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# Missing Millions and Measuring Development Progress

ROY CARR-HILL\*

*Institute of Education, London, UK*

**Summary.** — In developing countries, assessments of progress toward development goals are based increasingly on household surveys. These are inappropriate for obtaining information about the poorest. Typically, they omit *by design*: the homeless; those in institutions; and mobile, nomadic, or pastoralist populations. Moreover, *in practice*, household surveys typically under-represent: those in fragile, disjointed households; slum populations and areas posing security risks. Those six sub-groups constitute a large fraction of the “poorest of the poor”. We estimate that 250 million are missed worldwide from the sampling frames of such surveys and from many censuses and their omission may well lead to substantial biases.

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**Key words** — household surveys, inequalities, invisible populations, measurement of poverty, millenium development goals, accurate population counts

## 1. INTRODUCTION

For several decades and in some countries for centuries, populations have been counted through national, usually decennial, censuses in which enumerators go to households. Inter-censal population estimates have usually depended on reliable birth and death registration systems. In the 2001 Census, the UK moved away from direct enumeration by asking people to self-report. In many developed countries, there are moves toward substituting administrative records such as municipal population registers and *ad hoc* or existing surveys for the once-in-a-decade census which is seen as cumbersome, rapidly out-of-date and encountering increasing difficulty in getting citizens to complete the census form. Comparing 2000 and 2010 for 40 European countries, Valente (2010) shows how the number using the traditional method has declined from 27 to 21 while the numbers using registers or a mixture of registers and total enumeration of sample surveys has increased from 9 to 18.

In other rich countries there is an increasing reliance on data linkage through, for example, linking the tax system with an Identity Card or Number that citizens are required to have by law. In most middle and low income countries, however, vital registration systems have never been fully functioning (Chan et al., 2010; Powell, 1981; Vlahov et al., 2011), and there has been a similar decline in donor interest in censuses and vital registration systems (Setel et al., 2007), as evidenced by the demise of the International Institute for Vital Registration and Statistics, and an increasing reliance on household surveys.

Many countries run national economic and social surveys to provide detailed information on consumer prices, income, and employment and other relevant data for planning. But the main sources are often internationally standardized surveys with reasonably large sample sizes (see Table 1); and, although now many of these surveys are funded at least in part by national governments, there is in fact very little variation in either content or methodology to respond to national circumstances.<sup>1</sup>

There is the obvious “throwing the baby out with the bathwater” problem with this move away from censuses to relying on surveys because drawing a sample for a survey depends on having a sampling frame in the first place which is frequently based on the census. Clearly any problem with the census, if

used as the sampling frame for a national survey, will lead to that sampling frame being biased. In addition, household surveys almost always have less complete coverage by design than censuses in ways we discuss later in this section. But there is—rather strangely—little recognition of the problems, which may be partly derived from reliance on an incomplete sampling frame and partly because of their design, in using household surveys to count or measure absolute numbers and the rates of income poverty or other forms of deprivation, especially for children who are the focus of many development goals such as the Millennium Development Goals (MDGs).

The issue is covered by Atkinson and Marlier (2010) but only briefly which is surprising given the focus of their book is on social inclusion. Mishra, Barrere, Hong & Khan (2008) claim to correct for bias in HIV sero-prevalence estimates from national household surveys including not only non-response in 14 countries but also non-household population groups in five countries. But their estimates of the non-household populations, which appear to be based solely on census reports, are very low and not consistent with the evidence.<sup>2</sup>

The remainder of this introduction provides illustrations of how censuses may themselves not always provide a complete sampling frame; how this may impact on assessments of levels of poverty; and introduces the added problems of using household surveys to measure poverty.

### (a) Coverage of censuses

Population censuses have always faced problems of complete enumeration. Groups of adults have been excluded from censuses in some countries for political or practical reasons. Non-citizens, cultural minorities or marginalized groups and specific categories of prisoners or rebels have often been excluded for political reasons (Buettner and Garland, 2008). Although this is probably now less frequent and certainly becoming more transparent, there are still several examples: coverage of tribal groups in the recent 2011 census in India

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Table 1. *Major International Social Surveys: Sample Size, Sponsor, Focus, and Coverage*

	Sample size	Sponsor	Focus	Coverage
Demographic and Health Surveys (DHS)	5,000–30,000 households	Macro International funded by USAID	Health, fertility, infant, and child mortality, HIV/STD, domestic violence	90 countries (200 + surveys), c. every 5 years
Labour Force Surveys (LFS)	“Relatively large-scale”	ILO or national statistical offices	Employment	Countries (200 + surveys), c. biennial
Living Standards Measurement Surveys (LSMS)	2,000–5,000 households	World Bank	Consumption and expenditure; household activities	34 countries (100 + surveys), c. every 5 years
Multiple Indicator Cluster Survey (MICS)	5,000–20,000 households	UNICEF	Children and women: education, maternal, and infant health	60 countries (200 + surveys), c. every 5 years

Sources: Information from main website pages of DHS, LFS, LSMS, MICS.

for example was disputed by the *Committee on Protection of Tribal Areas in the North East* (2011); Afghans in Iran are not counted (*Abbasi-Shavazi and Sadeghi, 2011*). Rebellious territories, isolated villages, or the number of Bangladeshi emigrants to India is disputed (*Pempel, 2011*).

People who object to or avoid government oversight have sometimes been excluded for practical reasons (*Buettner and Garland, 2008*). One population sub-group which is very often excluded from national censuses in developing countries is seasonal and temporary internal migrants or other highly mobile economic groups (*Deshingkar, 2006*). *Pincus and Sender (2008)*, based on a detailed analysis of the fluidity of the labor market in Vietnam, show how both censuses and household surveys exclude most temporary migrants because they are based on official household lists which excluded those who had arrived less than 6 months previously. While a subsequent Law of Residence in 2007 (*Refugee Research Tribunal, 2008*) relaxed those rigid requirements, the 2009 Population and housing census (*General Statistical Office, 2010, p. 31*) says that they were not enumerated in the Census.

In addition, in many developing countries, the census enumerators are often police or other government officials who tend to use security based national identity cards or family registration cards to validate the citizenship status of those they are enumerating. Their incentive is to confirm their own registration work and to catch anyone who has escaped their net. This practice is widespread in Africa; but also has happened in Asia in, for example China (*Di, 2011*) and Indonesia (*Dwinosumono, 2006*), although the latter has tried to overcome the problem with better training and recruitment of non-officials as enumerators.

Therefore, the general problem that censuses are not themselves necessarily complete or accurate is well understood (see also *Carr-Hill, 2009*); a specific example is provided by *Chandrasekhar (2005)* who attributes the puzzling decline of eight million slum dwellers in India over the nineties to an underestimation of the number of people living in the urban slums. There is an emerging consensus as to what constitutes good census practice (see *Appendix 1*); and clear adoption of these UN guidelines would at least make interpretation and comparison easier. At the same time, the quality of censuses in developing countries has probably improved during 2000–10, with many more countries carrying out censuses and technological innovation in mapping, enumeration, and data capture (*UN Statistical Division (UNSD), 2010*).

The guidelines are clear in principle but there can still be problems in enumeration in practice for each of the concepts:

(i) *Housekeeping concept*

While Cinderella is a fairy tale, the exclusion of poor servants from the census count in rich households (even though they will usually be sharing some of the household food) especially in Asia is not, and their personal poverty is therefore missed; for different reasons,<sup>3</sup>

(ii) *Mobile populations*

In developed countries, the young are highly mobile—usually male—are also difficult to count, especially when they live in collective households, but they are relatively well-off; in developing countries, the mobile are mainly nomads/pastoralists and rural–urban migrants, and they may well be among the poorest at least in income terms.

(iii) *Homelessness and counting De Facto rather than De Jure populations*

These will always be difficult to count, especially where there are disputes over nationality: for example over the stateless (“bidun jinsiya” meaning “without nationality”) in the Gulf States (*Kohn, 2011; Refugees International, 2007*); equally there are several millions internally displaced in many countries either as a result of civil war or because of environmental change (e.g. floods, nuclear accidents) have made their homes uninhabitable; and although counts tend to be compiled in more developed countries—for example in the Balkan States—this does not happen in Africa and Asia. A study of the nature and extent of homelessness in nine developing countries (*Centre for Architectural Research and Development Overseas (CARDO), 2003*) showed that most did not have any reliable data on the numbers of homeless people. Several did not have any official definition of homelessness to use in a census; but definition is important because “... most researchers agree on one fact: who we define as homeless determines how we count them”. (*Peressini, McDonald, & Hulchanski, 2010, p. 1, chap. 8.3*). In some countries, street sleepers are ignored for census purposes because they have no official house or address (*CARDO, 2003*).

(iv) *Institutional populations*

There are several different types of institutions (care homes, (some) factory barracks, hospitals, the military, prisons, refugee camps, religious orders, and school dormitories) and there is still considerable variation over how some of the institutional population groups should be included in the population count. For example, there was no agreement in the 2010 US Census as to where military who are deployed overseas should

be counted (whether at their originating barracks or allocated to their home States). Similarly, there are variations between the States of the US as to whether prisoners are counted where they are incarcerated or at their last home address; and, if the former, whether the Bureau relies on an administrative count or enumeration (Wagner, 2008). The problem is that their characteristics are often not fully reported and they are simply counted as special census blocks or special households.

(v) *Variations in census reporting of the level of coverage*

Careful reporting of censuses as per the UN guidelines will acknowledge how well these groups have been enumerated and most categories—including the military and prisoners—are included in estimated census population counts of developed countries but not in the census reports of many developing countries.

In particular, in developing countries, according to the UN Population Division (Buettner and Garland, 2008), children are *systematically under-counted*. For example, the one-child-policy in China will have led to substantial under-reporting: although in the 2010 census, China attempted to count children properly by reducing fines for those who had violated the one-child-policy; and, for the first time, the Census will count those born in other countries (Cohn, 2010); in the US, children are over-represented in hard-to-count areas (O'Hare, 2009) and are therefore under-counted.

(b) *Using official census statistics to assess poverty levels*

(i) *Measurement of poverty levels*

There is a huge literature on how to measure poverty on an international comparative basis<sup>4</sup> spanning several decades (International Labour Organisation (ILO), 1976; McGranahan, Richard-Proust, Sovani & Subramanian, 1972; Organisation of Economic Cooperation and Development (OECD), 1975) and several disciplines. But, in this context—the measurement of development progress—for better or for worse, a crude cash measure (US\$1 or US\$2 a day) has been adopted by most international organizations as the flagship measure, even though it makes little allowance for non-food needs which are mostly monetized in urban but not in rural areas (Mitlin & Satterwaite, 2012). The argument in this paper however applies not only to that crude cash measure but also to many other dimensions of deprivation whether in terms of lack of education, ill-health, mortality, under-nutrition, poor sanitation, lack of clean drinking water, etc.

(ii) *Do official census statistics adequately cover the poor?*

The census documents for several of the large-population developing countries have been examined for any commentary about difficulties or problems encountered; in fact, such internal commentary is rare and an extensive web search was carried out for other commentary. The sparse results of these efforts are included in Table 2. It is clear that many of the censuses have encountered severe difficulties in implementation; and that some either left out some groups by design or have been forced to omit certain areas or groups.

(c) *Using household surveys to assess poverty*

The problem with using household surveys to assess the *absolute level* of poverty or of any related characteristic is that, in contrast to the view of Munoz and Scott (2004), they are an inappropriate instrument for obtaining information about the poorest of the poor, especially in developing countries. This is

because household surveys, with rare exceptions, typically omit *by design*:

1. those not in households because they are homeless;
2. those who are in institutions, including refugee camps; and
3. mobile, nomadic or pastoralist populations.

In addition, *in practice*, because they are difficult to reach, household surveys will typically under-represent:

1. those in fragile, disjointed, or multiple occupancy households (because of the difficulty of identifying them),
2. those in urban slums (because of the difficulty of identifying and interviewing), and
3. may omit certain areas of a country deemed to pose a security risk.

If one wanted an empirical—as distinct from a theoretical—definition of the “poorest of the poor”, the above collection of six population sub-groups could hardly be bettered.

A comprehensive search was carried out of the meta-documentation of the four main standardized household surveys—the Demographic and Health Surveys (DHS), the International Labour Office/Labour Force Surveys (LFS), the Living Standard Measurement Surveys (LSMS), and the Multiple Indicator Cluster Surveys (MICS)—and a sample of country surveys. None of the meta-documents, including those from the LSMS (Grosh and Glewwe, 1998; Scott et al., 2005, chap. XXIII) or the DHS (Vaessen, Thiam & Le, 2005, chap. XXII) which is the most professional and most concerned with quality, justifying its relatively small sample sizes specifically because of its attention to non-sampling errors, had anything to say about the coverage of the homeless, institutional populations, the mobile and/or any special arrangements to cover slum areas.<sup>5</sup>

(d) *Comparing the intended coverage of censuses and household surveys*

Population censuses are, of course, themselves surveys of a kind, and, as we have illustrated above, have faced many of the same problems in the past; but a modern politically independent Census will intend to include the mobile (because they refer to those present in the household on a specific day or night), will cover those in institutions, will attempt to cover those in urban slums and in less secure areas exhaustively, will (if necessary) carry out special counts of the homeless, and will attempt to estimate the numbers of pastoralists, with varying degrees of success (Misra and Malhotra, 1982). In other words, a Census can potentially solve many of the problems of omitted populations; but this is not possible for household surveys.

The six groups identified above will also affect household surveys in developed countries, but to a lesser extent: there are fewer homeless; the geographically mobile tend to be the young and upwardly socially mobile rather than the income poor; there are fewer fragile households and urban slums are smaller. The only real issue in developed countries is the omission of the institutional population from the sampling frames of most surveys, which are usually household-based; and attempts to include them (National Centre for Social Research (NCSR), 2003) often leads to the use of proxy respondents which will usually be adequate for a census but not for a detailed household survey.

The extent to which household survey estimates can under-estimate poverty-related characteristics is illustrated for Vietnam, a country where the biennial household survey is considered to be one of the best designed and implemented (Pincus and Sender,

Table 2. *Known Omissions/Difficulties and Undercounts Officially Acknowledged In Large Country Censuses*

	Omissions	Difficulties	Estimate of Undercount
Bangladesh	Satellite mapping of slum areas although some omissions	Reliance on key informants	5%
Brazil	Institutions	11.1 million households not interviewed (6.1 million empty, 3.9 occasional use) out of 67.6 million	Populations estimated
China	One-child policy relaxed but not abolished means many female children under-counted	Counting illegal migrant workers	0.12%
India	High sex ratio presumed to be a consequence of feticide but female children could be hidden		n.a.
Indonesia	Insecure areas	Migrant workers	n.a.
Kenya	Under-representation of North-Eastern Kenya	Carrying out census in slums; other interests (famine/hunger, drought, resettlement); insecurity, enumeration of pastoralists	n.a.
Nigeria	Under-representation of minority ethnic and religious groups	2006: national census was met with protests, boycotts, charges of fraud, and at least 15 deaths. <sup>1</sup> Thousands of enumerators walked off the job because they had not been paid, and many people said they had not been counted. <sup>2</sup>	n.a.
Pakistan	Afghans in camps; tabulations focus on <i>De Jure</i> rather than <i>De Facto</i> populations	Balochistan and NWFP	n.a.
Philippines	Some people refused to answer enumerators because “it was a democracy”; homeless afraid of harassment	Security concerns; use police as enumerators discouraged responses; complicated rules about residence status	1.6%
Russian Federation	People without residence permit afraid to open doors; suspected to involve large numbers	Information poorly protected; authorities sometimes misuse census information; local authorities tempted to over-report numbers	n.a.
South Africa	Undercount estimation based on Post-enumeration survey	High walled area, migration, new settlement	14.6%
Thailand	Foreign officials, soldiers, diplomats, and their families; refugees or displaced persons in government facilities;	Census was a 1 in 20 sample in the first place!	n.a.
Vietnam	Post-enumeration surveys and checking specific groups	Migrants without registration	-0.3%

Sources: *Bangladesh*: Country Paper; Post-enumeration check; Angeles et al. (2009). *Brazil*: Instituto Brasileiro de Geografia e Estatística (2010) Censo 2010: população do Brasil e de 190,732,694 pessoas, Comunicação Social, 29 de novembro; see also Silva (2005). *China*: Tipple and Speak (2005). *India*: Agarawal (2011). *Indonesia*: Dwinosumono (2006). *Kenya*: Kenyan National Bureau of the Census, Opiyo (2010); also see Maron (2010). *Nigeria*: Lalasz (2006). *Pakistan*: Hasan (2006). *Philippines*: Landingin (2010). *Russia*: Sindelar (2010). *South Africa*: SANews.gov.za, October 30, 2012. *Vietnam*: General Statistical Office, Vietnam (2010); Pincus and Sender (2008).

2008, p. 110); the problem would be much larger in other countries.<sup>6</sup> In each socio-economic region, the comparison of the 2009 Census with the average scores for the 2008 and 2010 the Vietnam Health and Living Standards Survey (VHLSS) shows that the proportions reporting no qualifications are higher, the proportions reporting improved water are lower, and the proportions reporting agricultural, forestry, and fisheries are higher (and much higher in Red River Delta) except for the South East (see Table 3). The differences for agricultural, forestry, and fisheries might be related to the temporary residence problems described by Pincus and Sender (2008) but the different results for the other two characteristics are probably more simply related to the greater practical difficulties of carrying out sample surveys—as compared to censuses—in rural areas.

Nevertheless, although modern quality censuses recognize that they have to include these groups in the population counts, census officials, because of the difficulty of enumeration, even in developed countries, are often reduced (as we

have documented) to making estimates of their size and location, so that the members of those groups are often not included in the available sampling frames for household surveys. This poses additional design problems for sample surveys; and, in developing countries, these marginalized groups may not be included at all, even in the estimated population counts. The important consequence of this lack of recognition of the additional problems with the design and implementation of household sample surveys, particularly although not exclusively in developing countries, is that no systematic attempt has been made to estimate the size and distribution of the population groups “missing” from the sampling frames of national household surveys, in addition to those who might be missing from the census. For obvious reasons, it is difficult to estimate numbers in these groups; the following sub-sections document what is known or has been estimated.

Table 3. *Comparison of Survey and Census Results in Vietnam 2009*

	Population 15 + with no qualifications		Improve water		Proportion working in agriculture, forestry, and fisheries	
	Census, Table 7.8	VHLSS, Table 2.2	Census, Table A10	MICS, Table WS.1	Census, Table A8	VHLSS, Table 3.3
Entire country	86.7	85.1	86.7	92.0	51.9	47.7
Northern Midland and Mountains	86.7	86.0	61.5	80.7	75.0	68.7
Red River Delta	80.6	77.7	98.3	99.0	45.8	29.8
North and South Central Coast	87.8	86.8	89.7	89.8	58.5	56.2
Central Highlands	90.2	88.9	78.5	86.1	73.4	69.5
Southeast	84.2	82.3	97.1	98.4	18.5	20.7
Mekong Delta	93.4	92.3	77.9	93.1	56.9	52.1

Sources: Vietnam Population and Housing 2009 Census Findings; Vietnam Household Living Standards Surveys 2008 and 2010; Vietnam Multiple Indicator Cluster Survey 2001.

## 2. HOW MANY ARE POTENTIALLY MISSING FROM POPULATION COUNTS AND FROM SAMPLING FRAMES OF HOUSEHOLD SURVEYS

There are several groups that may be excluded from censuses which are not considered below because they are not necessarily the poorest: those caught up in civil wars may not always be the poorest; economic and environmental migrants may include the more ambitious (Myers, 1997) and therefore not the poorest. In addition, enumeration conventions (excluding temporary immigrants or non-nationals in censuses) leave out major groups (for example in the oil-rich Arab States) who may not be the worst off. Large numbers may be involved but, with the exception of foreign workers in Arab States, there is no credible source to estimate their numbers. The focus here is on groups for which there are credible sources, and that are normally among the poorest.

### (a) Homeless

It is well-known in “developed” countries that homeless people have more difficulty accessing education, health, and social services; in “developing” countries, the same is true especially for street children. Yet, rather obviously, household surveys will omit nearly all homeless and many street children. Estimating numbers is fraught with difficulties.

#### (i) Adults

UN Centre for Human Settlements (UNCHS) (2003) estimated the number of homeless people worldwide to be between 100 million and one billion, depending on how we count them and the definition used; essentially a distinction between those without any roof at all over their heads (the smaller estimate of 100 million) who will almost certainly be omitted from all household surveys, and the much larger numbers in informal—usually illegal—squatter settlements with no security of tenure and at risk of immediate eviction. Examples of how the latter are under-counted are provided by Sabry (2010) for people living in ashwa'iyat (informal settlements), and other homeless outside slums, in Cairo; Agarawal (2011) documents the scale of the official undercount of “slums” in cities in India; and it is common in many developing countries for construction workers and their families to live in temporary camps close to their construction sites (CARDO, 2003; Patel, 1990). Censuses and thorough household surveys will usually attempt to cover informal settlements, but with varying degrees of success.

#### (ii) Children

Over 20 years ago, the United Nations Childrens Fund (UNICEF) estimated that there were about 100 million street children (UNICEF, 1988). The same estimate was repeated 14 years later (UNICEF, 2002); but later qualified (UNICEF, 2005). The latter 100 million figure is still commonly cited, but has no basis in fact (Ennew and Milne, 1989; Green, 1998; Hecht, 1998); and many of them would be counted in conventional censuses and carefully designed household surveys where informal settlements are included if the children live with their families but work on the streets. But, equally, many will not be included.

### (b) Institutionalized populations

Household surveys, by definition, omit from their sampling frame those in institutions: care homes, (some) factory barracks, hospitals, the military, prisons, refugee camps, religious orders, and school dormitories. Even where the intention is to extend the coverage to some or all of these institutions, the census sampling frames may not cover them either because there was no attempt to enumerate them or because, as in the examples in the previous section, aggregate numbers and not names were collected; it would therefore require an additional special survey exercise to construct the sampling frame and this will only happen on a country-specific basis.

#### (i) Hospitals and care homes

Those in hospitals will on average be poorer because morbidity is associated with poverty (e.g. Lopez, 2002, chap. III). Hospital populations will, typically, be included in population censuses, but they are not included in the sampling frames of household surveys. People only stay for a short time in hospitals so, for example in the UK, there are about 14 million hospital episodes annually but because the average length of stay is over 5 days, there are only about 160,000 hospital beds. Given the weekday occupancy rate is over 90%, there will be about 145,000 individuals who cannot be interviewed. There are estimated to be about 20 million hospital beds worldwide, concentrated in developed countries,<sup>7</sup> so there are at least 20 million, depending on whether the Census is or is not being used as the sampling frame, missing from household surveys worldwide. Those in nursing or residential care homes, although counted in population estimates, will also not be included in the sampling frames of household surveys; and a substantial proportion will be among the poorest either because they could not pay or because the resources they had at entry into the homes will have been depleted; but this is mainly an issue in “developed” countries.

Table 4. *Numbers of Refugees and by World Region*

	All refugees	IDPs	Stateless	Others	Total
Arab States	2,005,920	1,969,740	694,260	74,230	4,754,150
Central and Eastern Europe	180,520	1,366,940	159,070	179,040	1,885,570
Central Asia	8,060	0	46,890	2,150	57,100
East Asia & Pacific	229,250	0	2,000	7,030	348,280
Latin America & the Caribbean	367,370	3,303,980	120	68,620	3,740,090
North America & Western Europe	1,911,880	0	486,460	989,650	2,247,650
South West Asia	3,508,690	3,902,100	804,270	154,880	12,627,400
Sub-Saharan Africa	2,074,860	7,314,840	100,000	731,150	10,220,920
World	10,396,550	17,857,600	6,559,570	1,646,610	36,460,330

Source: figures on numbers of official refugees for all countries are provided by UNHCR<sup>8</sup>

All refugees include official refugees and those in refugee-like situations.

IDPs included both IDPs and returned IDPs.

Stateless persons.

Others include Asylum seekers, returned refugees, and various.

### (ii) Prison

Those in prisons in developed countries will usually be poorer (Smith, Grimshaw, Romeo & Knapp, 2007; Clarke, 2012); in developing countries, the Thai Prime Minister acknowledged that “90% of convicts in prisons are poor people” (Thai Foreign Office, 2003). Walmsley (2003) estimates the total prison population of the world is estimated at about 9.8 million, mostly as pre-trial detainees (remand prisoners) or as sentenced prisoners. Almost half of these sentenced prisoners are in the US (2.29 m), Russia (0.89 m), or China (1.57 m); and these are counted in population censuses (although not always enumerated individually). The numbers in developing countries (not including India or South Africa) who are unlikely to be counted in population censuses is about 900,000. But none of these 9.8 million will be included in the sampling frames of household surveys.

### (iii) Refugees

Refugees will not be routinely counted in annual national population censuses in developing countries because they are not considered as part of any country's population<sup>8</sup>—nor are they included in the sampling frames of any household survey—so they cannot, of course, make any contribution to survey-based estimates. However, the United Nations High Commissioner for Refugees (UNHCR) (2010) publishes figures annually on numbers of registered refugees, internally displaced persons and stateless persons, and these are the figures in Table 4. The figures included in Table 4 are of *officially* registered refugees and stateless persons. The overall total is 36.5 million; but these figures do not include the large number of illegal immigrants: for example, Passel and Cohn (2010) estimated there were 11.1 million unauthorized (mostly Hispanic) immigrants into the USA.<sup>9</sup> Their estimate is that 10–15% of these will be omitted from any count (including in a national population count) and, of course, not in the sampling frames of household surveys; and some of the remaining 9.5 million will be reluctant to answer surveys.

### (c) Nomadic and pastoralist groups by world region

In developed countries, response rates are lowest among young men and this is usually presumed to be a consequence of their higher rates of mobility, in turn associated—at least for some—with higher incomes. But in any case, the permanently mobile are usually excluded from household surveys. In particular, censuses and surveys very rarely include gypsies and nomadic/pastoralist populations who have much less access to services partly because of discrimination (Lim et al., 2004); and, while it is

difficult to assess their income and wealth, and there clearly are some who are rich-in-kind (or asset rich), the majority are usually poor in all senses. In a survey of 6,500 pastoralist households across Somalia in 2011, Carr-Hill (2012a) found an average household income of under US\$1,000 a year for, on average, six people and their status on other dimensions of poverty was equally poor (idem).

There is no reliable information available on the number of nomadic pastoralists, including sea-faring mobile communities (Garcia and de Leiva Moreno, 2003) worldwide. Over 25 years ago, it was estimated that there were around 17.3 million pastoralists in Africa, 3.4 million in the Middle East and South Asia, and no more than 2 million in Central Asia, a total of 22.7 million (Sandford, 1983). More recent estimates, for most countries—with a few exceptions such as Iran and Mongolia—are much larger, and when added up the overall total at about 66 million is about triple the earlier estimate. In particular, in the Horn of Africa (excluding Somalia), the recent estimate was of about 24.2 million, i.e. a 72% increase over Sandford's estimate for the *whole* of Africa over the last 25 years. The only internationally comparable source is that compiled by the International Livestock Research Institute (see Thornton et al. (2003)), based partly on livestock numbers, and these are also much larger. The latter estimates have been used because they are consistent across countries (see Table 5); and although there are some substantial discrepancies in specific countries,<sup>10</sup> overall, the more recent estimates are in line with the Thornton-based estimates. Given that many of those included in those estimates will be mostly sedentary pastoralists who would be counted both by censuses and household surveys, low values of 1 in 10 and 1 in 5 are used to estimate the numbers who will probably be missing from the sampling frames of household surveys.

### (d) Difficult to reach

#### (i) Fragile and disjointed households

The task of the census enumerator or survey interviewer is made much more difficult when the household structure is ambiguous so that either identifying the household head and/or counting the numbers in the household is ambiguous. These will include elderly household heads with young children, grandparent households (Kalipeni, Craddock, Oppong & Ghosh 2004, p. 277), large households with unrelated fostered or orphaned children attached (Foster, 2000), child headed households (Richter and Desmond, 2008), and single-parent, mother or father headed households (Zimba & Tembo, 2007). While those groups will usually be included

Table 5. *Numbers of Nomads (millions)*

Region	Millions			1 in 10	1 in 5
West Asia, excluding N. Africa	31.1	67.4	38.4	3.8	7.7
East Asia, Inc. China	21.6	26.4	22.6	2.7	4.5
South Asia, Inc. Pakistan and India	19.3	51.9	25.8	2.6	5.2
Ex USSR	8.2	11.4	8.8	0.9	1.8
South East Asia	1.4	2.3	1.6	0.2	0.3
Sub-total	81.6				
Sub-Saharan Africa	61.9	147.4	79.0	7.9	15.8
North Africa	5.1	7.1	5.5	0.6	1.1
Sub-total	67				
Central and South America	32.1	49.6	35.4	3.5	7.1
Total	180.7	364.5	217.5	21.8	43.5

Source: Estimates for 2000 and 2050 are from Thornton et al. (2003) estimate for 2010 is obtained by interpolation.

in a census and often a survey, those in other types of living arrangements such as cluster foster care—where a group of children is cared for formally or informally by neighboring adult households (Gallinetti and Sloth-Nielsen, 2010)); children in subservient, exploited, or abusive fostering relationships; itinerant, displaced, or homeless children (Barnett and Whiteside, 2006, p. 203); neglected, displaced children in groups or gangs (Hunter and Fall, 1998) will often be excluded from both censuses and household surveys. This is particularly an issue in many countries in sub-Saharan Africa because new forms of household are developing as a response to the impact of HIV/AIDS. Despite the large number of studies, no systematic way of identifying these different types of household and then counting them has been agreed.

#### (ii) *Urban slums*

Those in slums will be among the poorest in any country (Montgomery, 2009). UN Habitat (2003a) defines a slum household as consisting: "... one or a group of individuals living under the same roof in an urban area, lacking one or more of the following five amenities: (1) durable housing (a permanent structure providing protection from extreme climatic conditions); (2) sufficient living area (no more than three people sharing a room); (3) access to improved water (water that is sufficient, affordable and can be obtained without extreme effort); (4) access to improved sanitation facilities (a private toilet, or a public one shared with a reasonable number of people); and (5) secure tenure (de facto or de jure secure tenure status and protection against forced eviction). Since information on secure tenure is not available for most countries included in the UN Habitat database, however, only the first four indicators are used to define slum households, and then to estimate the proportion of the urban population living in slums." (p. 47).

Accurate statistics are in fact difficult to come by, because poor and slum populations are often deliberately and sometimes massively under-counted by officials (Davis, 2006). In the late 1980s, for example, Bangkok had an official poverty rate of only 5%, yet surveys found nearly a quarter of the population (1.16 million) living in 1,000 slums and squatter camps (Rigg, 1991, p.143). Likewise the government of Mexico claimed in the 1990s that only one in ten urban residents were truly poor, despite uncontested UN data that showed nearly 40% living on less than \$2 per day (Imparato and Ruster 2003, p.52). Indonesia and Malaysian statistics are also notorious for disguising urban poverty. The official figure for Jakarta, where most researchers estimate that one quarter of the population are poor kampong dwellers, is simply absurd: less than 5% (McCarthy, 2003, p.2003). In Malaysia, the official poverty line "fails to take account of the higher cost of

urban living" and deliberately undercounts the Chinese poor (Rigg, 1991, p.119); and it is estimated that at least one eighth of the slum population of Manila is uncounted (Berner, 1997, pp. 21–26).

The most recent estimates from UN Habitat (2011) are that there are more than a billion living in urban slums in developing countries; the same figure has been repeated since 2003, while urban populations have increased from 2.1 to 2.5 billion, with no obvious signs of extensive urban redevelopment to cater for the growth in urban populations; in any case, the poorest urban populations are often simply not included in data-gathering:

"Data collection and analysis on urban slums encounters a critical problem. Information is rarely disaggregated according to intra-urban location or socio-economic criteria. Thus, slum populations and the poorest squatters are statistically identical to middle class and wealthy urban dwellers. *Worse, the poorest urban populations are often not included at all in data-gathering.*" (emphasis added) (UN Habitat, 2003b, Box 7, p. 48).

The issue of sub-groups of slum populations missed by household surveys is often therefore completely ignored (see also Montgomery, 2009). Agarawal (2011) shows how official statistics for India "do not include unaccounted for and unrecognized informal settlements and people residing in poor quality housing in inner city areas on construction sites, in urban fringe areas and on pavements" (p. 14); Sabry (2010) also shows how the census undercounts people living in informal settlements so that poverty-line studies based on household surveys under-estimate poverty rates. Some censuses—such as those in Bangladesh and India—have made special efforts to comprehensively cover those in slums, but this is not typical and, as we explain below (Section 4(a)(iii)), does not solve the household survey problem.

The few surveys that have been conducted in those slums show sharp gradients of participation in formal education with income quintiles within urban populations (UN Habitat, 2003a). Detailed analysis cannot be carried out for the large scale surveys because slums are not differentiated from other urban areas; Vlahov et al. (2011) discuss at length the limitations of national sample surveys in providing the detail needed by each district or urban locality for planning development interventions.

It is clear that—apart from the slum populations in European and North American cities—a substantial minority of households in the slum areas of developing country cities are uncounted in many censuses (and therefore not included in

Table 6. *Numbers in Urban Slums*

Major region or Area	Population estimates		Estimates of uncounted	
	Urban	Slums	1 in 10	1 in 5
North Africa	88.7	11.8	1.2	2.4
Sub-Saharan Africa	323.5	199.5	20.0	40.0
Latin America and the Caribbean	471.2	110.8	11.1	22.2
Eastern Asia	671.8	189.6	19.0	37.9
Southern Asia	545.8	190.7	19.1	38.1
South-Eastern Asia	286.6	88.9	8.9	17.8
Western Asia	145.2	35.7	3.6	7.1
Oceania	2.2	0.6	0.1	0.1
Developing regions	2,535.00	827.7	82.8	175.6

Source: UN Habitat (2011) *State of the World's Cities, 2010–11*.

Table 7. *Estimates of Population Groups Missing from Sampling Frames of Household Surveys*

		Minimum	Maximum
Pastoralists		21.8	43.5
Institutionalized	Refugees	36.5	73.0
	Hospitals	20.0	20.0
	Prisons	10.0	10.0
Slum populations		82.8	175.6
Total		171.1	322.1

the UN Habitat database referred to above). Moreover, even where they are counted in censuses, many would (because of interviewer reluctance) in practice, be excluded from the achieved samples of household surveys. The final two columns in Table 6 provide two estimates of the numbers who are possibly missing based on *arbitrary* but probably conservative estimates that 1 in 10 or 1 in 5 of the urban slum populations are uncounted. Those estimates suggest that there are between 43.5 and 87.1 million missing from the sampling frame of household surveys.

### (iii) *Insecure or isolated areas*

Given the security situation—or simply difficulty of transport—in many countries, it can often be difficult for the implementing institutions to carry out a fully representative survey or census. This will obviously be specific to context and country (e.g. North East Kenya, West Nepal, etc.). In a six-country study of nomads in the Horn of Africa (Carr-Hill, 2005), several areas were omitted from the surveys in Eritrea, Ethiopia, and Kenya for security reasons. A recent study of pastoralist households in Somalia (Carr-Hill, 2012a) has been severely limited by security issues for the Somalian interviewers.

## 3. OVERALL ESTIMATES, DISCUSSION, AND CONCLUSIONS

### (a) *Absolute numbers missing and poverty*

Worldwide, the totals in the sub-sections above add up to between 171 and 322 million (Table 7). Moreover, the estimates do not include the homeless, those in fragile or disjointed households or those in areas where there are security risks. It could be argued that the homeless would mostly be from urban slums so that there would be double counting (and if, as some have argued, the original UNICEF estimate is a massive over-estimate, the numbers look plausible), but the other two categories (large, but of unknown size) are

definitely additional. An estimate of between 300–350 million is not unrealistic.

As a 4.5–5.0% undercount of the world's population of c. 7 billion, this might be judged acceptable; as a 22.5–25.0% undercount of the poorest wealth quintile, scandalous; and it makes a mockery of monitoring development progress because neither the baseline nor the current estimates are secure. Estimates of absolute levels of poverty in different years—and, specifically the estimates for 1990 which are the baseline for MDGs—have to be revised.

### (b) *Relative levels*

The interest for national policy and planning, however, is often on the *relative* levels of, for example, childhood morbidity, mortality, or poverty in different regions or in different sub-groups of the population. For example, the planner as well as knowing how to allocate resources between social sub-sectors, might want to know whether to redistribute resources toward or away from rural areas. In order to do this, s/he needs to have an estimate of the relative levels of deprivation in the rural versus urban areas. Similarly, the measurement of inequalities depends on the relative values of deprivation or poverty in different socio-economic groups. There is debate among researchers as to how to measure socio-economic status (SES) in both developed and developing countries but there are usually country-specific conventionally adopted solutions for national surveys.

Some of the standardised international surveys such as DHS and MICS use asset to measure wealth but the list of assets tends to be biased toward urban areas and away from rural areas and differences in the needs of poor and rich households and between rural and urban populations are not considered in elaborating the asset indices (Houweling, Kunst, and Mackenbach, 2003). Finally, the DHS wealth index is often used for inter-country comparisons; but it can only be considered as internally valid for each country.

If one could assume that the biases of undercounting were uniform between geographic areas or across socio-economic groups, then the relative values would be a correct estimate, at least in terms of population. If there is no particular reason to believe *in general* that there will be more or less undercounting between geographical areas, so a planner could assume that the estimated relativities were a reasonable approximation to the true relativities. Unfortunately, in most cases, there are *country-specific* reasons to believe that there will be different levels of undercounting of the poor in rural as against urban areas and probably between geographical regions, so that the estimates of relativities will, in turn, be biased. In particular, the estimates of relativities between socio-economic groups will definitely be an *under-estimate* of the true value; but currently it is impossible to know by how much, or how this varies between countries, or over time.

### (c) *Impact on estimates of inequalities in access to water among urban populations in Sub-Saharan Africa*

Overall estimates for the 323.5 million estimated to be living in urban areas in Sub-Saharan Africa as presented by UN are shown in the first three rows of Table 8. If we base the estimate of inequalities on access to piped water then the inequalities are large: 5% compared to 62%; if we focus on all improved sources, then the inequalities are between 64% and 94%.

The re-estimation taking into account missing populations proceeds as follows. Each column represents 64.7 million people; however, the estimate of the numbers uncounted in urban



Table 8. *Percent of Water Sources for Each Quintile among Urban Populations of Sub-Saharan Africa Official and Corrected Figures*

		Poorest	Second	Middle	Fourth	Richest	All
UN figures	Piped water	5	15	25	39	62	
	Improved source	59	64	62	53	32	
	Unimproved source	36	21	13	8	6	
	Number in Quintile	64.7	64.7	64.7	64.7	64.7	323.5
Corrected figures	Piped water	0	0	18	45	67	
	Improved source	13	81	70	47	28	
	Unimproved source	87	19	12	8	5	
	Number in quintile	72.7	72.7	72.7	72.7	72.7	363.6

slums in Sub-Saharan Africa is 40.0 million. So the actual size of the quintiles should be 72.7 million. The extreme assumption is that the missing 40 million are assumed to be among the poorest and not to have any access to improved sources. This means that the distribution of access to water sources in the bottom quintile should be based on the 40 million without any access to improved water sources + the bottom 32.7 million (or 50.5%) of the tabulated percentages in Table 8, this means that the corrected figures for the bottom quintile are 87% without improved water sources and 13% with improved water sources but none with piped water; the percentages for the other quintiles are then calculated by “pushing up” those from the previous quintile.

The “corrected” figures for all five quintiles are shown in the bottom three rows: the inequalities are now even larger; for piped water, 0% compared to 67%; and for any improved water source, 13% compared to 95%. Clearly, these are extreme adjustments, but equally clearly, the omitted populations matter.

#### 4. DISCUSSION OF FINDINGS AND EXISTING PROPOSED SOLUTIONS

In developed countries, patterns or trends in inequalities are a major focus of debate but, like many other poverty related discussions, debate tends to focus on the numerator rather than the denominator; biases in estimates of population or of changes in population are ignored. Instead, the argument here is that it is urgent to understand the extent and nature of the denominator biases both for planning and research on inequalities: while this is relevant in developed countries (Carr-Hill, 2012b), it is especially important for assessing development progress (e.g., toward the MDGs) in developing countries.

Although there are technical procedures for improving census counts of special groups, these do not solve the sampling frame problems of household surveys which are the major source of poverty estimates in many developing countries. In developing countries, both problems remain: first, of counting in the census; and second, if one wants to carry out a survey, identifying the location and size of different segments of the population.

##### (a) *Counting displaced and illegal groups*

It is easy to count the numbers of formal refugees—even if they are not included in national censuses—because UNHCR manages the camps or national governments keep records of those who have been granted or are applying for asylum. It is much more difficult to count “informal” refugees; but perhaps preliminary estimates of immigrants at least into Northern countries can be made from the trends in the numbers applying for asylum in different countries (as a measure of

attractiveness) or, sadly, from the trends in the numbers caught trying to immigrate illegally into those countries. But those procedures would not work for South-South illegal migration because those countries do not generally keep those types of records.

In several countries, there are large internal migrant subgroups, who are omitted for quasi-political reasons: for example, scheduled castes and tribes in India (Gill, 2007); and, in addition, there are other groups that often left out such as gypsies, homeless, and illegal servants in rich households.

##### (b) *Counting and sampling nomads and pastoralists*

This is one of the most difficult groups to count simply because they are moving; however, in many cases, the men, women, and youth move but the grandmothers and children stay behind; so that there would be possibilities of counting the household populations in their tented settlements, so long as one can identify those settlements (Mayer et al., 2009). Reasonable samples of pastoralists have also been obtained through livestock censuses, for example through combining local level surveys with remote sensing (Galvin et al., 2001); but documenting change in their human population remains, on the whole, elusive and will remain so—whether through censuses or surveys—while at least some of nomadic/pastoralist groups remain permanently mobile.

##### (c) *Counting urban slum populations*

It is clear, that a substantial minority of slum populations are simply uncounted even in the censuses. The numbers missed by typical household surveys will be much larger. But the chaotic nature of some large urban slums makes it difficult to follow a systematic procedure whether counting for a census or constructing a sampling frame for a survey.

The Bangladesh Bureau of Statistics developed a procedure for constructing a sampling frame for their 2005 census. In the first phase, a basic map was constructed based on satellite images geo-referenced to produce accurate street maps of cities. Suspected slums based on estimated population density and roofing materials were located and delineated on the corrected maps, although a substantial number of slum areas (c. 30%) were not identified by the two criteria of density and roofing material. In the second phase, referred to as “ground truthing”, settlements identified as slums were assessed on the ground; and the teams checked for slum settlements; and after interviewing 3 local residents, compiled a comprehensive description of general conditions in suspected slum settlements including estimates of population size.<sup>11</sup>

Such procedures should, in principle, produce a reasonably reliable frame for a population census. But, even where satellite imagery to identify slum settlements based on settlement densities and building materials is used, some of the slum communities can be visually obscured and the need to rely on

relatively unknown key informants for estimating slum sizes may itself lead to politically local biases (Schurmann, 2009). These problems were encountered in the Bangladesh census and also when similar procedures were used in the Indonesian and Timor Leste censuses.<sup>12</sup> In any case, such procedures are not practicable for standard household surveys.

An alternative approach has been to conduct a survey based on one of the standardized surveys using a sample frame specially designed for informal slum settlements; the African Population and Health Research Centre in Nairobi structured a survey in Kibera and other slum settlements in Nairobi in 2000 so that its findings could be compared to the Demographic and Health Survey (African Population and Health Research Center (APHRC), 2002), KNBS (2009) carried out a specific survey in Mombasa's informal settlements. But special surveys like this are just that—special.

#### (d) Sampling frame problems for surveys

The fundamental problem of a household survey is precisely that it is a household survey and will therefore not cover those who are not in households. Although special surveys could be and have been carried out of those who are in fixed institutions, they tend to be expensive, they often involve proxy respondents (NCSR, 2003) and the results tend to be difficult to integrate with those from the corresponding household survey.

For those not in fixed institutions, satellite imagery together with verification on the ground is also possible (as above) but, at the moment, very expensive, and will still not solve the problems of identifying the poor. Thus:

- Refugees will not be identified through Global Positioning System (GPS) techniques and are unlikely to declare themselves or want to be interviewed when the interviewer arrives.
- Nomads and pastoralists will not be at the GPS location when the interviewer attempts to find them.
- A GPS position in an urban slum can be verified on the ground but, given the high level of mobility, this will not provide a satisfactory sampling frame.
- If censuses are used as the sampling frame, adjustments for new building or demolitions can have a big impact on small areas, with implications for weighting samples, and the logistics of field work.

Thus, although there are technical solutions to the problem of enumerating or at least counting population sub-groups currently missing from many censuses, the same procedures do not solve the sampling frame problem of household surveys.

#### (e) Post-enumeration surveys

The classic method of adjusting for a census undercount involves conducting a sample survey to identify people who were missed by the Census and people who were counted twice or counted in the wrong location. These methods have been used by many census organizations; but, in order to be successful in its objectives of identifying missing or duplicated people, “this (post-enumeration) survey has to secure participation by the people who were missed by the Census, and it has to be very accurate in matching individuals counted by the sample survey with individuals counted by the Census.” (Darga, 1998). But, as Breiman (1994) says, this would always be an impossible task: there were too many people who do not want the government to know where they are; in addition, it was not easy to match the results of the post-enumeration survey with the survey because of unreliable or fabricated interviews or ambiguity or misreporting of usual residence. Examination of the proce-

dures for more recent post-enumeration surveys shows that there has not been any improvement (Stark, 2004) and the US Census Bureau decided not to adjust the 2000 census count (Ronzio, 2007).

#### (f) International efforts to improve statistical procedures

In 2005, UNStats produced an edited compilation on the problems of household surveys in developing and transition countries. Yansaneh (2005, p. 22, chap. II) recognizes that non-coverage of household surveys was a major issue; and pointed to the exclusion of homeless people, those in institutions and nomads, because of “practical” difficulties but did not mention refugees nor many of those in urban slums. He goes on to claim that non-coverage of Primary Sampling Units was a less serious problem than non-coverage of households and of eligible persons but that is not necessarily the case in slum areas. Lepkowski (2005, p. 155, chap. VIII) adds that living quarters for seasonal and transitional workers are also very difficult to survey, especially when part-time survey staff are employed in the task of listing housing units.

Lepkowski (2005, p. 157, chap. VIII) also suggests that the initial housing list can be augmented by interviewers being trained to use a half-open interval procedure in which an interviewer is given a housing list and instructed to identify any additional housing units between the initial target house and the next house on the list. Finally he emphasizes that survey analytical reports ought to give clear definitions of the target population including any exclusions. The frame should be described in sufficient detail to see how non-coverage might arise and even to make an overall assessment of the size of the potential error.

In addition, several leading donor agencies have become concerned about data quality. The International Monetary Fund has developed the General Data Dissemination System (GDSS) and the Special Data Dissemination Standard (SSDS), promoting standardization of reporting about the quality of statistical data. These initiatives provide countries with (a) a framework for data quality to identify key problem areas; (b) an economic incentive through facilitating access to international capital markets; (c) a common motivation for advancing data quality discussions in private; (d) technical support for evaluation and improvement programs. Their prescriptions seem to have received more attention in developed countries (e.g. Laliberté, Grünwald & Probst, 2004).

#### (g) Community driven

A completely different alternative to enumeration is to involve local populations and rely on the community to drive data-gathering and mapping of settlements. Karanja (2010) and Livengood and Kunte (2012) discuss community-driven data-gathering strategies covering all informal settlements—the first in Kisumu, the second in Cuttack. Both also used GPS and produced maps and datasets that their local government came to accept. But, once again, this is not a possible universal strategy for standardized household surveys.<sup>13</sup>

## 5. RECOMMENDATIONS AND CONCLUSIONS

### (a) Recommendations

#### (i) Carrying out accurate censuses

International organizations should revive the International Institute for Vital Statistics and Registration—see also the recommendations in Vlahov et al. (2011)—to support national

census organizations in developing these standard procedures and in developing and testing procedures for counting pastoralists (perhaps based on livestock numbers) and other nomads (gypsies, highly mobile workers, long-distance truck drivers, travellers, etc.).

National census organizations in collaboration with international organizations should:

- Eliminate *De Jure* definitions in censuses and adopt a De Facto approach systematically to ensure that all people resident at the time of the census are enumerated, whether or not they have resided for a certain period, or are temporary residents (e.g. at a hotel) at that address, or been included in any form of national registration system.
- Adopt consistent and transparent definitions and procedures for counting the houseless and institutional populations whether fixed (care homes, hospitals, prisons, etc.) or mobile (e.g. the army);
- Use satellite imagery and on the ground verification for difficult-to-identify settlements such as slums.

### (ii) Statistical solution

In the absence of any simple solution to the sampling frame problem, this author has shown that, with an assumed pattern of desired outcomes by wealth quintile, it is possible to make top-down estimates of the missing populations (Carr-Hill, 2012b). This was based on the observation that, in several of the DHS datasets, the gradient of desired outcomes does not behave as expected. The gradient should be concave in that values of the bottom quintile should be lower than a linear projection from the other four quintiles because as severity of poverty deepens, then conditions get relatively worse: but, in many cases, the value in the bottom quintile was higher than the linear projection; and these datasets are from countries where there are estimated to be large numbers of missing populations. More sophisticated methods should be developed that can take into account the pattern of missing populations in each country.

In countries where there are estimated to be substantial numbers of missing population, it would then be possible to make an internal adjustment to the survey findings based on adjusting the size of the groups in the quintiles in order to reflect the estimated numbers of missing people (presumed all to be in the bottom quintile). The author has tried this on a pilot basis for DHS surveys in two countries where there appeared to be anomalies and it does restore the expected gradient. This might be a possible approach; but this is based on a series of statistical assumptions, which would have to be thoroughly tested.

### (iii) Comparing household surveys with censuses

Instead, an obvious approach would appear to be to compare the household surveys to the census sampling-frames

upon which those surveys are based. This could give us an idea of the quantitative extent of this problem, and the estimated undercounts in different strata which could be used to provide a range of post-stratification weights; and, if these estimates were available for several countries, this would allow for sensitivity analysis of the impact of undercounting across a range of countries. In principle, this is feasible with existing data and marks a clear way forward; for example, if data from a range of countries show that nomadic peoples get under-counted by 10–45%, then any household survey could carry out sensitivity analysis on its conclusions by up-weighting the nomads in its sample in accordance with the extremes of this range. Then, there would be a fruitful research agenda in explaining the variance in undercounting between countries. The problem currently is that, while micro data are available from several censuses Integrated Public Use Microdata Series (IPUMS) there are only a small number of contemporaneous household surveys for large countries (see endnote v).

## 6. CONCLUSIONS

Population undercounting means that any social program risks ignoring the poorest of the poor. This blindness is a public scandal affecting an estimate of between 300 and 350 million of the poorest in developing countries, leading to an over-estimate of progress toward development goals and a substantial under-estimate of inequalities. The estimates of missing populations are acknowledged to be crude estimates; but the example in Table 8 shows how an inequality in access to piped water between 64% in the bottom and 94% in the top quintile could be increased to a gap of 0% and 67% because of missing populations. The specific pattern of missing populations will vary from country to country; detailed country knowledge is needed to make more accurate estimates.

In the absence of a complete solution, two possible general short- to medium-term approaches have been suggested: one is a top-down statistical approach and the other involves detailed comparison of household surveys with the census in the same country. The latter is probably the most promising, but it is not research that can be carried out generically, but has to be carried out by locally knowledgeable researchers.

The problem should be addressed immediately by international and national organization, both in terms of promoting more reliable and transparent censuses, and of developing and testing agreed procedures for estimating the impact of missing populations on survey-based estimates of progress toward development goals. There is limited value in having goals *per se* and no point in using resources to monitor them if we do not know where we are or where we started from.

## NOTES

1. The Centre for Disease Control (CDC) have also carried out a series of reproductive and health surveys <http://www.cdc.gov/reproductive-health/Global/Surveys.htm> accessed 30th November 2012.

2. In Cambodia, about a quarter of million have been evicted (LICA-DHO) and there are 190,000 military (IISS, 2010) meaning are least 3% rather than 2%; the 0.1% figure in Ghana is because homelessness is defined as 'people not belonging to a household' so that those on the street or in institutions but with a relative are not counted as homeless; 1.0% in India when there are estimated to be 80 million nomads (Misra and

Malhotra, 1982) or 7% of the population; 0.05% in Lesotho when there are 2,000 military (IISS, 2010); 1.6% in Uganda when at least 5% of Uganda's population is nomadic (Ongweg and Odada, 2002).

3. There may be a growing problem of servants in rich households in developed countries: although they will be included in inter-censal estimates in terms of counts of immigration, they will not be in a census-based sampling frame and, even if a block of building approach to sampling is used, those servants are unlikely to reply to the survey.

4. The measurement and commentary on poverty itself has of course a much longer history: in the UK, obvious examples are Booth (1902–03) and Rowntree (1901).
5. UNICEF has carried out MICS surveys in Wave 4 of Roma Settlements in the former Yugoslavia and Informal Settlements in Mombasa but there is no indication that they used different approaches to identification of households.
6. In fact, mainly because the 2010 census round was often conducted in 2011 or 2012 and so the results are not available, it proved difficult to find examples of large-population countries with geographical breakdowns in the census data which could be compared with a household survey in the last five years.
7. The number of beds per 100,000 population ranges from 2,000 per 100,000 population in Monaco and Switzerland to 10 per 100,000 in Niger; all developed countries have more than 250 beds per 100,000; while all developing countries had less than 250 per 100,000 (WHO, 2011).
8. This is put more elegantly by Brun (2001, p.18) as follows: “Refugees are persons lawfully in flight (UN, 1951, 1967) ... but ... are not enjoying stable standing in any recognised political space ...”.
9. These estimates are based on the monthly Current Population Survey (CPS) with adjustments for omitted sub-groups based on comparisons with Mexican data, U.S. mortality data, and specialized surveys conducted at the time of the 2000 Census (Passel and Cohn, 2010).
10. For example, for India, the National Convention (2005) estimates that there are 60 million nomads in India and 110 million including De-Notified populations, compared to the Thornton-based estimate of about 3.75 million; in contrast, the estimate for Pakistan is ‘a few million’ (Spooner, 1984), while the Thornton-based estimate is over 18 million.
11. A community was declared to be a slum if it met 4 of 5 basic conditions: poor housing conditions, high overall population density, very poor sanitation, and inadequate water sources, high prevalence of people below poverty level, and insecure land tenure. (Angeles et al., 2009).
12. Both the Bangladeshi and Indian censuses go to considerable pains to locate and enumerate slum dwellers but, apart from the problems identified by Schurmann (2009), there were other critiques of the Bangladesh Census (bdnews24.com/nih/mr/1900h). The Indonesian and the 2004 Timor Leste censuses encountered security problems in the follow-up verification procedures.
13. While community engagement is like green grass—a good thing in itself—and although over 100,000 articles and papers have been published in journals about the importance/ success/ value of community engagement/ involvement, there has only been a handful demonstrating cost effectiveness (Mason, Carr-Hill, & Street, 2008). One has to be cautious about indiscriminate promotion of community driven strategies.

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## APPENDIX 1. SUMMARY OF UN GUIDELINES (2008)

### (a) Persons and households

Most individuals are in households; but some are in “institutions” (a subset of collective living quarters). Some of those living in institutions are not members of a household; they constitute the “institutional population”. Each person should have one and only one place of usual residence.

The usual concept of household is known as the “house-keeping concept”. It does not assume that the number of households and housing units are or should be equal; although some countries use the “household-dwelling” concept, which regards all persons living in a housing unit as belonging to the same household. Households consisting of extended families that make common provision for food may occupy more than one housing unit.

### (b) Homelessness

A household may also consist of one or more homeless people. The definition of the homeless varies because homelessness is essentially a cultural definition based on concepts such as “adequate housing”, “minimum community housing standard”, or “security of tenure” which can be perceived in different ways by different communities. [including]:

- (a) Primary homelessness (or rooflessness) . . . persons living in streets or without a shelter that would fall within the scope of living quarters;
- (b) Secondary homelessness. [including]:
  - (i) Persons with no place of usual residence who move frequently between various types of accommodation;

(ii) Persons usually resident in long-term (also called “transitional”) shelters or similar arrangements for the homeless.

(c) *Institutional population*

Persons living in hotels or boarding houses are not part of the institutional population and should be distinguished as members of one- or multi-person households, on the basis of the arrangements that they make for providing themselves with the essentials for living. Living quarters are structurally separate and independent places of abode. In some countries, it may be appropriate to use the “compound” as a unit of enumeration.

(d) *Mobile populations*

A number of special cases may be encountered, e.g.

(a) Students at boarding schools and living away from family homes at universities;

(b) Persons working away from their family home, including:

(i) People who spend the working week close to their work and weekends at home;

(ii) Workers who constantly travel to different places;

(iii) Workers on long-term, or semi-permanent assignment away from the family home.

(e) *De Jure and De Facto*

Censuses of population and housing should not only enumerate those people with a legal right to be in a place but rather should include either all those present at the place on census night or all those whose usual residence on census night was at the place. The “floating population” should be defined as referring to those people usually resident in an area without a legal basis for their residence.

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