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Measuring trends in access to modern infrastructure in Sub-Saharan Africa

Results from Demographic and Health Surveys

by Sudeshna Banerjee, Amadou Bassirou Diallo, and Quentin Wodon

Household surveys have long been used to estimate poverty and inequality trends but not to the same extent to assess trends in access to infrastructure services. A recent study for sub-Saharan Africa by Banerjee et al. (2007) uses Demographic and Health Surveys (DHS) from 22 countries that have conducted at least two such surveys between 1990 and 2005 in order to collect comparable information across countries on access to modern and alternative infrastructure services over time. In addition to national, urban, and rural trends in access, the study includes a distributional analysis of how access rates have evolved since 1990. That is, households are divided into five quintiles of population according to their level of wealth, with wealth defined using a principal components analysis. The objective of this note is to provide a summary of key findings from the study regarding access trends to electricity, piped water, flush toilets, and landline telephones over the period 1990-2005.

How is access defined?

DHS surveys have fairly standardized questionnaires, but the infrastructure categories used in the questionnaires vary sometimes. In order to generate comparable results, we standardized the infrastructure variables used to compute access rates to different infrastructure choices. The categories used are listed in Table 1.

Among the modern infrastructure services, the coverage of electricity is comparatively high. The direction of coverage ladder flows from landline ? flush toilet ? piped water ? electricity and holds for both rural and urban areas. Over 29% of all Africans report having electricity in their homes. However, only 16% of Africans have piped water, 12% have flush toilet and 7% have landline telephones. The use of electricity is widespread in urban areas of Africa with 70% of urban dwellers having access to electricity. In stark contrast, rural Africans lag behind in the absolute level of coverage - less than 5% of rural population use piped water, and around 13% use

electricity. Less than 2% of rural dwellers use a flush toilet to meet their sanitation needs. Growing from a low base, the rural population covered by network services either remained stable or increased in the past 15 years. The same cannot be said of urban Africa. While landlines and electricity coverage has either increased or remained stable since 1990, the coverage has declined for piped water, flush toilet and landline telephones. Except for electricity services, the poorest are left out of network coverage in Africa. The electricity coverage in the second poorest quintile has risen from 8% in late 1990s to 32% in early 2000s. As expected, the infrastructure coverage for the top quintile has increased for electricity, landline, and flush toilet and remained stable for piped water.

Monitoring the progress of infrastructure sectors such as water supply and sanitation (WSS) has been a significant by-product of adoption of Millennium Development Goals (MDGs). It is the only sector whose evolution is directly monitored by the MDG that aims to 'halve the number of people without access to safe drinking water and basic sanitation by 2015. The Joint Monitoring Program (JMP) managed by the United Nations Children's Fund (UNICEF) and World Health Organization (WHO) tracks the progress towards achieving the MDGs. There are differences between the methodology underlying JMP estimates and our work. First, JMP statistics include all African countries, whereas only a subset of countries is covered in our data set. Second, JMP statistics are based on a survey of surveys (including assessment questionnaires sent to UNICEF field representatives), whereas our results are based solely on DHS data. Third, JMP statistics apply standardized parameters in order to be able to separate protected from unprotected boreholes, and to determine to what extent traditional pit latrines can be considered as 'improved sanitation'. This difference is the primary reason for the discrepancy in the JMP and AICD estimates as wells/boreholes and traditional pit latrines serve the maximum number of households in Sub-Saharan Africa. Our analysis reports only what can be directly supported with DHS data.

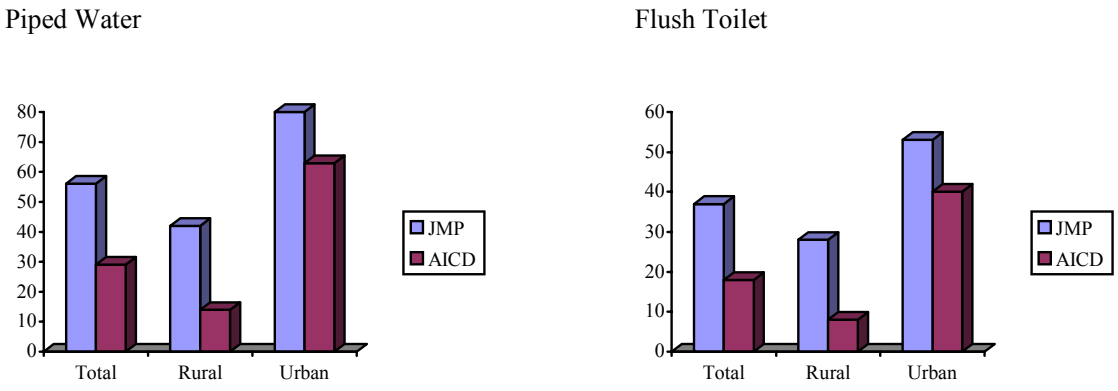
Owing to these methodological differences, there will necessarily be differences between JMP estimates of access rates and our figures. Our estimates for access to improved water and sanitation is consistently lower. However, the estimates for piped water coverage

Table 1: Definition of access and standardized categories of infrastructure services

Main source of water supply	AICD(*) category	JMP category
Piped water into dwelling or yard	Improved	Improved
Public tap or communal standpipe	Improved	Improved
Wells or boreholes, hand pumps, or rainwater	Unimproved	Improved/Unimproved
Surface water (e.g. lake, river, pond, dam, spring)	Unimproved	Unimproved
Vendors or tanker trucks	Unimproved	Unimproved
Others (e.g., bottled water)		
Toilet facility		
Flush toilet to network or septic tank	Improved	Improved
VIP latrine, San Plat, or chemical toilet	Improved	Improved
Traditional pit latrine	Unimproved	Improved/Unimproved
Bucket or other container	Unimproved	Unimproved
Other	Unimproved	Unimproved
No facility, nature, or bush	Unimproved	Unimproved

Source: JMP (2006) and authors. Note: AICD stands for Africa Infrastructure Country Diagnostic.

Figure 1: Access to Piped Water and Flush Toilet, 2000-2005



Source: JMP, 2006 and Authors' estimates

are similar. For instance, the urban and rural access to piped water is reported to be 40 percent and 4 percent respectively in the JMP; the corresponding numbers in our study are 36-40 percent (depending on the method used, as discussed below in this note) and 4 percent. On a country by country basis, there is less discrepancy between the urban access figures for both piped water and flush toilet. This could be because the wells/boreholes and traditional pit latrines are used more by rural dwellers than by urban dwellers.

In some cases, the definitions used to measure progress towards the MDGs lead to difficulties in monitoring. For example, access to safe drinking water is defined in the MDG as the "*percentage of the population using improved sources*" and is monitored by the JMP using household survey data, although changes in infrastructure categories over time in JMP statistics make it difficult to track the same categories in a fully consistent way. One way to deal with these issues is to propose a categorization of access based on modern services and its alternatives. This is done in Banerjee et al. (2007), but in this brief, in order to keep things as simple as possible, we report only on trends in access modern or advanced infrastructure services - to piped water into the dwelling or yard, electricity, and flush toilet to network or septic tank, and landline telephones.

How has access evolved over time?

Table 2 provides estimates of the trend in access to piped water, electricity, and flush toilets in sub-Saharan Africa as a whole. As mentioned earlier, these estimates are based on country-level estimates obtained from the DHS data. One difficulty in providing an Africa-wide trend in access rates stems from the fact that the panel of countries available through the DHS surveys is not balanced for each period. Countries have observations for different years.

Table 2: Trends in access to basic infrastructure services in Africa 1990–2005 (percent)

	Piped Water			Electricity			Flush Toilet			Landline telephone		
	1990-95	1996-2000	2001-2005	1990-95	1996-2000	2001-2005	1990-95	1996-2000	2001-2005	1990-95	1996-2000	2001-2005
National												
Method 1	12%	13%	10%	19%	29%	34%	7%	8%	10%			
Method 2	17%	17%	15%	23%	28%	31%	10%	10%	11%	6%	5%	7%
Method 3	17%	17%	16%	23%	28%	29%	10%	10%	12%			
Urban												
Method 1	38%	34%	25%	67%	72%	72%	26%	27%	26%			
Method 2	49%	44%	37%	70%	70%	70%	35%	32%	30%	18%	16%	19%
Method 3	49%	44%	40%	70%	70%	70%	35%	32%	30%			
Rural												
Method 1	4%	4%	4%	5%	13%	16%	1%	2%	3%			
Method 2	4%	4%	4%	6%	10%	13%	1%	1%	2%	1%	1%	2%
Method 3	4%	4%	4%	6%	10%	13%	1%	1%	2%			
Q1												
Method 1	0%	0%	0%	0%	1%	5%	0%	0%	0%			
Method 2	0%	0%	0%	0%	2%	3%	0%	0%	0%	0%	0%	0%
Method 3	0%	0%	0%	0%	2%	3%	0%	0%	0%			
Q2												
Method 1	1%	2%	1%	2%	8%	19%	0%	0%	1%			
Method 2	3%	4%	3%	2%	8%	32%	1%	1%	1%	0%	0%	1%
Method 3	3%	4%	4%	2%	8%	32%	1%	1%	1%			
Q3												
Method 1	3%	3%	4%	6%	20%	22%	2%	1%	2%			
Method 2	9%	8%	19%	12%	19%	25%	4%	4%	13%	2%	1%	2%
Method 3	9%	8%	20%	12%	19%	25%	4%	4%	13%			
Q4												
Method 1	14%	12%	13%	24%	41%	45%	7%	5%	7%			
Method 2	33%	19%	19%	27%	36%	40%	15%	12%	17%	7%	6%	6%
Method 3	33%	19%	20%	27%	36%	40%	15%	12%	17%			
Q5												
Method 1	42%	46%	35%	63%	73%	77%	27%	36%	41%			
Method 2	47%	48%	42%	65%	69%	71%	31%	34%	36%	20%	20%	28%
Method 3	47%	48%	48%	65%	69%	71%	31%	34%	36%			

Note: Q1–Q5 refer to the quintiles of wealth of households. **Source:** Banerjee et al. 2007.

Therefore three alternative methods were used to estimate overall access trends. The first method includes only the 11 countries for which there are data for three time periods, 1990–95, 1996–2000, and 2001-05 are available. The second method includes countries with data for only one or two time periods. For countries with data for only one time period the data are used for all three time periods, assuming no change over time in access. If data are available for two periods, the annual growth rate in coverage between the two periods is used to estimate the rate for the third period. The third method is similar but assumes that access rates cannot fall more than population growth. If access rates in the third period drop by more than what would be observed assuming no growth in the total number of connections, the survey data for the third period are replaced with the coverage rate in the second period times the ratio of the population in the second period divided by the population in the third period. In the case of landlines, due to a smaller number of observations, and increasing access in most countries, only the second method is applicable.

Given some issues of comparability between surveys in selected countries and the resulting need to correct for some outliers, our preferred estimates for the analysis are obtained from the third method. Yet the results form all three methods are broadly similar. They suggest that access rates for electricity and flush toilets have improved slightly over time but that access to piped water has not. Access rates within urban and rural areas have not changed much (except for countries with rural electrification projects), which suggests that migration from rural to urban areas has contributed to the higher access rates. Finally, the gains in access to electricity have been better shared across wealth groups (except for the very poor) than have the gains in access to flush toilets, which tend to have benefited the richest households the most. Among the poorest quintile access to all three basic infrastructure services remains virtually inexistent.

How far away is universal access?

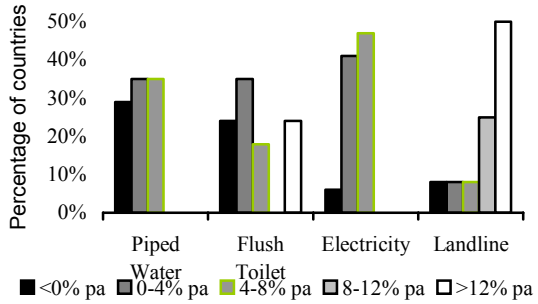
The overall average annual growth rates of the population covered by the different services in the countries in the sample is 4% for electricity, 1.6% for piped water, 7% for flush toilet, and 11% for landline telephones during the period 1996-2005 (because the data points for telephones are much fewer, access rates for this service were not included in table 1 above). Figure 1 provides data showing the share of countries with different levels of expansion rates for the services. It is striking that for piped water and flush toilets, around a quarter of the countries in the sample actually show evidence of negative growth rates, while another third report only modest growth rates of 0-4% per year. The strongest performers in terms of piped water service expansion are Benin, Burkina Faso, Chad, Ethiopia, Mali and Senegal, all showing growth rates of 4-8% per year. A significant minority of countries are expanding flush toilet service at a rate in excess of 12% per annum. These are a subset of the countries that are performing well for piped water service expansion: Burkina Faso, Chad, Ethiopia and Mali. However, this growth is taking place from a very low base, and hence does not amount to a great deal in absolute terms.

The rate of expansion of electricity service is more encouraging, with almost half of the countries reporting average annual growth rates in the 4-8% bracket. The fast expanding countries, once again, shows considerable overlap with that of the countries registering rapid expansion of piped water service: Benin, Burkina Faso, Chad, Madagascar, Mali, Senegal and Tanzania. The most rapid rates of coverage expansion are for landline service, where about half of the countries are expanding at over 12% per year, albeit from a very low base. The list of high performing countries is somewhat different in this case: Ethiopia, Ghana, Guinea, Kenya, Madagascar and Mali. The household surveys do not yet provide a time series for cellular telephones; however it is known from sector statistics that the rate of expansion for that service is much higher than for landlines. At the other extreme, one country that stands out as falling behind demographic growth in expansion of all its modern infrastructure services is Zambia, which reports a negative growth rate for piped water, flush toilet and electricity, and has been expanding landline service slowly.

Using the data on the annual growth rates in coverage at the country level, it is possible to project the year in which each country would reach universal access for each of the modern infrastructure services, based on the assumption of continued expansion

Figure 1a: Frequency distribution of average annual growth rates in service coverage

(a) Absolute average annual growth rate 1996/05



(b) Average annual growth rate relative to population growth

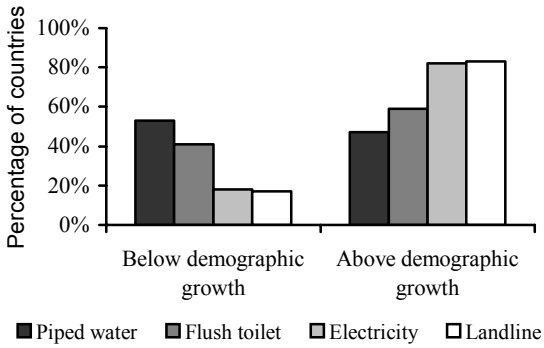
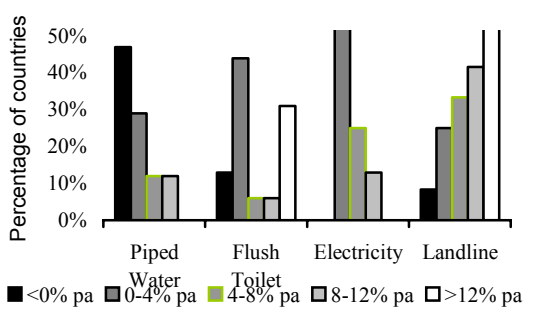


Figure 1b: Frequency distribution of average annual growth rates in service coverage (urban)



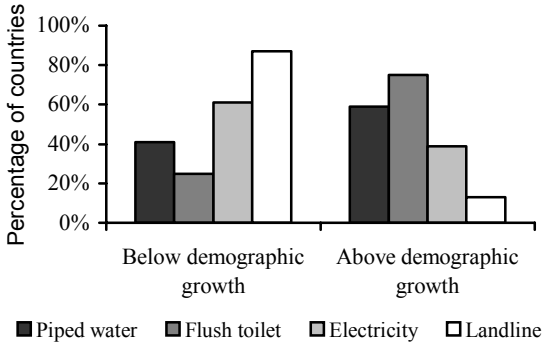
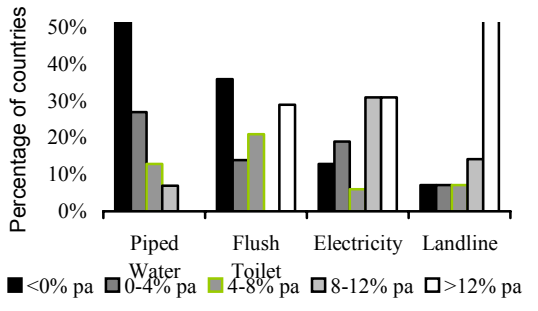
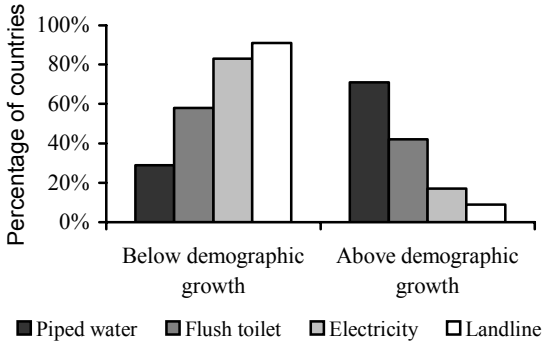


Figure 1c: Frequency distribution of average annual growth rates in service coverage (rural)



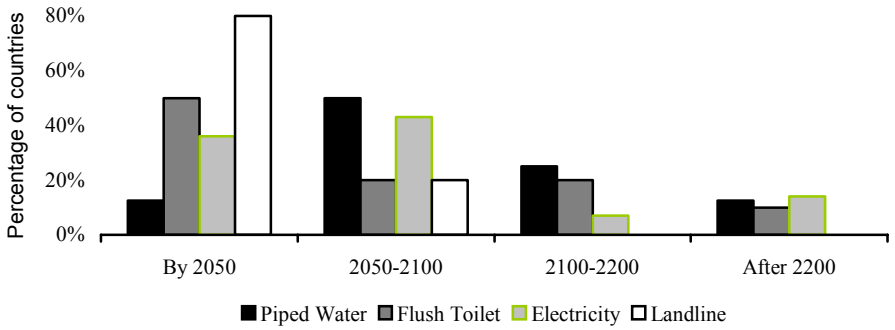


Source: Banerjee et al. (1997).

at 'business as usual' rates (Figure 2). The projections indicate that under 'business as usual' conditions fewer than 20% of countries would reach universal access for piped water by 2050, while fewer than 40% of countries would reach universal access to electricity by the same year. In a third of the African countries surveyed, universal service for piped water and electricity (if historic trends continue) would not be reached during the current century. The projections for flush toilet and landlines are less credible in the sense that both services are currently experiencing very high growth rates from very low base levels, and these growth rates are bound to slow down as penetration increases, particularly given the high cost of these services relative to the purchasing power of the population. Hence the estimates provided here regarding the time to reach universal coverage are bound to be too optimistic.

Another constraining factor is the fact that an additional trend is further complicating the achievement of universal access for network infrastructure services: namely that of shrinking households. The average African household appears to be getting

Figure 2: Estimated year of universal coverage under business as usual



Source: Banerjee et al. (2007).

smaller as GDP per capita rise. At work here is urbanization, declines in fertility, and greater economic resources, which allow nuclear families to disengage from extended households, in part because they no longer need the economies of scale provided by larger households. Because shrinking household size exerts such a strong effect on the need for new connections, countries with higher GDP per capita and lower population growth may not necessarily expect a smaller increase in connection needs than poorer countries, because the gains from lower population growth are often offset by the changes in household sizes (Diallo and Wodon, 2007).

Conclusion

This note has provided a brief description of the trend in access rates to basic infrastructure services in sub-Saharan Africa using data from DHS surveys. The results are not encouraging. Access rates for electricity and flush toilets have improved slightly over the last decade. Increase in electricity coverage appears to be driven by rural electrification. Urban electricity coverage has remained stable for the last 10 years and rural coverage has increased by three percentage points. Landline telephone is the only service where coverage has unequivocally improved, irrespective of geographical location or income group. But access to piped water has declined, and for all four services, among the poorest households access to remains virtually inexistent. The decline in water supply coverage is starker in the urban areas while the coverage has remained almost constant in the rural areas in the past 15 years. Furthermore, beyond broad averages, a large number of countries are failing to ensure that service expansion even keeps pace with population growth. For piped water and flush toilet, close to half of the countries are expanding too slowly to keep pace with demographic growth. For electricity and landline telephones, around 80% of the countries are managing to expand coverage faster than they are expanding population. But even for these countries, under a continuation of current trends, it will take a very long time to reach universal or even widely shared access. These results point to the need to increase efforts by governments and donors to progressively increase access to basic infrastructure services to Africa's population.

This note was prepared by Sudeshna Banerjee, Amadou Bassirou Diallo and Quentin Wodon, as part of a series of five briefs on household survey data analysis for the World Bank's 2007 *African Development Indicators* (at the suggestion of Jorge Arbache) as well as for the 2007 annual report on the Belgian Poverty Reduction Partnership, which helped fund this work, together with other donors. Feedback from Louise Fox is gratefully acknowledged. The note is based on the following report: Banerjee, S., Q. Wodon, A. Diallo, T. Pushak, H. Uddin, C. Tsimpo, and V. Foster, 2007, *Access, Affordability, and Alternatives: Modern Infrastructure Services in Africa*, Africa Infrastructure Country Diagnostic Study, World Bank: Washington, DC. This report is part of a larger effort to conduct analytical work on infrastructure led by Vivien Foster. On the impact of changes in household sizes on the demand for infrastructure, see Diallo, A. and Q. Wodon, 2007, Demographic Transition Towards Smaller Household Sizes and Basic Infrastructure Needs in Developing Countries, *Economics Bulletin*, 15(11): 1-11.