheless, when adjusted by population, the Government of Kenya still needs to make progress on ensuring that distribution of post offices with Internet is equitable. In particular, although Northeastern Province has done better on post offices with Internet, Central Province is still performing poorly, when considered by facilities per thousand persons.

B. Key Recommendations

- I recommend that the PS look at the numbers I have generated on distribution of facilities, and attempt to even out public communication facilities.
- Special attention should be paid to correcting inequities in facilities in Central, Northeastern and Coastal province.
- I recommend to the PS that he and Posta begin the practice of indicating when (by year) specific post offices (or other facilities) were built, and when specific technologies were put in place, so that the Kenyan government can do a more precise job of tracking progress in the area of ICT's in public facilities.
- Future databases on post offices (or schools or hospitals) should indicate 1) when the post office was built 2) when it received electricity 3) when it received telephones and 4) when it received other advanced services

II. Introduction

This research project arose out of my doctoral dissertation. I collected significant primary data on telecommunications infrastructure in several East African countries. The emphasis of my data collection has been on “advanced” technologies such as the Internet. Upon examination, the data struck me as predominantly spatial. Accordingly, geographic information systems turned out to be the most appropriate methodology to examine this data. This research project represents my initial effort to display and analyze some of the data I have collected in Kenya.

A. Motivation

Over twenty three African countries have begun writing and implementing Information and Communications Technology policies in the past decade. Studying and visualizing what actual progress countries have made “on the ground” regarding ICT infrastructure helps researchers and policymakers to understand how written ICT policies translate into implementation.

III. Context

In terms of gaps in technological access between countries, there is a serious gap between African countries and industrialized nations. Africa has the lowest telephone densities and the lowest levels of Internet connectivity in the world. According to the International Telecommunications Union, almost every Sub-Saharan African nation is a low access nation in terms of digital access indicators such as access to mobile and fixed line telephones, literacy, computer and Internet access. Further, ICT penetration levels vary within countries so that within the same nation, there may be pockets of high and low access levels, particularly along rural-urban divides.

In general in Africa, ICT infrastructure is not evenly distributed inside of countries, nor is it evenly distributed between countries. In almost all African countries, technological infrastructure has historically been concentrated in cities. In order to adequately care for their citizens, however, as well as in order to continue growing economically, countries in Africa need to continue to build core telecommunications infrastructure throughout their countries, with attention to rural areas.

It is worth noting that most rural citizens in Kenya, as well as in the rest of Sub-Saharan Africa, lack access to old types of communications infrastructure (such as landline telephone wires and electricity), while also being deprived of access to new types of communications infrastructure (such as fiber optic cable, and satellite towers to facilitate cellular telephony, as well as connectivity to the Internet). The differential access of citizens in Kenya, and in other African countries, to technological infrastructure raises questions about resource distribution, equity and fairness.

Developing nations lag behind developed nations in terms of most technological indicators, and in terms of ICTs in particular. Most developing countries, including African countries, lack both the infrastructure and the human resources to support widespread access to technologies such as computers, the Internet, and other communication technologies. However, mobile telephony is growing at an exponential rate in these countries.

IV. Research Questions

This project builds upon the issue of ICT penetration issues inside of country borders. I look at distribution between rural and urban areas, as well as between political boundaries within the country. In the case of Kenya, I look at distribution of publicly funded ICTs within provincial boundaries. Provincial boundaries are an appropriate unit of spatial analysis, as they are major administrative boundaries, and because they have remained largely stable since Kenya gained independence.

My basic research question for the purpose of this project is to examine how ICT is distributed spatially inside of Kenya. In other words, is infrastructure distributed “fairly”? One way of determining “fair” or “equitable” distribution is to evaluate whether areas with higher population density have more public infrastructure than areas with lower population density. A different way of distributing ICT infrastructure fairly (or equitably) would be to ensure that infrastructure was distributed *evenly* throughout different regions.

By contrast, if infrastructure is concentrated in an area out of proportion with its population or area, I suggest that alternative factors, such as political motivations, are driving infrastructure development.

V. Data

The data is primary data which I collected during the course of my fieldwork in Kenya from 2003-2007.¹ I collected data on all government-sponsored infrastructures with an information and communications technology component in Kenya, Uganda, Tanzania and Rwanda. The data which has been mapped here is data on postal offices on Kenya.

Although Kenya has ongoing plans to create tele-centers, digital schools, and digital villages, I was not able to independently verify that those tele-centers are operational. Accordingly, I have mapped post offices.

There are three different types of post offices. One set has no electricity. One set has electricity, and the third set has both electricity, as well as Internet, powered by GPRS technology. Inside of post offices with GPRS, the Internet is accessible to the public through small podium sized kiosks in each post office.

¹ I wish to thank Permanent Secretary for Information Bitange Ndemo and the Kenyan Postmaster General for giving me access to this data.

VI. Methodology

The main software used in the project was ArcMap and ArcGIS. I used two main methodologies in creating this project. The first methodology was to map the density of postal facilities with electricity and ICTs, respectively, in various Kenyan provinces. I created different ranges, and assigned graduated colors to those ranges on my maps. I mapped 1) raw numbers of post offices 2) post offices adjusted by provincial mileage and 3) post offices adjusted by provincial population.

In order to create the first set of maps, I acquired a dataset, with the assistance of Ben Lewis, of Harvard's Center for Geographic Analysis, which had Kenyan provinces along with their coordinates. I added a field which represented the number (in integers) of postal facilities of various types inside of this database. I was then able to use scaled symbology, using graduated colors, to show different levels of post office density by province. I used a manual method to assign class breaks.

The second methodology I used combined the information I had on the location and types of post offices in Kenya with X,Y coordinates on Kenyan locations gained from the National Geospatial Intelligence Agency. (*Please see the attached documentation on the shape file I created, as well as the "possible error section."*) My coordinates for Kenya were obtained from this website http://earth-info.nga.mil/gns/html/cntry_files.html.

This database has 29984 points including schools, areas, administrative units, hills, markets, streams, and some other units associated with their respective latitude and longitude. I have coded postal stations without electricity as 11, postal stations with electricity as 12, and postal stations with GPRS (i.e. Internet connectivity) as 13. Since I was working with original data, I developed this coding system myself, and also input the codes manually. I had to add a field to the original file. In essence, I created a database of sorts, which resulted in a map showing post offices with point data.

The result of this method is the creation of various maps showing point data on 1) post offices without electricity, 2) post offices with electricity and 3) post offices with electricity and GPRS and finally 4) all post offices.

VII. Analysis and Results

The maps I have created indicate fairly clearly that public communications infrastructure, as represented by the Kenyan Posta facilities, has not been distributed evenly throughout the country. Some rural areas have received significantly more infrastructure than their population or mileage would justify. In general, we see that post offices with Internet are more fairly distributed than post offices with electricity.

I have evaluated the provinces along six indicia: raw numbers of facilities (electricity and GPRS), facilities adjusted by mileage (electricity and GPRS), and facilities adjusted by population (electricity and GPRS). The point data is most useful to see what populated places may have large populations but few facilities. The provincial data is very useful to discern overall political patterns.

Table 1: Descriptive Statistics Regarding Placement of Postal Facilities in Kenya

Province Name	Raw Numbers of Postal Facilities with Electricity	Rank	Raw Numbers of Postal Facilities with Internet	Rank	Number of Miles Served by a Post Office with Electricity	Rank	Number of Miles Served by A Post Office with GPRS	Rank	Number of People Served by a Post Office with Electricity	Rank	Number of People Served by a Post Office with GPRS	Rank
Rift Valley	95	1	13	2	723	5	5280	7	61,000	2	448,000	7
Nairobi	59	2	16	1	5	1	19	1	19,000	1	69,000	1
Eastern	54	3	12	3	1125	7	5062	6	83,000	5	372,000	6
Nyanza	49	4	11	4	129	4	576	4	77,000	4	375,000	5
Western	45	5	10	5	69	2	310	2	84,000	6	347,000	4
Central	42	6	10	6	119	3	501	3	125,000	8	525,000	8
Coast	33	7	10	7	982	6	3239	5	66,000	3	216,000	3
Northeastern	6	8	6	8	8189	8	21208	8	90,000	7	90,000	2

Project Report on Kenyan Postal Facilities
Submitted to Permanent Secretary Dr. Bitange Ndemo
Report Prepared by Warigia Bowman
Created on 4/7/2008 12:31:00 PM

Consistent with reports from the ITU and other bodies, my GIS maps make it clear that there is a concentration of communication facilities in urban areas. In particular, Nairobi province, the smallest, but most densely populated province, (and the nation's capital) ranks first on five of six indicators.

In addition, Northeastern province has been systematically neglected in terms of public communications facilities. It ranks last on five of six indicators. Northeastern province is sparsely populated and large. In addition, it is populated by predominantly pastoralist peoples, and has been affected by intermittent violence between bandits. Accordingly, it makes some sense that it has very low infrastructure density. That being said, there is also a time-series component to its infrastructure. In terms of population, Northeastern does well with regard to Internet facilities in post offices.

Since Internet was likely installed under the Kibaki government, which is to say after the 2002 election, this suggests that the Kibaki government has been trying to improve infrastructure in Northeastern province.

In general, post office facilities with Internet seem to be distributed quite equitably between all provinces. Each province receives fairly similar numbers of GPRS facilities. The difference in raw numbers between the province with the least facilities (Northeastern) and the most facilities (Nairobi) is 7. In other words, the province with the most Internet in public facilities has two times the resources of the province with the least facilities. The average number of post offices in each province with GPRS (Internet) is 11. Five of the 8 post offices are within one facility of the average. The province with the smallest number of post offices with the Internet is Northeastern, however, every single post office in Northeastern which has electricity also has Internet. In addition, Northeastern ranks second in terms of the number of people who are served by a post office in the province.

By contrast, post office facilities with electricity do not seem to be distributed equitably. The province with the largest number of post offices, in terms of absolute numbers, is Rift Valley province. Rift Valley province has no major population centers. However, it is the home of former President Daniel arap Moi. There are more than 10 times the number of post offices in Rift Valley Province than in Northeastern Province: an order of magnitude more. Furthermore, Rift Valley ranks second in terms of the number of people served by a post office with electricity. I hypothesize that President Moi over - distributed communications infrastructure to his home province for political patronage reasons.

In addition, Central and Coast provinces seem to be generally underserved by public post offices. Central province ranks in the bottom three on four of the six indicators. Further, it ranks last on two indicators, and third to last on two indicators. Coast Province ranks in the bottom three on three of six indicators and second to last on two indicators.

Project Report on Kenyan Postal Facilities
Submitted to Permanent Secretary Dr. Bitange Ndemo
Report Prepared by Warigia Bowman
Created on 4/7/2008 12:31:00 PM

Accordingly, Central Province does respectably on mileage indicators. This phenomenon is explained by the fact that Central Province has a very dense population, and a small size. However, Central Province performs poorly in terms of raw numbers of post offices, on numbers of post offices with electricity adjusted by population and in terms of numbers of post offices with GPRS adjusted by population. Central Province ranks second to last in terms of number of people served by post offices with electricity. Central Province is squarely in the middle in terms of raw numbers of post offices with Internet. This data confirms research that indicates that the Moi government systematically underdeveloped and neglected Central Province for political reasons, in many arenas, including transportation infrastructure.

Eastern, Nyanza and Western all received reasonable amounts of infrastructure. They tend to fall around the mean on most indicators. I hypothesize that because these three provinces are crucial politically as “swing” provinces during elections that they always received acceptable amounts of infrastructure.

The trend is that infrastructure distribution in Kenya became more equitable and less politicized under the NARC government of President Mwai Kibaki, in terms of raw numbers of post offices with Internet.

I assume that Most post offices with electricity were likely built under the long tenure of the Moi government, although this should be confirmed with the Ministry of Information and Communications. I further assume that most post offices with Internet were built after 2002, under President Mwai Kibaki, since GPRS is a relatively new technology.

Nonetheless, when adjusted by population, the Government of Kenya still needs to make progress on ensuring that distribution of post offices with Internet is equitable. In particular, although Northeastern Province has done better on post offices with Internet, Central Province is still performing poorly, when considered by facilities per thousand persons.

The average number of people served by one post office with GPRS in Kenya is 246,000. (i.e. mean = 246,000) The province that performs the best on this indicator is Nairobi, which serves three times more people with a post office with Internet than the average. The province that performs the worst on this indicator is Central, (525,000) which serves approximately ½ of the people with a post office with Internet than the average. Nairobi serves about 7 times more people with a post office with Internet than Central. The average province has two times the number of facilities per thousand people than Central.

By contrast, the average number of people served by one post office with electricity in Kenya is 75,000 (i.e. mean = 75,000). In Nairobi, the strongest performer, one electrified post office serves 19,000 people. In Central Province, the weakest performer, one electrified post office serves 125,000 people. Again, roughly speaking Nairobi serves 7 times more people with a post office with electricity than Central Province does. When Nairobi is removed, Central Province still underperforms.

VIII. Possible Error

One source of error is precise information regarding the location of Kenyan post offices. [*I have attached detailed documentation regarding which maps I used and how I coded points.*] There were some towns where I had trouble reconciling the information on the sheet I received from the Kenyan post office, and the point data I was using from the National Geospatial Intelligence Agency.

In order to correct these coding problems, I plan to review points that did not match between the Kenyan Postal Service List, and the National Geospatial Intelligence Database with the Kenyan Post Office, and with the Permanent Secretary (PS) for Information and Communications in Kenya, Dr. Bitange Ndemo.

IX. Conclusions and Recommendations

The main contribution of this project is manifold. First of all, this is an original project in terms of data collection. Secondly, this is one of the first efforts to map data on Kenyan telecommunications infrastructure in GIS. Third, this project is the first effort to create a GIS data base on Kenyan telecommunications infrastructure. A simple search of data on Kenya indicates that currently, no such similar maps exist. Dr. Ndemo has indicated that the World Bank may be working on some GIS maps, but they are not as yet public. My goal is that this project will act as a baseline for future infrastructure mapping efforts in Kenya. As the Kenyan government expands its efforts in the area of ICT infrastructure, around projects such as tele-centers, GIS projects can continue to develop maps of these structures.

I recommend that the PS look at the numbers I have generated on distribution of facilities, and attempt to even out public communication facilities. The most efficient way to do this, however, is not to provide equal raw numbers of facilities per province. Rather the number of facilities per thousand people should be more equal.

Secondly, **Nairobi is overserved on all dimensions of postal facilities.** Particularly given the fact that there are numerous private cybercafes in Nairobi, there is little need to place public GPRS facilities in wealthy enclaves such as Westlands, where Posta currently has a facility with Internet.

Third, **special attention should be paid to correcting inequities in facilities in Central, Northeastern and Coastal province.** Due to the very tense political situation prevailing in the country to date, it may be difficult to build infrastructure in Central immediately, but concerted efforts should be made to improve equity in Coast and Northeastern, whereas efforts to improve infrastructure in Central can take place later.

Finally, **I recommend to the PS that he begin the practice of indicating when (by year) specific post offices (or other facilities) were built, and when specific technologies were put in place, so that the Kenyan government can do a more precise job of tracking progress in the area of ICT's in public facilities.** For example, future databases on post offices (or schools or hospitals) should indicate 1) when the post office was built 2) when it received electricity 3) when it received telephones and 4) when it received other advanced services

X. Future Research

In terms of project extensions, I hope to create a well thought out geodatabase of my Kenyan data. Furthermore, a Moran's I analysis would help confirm my hypothesis regarding political influence of infrastructure distribution.

I hope to continue creating GIS maps of ICT infrastructure in the region. I have data on Tanzanian telecenters, Rwandan ICT in schools and hospitals, and Ugandan telecenters, schools, hospitals, and Internet backbone. My next goal is to map these.

XI. Bibliography

Odhiambo, Fred Postmaster General and O'Brian O. Wejuli, PA to Postmaster General. Letter Regarding Postal Outlets Hooked to GPRS Edge, (Nairobi, Kenya: Posta Kenya, Posta House, March 2, 2007, photocopied) In private collection of Warigia Bowman.

Aduda, Kenneth and Myra Ohaga. "African Technology Policy Studies, Country Case Studies, Strengthening National ICT Policy in Africa: The Case of Kenya." (Nairobi, Kenya: African Technology Policy Studies Network, 2004, Photocopied)

Dzidonou, Clement. "A Blueprint for Developing National ICT Policy in Africa." Nairobi: Kenya: African Technology Policy Studies Network. 2002.

Eggleston, Karen, Robert Jensen and Richard Zeckhauser. Information and Communication Technologies, Markets, and Economic Development," in *The Global Information Technology Report: Readiness for the Networked World*. New York: Oxford University Press, 2002.

International Telecommunications Union. "Africa Reaches Historic Telecom Milestone." *ITU Telecommunication Indicators Update*. Geneva: ITU, 2001.

Okpaku, Joseph O. ed. *Information and Communications Technologies for African Development: An Assessment of Progress and Challenges Ahead*. New York: United Nations ICT Task Force, 2003.

Ormsby, Tim, et al. *Getting to Know ArcGIS Desktop*. Redlands: ESRI Press, 2004.