WPS4880

POLICY RESEARCH WORKING PAPER 4880

Trends in Household Coverage of Modern Infrastructure Services in Africa

Sudeshna Banerjee
Amadou Diallo
Vivien Foster
Quentin Wodon

The World Bank
Human Development Network
Development Dialogue on Values and Ethics Unit
&
Africa Region Vice Presidency
Sustainable Development Department
March 2009

Policy Research Working Paper 4880

Abstract

Household surveys have long been used to estimate poverty and inequality trends, as well as trends in education and health indicators, but they have not been used to the same extent to assess trends in the access to or coverage of modern infrastructure services. In this paper, we use Demographic and Health Surveys from a larger sample of sub-Saharan African countries in order to collect comparable information across countries on coverage of piped water, flush toilets, electricity, and landline telephones over time. The results suggest that coverage rates for electricity, flush toilets have improved slightly over the last decade. Coverage of piped water has declined, at the same time as coverage of landline (as well as cellular) telephone has increased rapidly. The decline has been primarily in the urban areas while the infrastructure coverage has either increased or remained stable in rural Africa. For all four services, among the poorest households coverage remains virtually inexistent. If business as usual continues, it would take a very long time to reach universal or widely shared coverage even in countries where coverage has improved. These results point to the need to increase efforts by governments and international community to progressively increase access to modern infrastructure services in Africa.

This paper—a product of the Development Dialogue on Values and Ethics in the Human Development Network and of the Sustainable Development Department in the Africa Region Vice Presidency—is part of a larger effort in the Network and Region to document the access to, and affordability of basic infrastructure services. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The corresponding author may be contacted at sbanerjee@worldbank.org.

Trends in Household Coverage of Modern Infrastructure Services in Africa[1]

Sudeshna Banerjee, Amadou Diallo, Vivien Foster, and Quentin Wodon

Keywords: infrastructure; electricity; water; Africa

JEL codes: O12, R21, R31

[1] This paper was prepared jointly for the Development Dialogue on Values and Ethics unit in the Human Development Network at the World Bank and for the Africa Infrastructure Country Diagnostic (AICD), a program of research to improve knowledge of infrastructure in Africa. The AICD is implemented by the World Bank on behalf of a Steering Committee representing the African Union, NEPAD, the Regional Economic Communities, the African Development Bank and major donors. For information on AICD, please refer to www.infrastructureafrica.org. The authors are grateful to Branko Milanovic, Tito Yepes, Siobhan Murray, Cecilia Briceno, Tarik Chfadi, Chris Rockmore, Rose Mungai, Zena Angesom for their guidance and support throughout the project.

1. Introduction

Policymakers around the world face the challenge of providing reliable and affordable infrastructure services to their people. The oft-quoted statistic is that one billion people do not have access to safe water, two billion people lack electricity and safe sanitation facilities and three billion have never used a telephone; a majority of these people reside in Sub-Saharan Africa or South Asia (Brook and Smith, 2001; Anand, 2006). The adoption of the Millennium Development Goals (hereafter MDGs) by the development community and a surge in academic literature reaffirming the role of infrastructure in development has brought infrastructure sharply into focus.

A strong network of public infrastructure is a precondition for national and regional economic growth and a channel through which private enterprise invests in developing countries. Infrastructure directly affects productivity and output by enlarging the size of product and labor markets (Prod'humme, 2004). Infrastructure supports pro-poor growth by enhancing overall expansion, removing barriers that hurt poor people, and encouraging poor people's participation in the growth process (OECD, 2006). In an analysis covering 100 countries to study the relationship between infrastructure development and growth and income distribution from 1960 to 2000, Calderon and Serven (2004) find that the infrastructure stock positively affects growth and that superior quality and quantity of infrastructure reduces income inequality (for a useful literature review on many of these issues, see Estache, 2004 as well as Estache and Wodon, forthcoming).

The private sector was expected to step in the early 1990s to help improve infrastructure when infrastructure gaps were acknowledged as a key constraint to meeting growth targets and achieving welfare improvements for the population of Africa. Between 1995 and 2005, the private sector invested almost $37 billion in infrastructure in Africa according to data from the Private Participation in Infrastructure Database at the World Bank). By contrast, the donor community retreated from infrastructure investments. In the late 1990s, infrastructure was considered a 'sunset' sector, with an all-time low of only 30 percent of total World Bank lending dedicated to infrastructure. Unfortunately, the private sector appetite for investments in Africa's infrastructure has been on the decline in recent years due to difficult political economy constraints for cost recovery and several failed and renegotiated infrastructure transactions. The MDGs and the renewed emphasis on the direct and indirect relationships between MDG targets

and infrastructure made investments in infrastructure a priority again for the donor community. This is resulting in renewed flows of official development assistance for infrastructure projects in sub-Saharan Africa to try to bring the continent at par with other regions of the world.

The rejuvenated emphasis on infrastructure in Africa is welcome, as today Africa is lagging behind in the coverage of network infrastructure services compared to all the other regions in the world. Most of the countries in Eastern Europe and Central Asia have almost universal access or coverage (we will use both terms without differentiating them in this paper[2]) so that the infrastructure policy debate revolves there around improving service quality. Latin America and the Middle East and North Africa are following closely behind. With respect to gross national income (GNI), Africa comes closest to South Asia (SA) among the regions of the world. Yet population growth and urbanization trends are highest in Africa, which results in faster rising infrastructure needs at the household level than in South Asia. Overall, Africa lags behind other regions in the provision of improved water and sanitation services. In case of fixed and mobile phone coverage, Africa is ahead of South Asia, a testimony to the explosion of cell phone networks, services and subscribers (Table 1).

While there is a renewed consensus towards providing more support for improving the coverage of modern infrastructure services in Africa, the capacity to monitor and evaluate the progress achieved or to be achieved remains limited. Our objective in this paper is to provide detailed evidence on the trends in household access to modern infrastructure services in sub-Saharan Africa. To this end, we rely on a large number of Demographic and Health Surveys because these surveys have very wide coverage (they are fielded in most countries at regular intervals of time) and they are also relatively comparable between countries and over time. In a few countries where there is no DHS or there is only one survey in the past 15 years, Multi-indicator cluster surveys (MICS) have been sparingly employed. MICS are the closest to DHS with respect to sample and questionnaire design.

How does our work compare with previous work? In general, water supply and sanitation (WSS) is the only sector whose evolution is directly monitored because of the target set forward in the MDGs to "*halve the number of people without access to safe drinking water*

[2] In other work, some of the authors of this paper have differentiated between access, to be understood as a household living in an area where access to a service is potentially available, and coverage, which represents the actual use by the household of the service (coverage thus represents the product of the access rate and the take-up rate for the service where access is available). In this paper, this distinction is not essential, hence we will use both terms of access and coverage interchangeably.

and basic sanitation by 2015". This explains why the World Health Organization and UNICEF have jointly sponsored the Joint Monitoring Program (JMP, 2006) on water supply and sanitation which systematically tracks access to improved water sources. There are however 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 directly on DHS data. Third, JMP statistics apply standardized parameters in order to be able to separate protected from unprotected wells/boreholes to estimate 'improved water', and to determine to what extent traditional pit latrines can be considered as 'improved sanitation'. Our analysis does not employ any parameters and reports only the statistics from the surveys.

Beyond water and sanitation, relatively little is known about the household coverage of other modern infrastructure services in Africa. Indeed, while use of household surveys as an instrument for analyzing poverty and inequality trends as well as changes in education and health indicators has been longstanding, household surveys have rarely been used to analyze trends in access to infrastructure services[3]. There is thus an important gap in the development literature here, especially given the fact that household surveys are the only quantitative instrument that can establish relationships between use of infrastructure services, socioeconomic variables and government subsidy policies (Lobo, Foster, and Halpern, 2000). In this paper, after providing a brief description of our data and methodology in Section 2, we provide in Section 3 both country-level and Africa-wide trends in access to electricity, water, sanitation, and landline telephones for the period 1990-2005. A brief conclusion follows.

2. Data and methodology

In order to document trends in access to modern infrastructure services, we constructed a cross-country database relying on Demographic and Health Surveys (DHS hereafter; the list of surveys is provided in Annex). DHS are nationally representative surveys conducted by MACRO International that collect comparable information across countries on health, HIV-

[3] Among previous work in this area, one should mention global infrastructure study by Komives, Whittington, and Wu (2003) which relied in surveys for 15 countries to present access trends and to evaluate the relationship between access to infrastructure and household income. For Africa, the reader is also referred to Estache and Wodon (2007) who present evidence on infrastructure and access and affordability trends for most countries in Africa.

AIDS, and nutrition, among others. These surveys are conducted every few years in a large number of countries, so that it is possible to track similar indicators over time. Out of the 30 countries in Africa that have at least one publicly available DHS survey conducted since 1990, 22 countries are covered by at least two DHS surveys data points between 1990 and 2005. A few other countries – Togo, Central African Republic, Comoros, Congo-Brazzaville, Gabon, and Lesotho only have one data point during the period. In countries such as the Democratic Republic of Congo (DRC), Lesotho, and Sudan where data is not available at all or only one data-point is available, Multi-indicator Cluster Surveys (MICS) has been used as a substitute (Annex 1). The resulting database is called AICD DHS/MICS Survey Database, 2007 and is referred to throughout this paper.

Based on a review of the DHS surveys implemented in Africa since 1990, analysis on the following sub-sectors is possible - water supply, sanitation, lighting and cooking fuels, rubbish disposal, and landline and cell phones. The DHS are undertaken in phases and there have been five phases since 1990. New questions are added in each phase and questions posed in each phase are relatively harmonized across surveys. Questions on water supply, sanitation, and cooking fuels are available since 1990 while some questions on electricity, rubbish disposal, and cell phones are more recent. Only five countries in the sample include questions on cell phone use, which makes it difficult to track improvements over time for cell phone use. The limited coverage of infrastructure modules in the DHS is not surprising as the objective of the surveys is to gather information on infrastructure that has direct relevance to health and nutrition – such as water, sanitation, and cooking fuel.

To conduct a distributional analysis of access, a household welfare measure to establish a correlation between access to infrastructure and well-being needs to be constructed. The DHS does not collect any income or expenditure information on households. Therefore, we construct instead an index of wealth or assets, which is known to be highly correlated to income and consumption in surveys where this information is available. The number of asset variables available for the construction of the asset index varies across countries and time periods. Thus, an asset index that would be completely consistent for all countries and years would lead to not using substantial data on wealth that is available for some countries, or some time periods only. This is why, following Diallo and Wodon (2007a), the asset index is constructed using principal components analysis based on the maximum amount of information available on assets for each

country at each point in time. Usually, these variables consist of housing attributes, infrastructure use, and a range of other assets owned by households[4]. The asset or wealth quintiles are created using this asset index.

The standard categories of the infrastructure variables are presented in Table 2. In addition to standard categories, additional categories can be used to follow water and sanitation indicators, for example by computing access to so-called improved or unimproved water sources, which is an indicator for the Millennium Development Goals. For example, 'access to safe drinking water' is defined as the 'percentage of the population using improved water sources' and is monitored by the JMP. The fact that infrastructure categories are added in the DHS and sometimes changed in each phase makes it difficult to track the same categories over time in some cases. Therefore, in addition to the improved and unimproved water and sanitation source categorization adopted in the JMP, we use also in this paper a categorization based on modern, intermediate and basic service options suggested by Komives et al. (1999) (Table 2).

It would be interesting to know whether the service received meets some quality standards. Unreliable and infrequent electricity provision costs households and businesses losses and may lead to a dependence on alternative and often more expensive sources of energy. Also, households may be receiving water for only two hours in a day even when they are connected with piped supply. The availability of this information has significant policy implications. In Eastern Europe and Central Asia, where there is universal access, household surveys report quality of service delivery in some countries. Unfortunately, this type of information is not available in the DHS or MICS surveys for Africa.

3. Access Trends

3.1. Country level estimates

Table 3 provides the estimates of access at the national level to piped water, flush toilets, electricity, and landline phones. Rather than detailing the findings for each country, it is easier to look at Figures 1 through 4 which provide the same information in terms as access rates at the

[4] In most countries, the asset index is based on the following variables: type of main floor, wall and/or roof material, radio, television, refrigerator, bicycle, car/motorcycle, livestock ownership, farmland/other land, number of persons sleeping per room, car/truck, telephone, type of cooking fuel, bed net for sleeping, access to electricity, source of drinking water, type of toilet facility, and time to get to closest water source. We recognize that including access to electricity as well as the type of water and sanitation facilities used creates an endogeneity issue since these are also the variables for which we are conducting a benefit incidence analysis, but the bias is likely to be small due to the fact that many other variables are included in the asset index.

national level for the latest survey available, as a function of the level of Gross National Income (GNI) per capita of the country (in thousand US$ of 2000). There is clearly a relationship between access rates and economic development. In poor countries such as Burkina Faso, Burundi, Chad, Ethiopia, Kenya, Madagascar, Malawi, Mozambique, Niger, Rwanda, Sierra Leone, Tanzania, and Uganda, more than 80 percent of the population does not use any modern infrastructure service. At the other extreme is high income and urbanized Gabon where only 16 percent of the households do not have any of the services. The two richest countries (South Africa and Gabon) have the highest access rates to piped water and electricity. South Africa also has the highest coverage rate for flush toilets and landline phones.

The simple univariate regressions in Figures 1 to 4 suggest that more than 50 percent of the variation in access rates is accounted for by the variation in GNI per capita. The regressions suggest that an increase in GNI per capita of one thousand dollars is associated with an increase in access rate at the national level of 15 percent for piped water, 11 percent for flush toilets, 18 percent for electricity, and a much lower 6 percent for landline phones (but this does not take into account the impact of income on the fast rising mobile phone sector). Still, while there is a strong correlation between GNI per capita and access rates, some countries are performing better than suggested by their level of economic development. For example, Lesotho, Namibia and Senegal perform well for landline phones, while Namibia, Senegal, and Zimbabwe do well for flush toilets. At the same time, some countries do not perform as well as expected. This is apparently the case among others for Lesotho and Cameroon for access to piped water, these two countries plus the Republic of Congo for access to flush toilet, Namibia and Lesotho again for electricity, and finally Cameroon and the Republic of Congo for landline phones. Of course, all these results should be interpreted as simple descriptive statistics, given that the relationship observed between economic development and access rates in figures 1 through 4 does not control for other potentially important determinants of access rates, such as the rate of urbanization, the population density per squared kilometer in the country, and the type of service provider or regulation system in place, among others.

In tables 4 and 6, access rates are provided for urban areas and rural areas. As expected, coverage in urban Africa fares better, especially in comparatively richer countries. Access rates are highest in capital and other major cities. By contrast, in most countries the rural population is almost completely left out of the modern infrastructure service coverage. The provision of

sewerage service lags behind other network services such as piped water and especially electricity. In Burkina Faso, Chad, Lesotho, Madagascar, Mauritania, Rwanda, and Uganda, less than two percent of the population use flush toilet to sewerage system or septic tanks to meet their sanitation needs. Except in Senegal, South Africa, Gabon, and Namibia, a negligible proportion of rural dwellers in Africa use modern sanitation services. Access to piped water is higher, especially in Gabon and South Africa, followed by Senegal and Zimbabwe, as mentioned earlier. In countries such as Benin, Cote d'Ivoire, Gabon, Kenya, Namibia, Senegal, South Africa, Togo and Zimbabwe, more than half of the urban population use piped supply to meet their drinking water needs. Yet within country, there are sharp differences. In Zimbabwe, the urban coverage rate is very high at 93 percent while the rural coverage rate is only four percent. Among rural households in Burkina Faso, Central African Republic (CAR), Chad, Ethiopia, Mozambique, Niger, Rwanda, Uganda and DRC, less than one percent of the population has access to piped water supply. Cote d'Ivoire, Cameroon, Gabon, Nigeria, Senegal, South Africa lead in the provision of electricity – more than 45 percent of their population have electricity connections. In these and a few other countries such as Ethiopia, Namibia, and Zimbabwe, more than three-fourths of the urban households use electricity in their homes.

The fact that a majority of Africans are left out of modern infrastructure service leads one to wonder if access has improved in Africa despite the impetus in the past decade to step up infrastructure investments and the focus on pro-poor service delivery. That is, has the infrastructure expansion policy resulted in more people being covered in this decade starting from a low base in the early 1990s? To answer this question at the country level, we plot in Figure 5 the access rates in 2001-2005 against the access rate in 1995-2000. The results suggest in a few countries, access has increased but that the increase has been lower than one would have hoped. In both rural and urban areas, evolution of access as expressed by the regression coefficient has been barely positive (i.e., the coefficient for the slopes of the regression lines is often not very different from unity, at least for water, sanitation, and electricity; the coefficients are higher for landline phones, but this is from a very low base in 1995). The intercept term is also important. One likely path for improvement over time would be rapid expansion in the countries where coverage was particularly low in the base year, with slower expansion in the countries where coverage was relatively high in the base year because further gains are more

difficult to achieve when coverage is already high[5]. In such a case, we would observe a slope coefficient below one together with a positive and potentially large intercept term, which is indeed what is often obtained in Figure 5, at least in urban areas where coverage is higher.

The capital and major cities have recorded impressive gains compared to small towns and rural areas in Africa. In Benin, Cameroon, Ethiopia, Gabon, Ghana, Guinea, Madagascar, Senegal, South Africa, and Zimbabwe, about three-fourths of the residents in capital and major cities have electricity. More than half of the population in cities of Ethiopia, Kenya and South Africa have landline telephones. In Benin, Senegal, Zimbabwe, and South Africa, more than 90 percent of city households are covered by piped water supply. More than three-quarters of the city dwellers in Senegal, South Africa and Zimbabwe depend on sewerage systems to meet their sanitation needs. Capital and major cities in Namibia are exceptional in the coverage of modern infrastructure services – 96 percent had piped water, 97 percent had flush toilets, and 88 percent of urban dwellers had electricity as of 1992 (Table 5).

There has been a revolution in the availability of communications services in Africa in the past decade. Governments have issued licenses for mobile operators and competition has spurred private investment and competition. Telecommunications, particularly mobile phones are now part of every-day life in most African countries. Although this is not discussed here, it can be shown using other data sources (household expenditure surveys rather than DHS) that mobile phone coverage is higher than landline use in all the countries for which information on both services is available. For instance, in the Democratic Republic of Congo, 11 percent of the population has cell phones compared to less than one percent of households using a landline. Given that households are using cell phones as substitutes to land lines and not as complements, households use either one of the two services and very few households use both.

In table 7, data are provided at the national level regarding within country coverage rates according to the quintile of wealth of the household. This is done for each country using the latest year of data available. Clearly, and as was to be expected, coverage is virtually inexistent among the very poor in most countries, and in quite a few countries, coverage is also low even in the top quintile. As richer households who do not yet have modern infrastructure services are likely to benefit the first from potential increases in access, this suggest that coverage among the poor will remain very low in most countries for quite some time.

[5] We are grateful to Ken Simler for drawing our attention to this aspect of coverage expansion.

3.2. Africa level estimates of trends in access

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. 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 provided in table 8 from 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 areas have either declined or remained stable and rural areas have not changed much or increased 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? While this may seem to be a misplaced question given the low coverage rates for many services in most countries, it helps in showing how slow progress will be if substantial investments are not made in order to improve coverage faster. The

predicted year of universal access is computed in a very simple way by taking into account the difference for each country and each service between the growth rate in coverage (in terms of number of connections made available) and the growth rate of the population over time. The average Africa-wide annual growth rates in coverage for the different services in the countries in the sample is 5 percent for electricity, 1.4 percent for piped water, 7 percent for flush toilet, and 12 percent for landline telephones during the period 1996-2005 (Table 9). Figures 6 to 8 provide data showing the share of countries with different levels of expansion rates for the various services at the national, as well as the urban and rural levels. 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 in coverage, while another third report only modest growth rates of 0-4 percent 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 percent per year. A significant minority of countries are expanding flush toilet service at a rate in excess of 12 percent 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 percent range. 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 percent 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 at 'business as usual' rates (Figure 9). The projections indicate that under 'business as usual' conditions fewer than 20 percent of countries would reach universal access for piped water by 2050, while fewer than 40 percent 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 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, 2007b).

4. Conclusion

This paper has provided a 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 declined slightly in 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 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 percent 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 would 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.

While the overall results are not encouraging, the wide diversity of performance across countries suggests that there are valuable lessons to be learned. These aggregate statistics conceal substantial variation in performance across countries. A significant number of countries have succeeded in expanding the population served with water, electricity and sanitation by an annual average of 5-10 percent, which is fast enough to make substantial coverage gains within a reasonable time frame. Further investigation is warranted to explain what determines the superior performance of these countries.

Moreover, the very positive experience of cellular telephony in the last decade highlights the possibility of making rapid progress under the right circumstances. Much of the explanation for the progress obtained with cellular telephony lies in factors that are unique to cellular technology, including the relatively low fixed investments, the novel and high value nature of the service, and the commercial innovation in terms of low entry charges and prepayment facilities. While not all of these things can be directly applied to other infrastructure services, they nonetheless provide pointers in terms of directions for change that could help to support faster coverage gains for other services. These include lowering capital costs, reducing up-front connection charges for households, and providing alternative and more flexible payment methods to the traditional ex-post monthly bill used for electricity and water.

The fact that a majority of Africa's population still relies on alternative service providers instead of using network-based services, or simply do without services altogether, also has implications. Although formal electricity and water service providers play an important role in urban areas – reaching about half the population with electricity and around three quarters with

a combination of private and public taps – overall they reach less than 25 percent of Africa's population. The remaining 75 percent of African households either makes do without safe water, sanitation and lighting or supply themselves from boreholes, traditional pit latrines and candles. Given the slow rates of coverage growth, this situation is likely to persist for some time to come. However, most policy efforts focus on improving the performance and expanding the ambit of the formal infrastructure providers. While this is necessary, it is also important to consider what measures, if any, could be taken to improve the lot of the large segment of the population that will not benefit any time soon from the expansion of modern infrastructure services. For example, "second best options" such as stand posts and improved latrines still have a long way to go in reaching a substantial share of the population. The coverage of "second best options" for water and sanitation is surprisingly low, and remains relatively skewed towards the upper income echelons. There is clearly substantial potential for these services to be expanded further.

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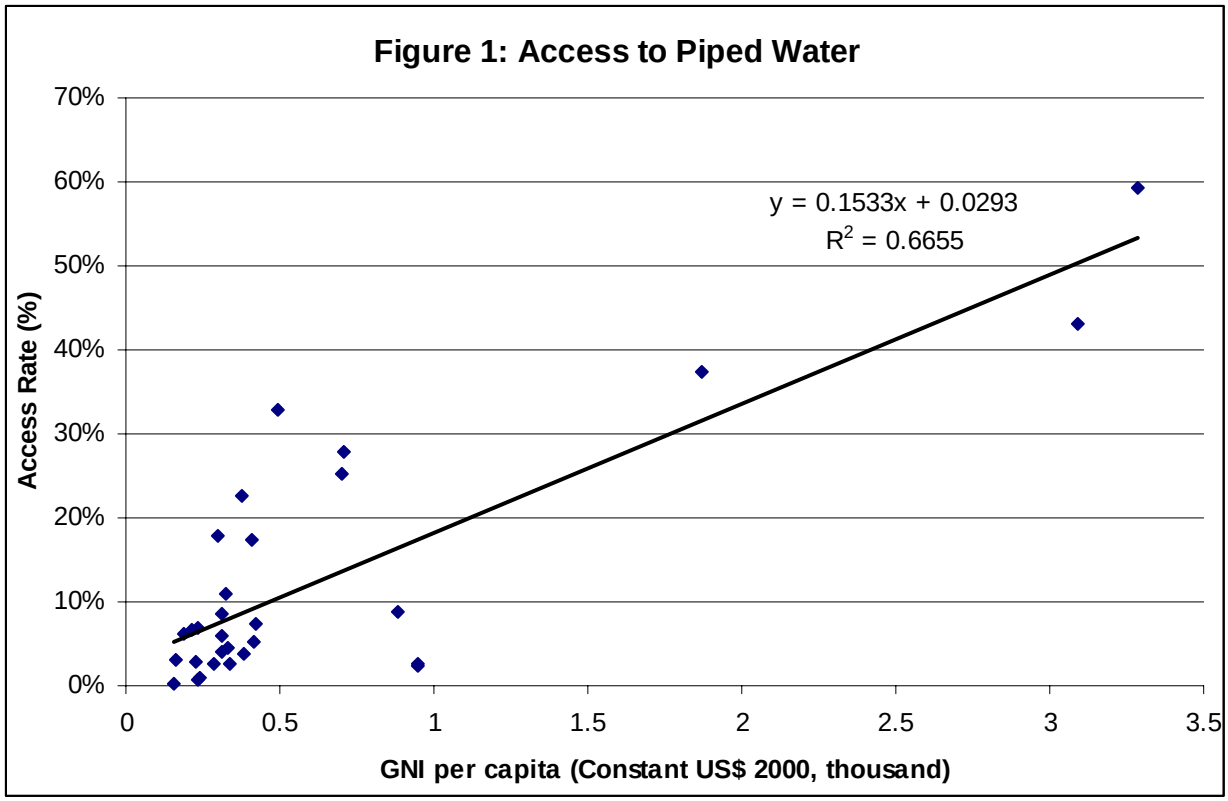
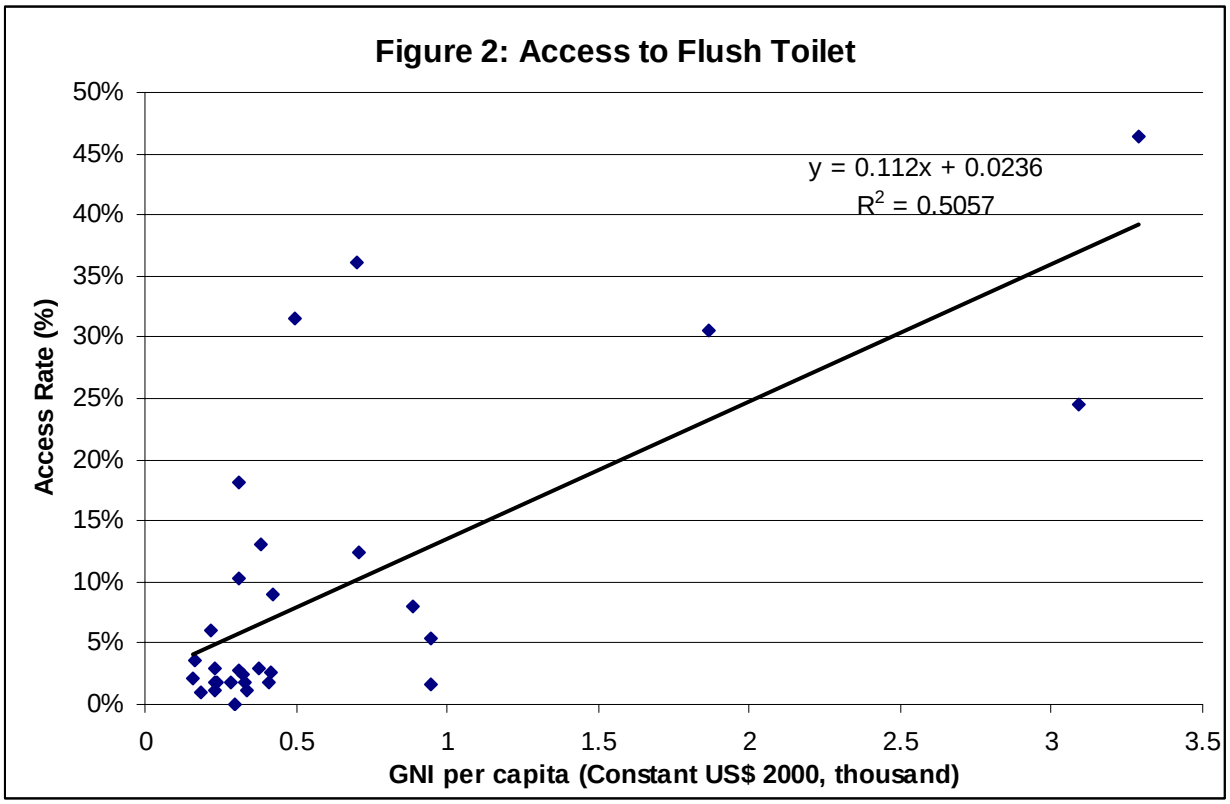
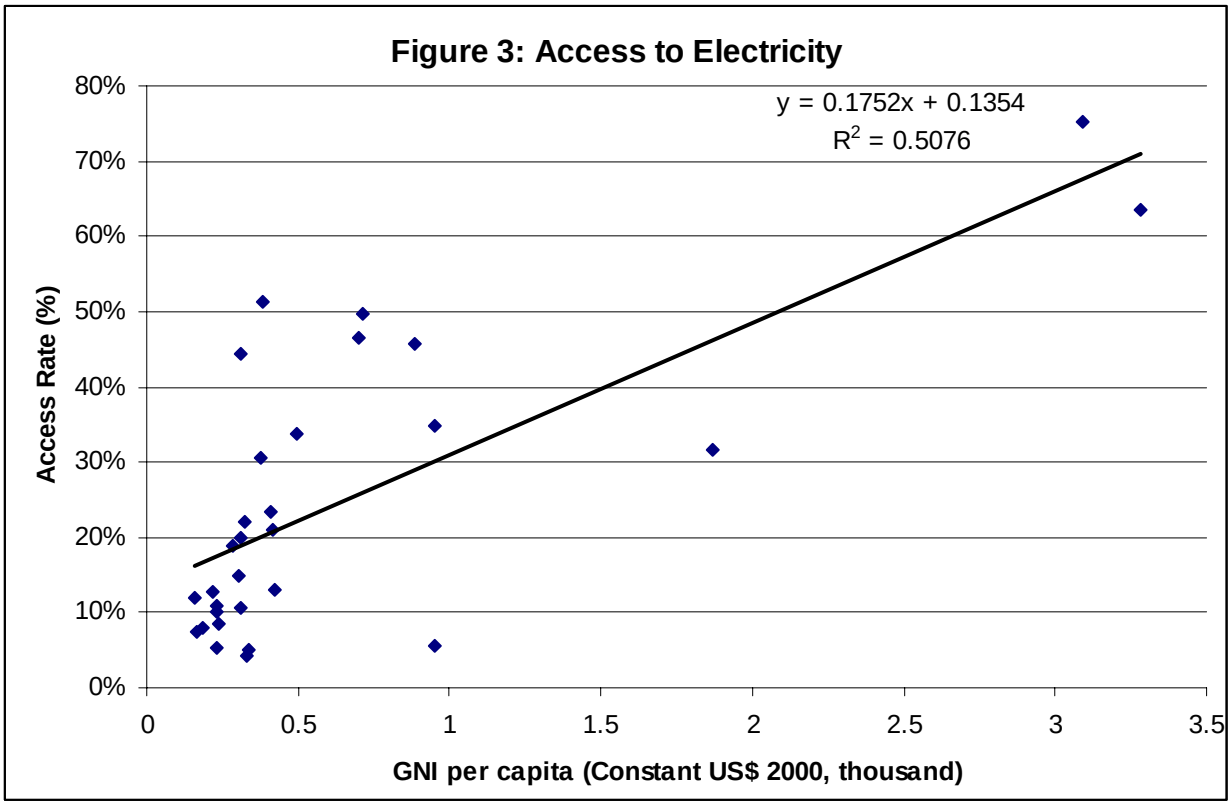


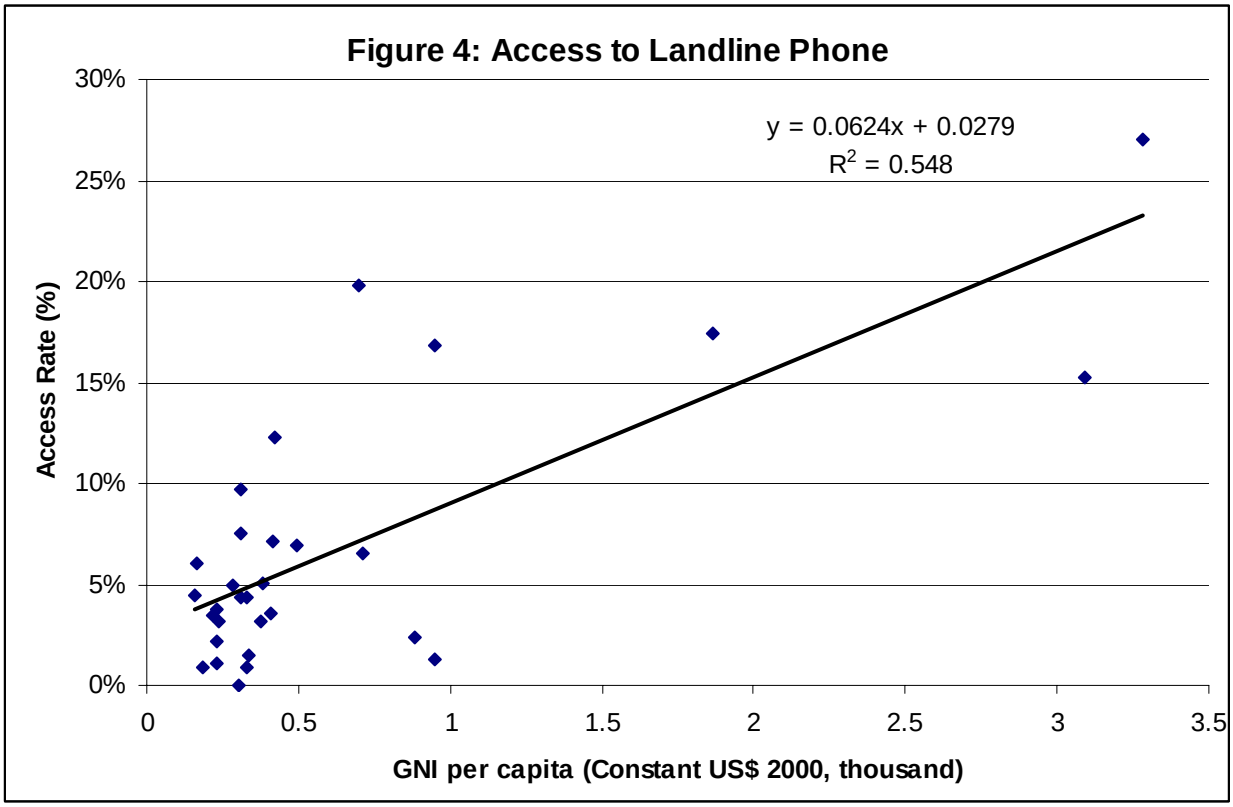
Source: Authors, using AICD DHS/MICS Survey Database, 2007.



Source: Authors, using AICD DHS/MICS Survey Database, 2007.



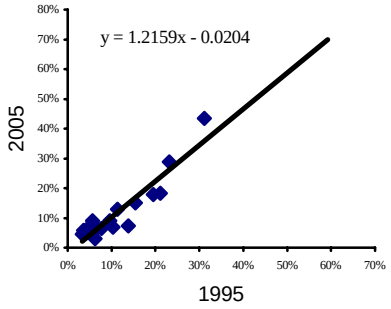
Source: Authors, using AICD DHS/MICS Survey Database, 2007.



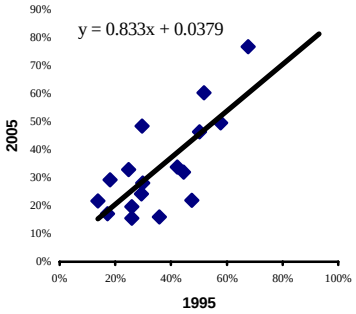
Source: Authors, using AICD DHS/MICS Survey Database, 2007.

Figure 5: Evolution of Access to Infrastructure Services 1990-2005

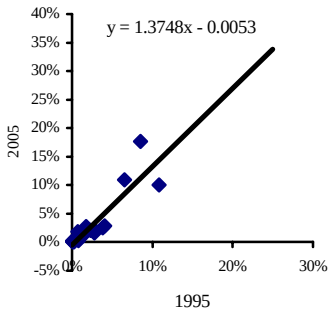
Piped Water Supply – National



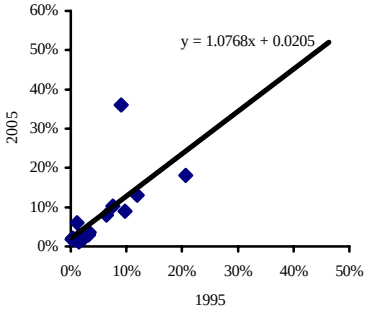
Piped Water Supply – Urban



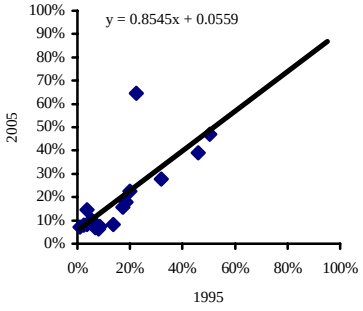
Piped Water Supply – Rural



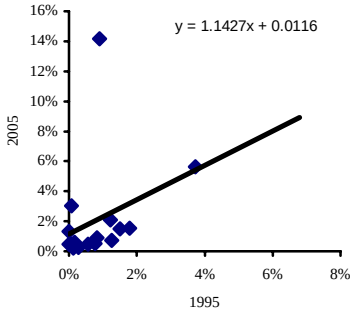
Flush Toilet – National



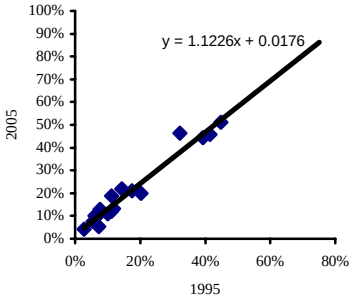
Flush Toilet – Urban



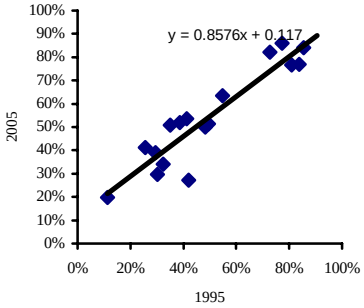
Flush Toilet – Rural



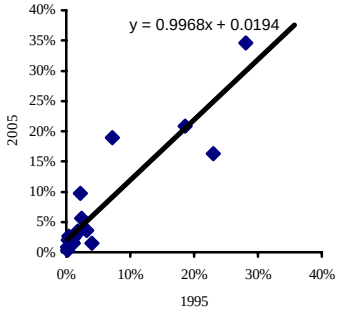
Electricity – National



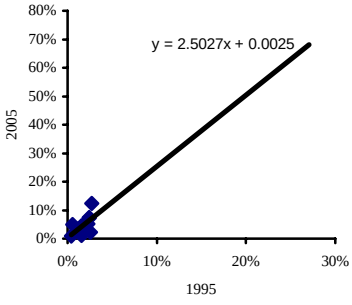
Electricity – Urban



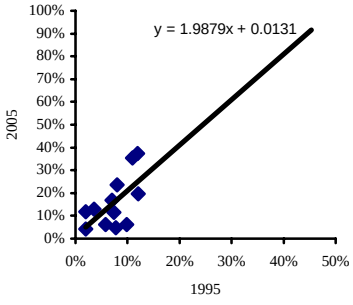
Electricity – Rural



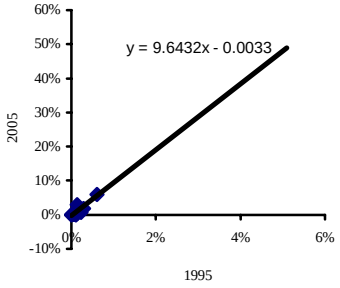
Landline – National



Landline – Urban



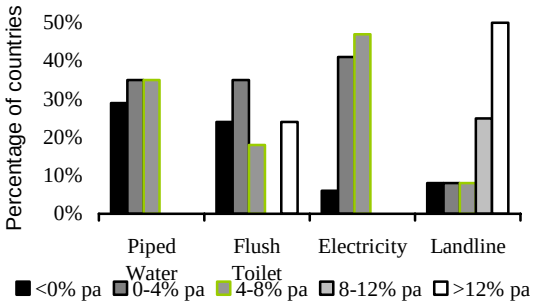
Landline – Rural



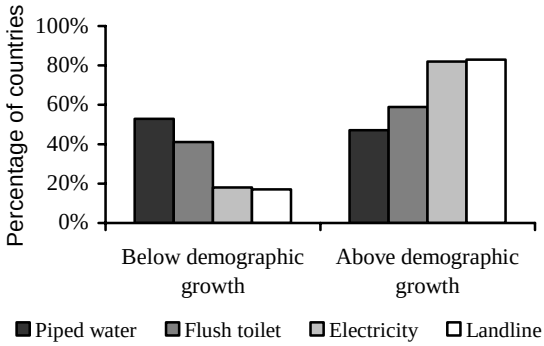
Source: Authors, using AICD DHS/MICS Survey Database, 2007.

Figure 6: Frequency distribution of average annual growth rates in service coverage

(a) Absolute average annual growth rate 1996/05

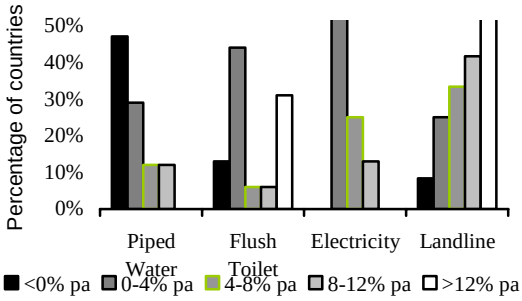


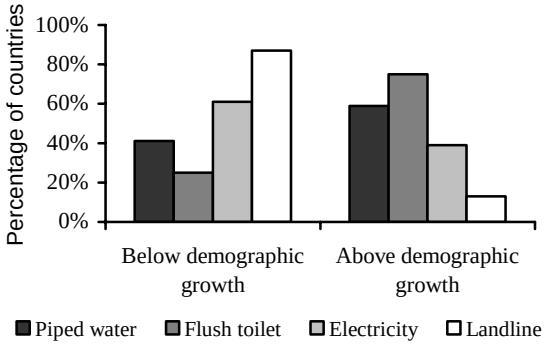
(b) Average annual growth rate relative to population growth



Source: Authors, using AICD DHS/MICS Survey Database, 2007.

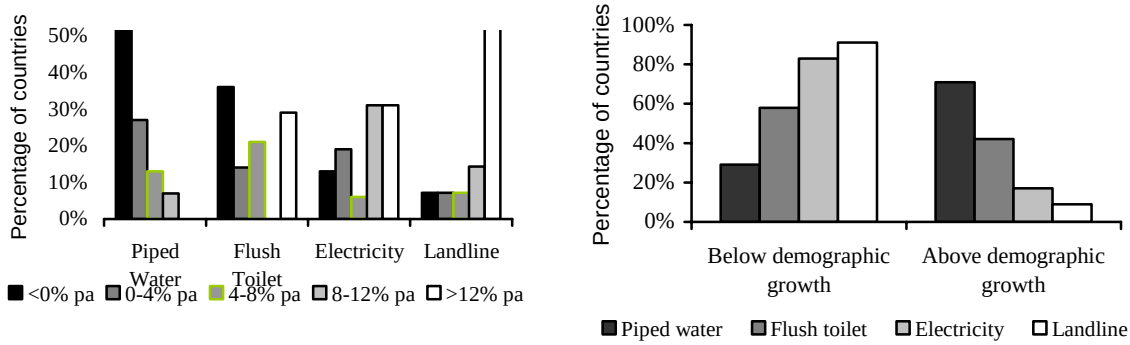
Figure 7: Frequency distribution of average annual growth rates in service coverage (urban)





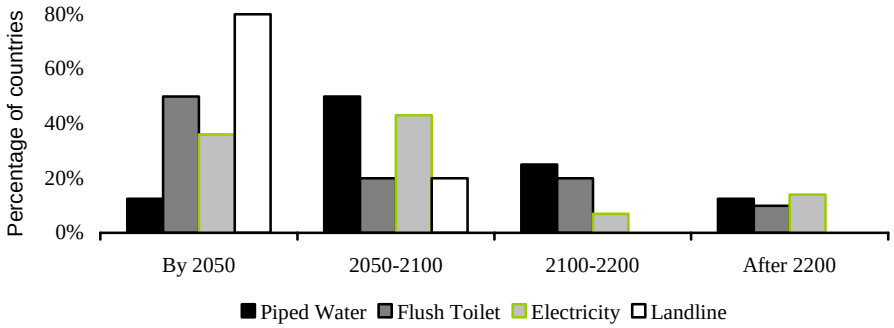
Source: Authors, using AICD DHS/MICS Survey Database, 2007.

Figure 8: Frequency distribution of average annual growth rates in service coverage (rural)



Source: Authors, using AICD DHS/MICS Survey Database, 2007.

Figure 9: Estimated year of universal coverage under business as usual



Source: Authors, using AICD DHS/MICS Survey Database, 2007.

Table 1: Access to Basic Infrastructure Services in Various regions of the World

Region	GNI (current US$) 2005	Fixed line and mobile phone subscribers (per 1,000 people), 2003	Improved water source (% of population with access) 2004	Improved sanitation facilities (% of population with access) 2004	Population growth (annual %), 2005	Urbanization growth (annual %), 2005
EAP	1627.0	349.35	78.54	50.65	0.82	3.1
ECA	4112.5	536.20	91.91	85.37	0.08	0.2
LAC	4007.7	400.45	90.98	77.17	1.35	1.9
SA	683.9	56.05	84.41	37.17	1.66	2.6
SSA	744.8	64.12	56.24	37.05	2.15	3.6
MENA	2241.4	204.02	89.49	76.16	2.00	2.5

Source: Authors, based on the World Bank's World Development Indicators (WDI).

Table 2: Standardized categories of infrastructure services

Main source of water supply	JMP category	AICD category	AICD category
Piped water into dwelling or yard	Improved	Improved	Modern
Public tap or communal standpipe	Improved	Improved	Intermediate
Wells or boreholes, hand pumps, or rainwater	Improved/Unimproved	Unimproved	Intermediate
Surface water (e.g. lake, river, pond, dam, spring)	Unimproved	Unimproved	Basic
Vendors or tanker trucks	Unimproved	Unimproved	Basic
Others (e.g., bottled water)	Unimproved	Unimproved	Basic
Main source of lighting/cooking			
Electricity			Modern
LPG or natural gas			Modern
Kerosene or paraffin or petrol or oil			Intermediate
Wood or charcoal			Basic
Crop residue or animal dung or leaves			Basic
Other			Basic
Toilet facility			
Flush toilet to network or septic tank	Improved	Improved	Modern
VIP latrine, San Plat, or chemical toilet	Improved	Improved	Intermediate
Traditional pit latrine	Improved/Unimproved	Unimproved	Intermediate
Bucket or other container	Unimproved	Unimproved	Basic
Other	Unimproved	Unimproved	Basic
No facility, nature, or bush	Unimproved	Unimproved	Basic

Source: JMP 2006 and authors.

Table 3: Evolution of access to network infrastructure, national level (%)

	Piped Water			Flush Toilet			Electricity			Landli
Country	1990-95	1996-00	2001-05	1990-95	1996-00	2001-05	1990-95	1996-00	2001-05	1990-95
Benin		23.15	28.74			2.39		14.39	21.96	
Burkina Faso	5.64	3.62	5.89	0.89	0.58	1.86	6.23	6.06	10.16	
CAR	2.65			1.11			5.04		.	1.49
Cameroon	12.07	11.34	12.95	6.56	6.41	8.07	31.28	41.52	45.76	
Chad		3.36	4.45		0.24	1.83		2.76	4.33	
Comoros		22.67			2.93	.		30.47		
Congo (Brazza)			25.81			5.33			34.86	
Cote d'Ivoire	23.98	27.93		14.03	12.45		38.59	49.74		
Ethiopia		4.21	5.98		0.34	2.13		11.28	12.04	
Gabon		43.03			24.50			75.18		
Ghana	13.65	15.38	15.08	5.94	7.57	10.28	27.85	39.36	44.26	
Guinea		9.62	9.13	.	2.65	2.62		17.41	20.93	
Kenya	16.04	19.54	17.94	7.99	9.75	8.97	8.81	11.79	13.10	
Lesotho		11.03	10.74			1.61			5.70	
Madagascar	5.29	5.90	5.30	2.54	2.26	1.88	9.24	11.13	18.82	
Malawi	6.11	7.74	6.49	2.62	3.30	3.58	3.69	5.59	7.48	
Mali		5.66	9.06		1.12	6.05		7.63	12.84	
Mauritania			17.41			1.77			23.36	
Mozambique		6.55	6.86		3.22	2.88		10.00	11.02	
Namibia	30.53	37.29		26.65	30.56		20.31	31.68		
Niger	5.39	6.09		1.25	1.05		5.67	7.90		
Nigeria	10.58	10.28	6.88	8.46	11.90	13.12	26.08	44.85	51.26	
Rwanda	1.77	6.28	2.95	1.05	1.47	1.16	2.35	7.35	5.42	
Senegal	26.60	31.10	43.36	10.62	9.07	36.04	25.29	32.18	46.41	
South Africa		59.18			46.37			63.42		
Tanzania	10.23	13.78	7.36	1.41	1.66	2.75	6.36	7.27	10.57	
Togo		17.75						14.91		
Uganda	1.80		1.99	1.59		1.73	6.95		8.41	0.59
Zambia	31.41	21.03	18.32	27.13	20.69	18.09	23.25	20.28	20.07	
Zimbabwe	26.68	32.75		26.25	31.45		23.28	33.86		
DRC	21.00		15.03	2		1				
Sudan		21.12			6					

Source: Authors, using AICD DHS/MICS Survey Database, 2007.

Table 4: Evolution of access to network infrastructure, urban areas (%)

	Piped Water			Flush Toilet			Electricity			Landline Telephone		
Country	1990-95	1996-00	2001-05	1990-95	1996-00	2001-05	1990-95	1996-00	2001-05	1990-95	1996-00	2001-05
Benin		51.75	60.37			6.00		34.95	50.95			10.32
Burkina Faso	27.56	24.88	32.98	5.04	3.77	8.22	32.51	41.20	53.51		12.03	19.80
CAR	0.00			2.48			11.16			3.42		
Cameroon	27.94	29.40	24.23	15.75	17.32	15.76	65.53	80.82	76.67		7.72	4.75
Chad		13.76	21.71		1.02	7.13		11.29	19.90		1.93	4.27
Comoros		42.52			7.55			54.38			9.33	
Congo (Brazza)			46.21			9.78			51.35			2.20
Cote d'Ivoire	55.38	64.58		33.69	30.07		75.28	89.71			14.66	
Ethiopia		29.57	48.45		2.41	7.99		77.31	85.89		10.94	35.35
Gabon		55.06			31.56			90.57			20.00	
Ghana	38.43	42.30	33.91	16.51	19.90	22.56	74.76	83.78	77.00		7.04	16.99
Guinea		29.77	28.06		8.60	7.51		54.92	63.49		7.96	23.66
Kenya	58.24	57.85	49.67	50.97	46.07	39.06	47.70	49.60	51.41		11.96	37.44
Lesotho		39.44	50.44		7.37	8.34			28.06			45.84
Madagascar	28.85	17.11	17.20	15.08	6.80	6.89	47.29	38.55	51.98		1.96	11.88
Malawi	37.05	44.53	32.04	16.98	18.50	17.87	22.81	32.26	34.05			26.66
Mali		18.03	29.25		3.74	14.56		25.57	41.28		3.58	12.84
Mauritania			27.51			4.06			50.72			7.98
Mozambique		25.92	19.72		13.60	8.12		30.27	29.78		5.79	6.12
Namibia	84.08	79.30		83.04	78.54		63.09	74.60			43.52	
Niger	27.57	31.29		6.90	4.58		32.03	40.52			4.87	
Nigeria	33.52	25.97	15.49	29.47	31.81	27.80	81.89	85.42	84.00		7.32	11.65
Rwanda	28.04	35.71	15.97	14.21	8.05	6.27	32.14	42.10	27.18	.	9.87	6.06
Senegal	56.90	67.66	76.76	25.25	22.30	64.51	63.49	72.66	82.05			35.94
South Africa		87.72			80.21			86.47			45.39	
Tanzania	38.35	47.40	21.87	4.58	5.47	10.12	23.04	29.35	38.90			31.37
Togo		51.30						44.45				
Uganda	14.10		14.39	11.22		10.67	44.50		47.48	3.66		18.49
Zambia	61.54	50.30	46.43	54.30	50.29	46.92	44.50	48.41	49.99			11.16
Zimbabwe	93.33	93.04		95.46	95.12		82.85	90.08			19.32	
DRC	61.57		40.45	4.26		3.83						
Sudan		37.44			14.02							

Source: Authors, using AICD DHS/MICS Survey Database, 2007.

Table 5: Evolution of access to network infrastructure, capital cities (%)

	Piped Water			Flush Toilet			Electricity			Landline	
Country	1990-95	1996-00	2001-05	1990-95	1996-00	2001-05	1990-95	1996-00	2001-05	1990-95	199
Benin		96.35	99.85			12.43		60.00	77.56		
Burkina Faso	30.14	28.37	36.06	6.13	6.62	14.39	34.39	42.51	56.93		1
CAR	10.48			4.73			18.12			6.55	
Cameroon	38.21	36.46	30.82	23.90	26.34	25.87	88.13	96.21	97.00		1
Chad		24.99	31.04		2.30	12.29		21.30	34.90		4
Comoros		26.28			14.30			61.28			1
Congo (Brazza)			49.83			10.33			59.21		
Cote d'Ivoire	70.62	77.82		48.07	41.75		79.32	94.52			1
Ethiopia		63.11	70.17		5.27	11.20		97.50	97.19		2
Gabon		62.20			35.96			94.61			2
Ghana	60.48	65.04		27.54	35.21		89.64	94.43			1
Guinea		40.47	46.99		12.78	12.24		73.80	95.43		1
Kenya	58.24	68.18	64.37	50.30	53.98	57.46	50.86	62.25	69.36		1
Lesotho											
Madagascar	34.75	30.50	26.20	23.13	19.06	15.02	62.52	72.92	82.96		5
Malawi	44.10	44.52	31.39	18.20	17.98	20.00	22.48	34.29	34.73		
Mali		19.43	41.62		5.06	22.75		39.29	59.35		5
Mauritania			27.36			4.90			48.38		
Mozambique		25.93	41.16		13.61	17.82		30.26	55.84		5
Namibia	95.85			97.15			88.46				
Niger	33.80	34.63		7.42	4.94		42.63	53.12			6
Nigeria	20.14	32.53	20.82	51.98	49.07	34.99	98.60	96.25	95.89		1
Rwanda	30.66	37.04	23.47	13.33	6.24	9.94	37.68	47.46	43.93		1
Senegal	64.77	81.17	90.62	33.93	36.05	75.47	74.55	80.48	90.95		
South Africa		89.75			86.83			89.20			5
Tanzania	77.30	78.97	18.74	3.94	4.33	11.19	32.02	49.61	51.64		
Togo		67.85						55.66			
Uganda	14.89		18.13	11.78		13.47	55.19		59.67	4.90	
Zambia	60.69	51.15	27.28	41.82	43.75	20.53	39.22	54.66	47.28		
Zimbabwe	94.76	93.42		96.39	92.45		77.15	84.55			2

Source: Authors, using AICD DHS/MICS Survey Database, 2007.

Table 6: Evolution of access to network infrastructure, rural areas (%)

	Piped Water			Flush Toilet			Electricity			Landline Telepl	
Country	1990-95	1996-00	2001-05	1990-95	1996-00	2001-05	1990-95	1996-00	2001-05	1990-95	1996-00
Benin		6.50	10.91			0.35		2.41	5.61		
Burkina Faso	0.96	0.09	0.06	0.00	0.05	0.49	0.62	0.23	0.83		0.09
CAR	0.00			0.11			0.52			0.06	
Cameroon	1.99	2.81	2.20	0.73	1.27	0.73	9.52	22.96	16.27		0.11
Chad		0.22	0.00		0.00	0.46		0.18	0.32		0.00
Comoros		15.06			1.16			21.36			0.87
Congo (Brazza)			2.99			0.35			16.40		
Cote d'Ivoire	5.13	6.73		2.23	2.26		16.49	26.63			1.89
Ethiopia		0.01	0.21		0.00	1.34		0.32	1.98		0.01
Gabon		8.84			4.45			31.37			1.78
Ghana	1.81	2.77	1.66	0.89	1.79	1.52	5.42	18.57	20.88		0.22
Guinea		1.24	1.22		0.17	0.58		1.79	3.19		0.14
Kenya	9.47	10.84	10.04	1.31	1.51	1.48	2.76	3.20	3.56		0.60
Lesotho		1.96	2.13			0.15			0.84		
Madagascar	0.84	2.27	2.03	0.17	0.78	0.50	2.05	2.23	9.71		0.13
Malawi	1.78	1.73	1.68	0.61	0.82	0.89	1.02	1.23	2.48		
Mali		0.69	1.86		0.07	3.01		0.41	2.65		0.05
Mauritania			9.84			0.05			2.73		
Mozambique		0.81	0.33		0.14	0.21		3.98	1.49		0.03
Namibia	8.02	16.48		2.95	6.80		2.35	10.39			4.47
Niger	0.83	0.20		0.09	0.23		0.26	0.26			0.00
Nigeria	3.49	3.84	2.49	1.97	3.72	5.65	8.81	28.08	34.58		0.28
Rwanda	0.31	0.98	0.59	0.32	0.29	0.24	0.68	1.08	1.49	.	0.07
Senegal	8.54	8.50	17.68	1.90	0.90	14.15	2.52	7.18	18.97		
South Africa		24.99			5.84			35.74			5.10
Tanzania	2.36	4.09	2.86	0.52	0.56	0.47	1.69	0.89	1.76		
Togo		3.11						2.00			
Uganda	0.14		0.15	0.29		0.40	1.87		2.59	0.18	
Zambia	3.45	1.78	2.73	1.93	1.23	2.11	3.45	1.76	3.46		
Zimbabwe	3.24	4.43		1.91	1.54		2.36	7.40			1.10
DRC	0.10		0.35	0.17		0.02					
Sudan		9.73			1.12						

Source: Authors, using AICD DHS/MICS Survey Database, 2007.

Table 7: Access to Infrastructure Services by Quintile of Wealth, National level and latest year (%)

		Piped Water Supply		Flush to sewerage or septic tank		Electricity		Landline	
	Year	Quintile 1	Quintile 5	Quintile 1	Quintile 5	Quintile 1	Quintile 5	Quintile 1	Quintile 5
Benin	2001	0	89	0	11	0	82	0	18
Burkina Faso	2003	0	34	0	9	0	57	0	21
CAR	1995	0	13	0	5	0	25	0	7
Cameroon	2004	0	49	0	38	1	98	0	10
Chad	2004	0	22	0	8	0	21	0	4
Comoros	1996	0	46	0	14	4	84	0	15
Congo (Brazza)	2005	0	90	0	24	5	88	0	4
Cote d'Ivoire	1999	0	98	0	60	4	100	0	32
Ethiopia	2005	0	30	0	6	0	56	0	22
Gabon	2000	0	100	0	95	17	99	0	48
Ghana	2003	1	60	0	43	8	90	0	31
Guinea	2005	0	44	0	12	0	83	0	32
Kenya	2003	0	62	0	43	0	57	0	49
Lesotho	2005	0	50	0	8	0	27	0	57
Madagascar	2004	0	24	0	8	0	82	0	23
Malawi	2004	0	30	0	16	0	34	0	27
Mali	2001	0	38	0	18	1	54	0	17
Mauritania	2001	0	57	0	8	0	81	0	16
Mozambique	2003	0	34	0	14	0	51	0	11
Namibia	2000	0	100	0	99	1	100	0	70
Niger	1998	0	26	0	3	0	36	0	4
Nigeria	2003	0	18	0	54	10	91	0	21
Rwanda	2005	0	13	0	5	0	25	0	5
Senegal	2005	1	96	1	78	4	94	0	51
South Africa	1998	3	100	0	100	10	100	0	84
Tanzania	2004	0	30	0	13	0	50	0	42
Togo	1998	1	100	0	0	0	62		
Uganda	2001	0	10	0	7	0	38	0	15
Zambia	2002	0	77	0	76	0	84	0	17
Zimbabwe	1999	0	100	0	99	0	97	0	23
DRC	2001	0	59	0	6				
Sudan	2000	0	77	0	31				

Source: Authors, using AICD DHS/MICS Survey Database, 2007

Table 8: Trends in access to basic infrastructure services in Africa 1990–2005 (%)

	Piped Water			Electricity			Flush Toilet			Landline		
	1990-95	1996-2000	2000-2005	1990-95	1996-2000	2000-2005	1990-95	1996-2000	2000-2005	1990-95	1996-2000	
National												
Method 1	12	13	10	19	29	34	7	8	10	5	4	
Method 2	18	17	16	23	28	31	9	9	10	6	5	
Method 3	18	17	17	23	28	31	9	9	10			
Urban												
Method 1	38	34	25	67	72	72	26	27	26	0	6	
Method 2	50	43	37	72	73	71	35	32	30	18	16	
Method 3	50	43	39	72	73	71	32	29	27			
Rural												
Method 1	4	4	4	5	13	16	1	2	3	0	0	
Method 2	4	4	4	6	10	13	1	1	2	1	1	
Method 3	4	4	4	6	10	13	1	1	2			
Q1												
Method 1	0	0	0	0	1	5	0	0	0	0	0	
Method 2	0	0	0	1	2	4	0	0	0	0	0	
Method 3	0	0	0	1	2	4	0	0	0			
Q2												
Method 1	1	2	1	2	8	19	0	0	1	0	0	
Method 2	3	3	3	6	8	35	0	1	1	0	0	
Method 3	3	3	4	6	8	35	0	1	1			
Q3												
Method 1	3	3	4	6	20	22	2	1	2	0	0	
Method 2	8	7	18	12	19	25	4	3	11	2	1	
Method 3	8	7	18	12	19	25	4	3	12			
Q4												
Method 1	14	12	13	24	41	45	7	5	7	0	0	
Method 2	33	19	20	27	37	40	14	10	15	7	6	
Method 3	33	19	21	27	37	41	14	10	16			
Q5												
Method 1	42	46	35	63	73	77	27	36	41	0	0	
Method 2	53	51	47	69	73	74	29	32	35	20	20	
Method 3	53	51	52	69	73	74	29	32	35			

Source: Authors, using AICD DHS/MICS Survey Database, 2007

Table 9: Annual population growth rates and growth in access rates (%)

	Population	Piped Water	Flush Toilet	Electricity	Landline
Benin	1.73	4.21		6.62	
Burkina Faso	1.70	7.35	15.71	7.70	10.30
CAR	0.87				
Cameroon	1.12	2.62	3.73	2.22	0.12
Chad	1.89	5.12	27.86	7.10	9.79
Comoros	1.18				
Congo (Brazza)	1.76				
Cote d'Ivoire	1.08				
Ethiopia	1.26	5.28	24.05	1.99	13.62
Gabon	1.12				
Ghana	1.22	1.01	4.72	2.55	14.92
Guinea	1.20	0.62	1.10	3.29	14.16
Kenya	1.24	0.29	0.31	2.43	19.80
Lesotho	0.28	-0.01	-2.67	18.07	
Madagascar	1.61	0.39	-0.45	7.71	28.90
Malawi	1.38	-0.58	2.30	4.72	
Mali	1.63	7.07	22.52	7.68	15.95
Mauritania	1.64				
Mozambique	1.19	1.71	-0.08	2.28	6.45
Namibia	1.07				
Niger	1.92				
Nigeria	1.30	-3.13	2.40	2.82	10.54
Rwanda	2.75	-5.53	0.06	-0.66	-1.43
Senegal	1.36	5.18	18.15	5.57	
South Africa	0.87				
Tanzania	1.16	-5.65	6.99	5.44	
Togo	1.71				
Uganda	1.82				
Zambia	1.07	-0.47	-0.42	0.96	
Zimbabwe	0.48				
DRC	1.37				
Sudan	1.14				
Average	1.35	1.42	7.43	4.92	11.93

Source: Authors, using AICD DHS/MICS Survey Database, 2007

Annex 1: List of DHS and MICS Surveys

	Country	DHS Surveys	MICS Surveys
1	Angola		
2	Benin	1996, 2001	
3	Burkina Faso	1993, 1999, 2003	
4	Burundi		
5	Central African Republic	1995	
6	Cameroon	1991, 1998, 2004	
7	Cape Verde		
8	Chad	1997, 2004	
9	Comoros	1996	
10	Congo, Rep.	2005	
11	Cote d'Ivoire	1994, 1999	
12	Congo, DRC		1995,2001
13	Ethiopia	2000, 2005	
14	Gabon	2000	
15	Ghana	1993, 1998, 2003	
16	Guinea	1999, 2005	
17	Guinea-Bissau		
18	Kenya	1993, 1998, 2003	
19	Lesotho	2005	2000
20	Madagascar	1992, 1997, 2004	
21	Malawi	1992, 2000, 2004	
22	Mali	1996, 2001	
23	Mauritania	2001	
24	Morocco		
25	Mozambique	1997, 2003	
26	Namibia	1992, 2000	
27	Niger	1992, 1998	
28	Nigeria	1990, 1999, 2003	
29	Rwanda	1992, 2000, 2005	
30	Sao Tome and Principe		
31	Senegal	1993, 1997, 2005	
32	Sierra Leone		
33	South Africa	1998	
34	Sudan		2000
35	Tanzania	1992, 1999, 2004	
36	Togo	1998	
37	Uganda	1995, 2001	
38	Zambia	1992, 1996, 2002	
39	Zimbabwe	1994, 1999	
	Total	**63**	**4**

Source: AICD DHS/MICS Survey Database, 2007.