

ESTIMATING GLOBAL SLUM DWELLERS

- MONITORING THE MILLENNIUM DEVELOPMENT GOAL 7, TARGET 11-

- Harvey Herr and Guenter Karl¹

Introduction.

The Millennium Declaration of the United Nations was adopted by 147 heads of states during the year 2000 general assembly. This declaration contains detailed goals that were further detailed in the General Assembly 2001 document entitled “Road Map towards the implementation of the United Nations Millennium Declaration.” The Road Map contains 8 goals, 18 targets and 48 indicators. Millennium Development Goal 7 is “Ensure Environmental Sustainability”, Target 11 is “By 2020 to have achieved a significant improvement in the lives of 100 million slum dwellers.” The indicators associated with this target are as follows: indicator 30, “proportion of urban population with access to improved sanitation”, and indicator 31, “proportion of households with secure tenure.”

Goal 7, Target 11 requires an estimation of global slum dwellers. Research on estimating the number of slum dwellers started with an attempt to measure the phenomenon “secure tenure.” Secure tenure is the concept of “protection from involuntary removal from land or residence except through due legal process.” The lack of data based on a specific and operational definition made direct estimation impossible. Initial efforts attempted unsuccessfully to use tenure status data (owner, renter and squatter) as a proxy measure. Deliberation by UN-HABITAT professional staff proposed that the attribute of secure tenure would be demonstrated in household behaviour. Households with secure tenure would tend to have more improvements than households without secure tenure and that this could be measured by a proxy index that included dwelling structure and amenities data. This was seen as a subset of the UN-HABITAT slum index initiative that was already underway. The resulting secure tenure index provides a fair assessment of the magnitude of slum dwellings based on city summary data collected from 237 cities by UN-HABITAT.

There are two objectives of this paper. First is to explain and document how the slum population has been estimated by using a composite index. Second is to outline the way the MDG goal on slum dwellers will be monitored in the years to come. The following parts discuss the data and methodological issues.

Estimating Total Slum Dwellers.

Primary data sources:

The Urban Indicators Programme of the Urban Secretariat, UN-HABITAT provided the database for the estimation. The data have been collected to monitor the Habitat Agenda based on Resolutions 15/6 and 17/1 of the UN Commission on Human Settlements. 1998 data were collected from 232 cities in year 2000-2001 and 1993 data from 237 cities in year 1995-1996. The mandate for collection of city level data in 1995-1996 covered 46

¹ Harvey Herr is a consultant to UN-HABITAT; Guenter Karl is Co-ordinator Global Urban Observatory and Statistics Section of UN-HABITAT. The opinions expressed by the authors do not reflect the official views and policies of the United Nations Human Settlements Programme (UN-HABITAT).

indicators; this was reduced to 23 indicators for the 2000-2001 collection. The data are city summary data, i.e.; data were collected at the city level and not the household level.

Secondary data sources.

Numerous local studies of cities and slums are cited in the text below. These data were used to illustrate and confirm the findings of the secure tenure based proxy estimates of slum dwellers and to update the data in the Urban Indicators database.

Preparing the data for analysis.

The Urban Indicators data were first reviewed and improved to compensate for non-response and missing data.

Using the data from 1993 and 1998.

The Secure Tenure Index is prepared for the MDG baseline year using Urban Indicators 1993 data. The Urban Indicators 1998 data were used to cross-reference and test the 1993 findings. Not all the data necessary for the formulation of the Secure Tenure Index were available in the 1998 data. Weights were prepared and validity checks made on both the 1993 and the 1998 data.

Checking the data for anomalies.

Frequency distributions for the variables were examined for irregularities and outliers. 1993 and 1998 data were compared. Consistency checks were performed including a summary check of total tenancy to ensure that all categories of tenancy totalled to approximately 100%. Consistency checks did reveal errors that were remedied. There were frequent instances of missing data.

Replacement of missing data.

Not all cities reported on all items requested. Where possible alternative sources of city data were used to replace missing data. Among these sources of data were: 1) Metro Housing (1999), "Report on Selected Findings Related to Housing from the Quality of Life Survey", May 1999, Metro Housing, Durban, South Africa; 2) Felisa U. Etemadi (2000), "Civil society participation in city governance in Cebu City", Environment&Urbanization Vol 12 No 1 April 2000; 3) Solomon Benjamin(2000) "Governance, economic settings and poverty in Bangalore", op. cit.; 4) Carole Rakodi, Rose Gatabaki-Kamau, and Nick Devas (2000), "Poverty and political conflict in Mombasa", op. cit.; 5) Jo Beall, Owen Crankshaw and Susan Parnell (2000), "Local government, poverty reduction and inequality in Johannesburg", op. cit.; 6) Asian Development Bank "Cities Data Book" <http://www.citiesdatabook.org/index.cfm>; 7) World Bank (1997), "Poverty in Cote d'Ivoire, A Framework for Action", Report No. 15640-IVC, June 14, 1997, Human Development Technical Group III, Cote d'Ivoire Country Department, Africa Region, World Bank Poverty Assessment, a World Bank publication; 8) The Republic of Uganda (2000), "Kampala District Report", Uganda Participatory Poverty Assessment Process, The Republic of Uganda, Ministry of Finance, Planning and Economic Development, Kampala, January 2000; 9) UN-HABITAT (2001), "Nairobi Situation Analysis, Consultative Report",

Government of Kenya, UN Habitat, Collaborative Nairobi Slum Upgrading Initiative, June 2001; 10) Nairobi City Council (2001), “Huruma Informal Settlements”, Planning Survey Report, December 2001, compiled by representatives of the Huruma informal settlements, the Nairobi City Council, the Nairobi Informal Settlements Co-ordination Committee and Pamoja Trust.

Systematic replacement of missing data.

Following the insertion of missing data from alternative sources (above), missing value replacement routines were employed to replace the remaining missing values. These routines estimated the missing value by taking the mean value of the two adjacent cities. The reporting cities were first sorted by region and country so those cities from the same region and/or country were adjacent. The data were examined comparing pre and post missing value replacement. Original variables were retained in the database alongside the missing value adjusted variables. No significant changes in the distributions were introduced as evidenced by comparing mean, mode and variance before and after adjustment.

The effect of missing value adjustment on the estimates.

The following table illustrates the effect of missing value adjustment. The variables listed on the left-hand-side show first the Missing Value adjusted attribute followed below by the unadjusted attribute. The mean, median and standard deviation values are shown split across developing and developed regions (UNSD definition). It can be seen that the effect of missing value adjustment has been small on the mean and median values.

Urban Indicators 1993

	Developing Region			Developed Region		
	Mean	Median	Std Deviation	Mean	Median	Std Deviation
Water Access 200m (MV adjusted)	.814	.857	.169	.987	1.000	.030
Water Access 200m	.824	.871	.179	.991	1.000	.027
Connections to Sewer (MV adjusted)	.423	.460	.309	.932	.960	.090
Connections to Sewer	.391	.320	.338	.933	.970	.092
Secure Tenure(% of Households) MV adjusted	.929	.972	.097	.986	1.000	.026
Secure Tenure (% of Households)	.916	.972	.114	.988	1.000	.026

Urban Indicators 1998

	Developing Region			Developed Region		
	Mean	Median	Std Deviation	Mean	Median	Std Deviation
Water Access 200m (M.V. adjusted)	.846	.900	.186	.983	1.000	.062
Households with access to water within 200 m (%)	.848	.900	.189	.985	1.000	.060
Connections to Sewer (M.V. adjusted)	.550	.603	.308	.959	.980	.060
Household connections to sewer (%)	.577	.613	.316	.962	.998	.054
Secure Tenure (% of Households) MV adjusted	.870	.916	.141	.968	1.000	.115
Secure Tenure (% of Households)	.874	.902	.119	.959	1.000	.145

Weighting the data for global estimates

The data from the 1993 Urban Indicators and the 1998 Urban Indicators cities do not represent a probability sample of cities drawn from a sampling frame (list of all known cities). To correct the distributions of the reporting cities to reflect the true underlying distribution of cities by size and region required the introduction of a weighting factor. DESA geographic standards for development category, major area and region classifications were applied to the Urban Indicators data. A global list of cities was developed by UN-HABITAT and the global distribution of cities by size and DESA major area tabulated. The distribution of cities from the Urban Indicators programme was compared with the distribution of cities from the global list of cities. Weights were then calculated by major area and size to permit initial estimates of the global situation. These weights were applied to the 1993 Urban Indicators data and used to provide the estimates for the major areas and the development category (Developed/Developing).

The following tables compare the number of cities by size and major area for:

1. UIP 1993 and UIP 1998 reporting cities;
2. the global list of cities of size 100,000 or more (the universe of cities);
3. the UIP 1993 and UIP 1998 weighted cities.

The percentages in the tables are the **per cent that the table cell is of the total table**. Table 2 is the “benchmark” and represents the true distribution of cities. Comparing Tables 1 and 2 it is readily seen that the UIP reporting cities under represented the smaller size cities. UIP 1993 had no cities reporting in the lowest size category for North America. This is seen in Table 1A and in Table 3A. Caution is advised therefore in using the North American estimates:

Table 1A – UIP 1993 Cities (Unweighted Distribution)

Major UN DESA Regions * City Size Group 2 Crosstabulation

			City Size Group 2				Total
			less than 300,000	300,000 to 999,999	1,000,000 to 4,999,999	5,000,000 or more	
Major UN DESA Regions	Africa	Count	44	32	16	3	95
		% of Total	18.6%	13.5%	6.8%	1.3%	40.1%
	Asia + Oceania	Count	9	12	21	10	52
		% of Total	3.8%	5.1%	8.9%	4.2%	21.9%
	Europe	Count	16	19	14	2	51
		% of Total	6.8%	8.0%	5.9%	.8%	21.5%
	Latin America and Caribbean	Count	11	7	10	4	32
		% of Total	4.6%	3.0%	4.2%	1.7%	13.5%
	Northern America	Count		2	4	1	7
		% of Total		.8%	1.7%	.4%	3.0%
Total	Count	80	72	65	20	237	
	% of Total	33.8%	30.4%	27.4%	8.4%	100.0%	

Table 1B – UIP 1998 Cities (Unweighted Distribution)

Major Area * City Size Group 2 Crosstabulation

			City Size Group 2				Total
			less than 300,000	300,000 to 999,999	1,000,000 to 4,999,999	more than 5,000,000	
Major Area	Africa	Count	19	17	23	3	62
		% of Total	8.3%	7.4%	10.0%	1.3%	27.0%
	Asia + Oceania	Count	9	11	17	10	47
		% of Total	3.9%	4.8%	7.4%	4.3%	20.4%
	Europe	Count	19	18	15	2	54
		% of Total	8.3%	7.8%	6.5%	.9%	23.5%
	Latin America and Caribbean	Count	27	7	14	5	53
		% of Total	11.7%	3.0%	6.1%	2.2%	23.0%
	Northern America	Count	1	2	10	1	14
		% of Total	.4%	.9%	4.3%	.4%	6.1%
Total	Count	75	55	79	21	230	
	% of Total	32.6%	23.9%	34.3%	9.1%	100.0%	

Table 2 - The Global List of Cities of Size 100,000 or more (the true distribution).
 Table 3A – UIP 1993 (Weighted Distribution)

Major UN DESA Regions * City Size Group 2 Crosstabulation

			City Size Group 2				Total	Total
			less than 300,000	300,000 to 999,999	1,000,000 to 4,999,999	5,000,000 or more		
Major UN DESA Regions	Africa	Count	348	99	36	3	486	486
		% of Total	8.1%	2.3%	.8%	.1%	11.3%	10.6%
	Asia + Oceania	Count	1289	595	199	23	2106	2106
		% of Total	30.0%	13.9%	4.6%	.5%	49.0%	50.0%
	Europe	Count	723	198	52	3	976	976
		% of Total	16.8%	4.6%	1.2%	.1%	22.7%	13.3%
	Latin America and Caribbean	Count	380	174	47	12	613	608
		% of Total	8.8%	4.1%	1.1%	.3%	14.3%	13.3%
	Northern America	Count	nil	83	31	1	115	398
		% of Total		1.9%	.7%	.0%	2.7%	3.7%
Total		Count	2740	1149	365	42	4296	4574
		% of Total	63.8%	26.7%	8.5%	1.0%	100.0%	100.0%

Table 3B – UIP 1998 (Weighted Distribution)

Major Area * City Size Group 2 Crosstabulation

			City Size Group 2				Total
			less than 300,000	300,000 to 999,999	1,000,000 to 4,999,999	more than 5,000,000	
Major Area	Africa	Count	348	99	36	3	486
		% of Total	7.6%	2.2%	.8%	.1%	10.6%
	Asia + Oceania	Count	1289	595	199	23	2106
		% of Total	28.1%	13.0%	4.3%	.5%	46.0%
	Europe	Count	723	198	52	3	976
		% of Total	15.8%	4.3%	1.1%	.1%	21.3%
	Latin America and Caribbean	Count	380	174	47	15	616
		% of Total	8.3%	3.8%	1.0%	.3%	13.4%
	Northern America	Count	281	83	31	1	396
		% of Total	6.1%	1.8%	.7%	.0%	8.6%
Total		Count	3021	1149	365	45	4580
		% of Total	66.0%	25.1%	8.0%	1.0%	100.0%

Effects of weighting on the estimates.

The weights were designed to compensate for the distortions in the UIP reporting cities. Smaller cities have a larger weight assigned than do larger cities. Weighting has tended to marginally increase the estimates. This can be seen in the weighted and unweighted estimates below. No systematic bias was detected in the procedure:

Table 4A - Unweighted estimates by size category (UIP 1993)

		Water Access 200m (MV adjusted)	Connections to Sewer (MV adjusted)	Secure Tenure(% of Households) MV adjusted
less than 300,000	Mean	.790	.385	.964
	Median	.811	.288	.993
	Std Deviation	.202	.380	.079
300,000 to 999,999	Mean	.843	.447	.933
	Median	.923	.317	.982
	Std Deviation	.193	.412	.121
1,000,000 to 4,999,999	Mean	.892	.603	.952
	Median	.970	.727	.988
	Std Deviation	.162	.347	.069
5,000,000 or more	Mean	.907	.602	.909
	Median	.939	.634	.987
	Std Deviation	.107	.339	.125
Group Total	Mean	.844	.482	.946
	Median	.920	.460	.989
	Std Deviation	.187	.387	.097

Table 4B - Unweighted estimates by size category (UIP 1998)

		Water Access 200m (MV adjusted)	Connections to Sewer (MV adjusted)	Secure Tenure(% of Households) MV adjusted
less than 300,000	Mean	.845	.561	.954
	Median	.912	.631	.972
	Std Deviation	.172	.349	.064
300,000 to 999,999	Mean	.878	.540	.925
	Median	.918	.600	.981
	Std Deviation	.154	.361	.127
1,000,000 to 4,999,999	Mean	.918	.604	.938
	Median	.980	.600	.965
	Std Deviation	.124	.333	.078
5,000,000 or more	Mean	.908	.620	.910
	Median	.938	.688	.986
	Std Deviation	.102	.303	.117
Group Total	Mean	.861	.560	.944
	Median	.920	.600	.972
	Std Deviation	.165	.351	.088

Table 5A – Weighted estimates by size category (UIP 1993)

		Water Access 200m (M.V. adjusted)	Connections to Sewer (M.V. adjusted)	Secure Tenure (% of Households) MV adjusted
less than 300,000	Mean	.886	.648	.928
	Median	.945	.679	.944
	Std Deviation	.154	.312	.085
300,000 to 999,999	Mean	.864	.677	.883
	Median	.949	.800	.939
	Std Deviation	.192	.326	.160
1,000,000 to 4,999,999	Mean	.911	.689	.891
	Median	.980	.797	.933
	Std Deviation	.162	.330	.156
more than 5,000,000	Mean	.879	.722	.875
	Median	.985	.800	.858
	Std Deviation	.204	.307	.100
Group Total	Mean	.888	.676	.900
	Median	.970	.780	.936
	Std Deviation	.171	.320	.134

Table 5B – Weighted estimates by size category (UIP 1998)

		Water Access 200m (M.V. adjusted)	Connections to Sewer (M.V. adjusted)	Secure Tenure (% of Households) MV adjusted
less than 300,000	Mean	.905	.734	.935
	Median	.990	.743	.960
	Std Deviation	.131	.243	.077
300,000 to 999,999	Mean	.910	.753	.876
	Median	.943	.820	.902
	Std Deviation	.122	.230	.141
1,000,000 to 4,999,999	Mean	.924	.734	.896
	Median	.980	.797	.965
	Std Deviation	.152	.274	.169
more than 5,000,000	Mean	.913	.757	.863
	Median	.985	.810	.854
	Std Deviation	.152	.271	.096
Group Total	Mean	.908	.739	.916
	Median	.970	.780	.946
	Std Deviation	.131	.243	.109

Known problems with data for secure tenure.

Data collected through the Urban Indicators programme are city summary data on 46 indicators in 1993 and 23 indicators in 1998. Tenure data, for example, reported by the cities was typically from the most recent census. Census questionnaires ask tenure status in a form that apparently does not readily reveal the underlying security of tenure. For example, the tenure questions on the census (e.g., Kenya Population and Housing Census 1999) ask unit tenure status broadly divided into owner occupied and renter occupied categories. Owner status categories are typically: 1) Purchased, 2) Constructed, and 3) Inherited. Renter status asks whom the unit is rented from 1) Government, 2) Local Authority, 3) Parastatal, 4) Private Company, 5) Individual or 6) other form of tenure.

It is important to note that within the tenure categories unsecure tenure situations may be masked. An explicit example of this is revealed from the enumeration of an informal settlement in Nairobi, Kenya (Huruma Informal Settlement). The study enumerated all households within the informal settlement asking among other questions the status of tenancy. 48% of responding households report they were tenants, 43% reported that they were structure owners, the remaining households were either vacant or of unknown tenancy status.

The same report notes that “security of tenure is an over-arching problem that affects all informal settlements in the city.” The land where this informal settlement is situated is public land under the trusteeship of the city council and no individual ownership or tenancy

has been allocated to the residents. The residents do not have secure tenure, but their response to the tenancy status suggests that 91% of the residents enjoyed secure tenure when the reality is that none have secure tenure.² In 1993 Nairobi as a whole reported 95% secure tenure, whereas Nairobi City Council officials believe that the true figure is between 40-50%. The preceding leads to the conclusion that using the tenure status proxy is inadequate and leads to a systematic over statement of secure tenure and an underestimation of slum dwellers. Based on these findings a proxy secure tenure index was proposed and implemented by UN-HABITAT. This index is described below.

Further examples of the overstatement of secure tenure are extracted from recent UN Habitat field reports:

Tanzania:

Field Study Observation	Studies conducted in 1995 indicate that nationally about 70 percent of urban population live in squatter/unplanned settlements and that about 60 percent of urban housing stock are to be found in these settlements: in Dar es Salaam, Arusha and Mbeya about 70 percent and in Mwanza, 40 percent.
Estimated from tenure status alone	UIP 1993 reported 100% secure tenure; no slums

Ethiopia

Field Study Observation	The urban poor in Addis Ababa live in a crowded, dilapidated environment, with very poor or non-existing sanitation facilities. According to 1994 census, only 0.3 and 1.3% of the housing units and people are connected to systems of modern sanitation, respectively while 24% lack any toilet facilities and 63,1% use pit latrines. Solid waste collection in the city capital is far below satisfactory level. Consequently, it is estimated that more than 80% of the population is living in slums.
Estimated from tenure status alone	UIP 1993 reported that Addis Ababa had 98.1% secure tenure; or 1.9% slums.

Methodology.

Foundations of the Secure Tenure Index

The Secure Tenure Index is a summary measure of the manifestation of security of tenure in cities. It hypothesises the physical result of security of tenure in the city. Where secure

² Representatives of the Huruma Informal Settlements, the Nairobi City Council, the Nairobi Informal Settlements Coordination Committee and Pamoja Trust (2001), Huruma Informal Settlements, Planning Survey Report, December, Nairobi, Kenya.

tenure exists there will be comparatively more dwelling unit assets and amenities. The characteristic variables for the Secure Tenure Index include the following³:

- the Proportion of Households with Access to Water (within 200 meters),
- the Proportion of Permanent Structures in the Housing Stock,
- the Proportion of Housing that is in Compliance with Local Regulations,
- the Proportion of Households Connected to a Sewer,
- the Proportion of Households Connected to Electricity.

Confirming the Secure Tenure Index Hypothesis – Principal Component Analysis

Principal Component Analysis (PCA) was used as a confirmatory procedure for the Secure Tenure Index hypothesis that the selected variables are related and together forms a common component. The PCA simplifies a complex phenomenon represented by many variables into a parsimonious component(s) that well represents all the contributing characteristics to the phenomenon. The result of the PCA applied to our hypothesised characteristic variables did confirm, using the standard statistical procedures for PCA, that the five characteristics were measuring the same underlying phenomenon. The result of the application of PCA was that a single component was formed that explains the underlying phenomenon of security of tenure. Since it is a summary measure of the infrastructure condition, permanency of structure and legality of the slum dwelling, it is a good estimator of slum conditions. The index was therefore proposed as an alternative proxy measure for estimating the number of slum dwellers. The selection of the hypothesised variables for the PCA was achieved through a combination of policy direction (e.g., which variables make sense and are the responsibility of UN-HABITAT), the measurement requirements for Target 11 of the MDG, and availability of the data.

The PCA for the Secure Tenure Index

A PCA solution reduces the contributing variables into sets of variables that are highly correlated with one another, but unrelated to other sets of correlated variables. The PCA “extracts” these sets of variables by examining the correlation matrix of all the variables. A common measurement for the suitability of a correlation matrix for PCA is the Kaiser-Meyer-Olkin Measurement of Sampling Adequacy.⁴ Values for this test of adequacy should be above 0.7. A second measure of the suitability of the correlation matrix for PCA is the Bartlett Test of Sphericity. This last measure tests the hypothesis that the correlation matrix is an identity matrix. If the significance measurement is large, it suggests that the hypothesis that the correlation matrix is an identity matrix cannot be rejected. The table below confirms that the PCA for the Secure Tenure Index is using a suitable correlation matrix.

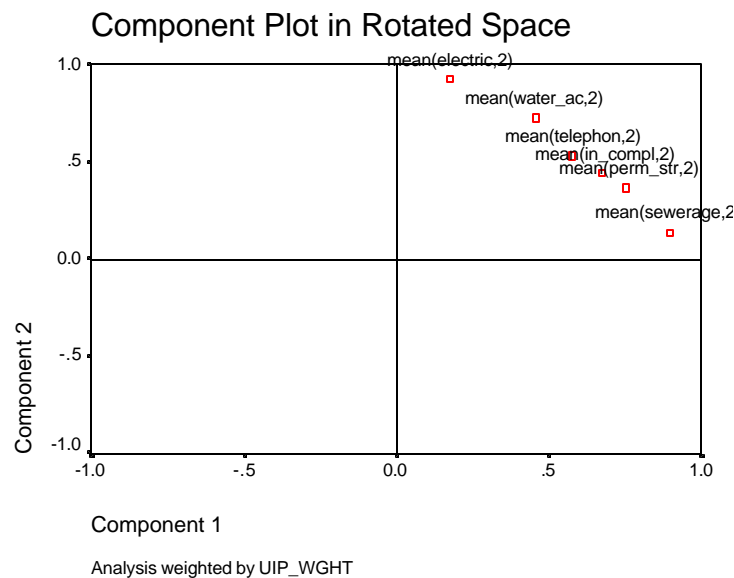
³ N. Bazoglu and D. Biau, “Measuring Slums: a Composite Index”, a paper presented at Cities Alliance Consultative Group Meeting, Kolkata, 11 December 2001. The constituent variables of this index are in compliance with the corporate thinking in UN-Habitat that was developed via a series of task-force meetings. Participants at that meeting were: Nefise Bazoglu, Eduardo Moreno, Christine Auclair, Guenter Karl, Daniel Biau, Farouk Tebbal, Inge Jenssen, and Gulelat Kebede

⁴ Jae-On Kim and Charles W. Mueller (1994), “Factor Analysis: Statistical Methods and Practical Issues”, page 122, in Factor Analysis and Related Techniques, Michael S. Lewis -Beck ed., International Handbook of Quantitative Applications in the Social Sciences, Volume 5.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.			.782
Bartlett's Test of Sphericity	Approx. Chi-Square	9684.015	
	df	10	
	Sig.	.000	

The analysis tested the PCA solution for 1, 2 and 3 component extractions. Since the purpose of PCA is parsimony it was determined that a single component solution was appropriate based on an examination of the component loading plot and the initial eigenvalues of the component solutions.⁵ The plot of a two-component solution shows that the variables in the solution are well grouped and that a single component solution is achievable.



The most commonly used procedure for determining the number of initial components (or factors) to be extracted is a rule-of-thumb--the rule known either as the Kaiser or eigenvalue criterion (eigenvalue greater than or equal to 1).⁶ The table below of Total Variance Explained shows that only the first component has an eigenvalue greater than 1.

⁵ Jae-On-Kim and Charles W. Mueller (1994), "Introduction to Factor Analysis: What It Is and How to Do It" page 38, in Factor Analysis and Related Techniques, Michael S. Lewis -Beck, International Handbooks of Quantative Applications in the Social Sciences, Volume 5, Sage Publications, note that: "For example, given that both one-common factor and two-common factor models are consistent with the observed data, we accept on faith the more parsimonious model."

⁶ Jae-On Kim and Charles W. Mueller (1994), "Introduction to Factor Analysis: What it is and How to Do It", page 43, in Factor Analysis and Related Techniques, Michael S. Lewis -Beck ed., International Handbook of Quantitative Applications in the Social Sciences, Volume 5; A. Koutsoyannis (1977) Theory of Econometrics, second edition, p. 433.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.178	63.563	63.563	3.178	63.563	63.563
2	.694	13.875	77.438			
3	.476	9.517	86.955			
4	.407	8.136	95.091			
5	.245	4.909	100.000			

Extraction Method: Principal Component Analysis.

The single component solution explains 64% of the variance and was deemed adequate for calculating the Secure Tenure Index. The single component solution can be easily scaled from 1 to 100 and is therefore more intuitively appealing. A single component also has the advantage of a simple definition. The largest principal component is sometimes called the “size factor” when the loadings are all positive and about of the same magnitude. “If we wanted only a single index that best summarised the data, the first component is it.”⁷ The component loadings are shown below and are all positive and approximately homogenous. Each of the variables contributes approximately equally to the component.

Component Matrix^a

	Component
	1
Permanent Structure	.835
In Compliance	.829
Water Access	.819
Sewer Connection	.757
Electricity Connector	.743

Extraction Method: Principal Component Anal;

a. 1 components extracted.

The reduction of the contributing variables to a component is accomplished through the calculation of a component (factor) score. The component score is a linear combination of the component score coefficient for the variable (see table below) with the standardised value of the variable. In this case the coefficient is the equivalent to regression weights obtained when the factor is regressed on the variables. The result is that each city has a factor score that represents a linear combination of the variables extracted for that component. The component score is the basis for the Secure Tenure Index.

⁷ George H. Dunteman (1994), “Principal Components Analysis”, page 189, in Factor Analysis and Related Techniques, Michael S. Lewis -Beck ed., International Handbook of Quantitative Applications in the Social Sciences, Volume 5.

Component Score Coefficient Matrix

	Component
	1
Electricity Connection	.234
In Compliance	.261
Permanency of Structure	.263
Sewer Connection	.238
Water Access	.258

Extraction Method: Principal Component Analysis

Rotation Method: Varimax with Kaiser Normalization

The Secure Tenure Index is the normalised component score. Normalisation is achieved by subtracting the minimum value for the component scores from the actual value of the component score for each city. Dividing this result by the maximum value for the all-component scores, less the minimum value for the all-component scores and multiplying the result of this division by 100 results in an index scaled from 0 to 100. (The Human Development Index calculates its “dimension indices” in a similar manner.)

Results.

Comparing the Secure Tenure Index with other Common Indicators

The resulting index is an intuitively suitable index that tracks well with other indicators such as under-five mortality rate, solid waste disposal and wastewater treatment. Shown graphically below through scattergrams, are the results that indicate a strong relationship to health as indicated by the under-five mortality rate (defined as the proportion of children who die before reaching their fifth birthday). Both the secure tenure index itself and the constituent component variables show a relationship with the under-five mortality rate.

Substantiating this relationship is recent information from local studies of Nairobi, Kenya slum areas showing empirically that the under-five mortality rate in Nairobi’s slums are 2-3 times higher (151 per 1000) than the city as a whole (62 per 1000) and 50% higher than rates in rural areas. The study applied the Demographic and Health Survey methodology to slum areas in Nairobi.⁸ The results suggest a significant infrastructure-led dichotomy in under-five mortality consistent with the secure tenure index.

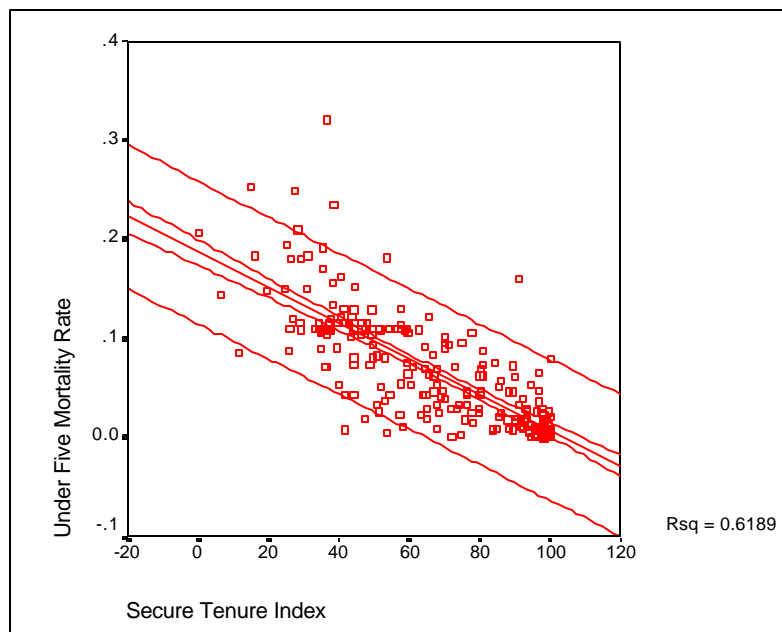
⁸ African Population and Health Research Center (2002), “Population and Health Dynamics in Nairobi’s Informal Settlements, Report of the Nairobi Cross-sectional Slums Survey (NCSS) 2000”, April : the results of a random probability sample of 3256 women and 1,683 men resident in the slums of Nairobi city.

The report states that “the data show that slum residents distinctively lack basic amenities such as electricity, drinking water and proper sanitation.” The following table demonstrates this relationship.⁹ This illustrates that an amenities based estimator for slum dwellers is appropriate.

	Nairobi (per cent)	Slum Areas of Nairobi (per cent)
Per Cent Connection to Electricity	60	18
Per Cent Connected Piped Water	78	22
Per Cent Connection to Sewer	56	7
Under-five Mortality Rate (per 1000)	62	151

Nairobi’s slum dwellers, in the same survey, expressed their most important general needs/concerns by selecting among nine choices of need. The four highest-ranking categories of need were (in rank order): unemployment, housing, and lack of toilets and lack of water. Similarly, slum residents expressed their most important health needs as follows (in rank order): toilets, water, drainage and access to health services. This sanctions the concept that residents would demonstrate a propensity to acquire these amenities given security of tenure. 75% of slum residents currently without access to piped water routinely purchase water for their use.¹⁰

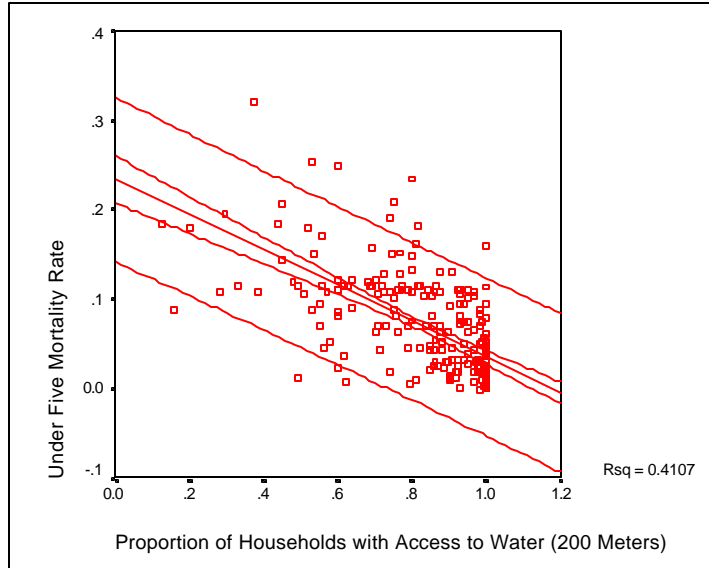
Relationship of the Secure Tenure Index to the Under Five Mortality Rate



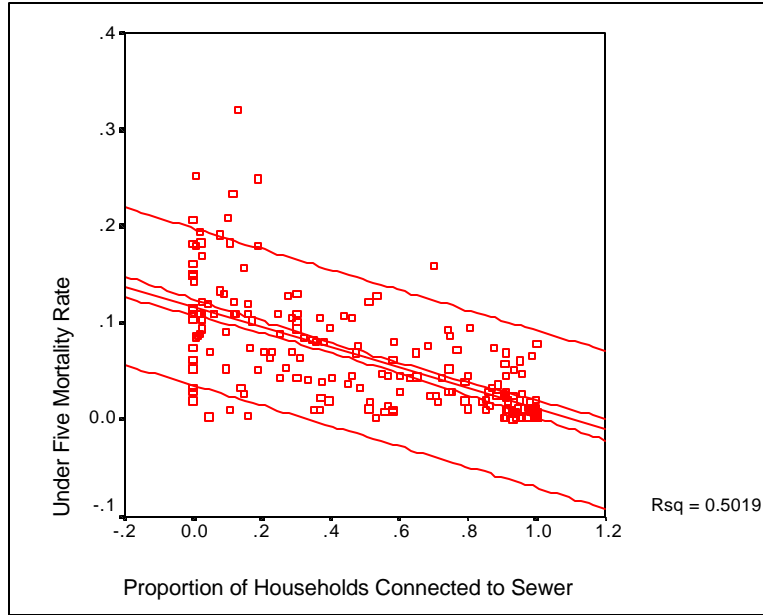
⁹ Op. Cit. Page 15

¹⁰ Op. Cit. Pages 15-20

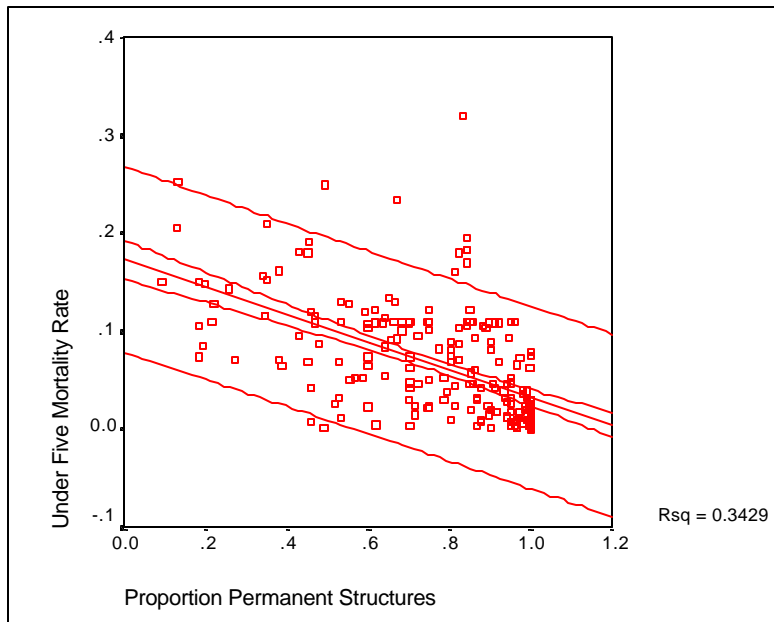
Relationship of Water Access to the Under Five Mortality Rate



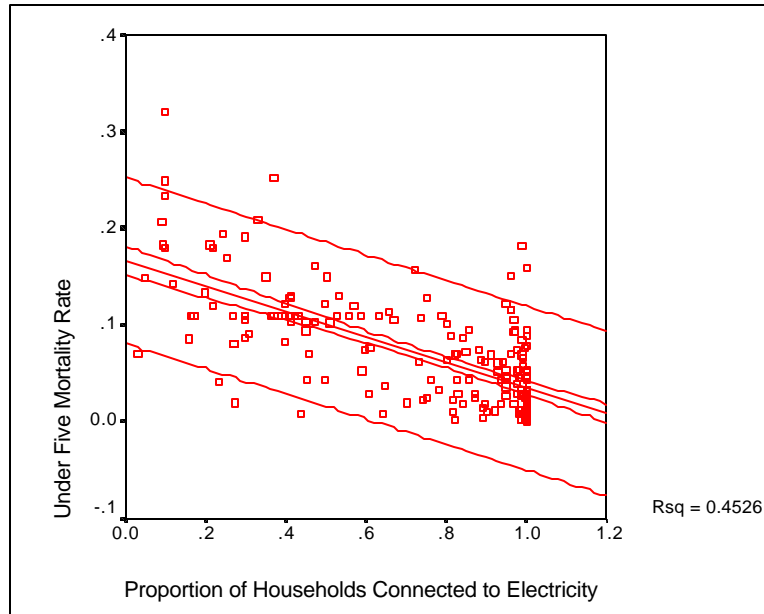
Relationship of Sewer Connection to the Under Five Mortality Rate



Relationship of Permanency of Structure to the Under Five Mortality Rate



Relationship of Electricity Connection to the Under Five Mortality Rate



Application of the index at the city level

How might cities themselves assess the index? Because of the relatively uniform factor loadings on the component by the variables (see above), an alternative linear combination of the variables may be proposed. This is to simply add the variables together assuming a factor loading or weight of 1 for each variable. Each of the variables is a city summary variable reporting the proportion of city households that fall within the category (e.g., per cent of households connected to sewer). Thus, each of the five variables has a range from 0% to 100%. The sum of the five variables therefore ranges from 0 to 500. Dividing the sum by 5 and subtracting from 100 closely approximates the index based on the normalised component score from the PCA. A city can calculate its position by adding the proportions and dividing by 5 and subtracting from 100. Estimates of global slum dwellers derived in this way closely approximate those obtained by the PCA calculation. The small difference is explained through assuming a weight factor of 1 for each of the variables in the calculation below, whereas the PCA uses the actual component loadings noted above.

Example: Harare, Zimbabwe

Variable	Percentage
Per cent with Electricity Connections	64
Per cent with Access to Water	97
Per cent with Sewer Connection	93
Per cent of Households in Compliance	88
Per cent of Permanent Structures	88
Total	430
Calculated Score (100 – (430/5))	14

Slum Dweller Population Estimates

The Secure Tenure Index is a proxy for the percentage of households with inadequate housing attributes. The percentage of households is converted directly into a population estimate using the World Urbanisation Prospects¹¹ population figures and projections. The baseline year (1993) estimate of global slum dwellers is 712 Million. The straight-line projection for 2001 based on the urban population projection is 837 Million. These estimates show that as many as 30% of the urban population in 1993 were living in inadequate housing conditions. Developing country cities have an estimated 38% of urban residents living in slums, while for developed country cities the estimate is 4%. Data by region is presented in the table below. Notable is Africa where 56% of the urban population is estimated to be living in slums. This unfortunate reality is in line with findings on Africa for higher consumption poverty and higher under-five mortality rates. Although slum dwellers and the urban poor are largely co-located, not all slum dwellers may be classified as poor. The attribute of slum dwelling is measured through the attributes of the Secure Tenure Index, whereas those living on less than \$1 per day (MDG Goal 1, Target 1) measure poverty for the MDG.

Most of the population growth of the last decade has occurred in the urban areas. Average annual growth rates for urban population in the least developed countries during the period 1995-2000 was 4.58% compared to a global figure of 2.11%. For the same period the rural population of least developed countries grew by 1.65% compared to a global rural growth of just 0.66%.¹² In Kenya, 85% of the population growth during the period 1989 to 1999 was in urban areas¹³ and this growth is largely believed to have been absorbed in informal settlements.

	Secure Tenure Index (1993)
Developing Region	62
Developed Region	96
Table Total	71

Major Area	1993 Urban Population ('000)	Secure Tenure Index 1993	Population Living in Slums 1993 ('000)
Africa	224592	44	125771
Asia + Oceania	1143933	63	423255
Europe	526926	96	21077
LAC	336326	74	87445

¹¹ United Nations (2001), World Urbanization Prospects: The 2001 Revision, Department of Economic and Social Affairs, Population Division, New York.

¹² United Nations (2000), World Urbanization Prospects, The 1999 Revision, Department of Economic and Social Affairs, Population Division, New York, Table A.6 and Table A.7

¹³ African Population and Health Research Center (2002), "Population and Health Dynamics in Nairobi's Informal Settlements, Report of the Nairobi Cross-sectional Slums Survey (NCSS) 2000."

Northern America	221739	99	2217
Total	2453515	71	711519

Monitoring Improvement in the Lives of 100 Million Slum Dwellers.

Future Data Collection and Analysis Activities:

Using the index at the household level.

A legitimate criticism of the index is that when used at the city summary level it has no cut-off point. It implies, correctly, that all cities can potentially have slums. UN-HABITAT is applying the principles of the index to the household level. UN-HABITAT wants to determine at the city level how many households have all, some, or none of the attributes associated with the index variables. In this way it will be able to determine the spectrum of slum dwellers that will range from those missing just one attribute to those that are missing all the attributes (the most severe cases). A decision can then be made to establish a cut-off point for slum dwellers, e.g., those missing two or more attributes. Initially, this will be tested in Nairobi, Kenya and for Mexico City household data.

The Global Sample of Cities

In the future data will be collected from a probability sample of cities of size 100,000 or more. This Global Sample of Cities (GSC) is designed to achieve estimation domains by city size and UN regions. UN-HABITAT has developed a sample frame of cities of size 100,000 or more. The sample frame currently contains 4574 cities. The number of cities selected in the initial trial sample is 427. The sample design anticipates a non-response rate of up to 20%. The probability sample will permit the calculation of confidence intervals for the estimates. The GSC is the principal tool for monitoring the MDG.

The initial GSC survey of cities will ask the sampled cities to both estimate the number of slum dwellers and to determine the number of households with all, some or none of the attributes contributing to the secure tenure index. This information will be used by UN-HABITAT to confirm and calibrate the slum dweller estimates.

The GSC is used primarily to collect city summary data with the city as the unit of analysis. A sub-sample of cities with the household as the unit of analysis is planned for up to 50 cities (plans are to primarily cover Africa, Asia and LAC countries). The sub-sample of cities is a probability sample with limited estimation domains. In these cities of the sub-sample, surveys will be conducted as add-ons (e.g., additional slum specific survey coverage and survey modules) to existing surveys. The DHS, LSMS, MICS, FAFO, PAPFAM, CWIQ or other type of household survey that provides the thematic focus and survey are examples. Secondary analysis of existing household data from the same sources is expected whenever the sample design will permit definition of estimation domains for the city. The purpose is to estimate intra-city differentials between the slum population and other urban neighbourhoods using Human Development Indicators such as IRM, U5MR, schooling rates, employment and poverty. This information is necessary for monitoring the MDG and the Habitat Agenda Goals.

Defining Secure Tenure.

A specific definition of secure tenure is necessary for future data collection rounds. We have identified the shortcomings of the current proxy definitions of secure tenure (see above). A specific definition of secure tenure is under review and will be the topic of expert group meetings before the end of 2002. Habitat will promote the use of this definition through the official international statistical institutions. The current prevailing definitions guiding this development are noted in the UN Principles and Recommendations for Population and Housing Censuses¹⁴. The definitions of tenure status apparently incorporate the meaning of secure tenure, but the legality of the relationship is not being captured and/or is being misunderstood during the enumeration. In the elaboration of an operational definition of secure tenure the Cities Alliance¹⁵, the Global Campaign for Secure Tenure¹⁶ and selected member countries¹⁷ will play a major role because they are directly involved in the implementation of slum upgrading projects.

Monitoring the Millennium Development Goal on Slums¹⁸.

UN-HABITAT is mandated to monitor MDG Goal 7, Target 11 through the year 2020. The Urban Secretariat of UN-HABITAT convened a meeting of its professionals to propose a methodology to measure “a significant improvement in the lives of at least 100 Million slum dwellers.”¹⁹ Two methodological options, not necessarily mutually exclusive, are under consideration. One option is city and household based and the other is based on a cohort population of slum dwellers.

Option I: Slum Appraisal

The Slum Appraisal is based on the GSC. The centrepiece is a brief questionnaire relevant to the MDG that includes an inventory of available data for the city. The objective is to summarise the information available in the sample cities, determine the quality of these data, and the ability of cities' to respond to regular data requests made by UN-HABITAT. The questionnaire is kept short to facilitate quick response and a higher response rate. Using standardised questions, the questionnaire will ask for information believed to be already available at a high percentage of cities, or that can be collected easily in a limited time with limited financial and technical resources:

¹⁴ United Nations (1998) Principles and Recommendations for Population and Housing Censuses, Revision 1, New York, Department of Economic and Social Affairs, Statistics Division, Statistical Papers, Series M No. 67/Rev.1 [ST/ESA/STAT.SER.M/67/Rev.1].

¹⁵ Joint programme between the World Bank and UN-HABITAT.

¹⁶ UN-HABITAT Campaign carried out by the Shelter Branch.

¹⁷ Brazil, Mexico, South Africa, India, Kenya and Viet Nam.

¹⁸ UN-HABITAT (2002), Urban Secretariat, “Road Map on Monitoring the Millennium Development Goal on Slum Dwellers”, May.

¹⁹ Instrumental in the definition of the monitoring programme were the contributions of Christine Auclair and Martin Raithelhuber of the Urban Secretariat. Their input is hereby greatly acknowledged.

	1990	2000
1. City population	X	X
2. % of households with access to water (200m distance)	X	X
3. % of households with access to sanitation	X	X
4. % of households living in permanent structures	X	X
5. % of households having secure tenure	X	X
6. % of households having any of combination of the four elements of the definition	X	X
7. Inventory of all data available on cities and slums with detailed source description (census, estimate, sample surveys, case studies, ...)	X	X
8. Local slum definition		X
9. No. of slum dwellers according to local definition	X	X

The survey can be completed at the Local Urban Observatory. The data will provide information about the percentage of slum dwellers worldwide and about the changes in the percentage of slum dwellers in the different major areas of the world between 1990 and 2000. The data are direct observation of slum dweller populations that we are currently estimating with the Secure Tenure Index. The response rates and the data quality for all questions except questions 6 are expected to be high. As question 6 is crucial for the slum appraisal, guidelines will be provided on how to use census data to prepare a response (these guidelines are one result of applying the Secure Tenure Index at the household level in Nairobi and Mexico City).

City Household Surveys

The objective of the household survey is to obtain intra-city differentials on the adversity of slum dwelling and to increase the precision of the estimate of slum dweller population. Some GSC cities may not be capable of obtaining data to respond to question 6 in the slum appraisal questionnaire. In these cities the intent is to intervene directly or in collaboration with other programmes to provide the information needed to assess and monitor the slum condition. Case studies of specific slums in the sample cities are a complementary tool providing a specific example of the living conditions of slum dwellers.

Consolidation of Monitoring

UN-HABITAT requires a regular monitoring of MDG Target 11 and the UN-HABITAT Agenda. Therefore, the relationship with the sample city needs to be long-term and institutionalised in UN-HABITAT client city network. The same sample of cities will be used for similar surveys as frequently as every two years. Those GSC sample cities not yet part of the Global Urban Observatory network will be integrated into the UN-HABITAT client city network structure. The GSC will then remain as a panel of cities and the subject of passive and direct capacity building over the next decades.

Option II: Cohort Monitoring / Family Life Survey

Option II is a longitudinal study of "cohorts" of slum families in different cities around the world. Cohort slum household conditions are monitored over time, starting in 2002 and ending 2020. In addition to the five quantitative elements of the UN-HABITAT slum definition, this survey is intended to track changes in the family situation of specific slum dwellers.

The cities for this survey will be selected purposefully in order to cover the impact of ongoing slum upgrading projects. The design of the study will draw upon previous surveys like the "Indonesia Family Life Survey"²⁰ done 1993/94 and 1997/98 (around 7000 households), the "Livelihood trajectories" done in Nepal between 1976 and 1996²¹, and the Population and Health Dynamics in Nairobi's Informal Settlements currently underway.

There are at least two ways to design such longitudinal studies. Most studies use the family in a household as their base unit, assuming that the changes in family composition and socio-economic situation over time give meaningful information about the well being of the household members. Families are tracked after a set period of time and the household members at that time are (re-) interviewed. An alternative design focuses on individual life stories, tracing a specific sample of people over time. This research work is proposed to be performed in five-year intervals by centres of excellence, e.g., universities or research institutes, with experience in longitudinal family surveys. There are opportunities for UN-HABITAT to add-on to or use existing longitudinal studies. Funding for these activities is anticipated from national and international research funding institutions. UN-HABITAT has a co-ordinating role in option II.

Monitoring the 100 Million in Summary

The aforementioned short questionnaire is the starting point for monitoring. Subsequent activities include the sample survey explained above and the periodic measurement on the Secure Tenure Index. Concurrently, UN-HABITAT will continue developing the Secure Tenure Index with the intention of producing a Slum Index that more comprehensively evaluates the extent of the slum conditions. The Slum Index is to include (but is not limited to) a direct measure of secure tenure, water and sanitation, permanency of structure, density and community attributes.

The first round survey identifies supplementary data and secondary analyses of cities and slums within cities. These data sources include: Demographic and Health Surveys (DHS), Living Standard Measurement Surveys (LSMS), Living Condition Surveys (Fafo Institute for Applied Social Science, Oslo, Norway), Multiple-Indicator Cluster Survey (MICS), Papfam and other large scale surveys that permit statistically valid analysis at the city level. Analysis of these data will guide development of the Slum Index and will calibrate the slum dweller estimates in those cities. We anticipate that these analyses will guide future expansion of data collection rounds while maintaining the basic set of variables necessary to track the slum dweller population over time.

²⁰ Rand Corporation (1994), Indonesia Family Life Survey: <http://www.rand.org/labor/FLS/IFLS/>

²¹ Blaikie, P., J. Cameron, et al. (1998). Livelihood Trajectories and Long Term Change. Final Report to ESCOR, January, Norwich.

References

African Population and Health Research Centre (2002) Population and Health Dynamics in Nairobi's Informal Settlements, Report of the Nairobi Cross-Sectional Slums Survey (NCSS) 2000, Nairobi, April.
Asian Development Bank (2002) Cities Data Book, http://www.citiesdatabook.org/index.cfm
Bazoglu, N. and Biau, D. "Measuring Slums: a Composite Index", a paper presented at Cities Alliance Consultative Group Meeting, Calcutta, 11 December
Beall Jo, Wankshaw Owen, Parneel Susan (2000) Local Government, Poverty Reduction and Inequality in Johannesburg , in Environment and Urbanization, Vol. 12 No. 1, April
Benjamin, Solomon (2000) Governance, Economic Settings and Poverty in Bangalore, in Environment and Urbanization, Vol. 12 No. 1, April
Blaikie, P., J. Cameron, et al. (1998) Livelihood Trajectories and Long Term Change. Final Report to ESCOR., Norwich.
Dunteman, George H. (1994) Principal Component Analysis, in: Michael S. Lewis Book (1994) Factor Analysis and Related Techniques, International Handbook of Quantitative Applications in the Social Sciences, Volume 5.
Etemadi, Felisa U. (2000) Civil Society Participation in City Governance, in Environment and Urbanization, Vol.12 No. 1, April
Gatabaki-Kamau, Rose and Nick Devas (2000) Poverty and Political Conflict in Mombasa in Environment and Urbanization, Vol. 12 No. 1, April
Government of Kenya and UNCHS (Habitat) (2001) Nairobi Situation Analysis, Consultative Report, Government of Kenya, UN-HABITAT, Collaborative Nairobi Slum Upgrading Initiative, June
Kim, Jae-On and Mueller, Charles W. (1994) Introduction to Factor Analysis: What it is and How to Do It, in Factor Analysis and Related Techniques, in Lewis-Beck, Michael S. (1994) International Handbook of Quantitative Applications in the Social Sciences, Volume 5.
Kim, Jae-On and Mueller, Charles W. (1994) Factor Analysis: Statistical Methods and Practical Issues, in Lewis-Beck, Michael S. (1994) International Handbook of Quantitative Applications in the Social Sciences, Volume 5.
Koutsoyannis A. (1977) Theory of Econometrics, second edition.

Metro Housing (1999) Report on Selected Findings Related to Housing from the Quality of Life Survey, Durban.
Rand Corporation (1994) Indonesia Family Life Survey: http://www.rand.org/labor/FLS/IFLS/
Representatives of the Huruma Informal Settlements, Nairobi City Council, the Nairobi Informal Settlements Coordination Committee and Pamoja Trust (2001) Huruma Informal Settlements, Planning Survey Report, December.
Republic of Uganda (2000) Kampala District Report, Uganda Participatory Poverty Assessment Process, Ministry of Finance, Planning and Economic Development, Kampala, January.
UN-HABITAT, Urban Secretariat (May 2002) “Road Map on Monitoring the Millennium Development Goal on Slum Dwellers”.
United Nations (1998) Principles and Recommendations for Population and Housing Censuses, Revision 1 (New York, 1998), Department of Economic and Social Affairs, Statistics Division, Statistical Papers, Series M No. 67/Rev.1 [ST/ESA/STAT.SER.M/67/Rev.1].
United Nations (2000) World Urbanization Prospects (1999) Department of Economic and Social Affairs, Population Division, The 1999 Revision, New York.
United Nations (2001) World Urbanization Prospects: The 2001 Revision, New York.
World Bank (1997) Poverty in Cote d'Ivoire, A Framework for Action, Report no. 15640-IVC, Human Development Technical Group III, Cote d'Ivoire, country department, Africa Region, World Bank Poverty Assessment, June.