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An Assessment of Progress With Respect to Water and Sanitation: Legacy, Synergy, Complacency or Policy?

P.B. Anand

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Abstract

Access to water and sanitation (target 10) is an important ingredient of quality of life. As per WHO-UNICEF assessments, globally, 77 per cent of population had access to water in 1990. This proportion has increased to 83 per cent in 2002, thus, on track to achieve the target of halving the proportion of population without safe access by 2015. However, there is considerable regional disparity in progress which remains significantly low in many countries in sub-Saharan Africa. Also, the question remains whether increased access is same as sustainable access. In 2002, some 2.6 billion people worldwide did not have access to safe sanitation options. Of these, nearly 2 billion were in the rural areas. While in almost all countries, the proportion of people having access to improved sanitation in 2002 has increased compared to the status in 1990, in 27 countries including India, Nepal, Lao PDR, Namibia, Ethiopia, Eritrea, and Yemen, two out of three people did not have access to improved sanitation in 2002.

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Keywords: MDGs, water, sanitation, access

JEL classification: C25, D12, L95, Q25, R22

* Bradford Centre for International Development, University of Bradford

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While the WHO-UNICEF interim assessment and Millennium Task Force reports also assessed progress with access to water and sanitation, this paper differs from those estimates in a crucial manner. Here, cross-country regression analysis is used to develop models which are then used to forecast the projected proportion of population with access to water and sanitation in 2015 based on current variables. This paper also revisits the relationship between per capita GDP and access to water and sanitation. Further, an attempt is made to explore whether the synergy effect is significant, i.e., are countries that have made a significant progress with one target more likely to make a significant progress with other related targets; and whether and to what extent the achievement or lack of progress on these two targets can impinge on performance in relation to other MDGs or targets.

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UNU World Institute for Development Economics Research (UNU-WIDER)

Katajanokanlaituri 6 B, 00160 Helsinki, Finland

Camera-ready typescript prepared by Lorraine Telfer-Taivainen at UNU-WIDER

1 Introduction

Millennium Development Goal 7 (MDG7) focuses on ensuring environmental sustainability. There are serious concerns whether countries which have made significant progress with regard to other MDGs may have made little progress with regard to sustainability issues, especially in relation to forest cover, biodiversity, and global climate change issues. Access to water and sanitation[1] (MDG target 10) is an important ingredient of quality of life and is also crucial to other MDGs, including reducing poverty and infant mortality, improving maternal health, gender equality, and educational opportunities for girls.

As per the WHO-UNICEF (2004) assessment, globally, compared to some 77 per cent of the population in 1990, about 83 per cent is estimated to have access to 'improved' sources of water in 2002.[2] Thus, on track to achieve the target of halving the proportion without safe access by 2015. Much of this increase is attributed to increased access in southern and East Asia. Coverage remains significantly low in much of sub-Saharan Africa though there has been significant progress in a small number of countries. So, while globally the target may have been achieved there will remain significant regional disparities. Also, the question remains whether the increased access is the same as sustainable access. For instance, in many cities in southern Asia, a significant proportion of population now depend on 'unimproved sources' such as tanker trucks for water supply. The groundwater resources are being depleted at significant rates raising the question whether the supplies can be sustained even until 2015. Pressures on contested water resources are testing the fragile nature of water entitlements and property rights institutions, triggering interstate, intersectoral, and community-level conflicts.

It is highly unlikely that the development target of halving the proportion of people not having access to adequate sanitation will be achieved. In 2002, some 2.6 billion people worldwide did not have access to safe sanitation options. Of these, nearly 2 billion were in rural areas. While in almost all countries, the proportion of people having access to improved sanitation in 2002 has increased compared to the status in 1990, in 27 countries including India, Nepal, Laos PDR, Namibia, Ethiopia, Eritrea, and Yemen, two out of three people did not have access to improved sanitation in 2002. On the other hand, significant progress seems to have been made between 1990 and 2002 in countries like Paraguay, Senegal, Pakistan, and Sri Lanka.

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[1] In the Millennium Declaration adapted by the UN General Assembly in 2000, only the target of halving the proportion of people without sustainable access to safe drinking water was included. Based on the recommendation of the Bonn Conference in 2002, a corresponding target to halve the proportion of people without access to improved sanitation was included and adopted at the World Summit for Sustainable Development in Johannesberg, 2002.

[2] The WHO-UNICEF joint monitoring programme adopted a definition of 'improved' source to mean water supply from household connection, public standpipe, borehole, protected well, protected spring, and rainwater collection. Sources of water such as unprotected wells, unprotected springs, vendor-provided water, bottled water, and water provided from tanker trucks, are considered as 'not improved' sources. Access is defined as having the availability of water from improved sources to the extent of 20 l per capita per day within a distance of 1,000 m from the user's dwelling.

There have been some previous assessments of progress with regard to MDG7 in general, and water and sanitation sectors in particular. The most notable study is that of the UN Millennium Project Task Force on Water and Sanitation (UNDP 2005). In that study, a number of issues related to water and sanitation sectors were examined and ten main recommendations made. These include the need to put water and sanitation firmly on the development agenda, the need to develop and strengthen various institutional mechanism including for state, NGO and private sectors, the need to pursue a policy of recovering the cost of operations, maintenance and investment based on users' willingness to pay while ensuring that the poor have access to the services and so on. While that study emphasises the urgency to act, it however did not examine systematically the progress made so far in order to identify patterns in terms of whether progress where it has been made is associated with other development and governance indicators. An interim assessment by WHO-UNICEF (2004) Joint Monitoring Programme which is responsible for monitoring target 10 relating to water supply and sanitation examined country-level data. Based on a comparison of progress made during the period 1990-2002, each country is assessed in terms of the likelihood of achieving the MDG (though this information is not included in the report). Among the main messages of this report are that:

- of the 1.1 billion people lacking access to an improved source of water in 2002, nearly two-thirds were in Asia;
- lowest drinking water coverage levels were in sub-Saharan Africa and the Oceania;
- people without access to water and sanitation are among '…the hardest to reach—families living in remote rural areas and urban slums, families displaced by war and famine, and families mired in poverty-disease traps' (p.17).

Other assessments such as the Global Monitoring Report (World Bank 2005) compare the progress made with regard to each MDG between 1990-2005 with the target year of 2015 for each region (such as sub-Saharan Africa, South Asia, and so on).

Jolly (2004: 273-91) also examines the progress with regard to water and sanitation targets (mainly at the regional level rather than at country level) and identifies a detailed agenda for reform. Shordt et al. (2004) focus mainly on monitoring aspects and provide a good summary of various approaches in use at the moment, including, participatory methods such as quantified participatory monitoring with examples from Karnataka and Malawi. UNDP (2003) also assesses progress with regard to each of the various MDGs but that analysis precedes the publication of WHO-UNICEF (2004) and hence the data used there is of earlier assessments. Forecasts about achievement or shortfall are made by region in that report, though the methodology behind the forecasts is not fully explained. While the above assessments provide considerable insight into progress that has been made and the magnitude of task that still lies ahead, there is limited information in the public domain on cross-country comparisons or patterns.

Against this background, this paper attempts to review and summarise the progress so far and based on available evidence examine: (a) whether there are patterns or regularities in progress with regard to the two targets in relation to per capita income, human development index and aspects of governance; (b) whether the synergy effect is significant, i.e., are countries that have made a significant progress with one target more likely to make a significant progress with other related targets; and (c) whether and to

what extent the achievement or lack of progress on these two targets can impinge on performance in relation to other MDGs or targets. The paper will use country-level data (available for two years, namely 1990 and 2002) and individual country case studies to highlight specific aspects.

2 Hypotheses, methodology, data and limitations

Why is there a significant variation across countries in the proportion of population having access to water and sanitation? A positive and significant relationship has been observed between GDP per capita and the proportion of population having access to water and sanitation in World Bank (1992) and Shafik (1994). This seems to suggest that water and sanitation are normal goods with positive income elasticities of demand. Water and sanitation are not pure public goods. Thus, while there is a significant role for the state, these are also private goods where 'exit' is possible. For instance, households can provide themselves with water supply by sinking a well or tube well and pumping groundwater or draw water from rivers, streams, etc. Similarly, sanitation technologies such as improved pit latrines, septic tanks enable households to provide themselves with safe sanitation when such goods are not provided by the state.

However, such self-provision is capital- and land-intensive and usually beyond the reach of the poor. Also, many households may not have such options due to terrain, climate, incomplete property rights institutions (to land and water) and human settlement patterns. However, while water and sanitation can be private goods at the level of individual, there are significant externalities in terms of public health impacts. For instance, when a significant proportion of the population does not have access to sanitation and as a result many individuals resort to what is euphemistically called the 'bush' latrine, the scope for contamination of water sources and the resulting risk of infectious diseases increases significantly.

Also, due to economies of scale, it is socially efficient that water and sanitation are provided for the whole human settlement rather than leave it to individuals. For these reasons, as incomes begin to increase, citizens may use their voice to put pressure on the state to act and thus the proportion of the population having access to water and sanitation starts to increase. Let us refer to this as the 'Kuznets effect'. While this is a plausible explanation, as the critics of environmental Kuznets curve (EKC) point out there is need for caution (see Munasinghe et al. 2001; Panayotou 2003; Goldin and Winters 1995). One interpretation of such a relationship is that access to water and sanitation will improve as incomes increase and thus low income countries can (and ought to) focus on improving incomes. An alternative interpretation is that improving water and sanitation is essential to achieve productivity growth which is crucial for sustaining progress and economic development. Against this background, the exploration in this paper attempts to examine the following issues:

(a) To what extent does access to water and sanitation continue to be associated with per capita GDP and other indicators such as the human development index?

(b) Is there a synergy between access to water and access to sanitation?

(c) Is access to water or sanitation determined by legacy or policy? That is, whether the proportion of people having access to water or sanitation in period *t* is determined

by the proportion of population with access to water or sanitation in period *t*-1 (*legacy*), or whether it is also determined by other policy-relevant variables.

(d) Is there any association between access to water and sanitation and other MDG relevant indicators?

(e) What are the policy implications?

2.1 Methodology

The analysis in this paper will be based on national-level data and cross-section regression analysis to identify associations between variables and use the regression models to forecast progress. We develop a model where access to water or sanitation in a given year (say 2000) is determined by access status is a previous year (say 1990) and various explanatory variables such as per capita GDP in recent years, past values of economic and population growth rates, social expenditures in total government spending, aid received, and so on. Based on this model, we then forecast the percentage of population that will have access to water and sanitation for a future year (2015) using the current values of explanatory variables. The projected access figures are compared with the MDG targets to ascertain how far off the country is going to be.

2.2 Data

Much of the analysis in this paper is based on data on access to water and sanitation at national level in terms of percentage of population having access. There is considerable subjectivity in defining access; also the data are furnished by national governments and may be difficult to verify. The most recent set of data is available for two years, 1990 and 2002, from the Millennium Indicators Dataset.[3]

There is a very important limitation in terms of endogeneity. Many of the variables considered in the analysis are all facets of development and change. At the same time, access to water and sanitation can significantly depend on many other variables such as actions of NGOs, communities, local-level leadership and private sector activity and so on. There is little data at aggregate-level on such variables to include in the models. Also national-level aggregates may not fully capture the considerable variation in a given country. Hence, the regressions attempted here may not capture the causality completely or adequately. Second, reliable data on access to water and sanitation is available for two points in time and this may not sufficiently capture the dynamic changes in institutional processes and policies. Third, there is considerable variation in the quality of data. For example, while up to 165 countries are listed in the WHO-UNICEF monitoring, for some countries data is available only for one of the two data years. The number of countries in the sample rapidly decreases when one attempts to increase the number of variables of interest such as per capita GDP or per capita quantity of freshwater available and so on.

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[3] However, there is some slight confusion. On closer inspection it is observed that the 2002 data comes from the WHO-UNICEF interim assessment and is precisely the same as the data reported for year 2000. Therefore, in this analysis, I have made a presumption that the two data points are years 1990 and 2000.

3 Analysis

3.1 Access to water and sanitation: state of progress

From the summary statistics in Table 1 it is clear that there is considerable variation in access to water and sanitation, mainly for low- or middle-income developing countries. As of 2000, there are at least six countries[4] where such coverage is less than 40 per cent of the population; that is three out of every five persons do not have access to water and sanitation. There are five countries[5] which have achieved substantial progress with regard to water (over 80 per cent of the population have access to improved source) but face serious deficit with regard to sanitation (coverage less than 40 per cent) On the other hand, Sri Lanka, Libya, and Kyrgyzstan have improved sanitation to cover over 90 per cent, but water supply coverage remains less than 80 per cent of the population. These peculiarities are indicators of the variations in progress.

Table 1: Mean and standard deviation of % of population having access to water and sanitation, 1990 and 2000

Access	Country category	N	Mean	Std deviation	Std error mean
WAT1990	Developing country	99	72.354	21.341	2.145
Access to water % of pop. 1990	Not a developing country	11	99.455	1.809	0.545
WAT2000	Developing country	137	76.613	19.326	1.651
Access to water % of pop. 2000	Not a developing country	11	99.636	1.206	0.364
SAN1990	Developing country	91	53.835	29.794	3.123
Access to sanitation % of pop. 1990	Not a developing country	10	98.700	4.111	1.300
SAN2000	Developing country	134	59.731	26.954	2.328
Access to sanitation % of pop. 2000	Not a developing country	10	98.700	4.111	1.300

Source: Author's calculations based on WHO-UNICEF (2004) data.

Given this considerable variation, it is necessary to examine whether there are any systematic tendencies and whether access to water and sanitation are influenced by various country-specific variables. This is attempted in the rest of this section.

4 These are: Afghanistan, Ethiopia, Chad, Cambodia, Somalia, Lao PDR.

5 Nepal, India, Gabon, Cote d'Ivoire, Comoros.

Table 2: Distribution of number of countries as per access to water and sanitation, 2000

% of people having access to water in 2000	% of people having access to sanitation in 2000						
	Less than 20%	20-40%	40-60%	60-80%	80-90%	90-100%	Total
Less than 20%	1						1
20-40%	3	2	1				6
40-60%	5	9	10				24
60-80%		10	15	5	2	3	35
80-90%		4	6	14		3	27
90-100%		1	3	7	9	30	50
	9	26	35	26	11	36	143

Source: Author's assessment based on WHO-UNICEF (2004) data.

3.2 Is access to water or sanitation a function of per capita GDP?

To examine this, a relationship is estimated using simple linear regression models. In the regressions R1 to R4 presented in Table 3, access to water or sanitation in a given year is considered to be a function of GDP per capita. The average of per capita GDP (expressed in constant US$ in 2000 prices) for three preceding years was used as the independent variable.

Table 3: Access to water or sanitation: is it a function of per capita GDP?

	Dependent variable	Independent variable	Constant	Parameter of Independent variable	R square	F value	N
R1	LogWAT1990	LogGDPCAP8789	2.201***	0.251***	0.543	107.023	92
			(11.039)	(10.345)			
R2	LogWAT2000	LogGDPCAP9799	2.90***	0.175***	0.421	86.648	121
			(18.733)	(9.308)			
R3	LogSAN1990	LogGDPCAP8789	-0.486	0.533***	0.577	114.603	86
			(1.198)	(10.705)		(0.000)	
R4	LogSAN2000	LogGDPCAP9799	0.638**	0.412***	0.507	118.063	117
			(2.062)	(10.866)		(0.000)	

Notes: 1. Independent variable is also log transformed. 2. WAT2000 is the percentage of people having access to water in 2000. 3. SAN2000 is the percentage of people having access to sanitation in 2000. 4. GDPCAP8789 and GDPCAP9799 respectively are the average of per capita GDP for years 1987, 1988 and 1989 and the average for years 1997, 1998 and 1999, all measured in constant 2000 prices in international dollars (from World Bank 2005). 5. Figures in parentheses are *t*-statistics. ***, ** and * indicate significance at less than 1%; 5%; and 10% respectively. These notations apply to all subsequent tables.

Source: Author's estimates.

The results for data relating to 2000 are shown in Figures 1 and 2. These results are in line with World Bank (1992) and Shafik (1994) estimates based on 1980s data.

Figure 1: GDP per capita (average for 1997-99 in US$, 2000 prices) and % of people having access to water in 2000

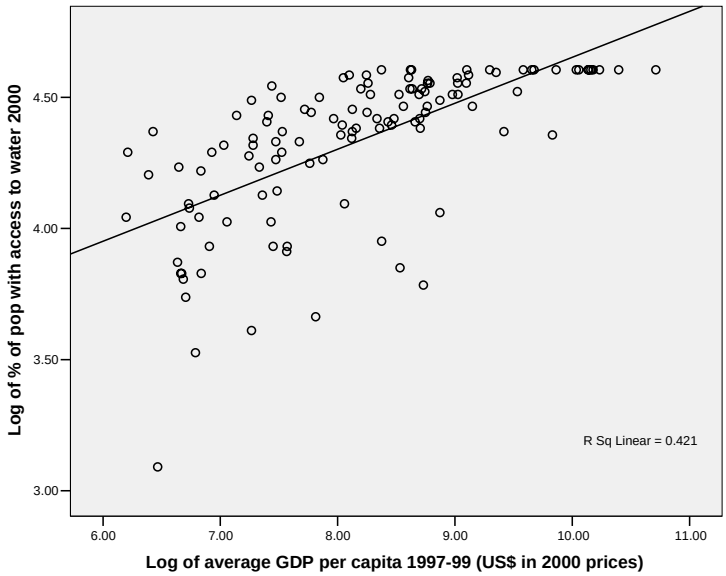
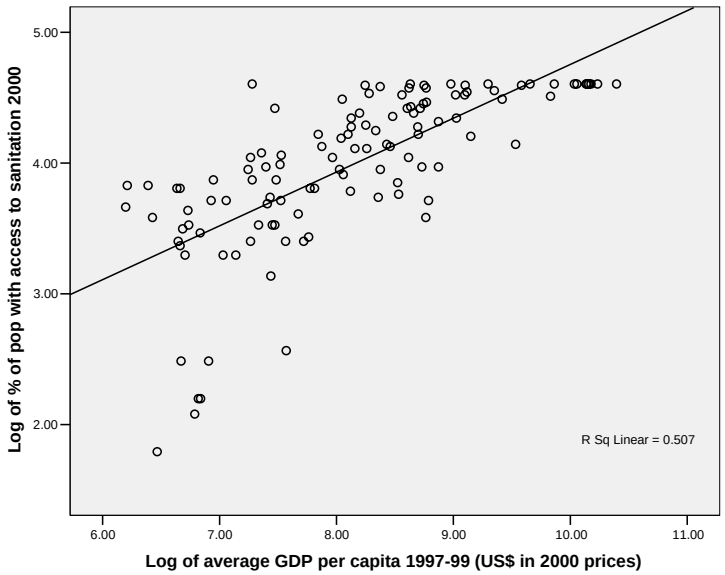


Figure 2: GDP per capita (average for 1997-99 in US$, 2000 prices) and % of people having access to sanitation in 2000



Since both the dependent and independent variables in Table 3 are in logarithmic form, the parameters can be interpreted as elasticities. Access to water and sanitation appear to be normal but inelastic goods (necessities). Why should the elasticities decrease over time? We can conjecture that as the better-off (and hence more organised) sections of the population get access to water (or sanitation), the pressure on governments to provide these services eases and as a result government resources are diverted to providing other normal (and elastic) goods and services.

An alternative interpretation is that in a world where every country has achieved 100 per cent access, the line becomes parallel to horizontal axis and the slope of the line (and hence the parameter) would be zero. Thus, the parameter values in Table 3 suggest that access to water and sanitation has improved between 1990 and 2000. Linear interpolation[6] of the changes suggest that if these trends continue, access to water will not approach 100 per cent until 2023 and access to sanitation will not approach 100 per cent until 2034. However, the regressions are only indicative of the structural relationships and it is lot more difficult to improve access from 80 per cent to 90 per cent of the population than it is from 20 per cent to 30 per cent of population. Hence, the parameters may approach zero asymptotically rather than in linear fashion and it may take far many more years to achieve 100 per cent access than the linear interpolation suggests.

An alternative indicator of the level of development is the human development index compiled by the UNDP. The index incorporates measures of poverty, inequality and life expectancy. Since the conjectures are that access to water and sanitation can have a bearing on life expectancy, it is of interest to explore the association between HDI and access to water and sanitation. This is explored in Table 4 with simple linear regressions where access to water or sanitation in a given year is considered to be a function of human development index in that (or a specified) year.

Table 4: HDI and access to water and sanitation

	Dependent variable	Independent variable	Constant	Parameter of independent variable	R square	F value	N
R5	LogWAT2000	HDI1990	3.628***	1.135***	0.461	86.276	103
			(46.622)	(9288)		(0.000)	
R6	LogWAT2000	HDI2000	3.591***	1.119***	0.423	65.271	91
			(38.734)	(8.079)		(0.000)	
R7	LogSAN2000	HDI1990	2.429***	2.548***	0.611	156.856	101
			(18.768)	(12.524)		(0.000)	
R8	LogSAN2000	HDI2000	2.198***	2.730***	0.600	130.573	88
			(13.765)	(11.427)		(0.000)	

Source: Author's estimates.

When we compare the results in Table 4 with those in Table 3 we find that in general access to water and sanitation are associated with HDI and that there may also be a lag effect i.e., access in period *t* may be influenced by human development in period (*t*-1). This seems to support the working of a Kuzents effect mentioned in previous section. Human development in period (*t*-1) may trigger people to put pressure on the state; however, as water and sanitation projects take time before the effects are felt, there is a lag effect. The results above also seem to suggest that such Kuznets effect is stronger

6 For example, the parameter of access to water decreased in 10 years from 0.251 (in 1990) to 0.175 (in 2000). If x is the number of years (from 1990) it takes for the parameter to become zero, from similar traiangles, we have (0.251/x)=(0.175/(x-10)). Solving for x gives us x=33 years.

with regard to access to sanitation. This is plausible given that 'exit' is more difficult and negative externalities are more pronounced with sanitation than water.

Apart from the association between access to water or sanitation and human development at a given point in time, change in human development over a period of time and change in access to water or sanitation is examined in Figures 3 and 4. These indicate that while improvement in access to water has no relationship with improvement in HDI during 1990-2000, with regard to access to sanitation, the picture is quite remarkable. There is a fairly strong positive association between change in HDI between 1990 and 2000 and change in access to sanitation between 1990 and 2000.

Figure 3: Change in HDI and change in % of population with access to water, 1990-2000

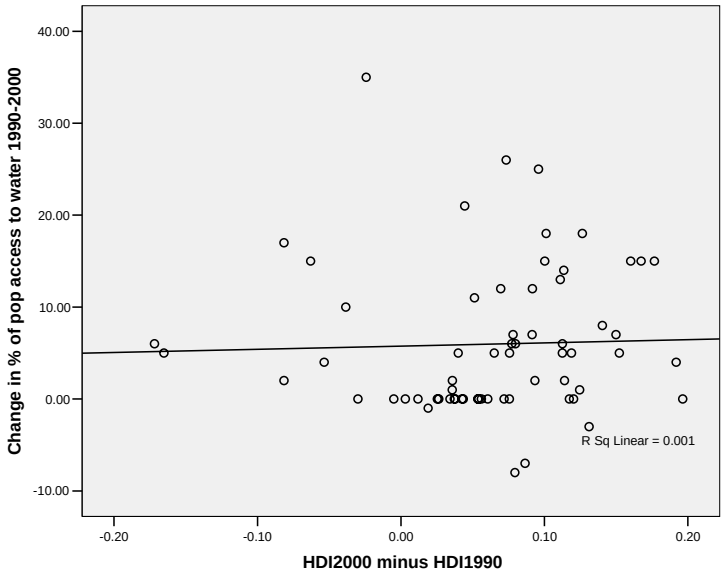
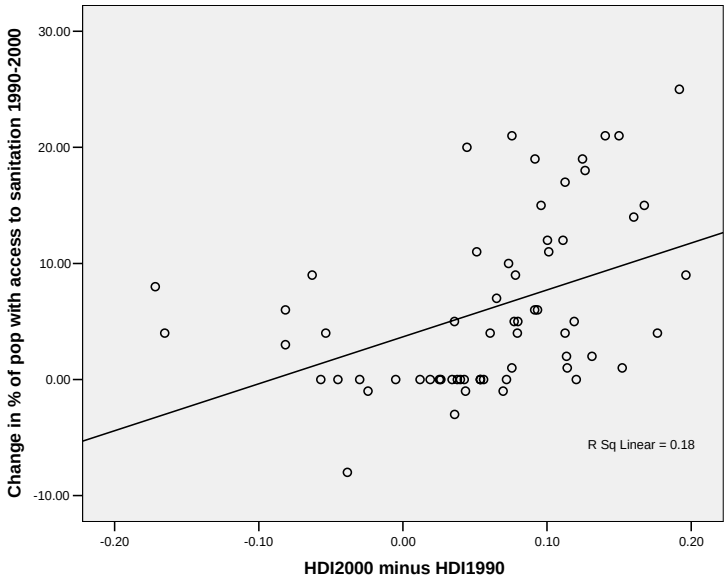


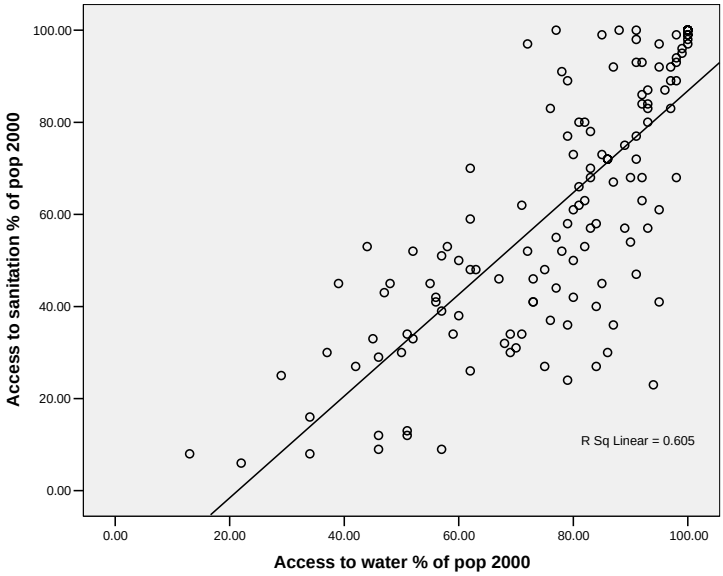
Figure 4: Change in HDI and change in % of population with access to sanitation, 1990-2000



3.3 Is there synergy in water supply and sanitation?

If the proportion of population having access to sanitation is correlated to the proportion of population having access to water, we can conjecture that there is some synergy between these two services. In general, countries that have done well with regard to access to water supply are also highly likely to do well with sanitation. This is evident from Figure 5.

Figure 5: Countries as per access to water and sanitation in 2000



The slope and intercept seem to suggest that there may be a slight lag between progress with regard to access to water and progress with sanitation. (This is also evident from model R11 in Table 5).

Table 5: Synergy in providing access to water and access to sanitation.

	Dependent variable	Constant	Parameter of the independent variable	Independent variable	R square	F value	Sample n
R9	LogSAN1990	-3.058***	1.624***	LogWAT1990	0.602	142.375	95
		(-5.281)	(11.932)			(0.000)	
R10	LogSAN2000	-2.252***	1.448***	LogWAT2000	0.602	213.670	142
		(-3.921)	(14.617)			(0.000)	
R11	LogSAN2000	-1.816***	1.374***	LogWAT1990	0.643	185.170	104
		(-4.213)	(13.608)			(0.000)	

Source: Author's estimates.

What does this mean? Of course, access to water is essential for sanitation to be functional. However, why a lag effect? We will return to this issue in the next sub-section.

3.4 Legacy or Policy? Does progress depend on the starting point?

Progress with regard to access to water and access to sanitation seems to depend much on the starting point (or legacy). Countries which had already made significant progress by 1990 have in general progress in 2000 too. This is evident from Figures 6 and 7.

Figure 6: Access to water in 1990 and in 2000

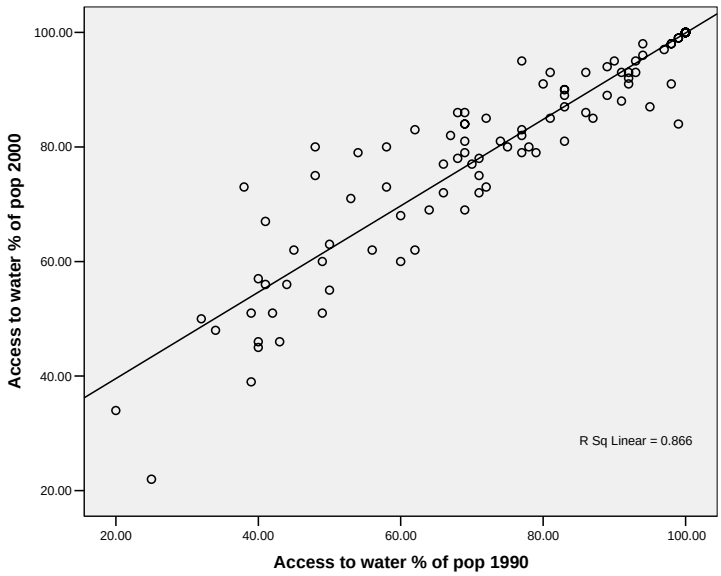
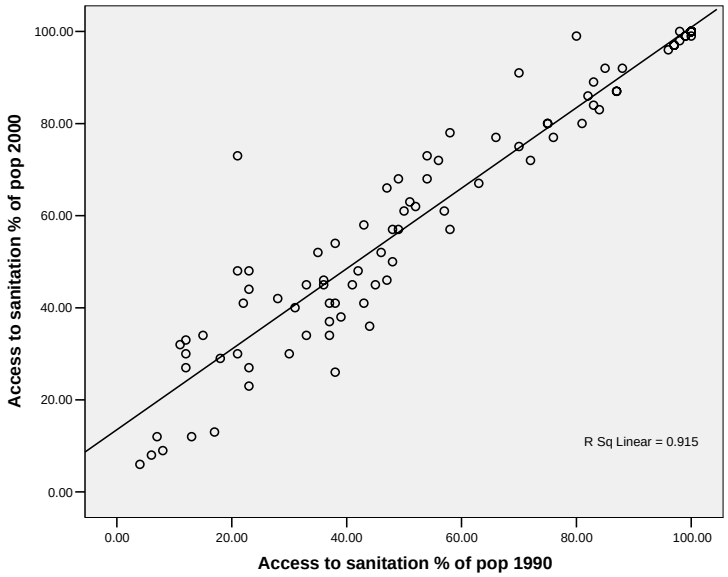


Figure 7: Access to sanitation in 1990 and in 2000



If the proportion of population having access to water or sanitation in a given year is closely related to the proportion of population having access in previous years, we can conjecture that legacy matters. This is explored in Table 6. It appears that the proportion of population with access to water and sanitation in period *t* (say, 2000) is very significantly influenced by the proportion of people having such access in period *t-1* (1990). This suggests that improving access to water and sanitation and developing

institutions to deal with this requires commitment over a considerable period of time rather than something that can be achieved in a short duration. This means that it may be far harder and more difficult for countries such as the six identified in Table 2 to make significant progress.

Table 6: Proportion of population with access to water and sanitation in 2000 is a function of the proportion of population having such access in 1990

	Dependent variable	Constant	Parameter of the independent variable	Independent variable	R square	F value	N
R12	LogWAT2000	1.358***	0.705***	LogWAT1990	0.845	577.078	107
		(10.821)	(24.022)			(0.000)	
R13	LogSAN2000	1.056***	0.769***	LogSAN1990	0.863	609.899	98
		(8.665)	(24.696)			(0.000)	

Source: Author's estimates.

This is an important point to keep in mind while assessing regional disparities in progress. For example, it is possible to argue that many sub-Saharan African (SSA) countries, which started with low coverage of water and sanitation services in 1990, continue to have low coverage in 2000. Results presented in Table 7 indicate that other things being the same, SSA countries tend to have made less progress with sanitation coverage than other countries.

However, legacy is not destiny. The above results do not mean that countries with low level of access are stuck in a low-level equilibrium trap. In percentage terms, the biggest increase in proportion of population having access to water during 1990-2000 was in the countries listed in Table 8. While the figures in Table 8 relate to increase in the proportion of population with access, countries achieving biggest increase in the absolute number of people provided with such access (in descending order) are: India, China, Indonesia, Pakistan, Brazil, Nigeria, Bangladesh, Mexico, Myanmar, and Turkey. Similarly, the top 10 countries in terms of increase in percentage of population having access to sanitation during 1990-2000 are listed in Table 9.

Table 7: Starting point effect and being in sub-Saharan Africa

	Dependent variable	Constant	LogWAT1990	LogSAN1990	SSA dummy	Adj. R square	F value
R14	LogWAT2000	1.280***	0.722***	-	0.019	0.842	287.100
		(7.293)	(18.226)		(0.631)		(0.000)
R15	LogSAN2000	1.523***	-	0.673***	-0.268***	0.936	400.272
		(10.829)		(20.164)	(-5.198)		(0.000)

Source: Author's estimates.

Table 8: Top 10 countries in terms of progress with regard to access to water (% of population) during 1990-2000

	% of people having access to water in 1990	% of people having access to water in 2000	Change during 1990-2000 in % of people having access	Total aid (ODA+OA) for water and sanitation in 1990-2000 $m
Tanzania	38	73	35	344.21
Myanmar	48	80	32	1.07
Central African Republic	48	75	27	54.17
Malawi	41	67	26	78.01
Ghana	54	79	25	336.56
Namibia	58	80	22	98.93
Paraguay	62	83	21	17.86
India	68	86	18	587.55
Haiti	53	71	18	9.63
Guatemala	77	95	18	121.43

Source: Based on WHO-UNICEF (2004).

Table 9: Top 10 movers with regard to % of population having access to sanitation: 1990 to 2000

	% of people having access to water in 1990	% of people having access to water in 2000	Change during 1990-2000 in % of people having access
Myanmar	21	73	52
Cameroon	21	48	27
Bangladesh	23	48	25
Benin	11	32	21
Madagascar	12	33	21
Sri Lanka	70	91	21
China	23	44	21
Paraguay	58	78	20
Nicaragua	47	66	19
Honduras	49	68	19

Source: Based on WHO-UNICEF (2004).

While 6 out of the top 10 countries achieving improved access to water were SSA countries, 3 out of the top 10 countries achieving significant progress with sanitation are from SSA. What distinguishes the high achievers? This is explored in Table 10.

Table 10: Were high achievers different?

	Top 10 countries in change in access to water between 1990-2000		Bottom 10 countries in change in access to water between 1990-2000	
Variables	N	Mean	N	Mean
Public expenditure on health as % of GDP average for 1998-2000	10	2.33	9	2.35
Average GDP per capita 1987-89 (in US$ 2000 prices)	9	2567.3	6	4038.5
Average GDP per capita 1997-99 in US $ 2000 prices	9	2498.1	7	3641.9
Per cap GDP growth rate 1990-2000	10	0.77	9	1.98
Gini index	7	50.8	6	36.9
HDI 1990	7	0.49	6	0.59
HDI 2000	6	0.56	6	0.64
Annual pop growth rate 1975-2000	10	2.58	9	2.47
Child mortality rate 1990	10	145.4	10	81.9
Child mortality rate 2000	10	128.1	10	70.3
Aid as % of GDP 1990	5	4.9	8	14.9
corruption perception index of TI 2004	9	2.5	7	3.1
Water resources cubic metre per capita	10	15765.6	7	2092.1

Source: Author's estimates.

Independent sample *t*-tests (not shown here) suggest that the mean values of the top 10 achievers are not significantly different from the mean values of the rest of the countries (N=97) or the bottom 10 countries in terms of change in percent of population having access to water between 1990 and 2000. If any thing, figures in Table 10 seem to suggest that the top 10 achievers had more hurdles to overcome than the bottom 10 countries (for example, lower level of GDP per capita, lower level of economic growth rate, greater inequality, higher level of child mortality rate and so on).

Thus, while legacy seems to be important, the examples in Tables 8 and 9 seem to suggest that countries can and do get out of the low-level equilibrium. We would like to explore whether this is due to policy or providence. By providence, we refer to variables such as population, inequality and per capita fresh water resources. To examine these issues, multiple regression analysis is used.

Table 11: Results of multiple regression analysis: dependent variable is access to water (% of population) in 2000.

		Model R16		Model R17		Model R18	
		Parameter	Collinearity diagnostic	Parameter	Collinearity diagnostic	Parameter	Collinearity diagnostic
Constant		12.436		16.146***		-8.539	
		(0.687)		(2.645)		(-0.499)	
Access to water as % of population in 1990	WAT1990	0.579***	0.467	0.763***	0.646	---	
		(6.341)		(16.197)			
Annual Population growth rate 1975-2000	POPGROW	1.670	0.443	---		-1.661	0.669
		(0.706)				(-0.936)	
Per capita GDP- average for 1997-1999 in	LogGDPCAP	2.131	0.473	---		12.310***	0.530
US$ in 2000 prices		(1.027)				(6.877)	
Per capita GDP growth rate 1990-2000	ECONGROW	0.676	0.579	---		1.365***	0.957
		(1.000)				(2.567)	
Health expenditure (public sector) as a	HEALTH	1.010	0.453	-0.153	0.698	0.119	0.643
share of GDP average for 1998-2000		(0.859)		(-0.261)		(0.914)	
Gini coefficient	GINI	-0.047	0.374	0.123*	0.817	---	
		(-0.283)		(1.535)			
Aid as % of GDP in 1990	AID2GDP	-0.100	0.696	---		---	
		(-0.638)					
Malnourished people as % of population	MALNURISH	-0.043	0.725	---		---	
1990		(-0.406)					
Fresh water resources available cubic	LogWATRES	0.690	0.636	0.476	0.886	-1.126	0.948
metres per capita (Log)		(0.783)		(0.408)		(-1.338)	
Adjusted R square		0.754		0.845		0.551	
F value		13.237		96.305		22.834	
		(0.000)					
Sample n		37		71		90	

Notes: Collinearity diagnostic, tolerance is the percentage of the variance in a given predictor that cannot be explained by the other predictors. When the tolerances are close to 0, there is high multicollinearity and the standard error of the regression coefficients will be inflated. Variance inflation factor was also estimated but not shown here. A rule of thumb is when the value of collinearity diagnostic is less than 0.5 (or VIF above 2) some degree of collinearity is present. In the above cases, all variables have VIF less than 2.
Source: Author's estimates.

Table 12: Results of multiple regression analysis: dependent variable is access to sanitation (% of population) in 2000.

		Model R19		Model R20		Model R21	
		Parameter	Collinearity diagnostic	Parameter	Collinearity diagnostic	Parameter	Collinearity diagnostic
Constant		38.573***		35.392***		-97.146***	
		(4.180)		(8.972)		(-3.819)	
Access to sanitation as % of population in 1990	SAN1990	0.754***	0.282	0.731***	0.282	---	
		(10.325)		(16.373)			
Population in 1990 in millions	POP1990	-0.00006	0.615	---		-0.016	0.648
		(-0.010)				(-1.497)	
Annual Population growth rate 1975-2000	POPGROW	1.259	0.534	---		-0.862	0.598
		(0.495)				(-0.752)	
Per capita GDP- average for 1987-1989 in US$ in 2000 prices	LogGDPCAP	---		---		22.817***	0.648
						(8.536)	
Per capita GDP growth rate 1990-2000	ECONGROW	---		---		0.286	0.564
						(0.801)	
Health expenditure (public sector) as a share of GDP average for 1998-2000	HEALTH	-1.974*	0.528	-1.543***	0.618		
		(-1.947)		(2.645)			
Gini coefficient	GINI	-0.103	0.678	---		-0.409	0.865
		(-0.792)				(-2.206)	
Aid as % of GDP in 1990	AID2GDP	0.091	0.651	---		-0.098	0.799
		(0.510)				(-0.493)	
Child mortality rate 1990	CMR	-0.103***	0.361	-0.098***	0.329		
		(-3.367)		(-5.698)			
Adjusted R square		0.913		0.936		0.712	
F value		67.324		466.376		22.020	
		(0.000)		(0.000)		(0.000)	
Sample n		45		97		51	

Source: Author's estimates.

In Table 11 are reported alternative models in terms of combinations of different independent variables. While a number of specifications are possible, only three selected regression models are presented in the table. Model R16 includes many variables of interest including WAT1990 and GDPCAP8789. There is a trade-off between increasing the number of variables and data availability. For this model, the sample size is 37 countries. In this model, apart from legacy indicator (WAT1990), three indicators of economy (GDPCAP, ECONGROW, AID2GDP); one indicator of demographic trend (POPGROW); two indicators of inequality (GINI, MALNURISH); one indicator of social sector spending (public sector expenditure on health) and one indicator of providence in terms of fresh water resources per capita are included. While the overall goodness of fit is very high (adjusted R square 0.754), the only variable that is statistically significant at less than 5 per cent level is WAT1990.

Model R17 is an alternative with fewer variables. Sample size increased to 71 and adjusted R square increased to 0.845. Here too, WAT1990 is still the only variable that is highly significant; the constant term is significant and GINI index is slightly significant.

Finally, model R18 is a specification where WAT1990 is omitted and instead the average per capita GDP in 1997-1999 is used as a predictor of the proportion of population with access to water in 2000. Though adjusted R square decreases to 0.551, the number of countries in the sample increased to 90. The model seems to suggest that if the legacy effect is excluded, then per capita GDP and also economic growth rate are significant and this seems to be in line with the Kuznets effect discussed earlier.

In Table 12 are presented similar results with regard to access to sanitation in 2000 (SAN2000). In this regression model R18, apart from SSA and governance quality, population size also seems to be important. This seems to be indicating the fact that apart from percentage of population, the magnitude of task in terms the absolute of number of people to provided with services in populous countries such as India, China, Ethiopia and Nigeria can be a significant challenge.

3.5 Forecasting access to water and sanitation in 2015 based on progress so far

Regression equations in Tables 11 and 12 were of the form equation 1 whereby proportion of population having access in period *t* is estimated based on independent variables of period *t-1*. Now, based on availability of data for period *t* (year 2000) using the regression equations, forecasts can be made for period *t+1* (year 2015). Two forecasts for access to water in 2015 based on equations R17 and R18 were made. The forecast is then compared with the MDG target. These are reported in Appendix 2. Similarly, for access to sanitation, forecasts were made using equations R19 and R 20. The forecasts and comparison with MDG target for sanitation for various countries are reported in Appendix Table 2.

These forecasts suggest that the MDG target with respect to water is highly likely to be in most of the countries. The gap between MDG target and projected figures of access is greater than 10 per cent of population for 12 countries. The scenario is much bleaker with regard to access to sanitation. 72 countries are expected to miss the MDG target by 10 per cent or more of population without access to sanitation. Of these, the gap between MDG target and projected access by 2015 is greater than 20 per cent for 40 countries. A regression equation with the gap between MDG and projected access to

water (MDGGAP) shown in the last column of Appendix Table 1 as the dependent variable suggests that such gap is positively associated with GDP per capita (2000) and quantity of fresh water resources available per capita. This seems to suggest that complacency may be affecting progress especially when a country is endowed with freshwater resources.

3.6 Does it matter?

The inclusion of access to water and sanitation as targets in MDGs signals the intrinsic importance attached by global community to achieving them. There are also possible instrumental reasons for improving access to water and sanitation. Access to water and sanitation seems to have a very significant impact on reducing child mortality rate. This is seen in the results[7] reported in Table 13. Since access to water and access to sanitation are strongly correlated, both of them have not been included in the same equation. The results do indicate that each of them is highly significant when included with other policy-relevant variables. With regard to maternal mortality, similar regression equations indicated that access to water was not significant; however, access to sanitation was highly significant at less than 1 per cent level.

Table 13: Whether child mortality rate (2000) is affected by access to water and sanitation

	Model R22	Model R23
	Parameter	Parameter
(Constant)	137.037***	172.477***
	(7.630)	(7.319)
Public expenditure on health as % of GDP average for 1998-2000	-4.272*	-5.76***
	(-1.806)	(-2.444)
Access to water % of pop. 2000		-1.068***
		(-4.614)
Access to sanitation % of pop. 2000	-0.932***	
	(-5.045)	
Urban pop as % of 1975 pop.	-0.075	-0.284
	(-0.372)	(-1.481)
Sub-Saharan Africa dummy	55.53***	56.672***
	(6.891)	(6.709)
Aid as % of GDP 2002	0.469	0.031
	(0.994)	(0.059)
Ginindex	-0.251	-0.191
	(-0.763)	(-0.592)
Adj R square	0.758	0.728
N	71	73

Source: Author's estimates.

As can be expected, there is no positive relationship between access to water or sanitation and malaria incidence. However, either of these variables when included, the improvement in adjusted R square suggests that the models are better specified when these are included along with other variables such as the share of (public sector) health

[7] See Anand (2006) for further details on the results discussed in this section.

expenditure in GDP, freshwater resources per capita, urban population's share in total population and SSA dummy. The last three variables were highly significant. Thus, while access to water and sanitation does not have any relationship per se with malaria, the regression seems to suggest that their availability may be important in as much as they are crucial in patient's recovery and whether recurrence of malaria is more likely if a patient is weak due to say, diarrhoea. These three explorations are indicative of the likely negative impacts of not achieving the MDG targets related to water and sanitation on other MDG targets.

4 Conclusions and further issues

While an assessment of progress with water and sanitation goals has been included in the Millennium Task Force reports and the WHO-UNICEF assessment, the strength of the present paper is that here regression models are used for forecasting the progress rather than merely comparing the increase in the percentage of population having access between 1990 and 2000 and assuming that same level of increase will continue. Therefore, the projections made here are methodologically more robust.

Much of the analysis here was limited to country-level average figures which do not capture considerable intra-country variations. Also, data is very limited in terms of observations for just two periods and these may not adequately capture the underlying institutional changes taking place over a period of time. In spite of these and other limitations, the following conclusions can be drawn from the various regression models presented here:

a. Access to water and sanitation is closely and significantly related to economic and human development.

b. There is strong evidence to suggest that legacy in terms of the starting point matters and as such there is a bigger mountain to climb for those countries which are starting with a lower base. Yet, the lists of top 10 countries presented here with respect to each target seem to suggest that it is possible to make significant progress.

c. There is some evidence also to suggest that apart from legacy, some policy variables matter. The most important ones seem to be per capita GDP, economic growth rate and social sector spending, represented in the analysis here by public sector health spending as a proportion of GDP.

d. The forecasts indicate that while the target related to water is likely to be achieved or only missed slightly in a majority of countries, the target related to sanitation is going to be missed in a great majority of countries.

e. There is some degree of synergy between access to water and access to sanitation. More importantly, access to water and sanitation have a highly significant impact on child mortality rate; access to sanitation seems to have a highly significant impact on maternal mortality rate; and there is some slight evidence that access to water and sanitation may also be negatively associated with malaria incidence (though the connections are not direct). These seem to highlight the instrumental role of access to water and sanitation in promoting health and well-being and other MDGs.

While the analysis in this paper has focused on national level aggregates, it is important to supplement such analysis with micro-level analysis based on case studies and other methods. First, assessing progress through indicators may seem like a technocratic exercise (Harcourt 2005). In detailed case studies on India (Anand 2001; Anand 2006) it is evident that citizens do not passively accept access to water and sanitation but actively engage in improving access through both 'exit' and 'voice' options. It is therefore, important to explore and understand the role of national and local governments, private sector, NGOs and community groups in significantly increasing access to water and sanitation in countries such as the top 10 identified earlier. Second, given that water is a highly contested resource, the institutional space is not without conflicts. As most of the fresh water resources are already committed in many countries, increasing access to water is not merely a matter of money and technology but involves conflicts between different users and legal and institutional mechanisms. Analysis presented elsewhere (Anand 2004) indicated that there may exist political incentives to increase water disputes or keep them unresolved. It is, therefore, important to identify conflict preventing and co-operation promoting mechanisms and good practices. Third, it is important to examine what role the so called new public management approaches in the late 1990s have played in changing management practices in water utilities and contributed to increased access. The micro-level evidence seems to suggest that where water utilities have become more customer-focused, their performance improves in terms of increasing access and also in delivering services efficiently. This needs further examination. Fourthly, it is important to find micro-level and longitudinal evidence for the Kuznets effect in terms of relationship between economic growth, development and access to water and sanitation as well as other health and quality of life indicators.

Appendix 1

Methodology

It is hypothesised that

$$ACCESS_{t,i} = \alpha + \beta_1 X1_{t-1,i} + \beta_2 X2_{t-1,i} + \ldots + \beta_n Xn_{t-1,i}$$

where the dependent variable is ACCESS (to water or sanitation) in country *i* in period *t* and the right hand side is an appropriate specification with X1, X2 and so on up to Xn being the various country-specific independent variables.

Based on observed relationships between access to water or sanitation in period *t* and other relevant independent variables in period *t-1*, an attempt will be made here to forecast access figures for *t+1* (year 2015):

$$PROJACCESS_{t+1,i} = \alpha + \beta_1 X1_{t,i} + \beta_2 X2_{t,i} + \ldots + \beta_n Xn_{t,i} \qquad (1)$$

The projected figures of access will then be compared with the MDG. The target is to halve the proportion of population without access to water and sanitation. Suppose that the proportion of population having access to water in country *i* in 2000 is estimated to be p_i.

$$TARGET_i = 0.5^* (100 - p_i) \qquad (2)$$

Therefore, $MDG_i = ACCESS2000_i + TARGET_i$ (3)

Appendix Table 1: Access to water: forecasts for year 2015 by country based on regression models

Country	Access to water % of pop. 1990	Access to water % of pop. 2000	Additional % of pop. to be provided water to meet MDG (half of 100 minus WAT2000)	MDG % of population with access to water in 2015 = Access in 2000 + IDTarget	Projection 1 for 2015 based on model R17	Projection 2 for 2015 based on model R18	Gap (Projection 1 minus MDG)
Oman	77	79	10.5	89.5	.	97.83	.
Argentina	94	.	.	.	.	97.79	.
Saudi Arabia	90	.	.	.	.	97.62	.
Lebanon	100	100	0	100	.	89.18	.
Belize	.	91	4.5	95.5	.	83.31	.
Gabon	.	87	6.5	93.5	.	83.08	.
Syrian Arab Rep.	79	79	10.5	89.5	.	82.29	.
Sudan	64	69	15.5	84.5	.	74.53	.
Togo	49	51	24.5	75.5	.	70.06	.
Haiti	53	71	14.5	85.5	.	69.14	.
Angola	32	50	25	75	.	69.11	.
Benin	60	68	16	84	.	65.25	.
Eritrea	40	57	21.5	78.5	.	64.50	.
Chad	20	34	33	67	.	60.16	.
Congo	.	46	27	73	.	54.98	.
Canada	100	100	0	100	100.00	100.00	0.00
Chile	90	95	2.5	97.5	100.00	95.53	2.50
Botswana	93	95	2.5	97.5	100.00	93.59	2.50
Uruguay	.	98	1	99	100.00	93.08	1.00
Costa Rica	.	97	1.5	98.5	99.89	92.69	1.39
Switzerland	100	100	0	100	99.88	100.00	-0.12
Netherlands	100	100	0	100	99.76	.	-0.24
Finland	100	100	0	100	99.71	100.00	-0.29
Austria	100	100	0	100	99.68	100.00	-0.32
Bulgaria	100	100	0	100	99.55	.	-0.45
Russian Fed	94	96	2	98	99.44	85.86	1.44
Malaysia	.	95	2.5	97.5	99.25	93.57	1.75
Sweden	100	100	0	100	99.13	100.00	-0.87
Guatemala	77	95	2.5	97.5	98.58	81.06	1.08
Israel	100	100	0	100	98.57	100.00	-1.43
Japan	100	100	0	100	98.46	.	-1.54
Hungary	99	99	0.5	99.5	98.29	100.00	-1.21
Egypt	94	98	1	99	98.08	84.05	-0.92
Bosnia and Herzegovina	98	98	1	99	97.82	.	-1.18
Albania	97	97	1.5	98.5	97.78	87.17	-0.72
Colombia	92	92	4	96	97.55	85.95	1.55
Panama	.	91	4.5	95.5	96.73	87.79	1.23
Dominican Rep	86	93	3.5	96.5	96.35	92.72	-0.15
Brazil	83	89	5.5	94.5	95.95	89.06	1.45
Mexico	80	91	4.5	95.5	95.90	93.32	0.40
Honduras	83	90	5	95	95.68	74.69	0.68
Iran (Islamic Rep.)	91	93	3.5	96.5	95.60	90.25	-0.90
Turkey	81	93	3.5	96.5	95.30	89.86	-1.20

Jamaica	92	93	3.5	96.5	95.17	81.73	-1.33
Armenia	.	92	4	96	94.51	.	-1.49
Trinidad and Tobago	92	91	4.5	95.5	94.08	96.65	-1.42
Moldova, Rep	.	92	4	96	94.01	.	-1.99
Korea Rep	.	92	4	96	93.38	100.00	-2.62
South Africa	83	87	6.5	93.5	92.61	.	-0.89
Pakistan	83	90	5	95	92.48	72.71	-2.52
Ecuador	69	86	7	93	91.84	.	-1.16
Jordan	98	91	4.5	95.5	91.83	85.86	-3.67
Bolivia	72	85	7.5	92.5	91.29	73.67	-1.21
Paraguay	62	83	8.5	91.5	91.20	79.55	-0.30
Philippines	87	85	7.5	92.5	90.58	82.25	-1.92
Uzbekistan	89	89	5.5	94.5	90.52	69.15	-3.98
Venezuela	.	83	8.5	91.5	90.19	82.73	-1.31
Guyana	.	83	8.5	91.5	90.18	.	-1.32
Thailand	81	85	7.5	92.5	90.16	92.01	-2.34
Cote d'Ivoire	69	84	8	92	89.62	70.65	-2.38
Namibia	58	80	10	90	89.50	88.58	-0.50
Kazakhstan	86	86	7	93	89.49	.	-3.51
Algeria	95	87	6.5	93.5	89.41	88.15	-4.09
Zimbabwe	77	83	8.5	91.5	89.21	80.58	-2.29
Nicaragua	69	81	9.5	90.5	89.19	77.56	-1.31
India	68	86	7	93	89.13	81.49	-3.87
Peru	74	81	9.5	90.5	89.02	83.98	-1.48
Nepal	69	84	8	92	88.90	69.08	-3.10
El Salvador	67	82	9	91	88.65	87.32	-2.35
Gambia	.	82	9	91	87.15	.	-3.85
Central African Rep.	48	75	12.5	87.5	85.72	63.70	-1.78
Lesotho	.	76	12	88	84.30	82.21	-3.70
Indonesia	71	78	11	89	84.28	80.72	-4.72
China	70	77	11.5	88.5	83.76	93.73	-4.74
Ghana	54	79	10.5	89.5	83.51	74.84	-5.99
Burundi	69	79	10.5	89.5	83.42	53.09	-6.08
Sri Lanka	68	78	11	89	83.37	100.00	-5.63
Azerbaijan	66	77	11.5	88.5	83.16	.	-5.34
Georgia	.	76	12	88	82.99	68.83	-5.01
Kyrgyzstan	.	77	11.5	88.5	82.03	65.65	-6.47
Bangladesh	71	75	12.5	87.5	81.45	72.24	-6.05
Viet Nam	72	73	13.5	86.5	80.48	79.66	-6.02
Tanzania-UR	38	73	13.5	86.5	79.91	57.36	-6.59
Senegal	66	72	14	86	79.84	69.50	-6.16
Turkmenistan	.	71	14.5	85.5	78.96	72.28	-6.54
Rwanda	58	73	13.5	86.5	78.04	67.06	-8.46
Malawi	41	67	16.5	83.5	76.48	60.59	-7.02
Yemen	69	69	15.5	84.5	75.20	64.90	-9.30
Cameroon	50	63	18.5	81.5	74.21	70.20	-7.29
Mongolia	62	62	19	81	72.75	69.79	-8.25
Sierra Leone	.	57	21.5	78.5	72.03	44.38	-6.47
Kenya	45	62	19	81	71.85	66.71	-9.15
Nigeria	49	60	20	80	71.62	61.66	-8.38
Guinea-Bissau	.	59	20.5	79.5	71.42	55.43	-8.08
Zambia	50	55	22.5	77.5	68.48	59.70	-9.02
Tajikistan	.	58	21	79	68.25	78.90	-10.75
Mauritania	41	56	22	78	67.37	71.51	-10.63

Romania	.	57	21.5	78.5	67.17	.	-11.33
Guinea	42	51	24.5	75.5	64.74	71.77	-10.76
Burkina Faso	39	51	24.5	75.5	64.01	66.09	-11.49
Mali	34	48	26	74	62.97	60.38	-11.03
Niger	40	46	27	73	60.94	57.78	-12.06
Madagascar	40	45	27.5	72.5	60.86	57.03	-11.64
Mozambique	.	42	29	71	57.07	67.47	-13.93
Lao PDR	.	37	31.5	68.5	53.95	70.37	-14.55
Cambodia	.	34	33	67	51.84	.	-15.16
Ethiopia	25	22	39	61	39.79	62.15	-21.21

Sources: Figures for 1990 and 2000 based on WHO-UNICEF (2004). Projections based on models discussed in the paper.

Appendix Table 2: Access to sanitation: forecasts by country based on regression models

	Access to sanitation % of pop. 1990	Access to sanitation % of pop. 2000	Additional % of pop. to be provided sanitation to meet MDG (half of 100 minus SAN2000)	MDG target Access by 2015	Projection 1 for 2015 based on model R19	Projection 2 for 2015 based on model R20	Gap (projection 2 minus MDG)
Cyprus	100	100	0	100	.	100.00	0.00
Mauritius	99	99	0.5	99.5	.	100.00	0.50
Libyan Arab Jamahiriya	97	97	1.5	98.5	.	100.00	1.50
Ukraine	99	99	0.5	99.5	.	100.00	0.50
Barbados	100	99	0.5	99.5	.	100.00	0.50
Finland	100	100	0	100	.	100.00	0.00
Trinidad and Tobago	100	100	0	100	100.00	100.00	0.00
Thailand	80	99	0.5	99.5	100.00	100.00	0.50
Bulgaria	100	100	0	100	100.00	100.00	0.00
Netherlands	100	100	0	100	.	99.74	-0.26
Austria	100	100	0	100	.	99.60	-0.40
Slovakia	100	100	0	100	100.00	99.57	-0.43
Switzerland	100	100	0	100	.	99.05	-0.95
Israel	100	100	0	100	100.00	98.82	-1.18
Japan	100	100	0	100	.	98.79	-1.21
Grenada	97	97	1.5	98.5	.	98.67	0.17
Lebanon	.	98	1	99	.	98.66	-0.34
St Kitts and Nevis	96	96	2	98	.	97.92	-0.08
Chile	85	92	4	96	.	97.90	1.90
Kyrgyzstan	.	100	0	100	100.00	97.70	-2.30
Sri Lanka	70	91	4.5	95.5	99.12	97.27	1.77
Tonga	97	97	1.5	98.5	.	97.16	-1.34
Cuba	98	98	1	99	.	97.00	-2.00
Uruguay	.	94	3	97	96.42	96.68	-0.32
Hungary	.	95	2.5	97.5	95.71	95.79	-1.71

Bosnia and Herzegovina	.	93	3.5	96.5	96.90	94.98	-1.52
Oman	83	89	5.5	94.5	.	94.68	0.18
Algeria	88	92	4	96	96.46	94.39	-1.61
Albania	.	89	5.5	94.5	96.85	94.33	-0.17
Jordan	.	93	3.5	96.5	96.27	93.72	-2.78
Saint Lucia	.	89	5.5	94.5	94.30	93.68	-0.82
Costa Rica	.	92	4	96	.	92.97	-3.03
Suriname	.	93	3.5	96.5	.	92.61	-3.89
Russian Fed.	87	87	6.5	93.5	90.20	92.02	-1.48
Armenia	.	84	8	92	91.37	90.52	-1.48
Georgia	.	83	8.5	91.5	90.38	90.03	-1.47
Iran (Islamic Rep.)	83	84	8	92	89.51	88.60	-3.40
Serbia and Montenegro	87	87	6.5	93.5	.	88.53	-4.97
Dominica	.	83	8.5	91.5	.	87.80	-3.70
Jamaica	75	80	10	90	87.79	86.97	-3.03
Tunisia	75	80	10	90	87.57	86.70	-3.30
Syrian Arab Rep.	76	77	11.5	88.5	.	86.13	-2.37
Turkey	84	83	8.5	91.5	86.12	85.73	-5.77
Colombia	82	86	7	93	83.52	85.61	-7.39
Mexico	66	77	11.5	88.5	.	84.74	-3.76
Paraguay	58	78	11	89	84.74	84.45	-4.55
Ecuador	56	72	14	86	83.44	82.40	-3.60
Philippines	54	73	13.5	86.5	83.49	82.40	-4.10
Brazil	70	75	12.5	87.5	79.68	81.40	-6.10
Iraq	81	80	10	90	.	80.86	-9.14
Venezuela	.	68	16	84	78.26	78.11	-5.89
Korea Re	.	63	18.5	81.5	.	77.70	-3.80
Myanmar	21	73	13.5	86.5	.	77.62	-8.88
Egypt	54	68	16	84	80.06	77.60	-6.40
Kazakhstan	72	72	14	86	77.48	77.57	-8.43
Moldova, Rep	.	68	16	84	76.11	76.31	-7.69
Honduras	49	68	16	84	76.78	76.30	-7.70
Panama	.	72	14	86	74.16	76.00	-10.00
Nicaragua	47	66	17	83	74.92	74.02	-8.98
Morocco	57	61	19.5	80.5	74.87	73.36	-7.14
Guyana	.	70	15	85	.	72.92	-12.08
Peru	52	62	19	81	72.58	72.76	-8.24
South Africa	63	67	16.5	83.5	68.90	72.56	-10.94
El Salvador	51	63	18.5	81.5	71.10	72.09	-9.41
Bhutan	.	70	15	85	.	71.56	-13.44
Guatemala	50	61	19.5	80.5	72.45	71.35	-9.15
Dominican Rep.	48	57	21.5	78.5	70.09	70.15	-8.35
Indonesia	46	52	24	76	69.07	67.58	-8.42
Turkmenistan	.	62	19	81	66.75	66.63	-14.37
Uzbekistan	58	57	21.5	78.5	67.37	65.63	-12.87
Azerbaijan	.	55	22.5	77.5	66.20	65.06	-12.44
Romania	.	51	24.5	75.5	64.18	64.96	-10.54
Mongolia	.	59	20.5	79.5	65.62	64.72	-14.78
Ghana	43	58	21	79	67.20	64.43	-14.57
Maldives	.	58	21	79	.	63.93	-15.07
Vanautu	.	50	25	75	.	63.56	-11.44
Tajikistan	.	53	23.5	76.5	64.77	62.63	-13.87

Pakistan	38	54	23	77	65.30	62.52	-14.48
Belize	.	47	26.5	73.5	.	61.92	-11.58
Bangladesh	23	48	26	74	63.32	61.09	-12.91
Fiji	.	43	28.5	71.5	.	60.73	-10.77
China	23	44	28	72	59.72	60.67	-11.33
Viet Nam	22	41	29.5	70.5	61.40	60.02	-10.48
Zimbabwe	49	57	21.5	78.5	53.89	58.16	-20.34
Gambia	.	53	23.5	76.5	60.42	57.93	-18.57
Senegal	35	52	24	76	58.65	57.10	-18.90
Cape Verde	.	42	29	71	.	56.74	-14.26
Equatorial Guinea	.	53	23.5	76.5	.	55.99	-20.51
Bolivia	33	45	27.5	72.5	55.87	55.58	-16.92
Kenya	42	48	26	74	54.69	55.34	-18.66
Swaziland	.	52	24	76	.	53.64	-22.36
Papua New Guinea	45	45	27.5	72.5	52.73	53.27	-19.23
Cameroon	21	48	26	74	52.50	52.55	-21.45
Djibouti	48	50	25	75	.	52.54	-22.46
Mauritania	28	42	29	71	56.78	51.84	-19.16
Botswana	38	41	29.5	70.5	46.45	51.30	-19.20
Gabon	.	36	32	68	.	49.86	-18.14
Sudan	33	34	33	67	.	49.43	-17.57
Tanzania-UR	47	46	27	73	.	49.28	-23.72
Solomon Islands	.	31	34.5	65.5	.	48.74	-16.76
Uganda	43	41	29.5	70.5	51.37	48.48	-22.02
Malawi	36	46	27	73	.	46.12	-26.88
India	12	30	35	65	46.63	46.03	-18.97
Zambia	41	45	27.5	72.5	.	45.73	-26.77
Lesotho	37	37	31.5	68.5	40.30	45.04	-23.46
Lao PDR	.	30	35	65	47.40	44.86	-20.14
Madagascar	12	33	33.5	66.5	45.60	44.27	-22.23
Haiti	15	34	33	67	.	44.15	-22.85
Nepal	12	27	36.5	63.5	45.81	44.11	-19.39
Cote d'Ivoire	31	40	30	70	.	43.99	-26.01
Yemen	21	30	35	65	47.08	43.45	-21.55
Mali	36	45	27.5	72.5	.	43.25	-29.25
Burundi	44	36	32	68	.	42.17	-25.83
Comoros	23	23	38.5	61.5	.	41.30	-20.20
Rwanda	37	41	29.5	70.5	.	41.10	-29.40
Nigeria	39	38	31	69	39.75	40.78	-28.22
Benin	11	32	34	66	.	40.31	-25.69
Togo	37	34	33	67	.	39.25	-27.75
Timor-Leste	.	33	33.5	66.5	.	38.66	-27.84
Dem. Rep. of the Congo	18	29	35.5	64.5	.	36.19	-28.31
Guinea-Bissau	.	34	33	67	.	35.81	-31.19
Central African Rep.	23	27	36.5	63.5	.	35.41	-28.09
Mozambique	.	27	36.5	63.5	.	34.37	-29.13
Sierra Leone	.	39	30.5	69.5	.	32.83	-36.67
Cambodia	.	16	42	58	33.24	31.88	-26.12
Somalia	.	25	37.5	62.5	.	29.75	-32.75
Angola	30	30	35	65	.	29.74	-35.26
Sao Tome and Principe	.	24	38	62	.	29.00	-33.00
Congo	.	9	45.5	54.5	.	28.46	-26.04
Eritrea	8	9	45.5	54.5	.	28.04	-26.46

Guinea	17	13	43.5	56.5	.	26.42	-30.08
Liberia	38	26	37	63	.	25.58	-37.42
Burkina Faso	13	12	44	56	.	21.10	-34.90
Ethiopia	4	6	47	53	.	18.83	-34.17
Chad	6	8	46	54	.	18.25	-35.75
Niger	7	12	44	56	.	14.56	-41.44

Sources: Figures for 1990 and 2000 based on WHO-UNICEF (2004). Projections based on models discussed in the paper.

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