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2010 World Population and Housing Census Programme

# Report on the Results of a Survey on Census Methods used by Countries in the 2010 Census Round

DEPARTMENT OF ECONOMIC AND SOCIAL AFFAIRS
UNITED NATIONS STATISTICS DIVISION

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This Report is available at http://unstats.un.org/unsd/census2010.htm

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The term “country” as used in this paper also refers, as appropriate, to territories or areas.

There is no established convention for the designation of “developed” and “developing” countries or areas in the United Nations system. In common practice and here, Japan in Asia, Canada and the United States in Northern America, Australia and New Zealand in Oceania and Europe are considered “developed” regions or countries (see http://unstats.un.org/unsd/methods/m49/m49regin.htm#ftnc)

**Prepared by the Demographic Statistics Section, United Nations Statistics Division**

Yacob Zewoldi
Margaret Mbogoni
Meryem Demirci
Seiffe Tadesse
Vysaul Nyirongo
Amor Laaribi

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# Chapter 1: Introduction

The population and housing census is vital for providing information about the population in order to present a full and reliable picture of the population in the country in terms of its size and spatial distribution, its demographic, social and economic characteristics, as well as its housing conditions. The census is the source for detailed information on the population at the level of small areas and small population groups. The census provides essential information for policy development and planning, for managing and evaluating programme activities across a broad range of sectoral applications, and for monitoring overall development progress. As a source for evidence-based decision making, census data have many uses, including in the demarcation of constituencies and the allocation of representation on governing bodies. Census data also play an indispensable role in ensuring equitable allocation of national funds and services. The census also provides data for the calculation of social indicators, particularly those that are needed for small areas or small population groups as well as those that may be observed infrequently in the population.

For over six decades, the United Nations has supported national census-taking worldwide through the World Programmes on Population and Housing Censuses spanning successive 10-year periods. During its thirty-sixth session in March 2005, the United Nations Statistical Commission launched the current 2010 World Population and Housing Census Programme covering the period 2005-2014. The 2010 World Programme was approved by the United Nations Economic and Social Council through its resolution 2005/13 which urges Member States to carry out a population and housing census at least once in the period 2005-2014 and to disseminate the census results in a timely manner.

In its role as the Secretariat to the 2010 World Programme, the United Nations Statistics Division (UNSD) has undertaken a variety of activities aimed at ensuring that countries undertake a census during the 2010 round. At its thirty-eighth session (see E/2007/24), the Statistical Commission requested the United Nations Statistics Division and other international agencies to increase their technical assistance to national statistical offices in order to strengthen national capacity for the implementation of the 2010 World Programme. In addition, the Commission requested countries to begin implementation of the revised *Principles and Recommendations for Population and Housing Censuses, Revision 2*.[1]

## 1.1. Implementation of the 2000 and 2010 census rounds

The 2000 census round—covering the period 1995-2004—was characterized by challenges in its implementation. As a result, 26 countries or areas did not carry out a census mainly in Africa where an estimated half of the population was not enumerated during the 2000 census round. Censuses were not conducted for a variety of reasons, including political instability, lack of funding and inadequate planning and management of the census operation. Also, in some

[1] *Principles and Recommendations for Population and Housing Censuses, Revision 2,* United Nations publication, Sales No. E.07.XVII.8 (2008). This publication is available in all official languages of the United Nation at http://unstats.un.org/unsd/demographic/sources/census/census3.htm.

countries that carried out a census, there were quality concerns due to problems with coverage, use of technology, managing the outsourcing of census operations, and untimely release of the data, and in others late or insufficient dissemination of the results.

The situation seems better for the 2010 round which, as already noted, spans the period 2005-2014. Since the start of the 2010 round to the end of December 2010, a total of 120[2] countries or areas worldwide have already carried out a census (see Table 1.1, Figure 1.1 and Figure 1.2). These censuses have enumerated an estimated 57% of the world's population. In 2010 alone, 42 countries or areas—consisting of 5 countries in Africa, 12 in Asia, 5 in Europe, 14 in Latin America and the Caribbean, 2 in Northern America and 4 in Oceania—would have conducted a census. In 2011, the peak year for the 2010 census round, 77 countries or areas will carry out a census, of which many are European countries under the terms of the European Community Regulation. By the end of 2011, an estimated 94% of the world's population is expected to be enumerated. In 2012, 17 countries or areas have scheduled to conduct a census. By the end of the census round, it is estimated that 99 per cent of the world's population would be counted. However, 6 countries or areas have not yet indicated a planned date for their census.

**Table 1. 1. Number of censuses taken or scheduled in the 2010 round by year and geographic region[3]**

| Geographic region | Census year (2010 round) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
| All geographic regions | 15 | 27 | 10 | 12 | 14 | 42 | 77 | 17 | 7 | 6 |
| Africa | 1 | 6 | 5 | 6 | 5 | 5 | 13 | 5 | 5 | 3 |
| Asia | 6 | 4 | 2 | 3 | 4 | 12 | 11 | 2 | 0 | 3 |
| Europe | 1 | 3 | 0 | 1 | 2 | 5 | 37 | 1 | 1 | 0 |
| Latin America and the Caribbean | 4 | 5 | 1 | 0 | 0 | 14 | 14 | 7 | 1 | 0 |
| Northern America | 0 | 1 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 |
| Oceania | 3 | 8 | 2 | 1 | 3 | 4 | 2 | 2 | 0 | 0 |

[2] Figures may be different from what is contained in the report of the Secretary General on Population and Housing Censuses, E/CN.3/2011/21, because some countries or areas postponed their censuses. The report is available at http://unstats.un.org/unsd/statcom/sc2011.htm.

[3] For purposes of this analysis, only one census – the first one – is counted for countries or areas that conduct more than one census in a decade.

**Figure 1. 1. Cumulative number of censuses taken in the 2010 census round**[4]

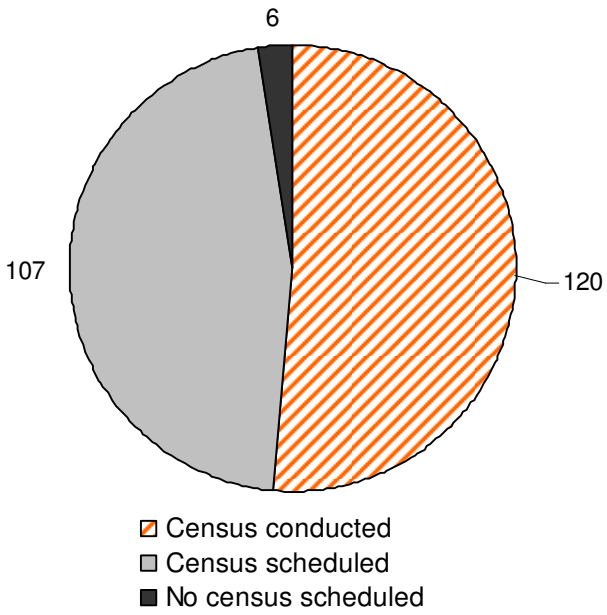
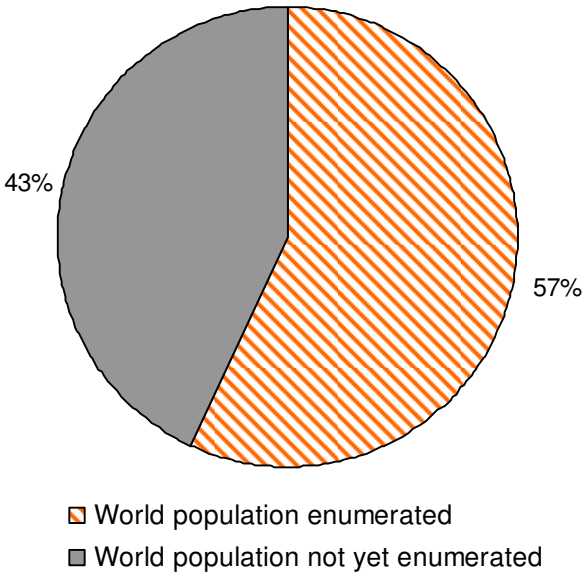



**Figure 1. 2. Estimated per cent of the world population enumerated in censuses taken in the 2010 census round**




[4] Figures may be different from what is contained in the report of the Secretary General on Population and Housing Censuses, E/CN.3/2011/21, because some countries or areas postponed their censuses. The report is available at http://unstats.un.org/unsd/statcom/sc2011.htm.

Table 1.2 and Figure 1.3 present a comparison between the 2000 and 2010 census rounds in the cumulative number of countries or areas that undertook a census or that are scheduled to do so. Comparatively more countries are conducting a census each year in the 2010 round compared to the 2000 round. Furthermore, if censuses are carried out as planned, 227 countries or areas will undertake a census in the 2010 round compared to 207 that did so in the 2000 round.

Since 2005 several countries have rescheduled their censuses at least once. For example, as of 2008, 64 censuses were expected to be conducted in 2010. The actual number of countries or areas that conducted a census in 2010 dropped to 42 and the remainder were postponed mainly to 2011. Based on initial scheduling and reporting by countries, the year 2010 had been expected to be the peak census year of the 2010 census round. However, as a consequence of postponements, the peak census year has now shifted to 2011, where a census is scheduled to be held in 77 countries or areas. The reasons for the postponement of census dates include budgetary constraints, technical issues, lack of skilled staff and political situations.

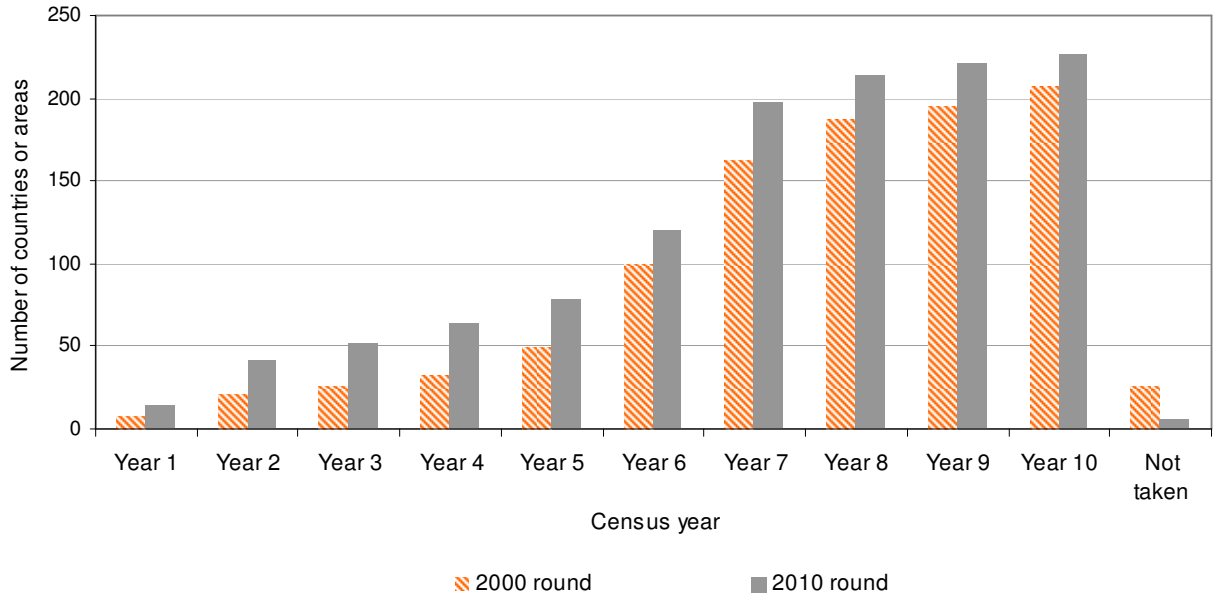
In the 2010 census round, we are witnessing increased interest and use of new and also improved technologies in the different phases of the census operation. Countries invest in technology and/or alternative methodologies in order to reduce costs, improve the quality and the timeliness of the dissemination of their census results. The 2010 census round witnesses the spread of technologies such as Geographic Information Systems, handheld devices, Internet-based questionnaires, mobile telephones for monitoring of field operations and data dissemination, optical data capture, and web-based data dissemination. Alternative methodologies such as the use of register-based censuses are being considered by a growing number of countries. The "rolling census" is used for the first time in this round in France, while the United States has used the American Community Survey—a continuous survey—to replace the traditional long form of the decennial census. Successful implementation of these new approaches will yield valuable information for other countries that may be interested in adopting them.

**Table 1. 2. Cumulative number of censuses taken by year in the 2000 and 2010 rounds[5]**

| Census year | 2000 round | 2010 round | Census year | 2000 round | 2010 round |
|---|---|---|---|---|---|
| Year 1 | 8 | 15 | Year 7 | 163 | 197 |
| Year 2 | 21 | 42 | Year 8 | 187 | 214 |
| Year 3 | 26 | 52 | Year 9 | 195 | 221 |
| Year 4 | 33 | 64 | Year 10 | 207 | 227 |
| Year 5 | 49 | 78 | Not taken | 26 | 6 |
| Year 6 | 100 | 120 | Total | 233 | 233 |

[5] For purposes of this analysis, only one census – the first one – is counted for countries or areas that conduct more than one census in a decade.

**Figure 1. 3. Cumulative number of censuses taken by year in the 2000 and 2010 rounds[6]**




## 1.2. Survey on census methods for the 2010 census round

In 2009 and early 2010, the United Nations conducted a survey to collect information on methods used by countries or areas in the planning and implementation of their 2010 round population and housing censuses. The survey also collected information on challenges that countries or areas faced or expect to face in the implementation of their censuses for the 2010 round as well as on aspects of the census process in which they may have expertise. This report presents the main results of a survey conducted by the United Nations

The questionnaire used for conducting the survey had 28 questions seeking information on: (i) source of population and housing census data; (ii) cartography; (iii) method(s) of enumeration; (iv) census evaluation; (v) data processing; (vi) data dissemination; (vii) census budget and source of funding; and (viii) technical assistance required and areas of expertise. The survey questionnaire is presented in Annex 1 to the report.

The survey questionnaire was sent to 233 countries or areas between May 2009 and January 2010. Completed questionnaires were received from 138 countries or areas implying a 59 per cent response rate. Table 1.3 presents a list of the countries or areas that responded to the survey by geographic region (Africa, Asia, Europe, Latin America and the Caribbean, Northern America and Oceania). A review of the responses shows considerable regional variation. For example,

[6] For purposes of this analysis, only one census – the first one – is counted for countries or areas that conduct more than one census in a decade.

about half of the countries or areas in Africa and also those in Latin America and the Caribbean responded. Responses were better than three-fourth (75%) in Asia, Europe and Northern America. In contrast, response was very low in Oceania where only 5 out of 25 countries or areas (20%) responded.

It is important to keep in mind that the information that was provided by countries or areas relates to the situation as of the time of the survey, i.e., mainly mid 2009. For a few countries or areas the information was provided in early 2010. Of the 138 countries or areas that responded to the survey, only 32 (23%) had already carried out their censuses when they participated in the survey. The interpretation of the results should, therefore, take into account the fact that for the majority of the responding countries or areas, the information provided relates to what was planned which is subject to change as these plans get implemented. For many countries or areas, therefore, information that was provided at the time of the survey, including even the timing of the census, may not be the same as what was actually done during the actual census. An end of decade study will provide a more accurate assessment of the national implementation of the 2010 census round.

**Table 1. 3. List of countries or areas that responded to the survey**

| | | | | Latin America and the Caribbean | | | |
|---|---|---|---|---|---|---|---|
| | Africa | Asia | Europe | Caribbean | Latin America | Northern America | Oceania |
| 1 | Angola | Afghanistan | Albania | Bahamas | Argentina | Bermuda | Australia |
| 2 | Botswana | Armenia | Austria | Cayman Islands | Brazil | Canada | Cook Islands |
| 3 | Burkina Faso | Azerbaijan | Belarus | Cuba | Chile | Greenland | Nauru |
| 4 | Burundi | Bahrain | Belgium | Dominica | Colombia | United States of America | New Zealand |
| 5 | Cape Verde | Bangladesh | Bosnia and Herzegovina | Dominican Republic | Costa Rica | | Tokelau |
| 6 | Central African Republic | Cambodia | Bulgaria | Grenada | Ecuador | | |
| 7 | Comoros | China | Croatia | Jamaica | Guatemala | | |
| 8 | Côte d'Ivoire | China, Hong Kong SAR | Czech Republic | Saint Vincent and the Grenadines | Honduras | | |
| 9 | Dem. Rep. of the Congo | China, Macao SAR | Denmark | | Mexico | | |
| 10 | Egypt | Cyprus | Estonia | | Nicaragua | | |
| 11 | Ethiopia | Georgia | Finland | | Paraguay | | |
| 12 | Gambia | India | France | | Peru | | |
| 13 | Ghana | Indonesia | Germany | | Suriname | | |
| 14 | Lesotho | Iran (Islamic Republic of) | Greece | | Uruguay | | |
| 15 | Liberia | Iraq | Hungary | | | | |
| 16 | Libya | Israel | Iceland | | | | |
| 17 | Malawi | Japan | Ireland | | | | |
| 18 | Mali | Jordan | Italy | | | | |
| 19 | Mauritania | Kazakhstan | Latvia | | | | |
| 20 | Mauritius | Kuwait | Lithuania | | | | |
| 21 | Morocco | Kyrgyzstan | Luxembourg | | | | |
| 22 | Namibia | Malaysia | Malta | | | | |
| 23 | Niger | Maldives | Montenegro | | | | |
| 24 | São Tomé and Príncipe | Mongolia | Netherlands | | | | |
| 25 | Seychelles | Nepal | Norway | | | | |
| 26 | South Africa | Occupied Palestinian Territory | Poland | | | | |
| 27 | Sudan | Pakistan | Portugal | | | | |
| 28 | Uganda | Philippines | Republic of Macedonia | | | | |
| 29 | United Rep. of Tanzania | Qatar | Republic of Moldova | | | | |
| 30 | | Republic of Korea | Romania | | | | |
| 31 | | Saudi Arabia | Russian Federation | | | | |
| 32 | | Singapore | Serbia | | | | |
| 33 | | Sri Lanka | Slovakia | | | | |
| 34 | | Tajikistan | Slovenia | | | | |
| 35 | | Thailand | Spain | | | | |
| 36 | | Timor-Leste | Sweden | | | | |
| 37 | | Turkey | Switzerland | | | | |
| 38 | | United Arab Emirates | Ukraine | | | | |
| 39 | | Yemen | United Kingdom | | | | |

## Chapter 2. Sources of Population and Housing Census Data

A population census is the total process of collecting, compiling, evaluating, analysing and publishing or otherwise disseminating demographic, economic and social data pertaining, at a specified time, to all persons in a country or in a well-delimited part of a country[7]. A housing census is the total process of collecting, compiling, evaluating, analysing and publishing or otherwise disseminating statistical data pertaining, at a specified time, to all living quarters and occupants thereof in a country or in a well-delimited part of a country.[8]

The vast majority of countries produce detailed and comprehensive population and housing statistics by conducting a traditional census, which in principle entails canvassing the entire country, reaching every single household and collecting information on all individuals and on a range of topics within a brief stipulated period. While the majority of countries continue to rely on the traditional census, some other countries are developing, testing, and implementing alternative methods for compiling key statistics that used to be generated by the traditional approach to population and housing censuses.[9]

Population and housing statistics produced through alternative methods are derived from administrative records, sample surveys, or from a combination of these methods. The motivation for introducing alternative census methods is to take advantage of the information in existing administrative sources, and in some cases, to reduce the large costs and to overcome the complex organizational problems associated with traditional censuses. The interest to produce reliable census-like data more frequently or on a continuing basis rather than every ten years is another reason. In other cases, alternative methods are sought to reduce the burden on respondents and to obviate public opposition to traditional censuses which are perceived to be too intrusive into people's private lives.

One of the alternative methods involves use of the traditional census with full enumeration in combination with continuous sample surveys. This design contains a full enumeration to collect only basic demographic data in the census year and a large sample survey to collect detailed demographic, social, economic and housing data every year throughout the decade. The sample is cumulated over time to produce data by small geographical areas.

Use of registers to produce census-like statistics takes advantage of existing administrative sources, namely different basic registers—population, buildings and dwellings and business registers—that contain comprehensive data on the units that are to be described in the population and housing census[10]. These registers are linked at the individual level with information on education, employment, income, taxation, and business, contained in other relevant registers. One of the essential preconditions of this approach is that the country should have an established central population register of high quality and good coverage linked with a system of continuous updating. The primary advantages of a register approach are reduced cost for the census process

[7] United Nations Principles and Recommendations for Population and Housing Censuses, Revision 2 . para. 1.4.
[8] Ibid, para. 1.6.
[9] Ibid, para. 1.58
[10] Ibid, para. 1.64 and 1.65.

and greater frequency of data. The use of administrative data sources also involves some drawbacks including the fact that the data that can be compiled is limited to what already exists in the registers.

To circumvent the above limitation and other shortcomings of registers, some countries or areas use a combination of data sources including registers with full or partial enumeration and/or sample surveys. This approach is mainly used by countries whose registers are not of good coverage or whose registers on different topics are not deemed equally developed or reliable enough to produce all required census results. Some countries using the combined approach produce partially pre-filled forms with information on respondents that is available in the register, and ratify or correct the information at the time of the interview.

A "rolling census" represents an alternative to the traditional model of the census by means of a continuous cumulative survey covering the whole country over several years.[11] Implementation of such an approach requires highly complex sampling and modelling techniques in order to allow sampling at very low levels of geography. The main advantage of this approach is the higher frequency for updating data. On the other hand, one of the disadvantages is the requirement for highly skilled staff for its implementation.

## 2.1. Main sources of census data

The survey collected information on the main sources of census statistics that are used by countries or areas for producing the total population count for their censuses of the 2010 round. In the survey, countries or areas were requested to indicate the main sources of data for the total population count from among four options: (i) traditional census (full field enumeration); (ii) administrative registers; (iii) rolling census; and (iv) other (data source to be specified by the countries or areas). The responses are summarized in Table 2.1.

The compiled information indicates that the traditional census, based on full field enumeration, is the predominant source of data for producing the total population count. Out of the 138 countries or areas that responded to the survey, 115 (83%) use the traditional census. Virtually all the countries or areas in Africa, Latin America and the Caribbean and Oceania are using the traditional census as the main source of data for the total population count. In Asia all countries or areas except four —Bahrain, Israel, Singapore and Turkey—have the traditional census as the main source. Among the Northern America countries or areas that responded to the survey, Greenland has a register-based census while the rest rely on the traditional census. In Europe, 54 per cent of the countries or areas use the traditional census, while the rest are using alternative sources to generate the total population count.

As table 2.1 indicates, of the 39 responding countries or areas in Europe, 12 (31%) use administrative registers to generate the total population count. Globally, a register-based census is the main source of census data in 15 countries or areas—two in Asia (Bahrain, Singapore), 12 in Europe (Austria, Belgium, Denmark, Finland, Germany, Iceland, Netherlands, Norway, Slovenia, Spain, Sweden, Switzerland) and one in Northern America (Greenland).

[11] Ibid, para. 1.69.

**Table 2. 1. Main sources of census data by geographic region**

| Geographic region | Number of responding countries | Main source of census data [i] | | | |
|---|---|---|---|---|---|
| | | Traditional census | Administrative register(s) | Rolling census | Other [ii] |
| | | | *Number* | | |
| All geographic regions | 138 | 115 | 15 | 1 | 7 |
| Africa | 29 | 29 | 0 | 0 | 0 |
| Asia | 39 | 35 | 2 | 0 | 2 |
| Europe | 39 | 21 | 12 | 1 | 5 |
| Latin America and the Caribbean | 22 | 22 | 0 | 0 | 0 |
| Caribbean | 8 | 8 | 0 | 0 | 0 |
| Latin America | 14 | 14 | 0 | 0 | 0 |
| Northern America | 4 | 3 | 1 | 0 | 0 |
| Oceania | 5 | 5 | 0 | 0 | 0 |
| | | | *Percentage* | | |
| All geographic regions | 100 | 83 | 11 | 1 | 5 |
| Africa | 100 | 100 | 0 | 0 | 0 |
| Asia | 100 | 90 | 5 | 0 | 5 |
| Europe | 100 | 54 | 31 | 3 | 13 |
| Latin America and the Caribbean | 100 | 100 | 0 | 0 | 0 |
| Caribbean | 100 | 100 | 0 | 0 | 0 |
| Latin America | 100 | 100 | 0 | 0 | 0 |
| Northern America | 100 | 75 | 25 | 0 | 0 |
| Oceania | 100 | 100 | 0 | 0 | 0 |

Note: i) The main source of census data refers to the source used for producing the total population count. ii) All the countries or areas that designated their main source of census data for total population count as "Other" used a combination of data sources including registers with full or partial enumeration and/or sample surveys.

The "rolling census", one of the alternative census data sources, is so far used only in one country—France. France also utilizes administrative registers to supplement the data from the rolling census. Though not used to produce the total population count, the United States also uses a continuous survey—the American Community Survey (ACS)—to produce data on socio-economic characteristics not collected through the traditional decennial census.

Table 2.1 also further shows that a few countries or areas—two in Asia (Israel and Turkey) and five in Europe (Estonia, Italy, Latvia, Lithuania, and Poland)—are utilizing another alternative source, the "other" approach, which is a combination of data sources including registers with full or partial enumeration and/or sample surveys. The significant factor that differentiates these countries or areas from those that rely entirely on registers is the extent to which their administrative registers are used for the production of population and housing census-like statistics. It should be mentioned that in some of these countries or areas, the information from the administrative registers are only used to support a range of census activities, including for

establishing address lists; to complement census data; or to verify and control the quality of the collected data.

## 2.2 Additional sources of census data

In the survey, countries or areas were requested to indicate additional sources—from among the following—that they used to provide data on specific census topics: (i) annual or other regular sample survey(s); (ii) ad-hoc sample survey(s) specifically conducted for the census; (iii) administrative register(s); and (iv) other source (to be specified by countries or areas). The information compiled from the responses of 138 countries is presented in Table 2.2.

In those cases where detailed and comprehensive population and housing statistics could not be produced entirely based on the main source of census data, countries or areas resort to additional sources. These include regular and ad-hoc sample surveys as well as administrative registers. Some countries use existing or regular sample surveys to provide data for specific census topics that are not available through the main source of data. For examples, in countries that use administrative registers as the main source of census data, ad-hoc sample surveys can be used to collect data on the characteristics that are not available in the registers or not collected for small geographic areas in existing or regular surveys. Also, when the traditional census is the main source of data, data for some of the census topics may be compiled from administrative registers such as building/housing registers, immigration records, tax records, etc.

The information in table 2.2 shows that 49 countries or areas, representing about 36 per cent of all countries or areas that responded to the survey, are using additional sources in their censuses for the 2010 round. Among these, 20 countries or areas are located in Europe, the region making the most extensive use of additional sources for producing census data. Additional sources are used to a lesser extent in the rest of the regions; 12 countries or areas in Asia, 7 in Africa and 6 in Latin America and the Caribbean reported using additional sources for augmenting their main source of census data.

Administrative registers are used as an additional source for census data in 24 countries or areas, while 16 countries or areas reported using ad-hoc sample surveys specifically conducted in conjunction with the census. Eighteen countries or areas reported augmenting their census data collection with annual or regular sample surveys. Among these countries or areas, the Labour Force Survey (LFS) was one of the most frequently cited regular sample surveys used as an additional source. The Demographic and Health Survey (DHS) and surveys on household living conditions and standards—such as the Survey on Income and Living Conditions (SILC) and the Living Standard Measurement (LSM)—were also reported as being used as additional sources. Multi-purposed and continuous surveys such as the Netherlands' Continuous Omnibus Survey and the American Community Survey (ACS) are used by the respective countries as sources for specific census topics.

Among countries or areas that rely on the traditional census as the main source of census data, only 31 out of 115 countries or areas (27%) reported supplementing their census collection with additional sources. In contrast, a significantly larger proportion of countries or areas employing alternative census methods as the main source of census data reported augmenting their census

collection with additional sources. Among the countries or areas using administrative registers as the main source of census data, 67% (or 10 out of 15) utilized additional sources. This may be due to the fact that registers are generally established for a specific purpose which is generally not the provision of statistics. As has already been mentioned, data that can be generated is limited only to what the register contains. In this case, other sources are relied upon to generate data that are not available in the registers. Virtually all of the countries or areas that use other alternative methods as the main source of census data have reported using additional sources.

**Table 2. 2. Additional sources of census data by geographic region and main source of census data**

| Geographic region (by Main census methodology) | Number of responding countries | Number of countries reporting using additional sources | Additional sources for census data | | |
|---|---|---|---|---|---|
| | | | Annual or Regular sample survey | Ad-hoc sample survey conducted specifically for the census | Administrative register(s) |
| | | | *Number* | | |
| All countries/areas | 138 | 49 | 18 | 16 | 24 |
| Traditional census | 115 | 31 | 12 | 8 | 17 |
| Administrative register(s) | 15 | 10 | 6 | 4 | 0 |
| Rolling census | 1 | 1 | 0 | 0 | 1 |
| Other | 7 | 7 | 0 | 4 | 6 |
| Africa | 29 | 7 | 5 | 1 | 4 |
| Traditional census | 29 | 7 | 5 | 1 | 4 |
| Asia | 39 | 12 | 3 | 7 | 5 |
| Traditional census | 35 | 8 | 3 | 3 | 4 |
| Administrative register(s) | 2 | 2 | 0 | 2 | 0 |
| Other | 2 | 2 | 0 | 2 | 1 |
| Europe (39) | 39 | 20 | 6 | 5 | 12 |
| Traditional census | 21 | 6 | 0 | 1 | 6 |
| Administrative register(s) | 12 | 8 | 6 | 2 | 0 |
| Rolling census | 1 | 1 | 0 | 0 | 1 |
| Other | 5 | 5 | 0 | 2 | 5 |
| Latin America and the Caribbean | 22 | 6 | 3 | 3 | 0 |
| Traditional census | 22 | 6 | 3 | 3 | 0 |
| Northern America | 4 | 2 | 1 | 0 | 1 |
| Traditional census | 3 | 2 | 1 | 0 | 1 |
| Administrative register(s) | 1 | 0 | 0 | 0 | 0 |
| Oceania | 5 | 2 | 0 | 0 | 2 |
| Traditional census | 5 | 2 | 0 | 0 | 2 |

Note: The sum of the figures under the "Additional sources for census data" do not add up to the figures under the "Number of countries using additional sources" column because a given country/area may use more than one additional source.

# Chapter 3. Census Cartography

Census cartography refers to the systematic subdivision of a country or area into a contiguous mosaic of small pieces of land, each big enough in terms of population and area, to be manageable by one enumerator during the enumeration phase. In addition to its traditional role of facilitating enumeration, census mapping has many other uses in the census process, both during the planning phase and for the presentation of data during dissemination. Activities that use maps include: delineating administrative boundaries at multiple levels or assigning administrative units to operational areas; assigning locations of field offices and enumerators; planning and managing logistics for the transportation of field staff and supplies; identifying rugged or inaccessible areas or hard-to-enumerate populations and collective living quarters; and, monitoring the census progress. Maps have also been used to present aggregate census results in cartographic form. Very few enumerations during the last several census rounds were executed without the help of detailed maps. Thus, mapping has been an integral part of census-taking for a long time.[12]

## 3.1 Census maps

In the survey countries or areas were requested to provide information on the basis for census mapping for demarcating enumeration areas in the conduct of their 2010 round censuses. They were asked to indicate the maps and/or images used from the following types: (i) sketch maps; (ii) digitized maps; (iii) aerial photography; (iv) satellite imagery; and (v) other/not applicable (to be specified by countries or areas).

A total of 122 out of 138 responding countries planned to use or used maps for demarcating enumeration areas. Only 16 countries, mostly those that conduct register-based censuses, did not use maps as they do not need to demarcate enumeration areas. Table 3.1 gives the number and percentage of countries using different types of maps. Digitized maps, which have a higher degree of accuracy, are increasingly being used in most regions of the world. Census maps are commonly digitized in both developed and developing countries and areas. The survey shows that close to 60% of the countries use digitised maps. Paper-based sketch maps are still used exclusively in 13 countries or areas, representing 11 per cent.

It is worth noting that while sketch maps are hand-drawn and can selectively include most useful features at any required scale, they however have low positional accuracy. About 30% of the countries simultaneously use different types of maps, supplementing sketch and digitised maps with aerial photography and satellite imagery. Aerial photography gives high accuracy and rapid completion of tasks, as does the high-resolution satellite imagery which is growing in use.

[12] Handbook on Geospatial Infrastructure in Support of Census Activities, Sales No. 09.XVII.8, United Nations, New York, 2009.

**Table 3. 1. Type of maps used by region**

| Region | Number of countries or areas using census maps | Type of map | | |
|---|---|---|---|---|
| | | Digitized map only | Sketch map only | Several types [(i)] |
| | | *Number* | | |
| All regions | 122 | 71 | 13 | 38 |
| Developed regions | 33 | 15 | 3 | 15 |
| Developing regions | 89 | 56 | 10 | 23 |
| Africa | 29 | 18 | 4 | 7 |
| Asia | 37 | 22 | 5 | 10 |
| Europe | 27 | 13 | 3 | 11 |
| Latin America and the Caribbean | 22 | 15 | 0 | 7 |
| Caribbean | 8 | 5 | 0 | 3 |
| Latin America | 14 | 10 | 0 | 4 |
| Northern America | 3 | 1 | 0 | 2 |
| Oceania | 4 | 2 | 1 | 1 |
| | | *Percentage* | | |
| All regions | 100 | 58 | 11 | 31 |
| Developed regions | 100 | 45 | 9 | 45 |
| Developing regions | 100 | 63 | 11 | 26 |
| Africa | 100 | 62 | 14 | 24 |
| Asia | 100 | 59 | 14 | 27 |
| Europe | 100 | 48 | 11 | 41 |
| Latin America and the Caribbean | 100 | 68 | 0 | 32 |
| Caribbean | 100 | 63 | 0 | 38 |
| Latin America | 100 | 71 | 0 | 29 |
| Northern America | 100 | 33 | 0 | 67 |
| Oceania | 100 | 50 | 25 | 25 |

Note: i) A combination of sketch, digitised maps and maps based on aerial photography and satellite imagery.

## 3.2 Use of GPS/GIS technology

The most common use of GPS/GIS technology in censuses includes the demarcation of enumeration areas, development of maps, and monitoring census field operations. Other common uses of GPS include locating important geographic features, such as landmarks, hospitals, schools, and settlements. Furthermore, GIS is used in disseminating census results.

As part of the survey, countries or areas were requested to indicate whether they used or planned to use GPS/GIS technology for census mapping. The responses from 138 countries or areas, presented by region, are summarized in Tables 3.2. The use of GPS for demarcating census enumeration areas is not applicable in about a quarter of the responding countries or areas in Europe as many rely on registers to produce census-like statistics. For all regions, 102 countries or areas, representing about 74% of the responding countries reported employing GPS/GIS

technology. The use of GPS/GIS technology for census mapping is quite common in developing countries conducting traditional based censuses. About 80% of the developing countries that responded indicated using this technology. In particular, 86% of African countries or areas, as well as all countries or areas in Latin America and the Caribbean that responded to the Survey reported the use of GPS/GIS technology for census mapping.

Some of the GIS and GPS related software applications reported by countries or areas as being used in census operations include ArcView, ArcGIS, ArcPad, Map Info, MapXtreme, Spatialware, Magellan and Geobase. Further details on some of the applications of GPS/GIS technology in census operations reported by responding countries or areas are given in Annex 2.

**Table 3. 2. Use of GPS/GIS technology for census mapping by region**

| Region | Number of responding countries | Use GPS/GIS technology | Not use GPS/GIS | Not applicable (i) |
|---|---|---|---|---|
| | | *Number* | | |
| All countries/areas | 138 | 102 | 23 | 13 |
| Developed countries/areas | 46 | 26 | 8 | 12 |
| Developing countries/areas | 92 | 76 | 15 | 1 |
| Africa | 29 | 25 | 4 | 0 |
| Asia | 39 | 30 | 8 | 1 |
| Europe | 39 | 20 | 8 | 11 |
| Latin America and the Caribbean | 22 | 22 | 0 | 0 |
| Caribbean | 8 | 8 | 0 | 0 |
| Latin America | 14 | 14 | 0 | 0 |
| Northern America | 4 | 3 | 0 | 1 |
| Oceania | 5 | 2 | 3 | 0 |
| | | *Percentage* | | |
| All countries/areas | 100 | 74 | 17 | 9 |
| Developed countries/areas | 100 | 57 | 17 | 26 |
| Developing countries/areas | 100 | 83 | 16 | 1 |
| Africa | 100 | 86 | 14 | 0 |
| Asia | 100 | 77 | 21 | 3 |
| Europe | 100 | 51 | 21 | 28 |
| Latin America and the Caribbean | 100 | 100 | 0 | 0 |
| Caribbean | 100 | 100 | 0 | 0 |
| Latin America | 100 | 100 | 0 | 0 |
| Northern America | 100 | 75 | 0 | 25 |
| Oceania | 100 | 40 | 60 | 0 |

Note: i) Most of the countries or areas in the "Not applicable" column conduct register-based censuses and do not need to demarcate census enumeration areas.

# Chapter 4. Mode of Enumeration

There are several modes of data collection: face-to-face interviews, self-enumeration (paper-based questionnaire or on the Internet), interviews by telephone, as well as combinations of these methods. In addition, data can be compiled from existing administrative registers.

Face-to-face interviewing as mode of enumeration is most commonly used in developing countries, where a substantial proportion of the population may not be literate enough to understand and fill in the census questionnaire on their own. Self-enumeration, on the other hand, is most common in developed countries and may be used due to concerns of privacy and confidentiality by the responding public when they have to provide personal information to an enumerator. Generally with self-enumeration, census questionnaires are mailed to the households and then mailed back to the census organization by the respondent. In other cases, they are dropped off at households by a census collector and then either picked up by the census collector or mailed back by respondents to the census organization. Self-enumeration whether on a paper questionnaire or on the Internet offers respondents more flexibility in terms of not having to complete the census form at one sitting.

The 2010 round of population and housing censuses is witnessing a rise in the use of the Internet for census data collection. Reasons for developing an Internet option are numerous, including cost reduction issues, or strong public demand related to new lifestyles and privacy concerns.

Generally, developed countries are more likely than developing countries to use a combination of data collection methods, such as use of self-enumeration combined with face-to-face interviews. For instance, for the 2011 census of Hong Kong SAR, China, a new multi-modal data collection approach will be used, under which the data collection process will be divided into two phases. In the first phase, households are encouraged to choose the self-enumeration mode through completion of an e-questionnaire online or by postal return. For the remaining households not choosing self-enumeration, the census office will arrange census officers to conduct face-to-face interview in the second phase. The 2010 census of Japan also employed a multimodal data collection method, i.e. collecting through census takers, by mail to municipal offices, and via the Internet (Tokyo only). Each household could choose the way to submit its census form. The aim was to make it easier for the general population to participate in the census and fill in the forms. According to the Statistics Bureau of Japan, more than half of the households in Japan chose the mail-back option, while the Internet response rate in Tokyo reached around 8.4% of total households (http://www.stat.go.jp/english/data/kokusei/pdf/20101101.pdf).

In the United States face-to-face interviews are used to collect information from households that have not sent back on time their filled-in census forms. In the 2010 Census, Malaysia also used a multi-modal approach of data collection. This included use of (i) face to face interviews by enumerators and (ii) self enumeration. The latter had two options: (i) drop-off and pick-up whereby enumerators dropped-off a census kit at respondents' living quarters and then return at the agreed time to pick up the completed questionnaire, and (ii) the e-Census whereby respondents fill up an electronic form. For the 2010 census, the Republic of Korea also used a variety of options to collect the data. There was more use of administrative registers than was the case for the 2005 census. In addition, respondents could participate in the census by filling in the

census questionnaire online through an Internet response system. If a household did not respond online, census takers visited the home to fill out the census form. In Australia for the 2006 census, two main modes of data collection were used, self-enumeration by a paper questionnaire and self-enumeration through the Internet. Face-to face interviews were also conducted for some groups of the Australian population.

Information collected on national practices for the 2010 census round, and presented in Table 4.1 and Figure 4.1, shows that face-to-face interviewing is the most common mode of data collection. In 117 (85%) out of the 138 countries or areas face-to-face interviews are the most common mode of data collection particularly in the African region and the Caribbean where all the responding countries indicated using this method. Also, at least 75 per cent of the responding countries or areas in each of the remaining regions use face-to-face interviews for census data collection. In Asia and Europe, 95 per cent of the responding countries or areas reported use of face-to-face interviews, as did 93 and 80 per cent of those in Latin America and Oceania, respectively. The lowest proportion (75%) is for Northern America.

The second most used mode of data collection is self-enumeration using paper questionnaire which was used by 28 per cent of the responding countries or areas. Internet self-enumeration and registers were used by 23 and 18 per cent, respectively, of the responding countries. Use of paper-based self-enumeration is higher in Oceania (60%) and Northern America (50%) than in the other regions, but the lowest in Latin America (7%).

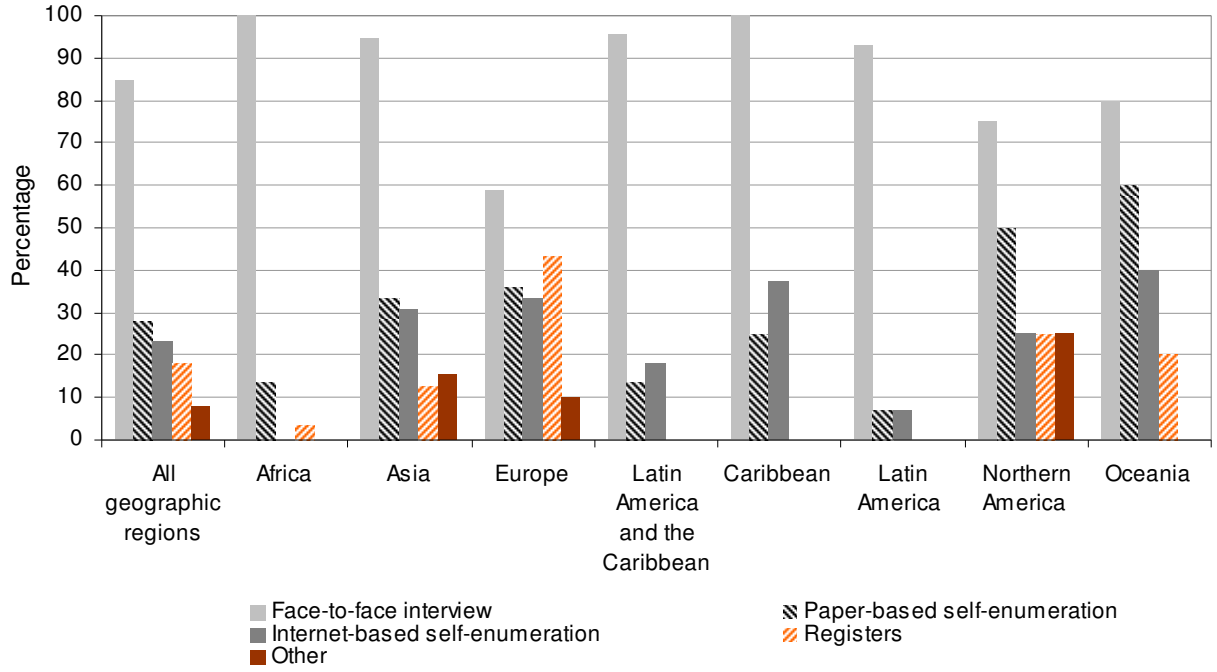
In 32 (23%) of the countries or areas that responded to the survey, there was self-enumeration through the Internet. This mode of data collection is used in all regions, except Africa. In some cases, data for the census are compiled from administrative registers. This is the case in 25 (18%) of the countries or areas that participated in the study.

Registers are used in 25 countries or areas, mainly in Europe (17 countries or areas), to generate census-like data. Particularly in the 2010 census round, some countries other than the Scandinavian countries that have used registers for a long time, are also using this mode of enumeration to generate some population data.

**Table 4. 1. Mode of enumeration by geographic region**

| Geographic region | Number of countries using | | | | |
|---|---|---|---|---|---|
| | Face-to-face interview | Paper-based self-enumeration | Internet-based self-enumeration | Register(s) | Other |
| | | | *Number* | | |
| All geographic regions | 117 | 39 | 32 | 25 | 11 |
| Africa | 29 | 4 | 0 | 1 | 0 |
| Asia | 37 | 13 | 12 | 5 | 6 |
| Europe | 23 | 14 | 13 | 17 | 4 |
| Latin America and the Caribbean | 21 | 3 | 4 | 0 | 0 |
| Caribbean | 8 | 2 | 3 | 0 | 0 |
| Latin America | 13 | 1 | 1 | 0 | 0 |
| Northern America | 3 | 2 | 1 | 1 | 1 |
| Oceania | 4 | 3 | 2 | 1 | 0 |
| | | | *Percentage* | | |
| All geographic regions | 85 | 28 | 23 | 18 | 8 |
| Africa | 100 | 14 | 0 | 3 | 0 |
| Asia | 95 | 33 | 31 | 13 | 15 |
| Europe | 59 | 36 | 33 | 44 | 10 |
| Latin America and the Caribbean | 95 | 14 | 18 | 0 | 0 |
| Caribbean | 100 | 25 | 38 | 0 | 0 |
| Latin America | 93 | 7 | 7 | 0 | 0 |
| Northern America | 75 | 50 | 25 | 25 | 25 |
| Oceania | 80 | 60 | 40 | 20 | 0 |

**Figure 4. 1. Mode of enumeration by geographic region**




Information in table 4.2 shows, however, that there was combined use of modes of enumeration for many countries. For example, while 117 (85%) of the 138 countries or areas that responded to the survey used or plan to use face-to-face interviews, 73 (62%) of these used or plan to use this mode of enumeration by itself while 44 (38%) used or plan to use it in combination with some other method(s). Similarly, of the 39 countries or areas that used or plan to use paper-based self enumeration, only 4 (10%) used or will use this method by itself. The remainder will use it in combination with one or more other methods. None of the 32 countries or areas with Internet-based self-enumeration have used or plan to use it as an only method of enumeration. Only 10 (40%) out of the 25 countries or areas that are using registers for their 2010 round censuses, are relying only on this source of information. In the remaining 15 (60%) it is used in combination with other methods. It is interesting to note that 9 (53%) out of the 17 countries or areas in Europe that are using registers use them as an only source while the other 8 (47%) use them in combination with other sources.

**Table 4. 2. Mode of enumeration used alone or combined by geographic region**

| Geographic region | Face-to-face interview | | | Paper-based self-enumeration | | | Internet-based self-enumeration | | | Registers | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total | Used alone | Combined | Total | Used alone | Combined | Total | Used alone | Combined | Total | Used alone | Combined |
| | | | | | | *Number* | | | | | | |
| All geographic regions | 117 | 73 | 44 | 39 | 4 | 35 | 32 | 0 | 32 | 25 | 10 | 15 |
| Africa | 29 | 24 | 5 | 4 | 0 | 4 | 0 | 0 | 0 | 1 | 0 | 1 |
| Asia | 37 | 18 | 19 | 13 | 0 | 13 | 12 | 0 | 12 | 5 | 0 | 5 |
| Europe | 23 | 13 | 10 | 14 | 3 | 11 | 13 | 0 | 13 | 17 | 9 | 8 |
| Latin America and the Caribbean | 21 | 17 | 4 | 3 | 1 | 2 | 4 | 0 | 4 | 0 | 0 | 0 |
| Caribbean | 8 | 5 | 3 | 2 | 0 | 2 | 3 | 0 | 3 | 0 | 0 | 0 |
| Latin America | 13 | 12 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 |
| Northern America | 3 | 0 | 3 | 2 | 0 | 2 | 1 | 0 | 1 | 1 | 1 | 0 |
| Oceania | 4 | 1 | 3 | 3 | 0 | 3 | 2 | 0 | 2 | 1 | 0 | 1 |
| | | | | | | *Percentage* | | | | | | |
| All geographic regions | 100 | 62 | 38 | 100 | 10 | 90 | 100 | 0 | 100 | 100 | 40 | 60 |
| Africa | 100 | 83 | 17 | 100 | 0 | 100 | – | – | – | 100 | 0 | 100 |
| Asia | 100 | 49 | 51 | 100 | 0 | 100 | 100 | 0 | 100 | 100 | 0 | 100 |
| Europe | 100 | 57 | 43 | 100 | 21 | 79 | 100 | 0 | 100 | 100 | 53 | 47 |
| Latin America and the Caribbean | 100 | 81 | 19 | 100 | 33 | 67 | 100 | 0 | 100 | – | – | – |
| Caribbean | 100 | 63 | 38 | 100 | 0 | 100 | 100 | 0 | 100 | – | – | – |
| Latin America | 100 | 92 | 8 | 100 | 100 | 0 | 100 | 0 | 100 | – | – | – |
| Northern America | 100 | 0 | 100 | 100 | 0 | 100 | 100 | 0 | 100 | 100 | 100 | 0 |
| Oceania | 100 | 25 | 75 | 100 | 0 | 100 | 100 | 0 | 100 | 100 | 0 | 100 |

Note: A short dash (–) indicates “not applicable”.

# Chapter 5. Census Evaluation

## 5.1. Methods of census evaluation

It is commonly accepted that a population census is not perfect and that errors can and do occur at all stages of the census operation.[13] Errors in the census results are classified into two general categories - coverage errors and content errors. Coverage errors arise due to omissions, erroneous inclusions, or duplications of persons or housing units in the census enumeration. Content errors are errors that arise due to the incorrect reporting or recording of the characteristics of persons, households and housing units enumerated in the census.

The quality of population and housing census data is very important for many reasons, including building public trust in the national statistical system.[14] It is therefore imperative that census evaluation is undertaken in order to provide users with a level of confidence when utilizing the data, and to explain errors in the census results.[15]Numerous methods are available for estimating coverage and content errors of censuses. Demographic analysis and post enumeration surveys (PES) are the two major methods for evaluating census data.

Many countries have recognized the need to evaluate the overall quality of their census results and have employed various methods for evaluating census coverage as well as certain types of content errors. Of the 138 countries or areas that responded to the survey, 126 (91%) have either undertaken or plan to carry out evaluation of their censuses. Of these 126 countries or areas, two did not indicate the method that will be used to evaluate the census. The analysis that follows refers to the 124 countries or areas that indicated a method or methods of evaluation for their censuses. Table 5.1 and Figure 5.1 show that of the 124 countries or areas that have evaluated or plan to evaluate their censuses, 96 (77%) have conducted or plan to conduct a PES,of which 58 (47%) will use it as the only method of evaluation. On the other hand 58 (47%) countries or areas used or plan to use demographic analysis – among which 20 (16%) used or will use it as the only method of evaluating their censuses. In 38 (31%) of the 124 countries or areas, census evaluation was undertaken or will be done by a combination of demographic methods and the PES. Eight (6%) of the 124 countries or areas stated that they have used or will use “other” method to evaluate their censuses.

There are observed regional differences in the methods of census evaluation. Use of only the PES is more common in Africa, Asia and Northern America than in the other regions, while use of only demographic methods is more prevalent in Oceania, Latin America and the Caribbean and in Europe. Use of both the PES and demographic methods is higher among countries or areas in Oceania, Northern America, and Latin America and the Caribbean, and lowest in Asia and Africa.

[13] *Principles and Recommendations for Population and Housing Censuses, Revision 2*,United Nations, 2008
[14] Ibid, para.1.379.
[15] *Post Enumeration Surveys: Operational Guideline* (Department of Economic and Social Affairs, Statistics Division, 2010)

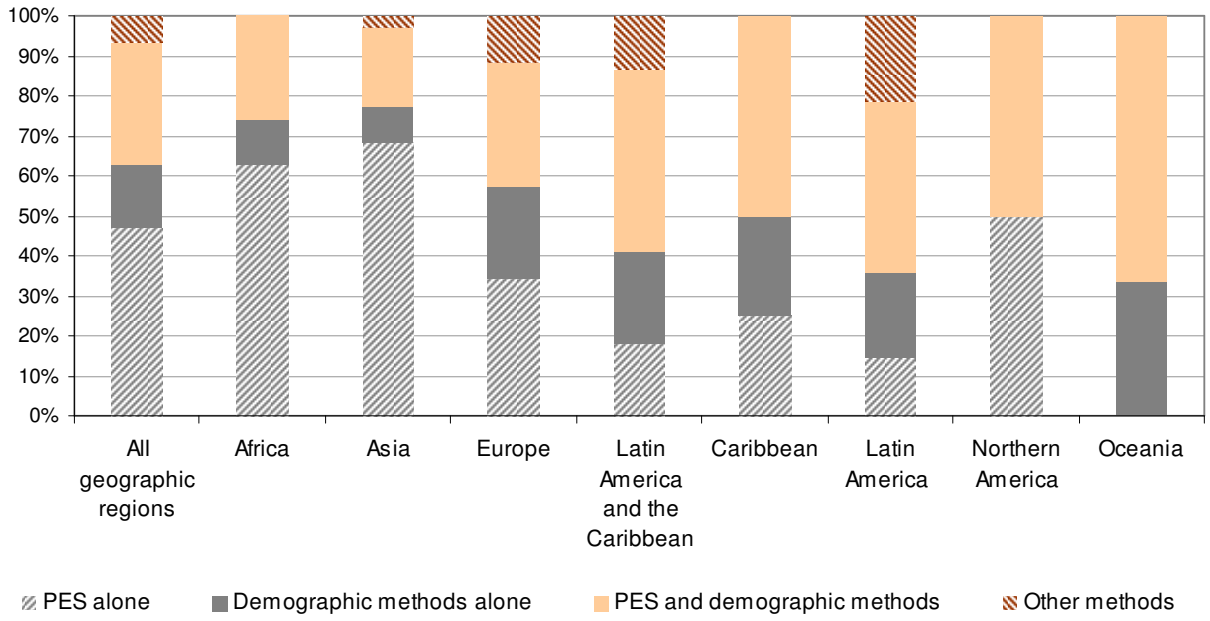
Information in Table 5.1 also shows that 32 (26%) of the countries who evaluate their censuses use the results to adjust the census figures. Forty-one per cent of the countries or areas from the African region that evaluate their censuses use the results to adjust their census results, as do 32 per cent of those from Latin America and the Caribbean, and also 25 per cent of those in Asia. On the other hand, none of the countries or areas in Oceania and Northern America uses the evaluation results to adjust their census figures.

**Table 5. 1. Methods of census evaluation by geographic region[16]**

| Geographic region | Number of countries evaluating census | Method of evaluation | | | | Evaluation results used to adjust census |
|---|---|---|---|---|---|---|
| | | PES alone | Demographic methods alone | PES and demographic methods | Other methods | |
| | | | | *Number* | | |
| All geographic regions | 124 | 58 | 20 | 38 | 8 | 32 |
| Africa | 27 | 17 | 3 | 7 | 0 | 11 |
| Asia | 35 | 24 | 3 | 7 | 1 | 9 |
| Europe | 35 | 12 | 8 | 11 | 4 | 5 |
| Latin America and the Caribbean | 22 | 4 | 5 | 10 | 3 | 7 |
| Caribbean | 8 | 2 | 2 | 4 | 0 | 3 |
| Latin America | 14 | 2 | 3 | 6 | 3 | 4 |
| Northern America | 2 | 1 | 0 | 1 | 0 | 0 |
| Oceania | 3 | 0 | 1 | 2 | 0 | 0 |
| | | | | *Percentage* | | |
| All geographic regions | 100 | 47 | 16 | 31 | 6 | 26 |
| Africa | 100 | 63 | 11 | 26 | 0 | 41 |
| Asia | 100 | 69 | 9 | 20 | 3 | 26 |
| Europe | 100 | 34 | 23 | 31 | 11 | 14 |
| Latin America and the Caribbean | 100 | 18 | 23 | 45 | 14 | 32 |
| Caribbean | 100 | 25 | 25 | 50 | 0 | 38 |
| Latin America | 100 | 14 | 21 | 43 | 21 | 29 |
| Northern America | 100 | 50 | 0 | 50 | 0 | 0 |
| Oceania | 100 | 0 | 33 | 67 | 0 | 0 |

[16] Note that of the 126 countries or areas that indicated having or planning to evaluate their censuses, 2 did not indicate a method of evaluation.

**Figure 5. 1. Methods of census evaluation by geographic region**

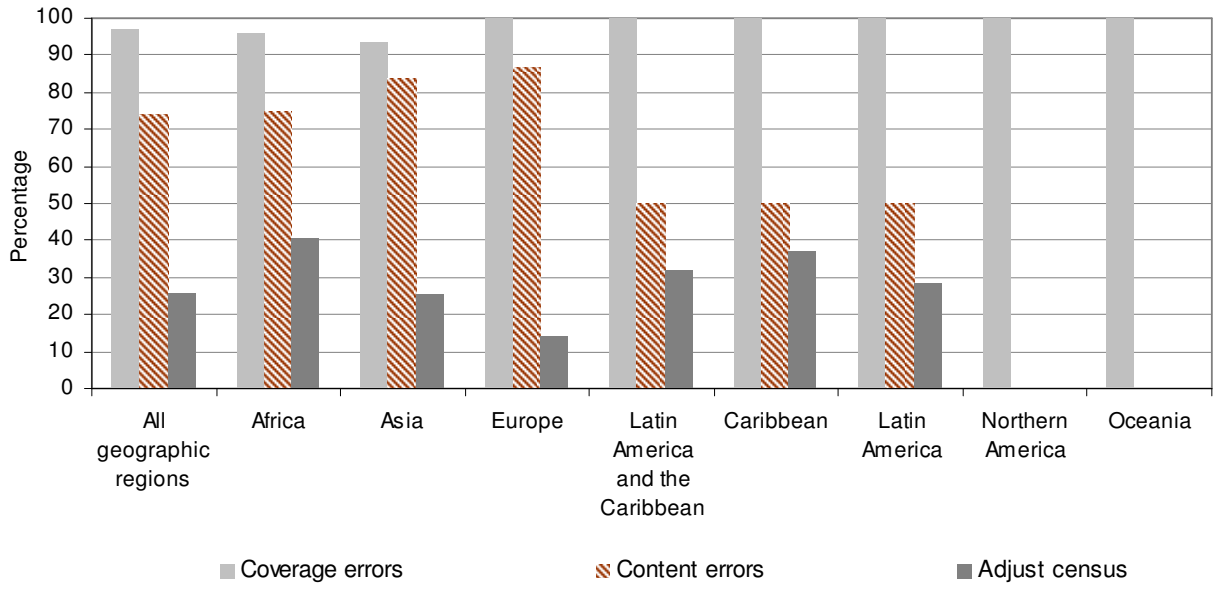



Information in Table 5.2 shows that of the countries or areas undertaking a PES, 93 (97 %) will evaluate coverage errors while 71 (74%) will evaluate content errors. Of the 96 countries or areas that conducted or plan to conduct a PES, only 3 (one in Africa and two in Asia) did not or plan not to measure coverage error. On the other hand, 25 countries or areas did not use or plan not to use the PES to measure content error. A review of information in Table 5.2 and Figure 5.2 further shows that while measurement of coverage error is undertaken by almost all the countries or areas that conducted or plan to conduct a PES in all the regions, this is not the case with regard to measurement of content error. For example, all the countries or areas in Northern America and Oceania did not or do not plan to assess content error as part of the PES while only 13, 16 and 25 per cent, in Europe, Asia and Africa respectively, did not or do not plan to do so.

**Table 5. 2. Purpose of the post enumeration survey by geographic region**

| Geographic region | Number of countries using PES | Evaluate coverage errors | | Evaluate content errors | |
|---|---|---|---|---|---|
| | | Yes | No | Yes | No |
| | | | *Number* | | |
| All geographic regions | 96 | 93 | 3 | 71 | 25 |
| Africa | 24 | 23 | 1 | 18 | 6 |
| Asia | 31 | 29 | 2 | 26 | 5 |
| Europe | 23 | 23 | 0 | 20 | 3 |
| Latin America and the Caribbean | 14 | 14 | 0 | 7 | 7 |
| Caribbean | 6 | 6 | 0 | 3 | 3 |
| Latin America | 8 | 8 | 0 | 4 | 4 |
| Northern America | 2 | 2 | 0 | 0 | 2 |
| Oceania | 2 | 2 | 0 | 0 | 2 |
| | | | *Percentage* | | |
| All geographic regions | 100 | 97 | 3 | 74 | 26 |
| Africa | 100 | 96 | 4 | 75 | 25 |
| Asia | 100 | 94 | 6 | 84 | 16 |
| Europe | 100 | 100 | 0 | 87 | 13 |
| Latin America and the Caribbean | 100 | 100 | 0 | 50 | 50 |
| Caribbean | 100 | 100 | 0 | 50 | 50 |
| Latin America | 100 | 100 | 0 | 50 | 50 |
| Northern America | 100 | 100 | 0 | 0 | 100 |
| Oceania | 100 | 100 | 0 | 0 | 100 |

**Figure 5. 2. Purpose of the post enumeration survey and adjustment of census results**



## 5.2. Publication of reports on census evaluation and quality of data

The survey sought information on whether countries or areas publish an official report on their census evaluations and on the quality of their census data from the 2010 round of population and housing censuses. The responses in Table 5.3 show that 104 countries or areas, representing 75 per cent of the countries or areas that responded to the survey, indicated having published or planning to publish an official report on census evaluation and quality of census data. Seven countries or areas did not provide an answer to this question, including one that indicated that no decision had yet been taken on this matter. More than three quarters of all responding countries or areas from Latin and Northern America, Africa, Europe and Northern America publish census evaluation reports. It is worth noting that a relatively high percentage of countries or areas from Africa (83 %) indicated publishing reports on census evaluation and quality of census data. In contrast, less than two-thirds of responding countries or areas in the Caribbean and Oceania regions publish such reports.

**Table 5. 3. Publication of official reports on census evaluation and quality of data by region**

| Geographic region | Number of responding countries | Publish on census evaluation and quality of data | Do not publish on census evaluation and quality of data | Did not respond to question |
|---|---|---|---|---|
| | | *Number* | | |
| All geographic regions | 138 | 104 | 27 | 7 |
| Africa | 29 | 24 | 5 | 0 |
| Asia | 39 | 27 | 11 | 1 |
| Europe | 39 | 30 | 5 | 4 |
| Latin America and the Caribbean | 22 | 17 | 4 | 1 |
| Caribbean | 8 | 5 | 3 | 0 |
| Latin America | 14 | 12 | 1 | 1 |
| Northern America | 4 | 3 | 0 | 1 |
| Oceania | 5 | 3 | 2 | 0 |
| | | *Percentage* | | |
| All geographic regions | 100 | 75 | 20 | 5 |
| Africa | 100 | 83 | 17 | 0 |
| Asia | 100 | 69 | 28 | 3 |
| Europe | 100 | 77 | 13 | 10 |
| Latin America and the Caribbean | 100 | 77 | 18 | 5 |
| Caribbean | 100 | 63 | 38 | 0 |
| Latin America | 100 | 86 | 7 | 7 |
| Northern America | 100 | 75 | 0 | 25 |
| Oceania | 100 | 60 | 40 | 0 |

# Chapter 6. Data Processing Methods

Census data processing is the process of converting raw data into usable information. The process consists of various successive phases: data capture, coding, editing and tabulation. The choice of an appropriate method of processing is determined by the circumstances of each country. Rapid advances in data processing technology have greatly increased the speed and reliability of producing census data, thereby making computer processing the standard method of processing around the world.[17]

This chapter presents country practices or plans for data processing for the 2010 round of population and housing censuses.

## 6.1. Data capture methods

Data capture converts the information obtained in the census to a format that can be interpreted by a computer. Data capture methods include manual data entry, optical capture methods (consisting of the optical mark recognition (OMR), the optical character recognition (OCR) and the intelligent character recognition (ICR)), personal digital assistant (PDA) and the Internet.[18] It is possible that different methods of optical capture are simultaneously used for data capture in a census in some of the countries or areas.

New technologies are playing a significant role in changing data capture methodology from manual data entry to more technologically advanced data entry methods. In the last decade, there has been a significant improvement in optical capture technology with potential for reducing the cost and duration of data processing.

Table 6.1 shows the distribution of countries or areas by the number and type of methods used for data capture. Out of the 136 responding countries or areas[19], 77 countries or areas (57%) indicated using only one method of data capture. Among these, 36 countries or areas—the majority of which are in Africa and Asia—depend on only manual data entry while 29 countries or areas rely only on optical data capture (OMR, OCR or ICR) methods. The remaining 12 countries or areas use some other method of data capture, such as administrative registers, PDA or computer assisted personal interviewing (CAPI) and computer assisted telephone interviewing (CATI). The table indicates that more than half of the responding countries or areas in Africa, Asia and Oceania use only one method of data capture.

In contrast, 59 countries or areas (43% of the 136 responding countries or areas) employ two or more methods of data capture. The majority of these countries use optical scanning (OMR, OCR or ICR) in combination with other methods. It should be mentioned that countries or areas using optical data capture as the main method may use another method, such as, manual entry for responses to open-ended questions.

[17] United Nations *Principles and Recommendations for Population and Housing Censuses, Revision2*, para.1.294
[18] Ibid, para. 1.303.
[19] Two of the 138 countries or areas that responded to the survey did not provide information on methods of data capture.

Table 6.1 also shows that optical data capture is the most commonly used method across the world. 67 countries or areas—representing about half (49%) of all the responding countries or areas—used or plan to use optical data capture in the 2010 round of censuses. Among these, in 29 countries or areas optical data capture is used as a sole method while in the remaining 38 countries or areas it is used in combination with other methods. In Asia, Europe, Latin America and the Caribbean and Northern America, optical data capture technology is more commonly used, compared to the other methods of data capture (see Figure 6.1).

**Table 6. 1. Methods of data capture by geographic region**

| Geographic region | Number of responding countries | One data capture method only | Two or more methods | One data capture method only | | | | | Two or more data capture methods | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Manual data entry | Optical | PDA | Registers | Other | Manual and others | Optical and others | PDA and others | Registers and others | Other methods |
| | | | | *Number* | | | | | | | | | |
| All geographic regions | 136 | 77 | 59 | 36 | 29 | 3 | 6 | 3 | 5 | 38 | 3 | 9 | 4 |
| Africa | 28 | 24 | 4 | 15 | 8 | 1 | 0 | 0 | 0 | 4 | 0 | 0 | 0 |
| Asia | 39 | 20 | 19 | 10 | 7 | 1 | 0 | 2 | 1 | 14 | 1 | 2 | 1 |
| Europe | 39 | 18 | 21 | 5 | 8 | 0 | 5 | 0 | 2 | 9 | 0 | 7 | 3 |
| Latin America and the Caribbean | 21 | 10 | 11 | 3 | 5 | 1 | 0 | 1 | 2 | 7 | 2 | 0 | 0 |
| Caribbean | 8 | 4 | 4 | 0 | 4 | 0 | 0 | 0 | 1 | 3 | 0 | 0 | 0 |
| Latin America | 13 | 6 | 7 | 3 | 1 | 1 | 0 | 1 | 1 | 4 | 2 | 0 | 0 |
| Northern America | 4 | 2 | 2 | 0 | 1 | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 0 |
| Oceania | 5 | 3 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 |
| | | | | *Percentage* | | | | | | | | | |
| All geographic regions | 100 | 57 | 43 | 26 | 21 | 2 | 4 | 2 | 4 | 28 | 2 | 7 | 3 |
| Africa | 100 | 86 | 14 | 54 | 29 | 4 | 0 | 0 | 0 | 14 | 0 | 0 | 0 |
| Asia | 100 | 51 | 49 | 26 | 18 | 3 | 0 | 5 | 3 | 36 | 3 | 5 | 3 |
| Europe | 100 | 46 | 54 | 13 | 21 | 0 | 13 | 0 | 5 | 23 | 0 | 18 | 8 |
| Latin America and the Caribbean | 100 | 48 | 52 | 14 | 24 | 5 | 0 | 5 | 10 | 33 | 10 | 0 | 0 |
| Caribbean | 100 | 50 | 50 | 0 | 50 | 0 | 0 | 0 | 13 | 38 | 0 | 0 | 0 |
| Latin America | 100 | 46 | 54 | 23 | 8 | 8 | 0 | 8 | 8 | 31 | 15 | 0 | 0 |
| Northern America | 100 | 50 | 50 | 0 | 25 | 0 | 25 | 0 | 0 | 50 | 0 | 0 | 0 |
| Oceania | 100 | 60 | 40 | 60 | 0 | 0 | 0 | 0 | 0 | 40 | 0 | 0 | 0 |

Notes: i) Two of the 138 countries or areas that responded to the survey did not provide information on methods of data capture. ii) Optical methods refer to OMR, OCR or ICR. iii) Other data capture methods include computer assisted personal interviewing (CAPI) and computer assisted telephone interviewing (CATI).

Following optical data capture, manual data entry is the second most commonly used method. In 41 responding countries or areas (30% of all the responding countries or areas) manual data entry is used; it is used as the only method of data capture in 36 of these countries or areas. More than half of the responding countries or areas in Africa (54%) and Oceania (60%) as well as about a

third of those in Asia and Latin America use manual data entry, either alone or in combination with other data capture methods (see Figure 6.1).

Administrative registers are used as a major method of data capture in 15 of the responding countries or areas. All but three of these countries or areas are in Europe. In the majority of these countries or areas administrative registers are used in combination with other methods.

With technological improvement, it seems that in addition to the optical data capture and administrative registers, the Internet and PDA will play an important role in the process of data capture in the 2010 round of censuses. The PDA was used or will be used in 13 of the responding countries or areas. Among these, in six countries or areas the PDA will be used as the principal data capture method. The list of countries using PDA for the purpose of data capture is given in Table 6.2. Data capture with Internet is used (mostly as an additional method) in all regions except Africa where there is no country or area planning to use it as a method of data capture. Table 6.2 also lists the countries or areas which indicated using the Internet for data capture.

**Figure 6. 1. Percentage of countries or areas by method of data capture and geographic region**

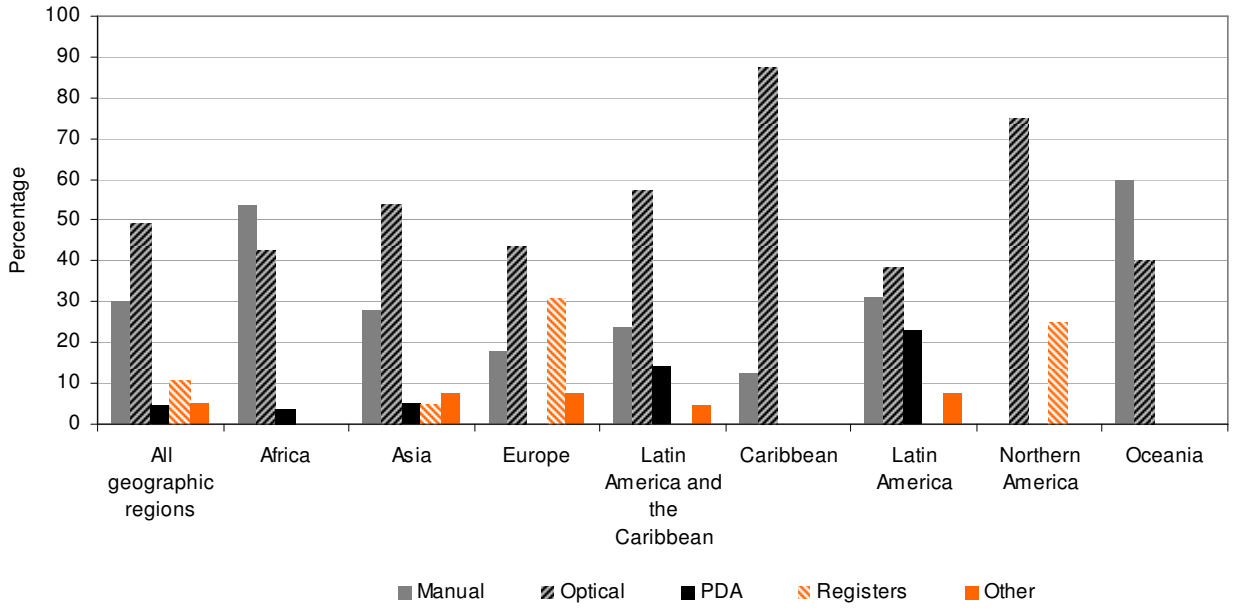


**Table 6. 2. List of responding countries or areas using the Internet or personal digital assistants (PDA) for data capture**

| | Africa | Asia | Europe | Latin America and the Caribbean | | Northern America | Oceania |
|---|---|---|---|---|---|---|---|
| | | | | Caribbean | Latin America | | |
| | | | ***Internet*** | | | | |
| 1 | | China, Hong Kong SAR | Czech Republic | Cayman Islands | Argentina | Canada | Australia |
| 2 | | China, Macao SAR | Estonia | Dominica | Brazil | | New Zealand |
| 3 | | Indonesia | Germany | Jamaica | | | |
| 4 | | Iran (Islamic Republic of) | Hungary | | | | |
| 5 | | Japan | Iceland | | | | |
| 6 | | Malaysia | Ireland | | | | |
| 7 | | Qatar | Italy | | | | |
| 8 | | Republic of Korea | Latvia | | | | |
| 9 | | Saudi Arabia | Lithuania | | | | |
| 10 | | Singapore | Poland | | | | |
| 11 | | Sri Lanka | Portugal | | | | |
| 12 | | Thailand | Slovakia | | | | |
| 13 | | | Spain | | | | |
| 14 | | | Switzerland | | | | |
| 15 | | | United Kingdom | | | | |
| | | | ***Personal digital assistants (PDA)*** | | | | |
| 1 | Cape Verde | Qatar | Czech Republic | Cuba | Brazil | | |
| 2 | | United Arab Emirates | Poland | Grenada | Colombia | | |
| 3 | | | Spain | | Guatemala | | |
| 4 | | | | | Paraguay | | |
| 5 | | | | | Uruguay | | |

## 6.2. Coding

Coding is done for some variables, especially those where answers are provided in free text (e.g. occupation and industry). Coding can be done by a coder (possibly computer-assisted) or by a dedicated computer program for automatic coding. Computer-assisted and automatic coding techniques may improve coding activities by enhancing the quality of operations, reducing coding errors and speeding up the coding process. However, automation may lead to inaccurate coding which could be costly and time consuming to correct. For computer-assisted and automatic coding to be successful, there is a need to set proper and well-tested specifications.

The survey collected information on whether or not coding is undertaken as part of census data processing. Table 6.3 shows that 90% of countries or areas used or plan to use some type of

coding method in the 2010 round. Only 14 countries or areas (10%) indicated that they are not coding any of the census variables. Most of these countries or areas (Norway, Iceland, Denmark, Slovenia, Sweden, Netherlands, Bahrain and Greenland) do not apply coding methods as they use registers for producing data. The remaining countries or areas, however, already conducted or plan to conduct their censuses using the traditional census method.

**Table 6. 3. Distribution of countries or areas using any type of coding method by geographic region**

| Geographic region | Number of responding countries | Coding using any method | Not coding |
|---|---|---|---|
| | | *Number* | |
| All geographic regions | 134 | 120 | 14 |
| Africa | 28 | 24 | 4 |
| Asia | 39 | 37 | 2 |
| Europe | 37 | 30 | 7 |
| Latin America and the Caribbean | 21 | 21 | 0 |
| Caribbean | 8 | 8 | 0 |
| Latin America | 13 | 13 | 0 |
| Northern America | 4 | 3 | 1 |
| Oceania | 5 | 5 | 0 |
| | | *Percentage* | |
| All geographic regions | 100 | 90 | 10 |
| Africa | 100 | 86 | 14 |
| Asia | 100 | 95 | 5 |
| Europe | 100 | 81 | 19 |
| Latin America and the Caribbean | 100 | 100 | 0 |
| Caribbean | 100 | 100 | 0 |
| Latin America | 100 | 100 | 0 |
| Northern America | 100 | 75 | 25 |
| Oceania | 100 | 100 | 0 |

Note: Four of the 138 countries or areas that responded to the survey did not indicate whether or not they apply coding.

Table 6.4 presents information about the type of coding methods used by countries or areas that responded to the survey. The information in the table shows that more than half of responding countries or areas use a combination of two techniques for coding. While about two-thirds or more of the countries or areas in Europe, Latin America and the Caribbean, Northern America and Oceania use combined methods for coding, only around 29% of countries or areas in Africa and 35% in Asia do so.

A combination of manual and computer-assisted coding is more common in Africa, Asia and Europe. On the other hand, the combination of computer-assisted and automatic coding is more common in Latin America and Oceania.

Manual coding is used as the only method of coding by 23% of the responding countries or areas in (12 countries or areas in Africa, 10 in Asia, 4 in Latin America and the Caribbean and 1 in Oceania). Countries or areas using only computer-assisted coding are mainly in Asia and Europe compared to the other regions. Table 6.4 shows that automatic coding is exclusively used by only 6 of the responding countries or areas.

**Table 6. 4. Methods of coding by geographic region**

| Geographic region | Number of responding countries using any coding method | Coding method | | | | Of those using a combination of coding methods | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Manual | Computer assisted | Automatic | Combination | Manual and computer assisted | Manual and automatic | Computer assisted and automatic | All methods |
| | | | | | *Number* | | | | |
| All geographic regions | 118 | 27 | 22 | 6 | 63 | 27 | 9 | 17 | 10 |
| Africa | 24 | 12 | 4 | 1 | 7 | 4 | 2 | 0 | 1 |
| Asia | 37 | 10 | 11 | 3 | 13 | 9 | 2 | 1 | 1 |
| Europe | 29 | 0 | 7 | 2 | 20 | 8 | 1 | 5 | 6 |
| Latin America and the Caribbean | 20 | 4 | 0 | 0 | 16 | 5 | 1 | 8 | 2 |
| Caribbean | 8 | 3 | 0 | 0 | 5 | 2 | 1 | 2 | 0 |
| Latin America | 12 | 1 | 0 | 0 | 11 | 3 | 0 | 6 | 2 |
| Northern America | 3 | 0 | 0 | 0 | 3 | 0 | 2 | 1 | 0 |
| Oceania | 5 | 1 | 0 | 0 | 4 | 1 | 1 | 2 | 0 |
| | | | | | *Percentage* | | | | |
| All geographic regions | 100 | 23 | 19 | 5 | 53 | 23 | 8 | 14 | 8 |
| Africa | 100 | 50 | 17 | 4 | 29 | 17 | 8 | 0 | 4 |
| Asia | 100 | 27 | 30 | 8 | 35 | 24 | 5 | 3 | 3 |
| Europe | 100 | 0 | 24 | 7 | 69 | 28 | 3 | 17 | 21 |
| Latin America and the Caribbean | 100 | 20 | 0 | 0 | 80 | 25 | 5 | 40 | 10 |
| Caribbean | 100 | 38 | 0 | 0 | 63 | 25 | 13 | 25 | 0 |
| Latin America | 100 | 8 | 0 | 0 | 92 | 25 | 0 | 50 | 17 |
| Northern America | 100 | 0 | 0 | 0 | 100 | 0 | 67 | 33 | 0 |
| Oceania | 100 | 20 | 0 | 0 | 80 | 20 | 20 | 40 | 0 |

## 6.3. Editing

Raw data files contain errors of many kinds, some generated by the respondents and others caused by enumerators when, for example, they misunderstand the respondents answers. Further mistakes are introduced in the data processing operations and during data entry and coding or in the course of the transcriptions that take place.[20]

[20] United Nations *Principles and Recommendations for Population and Housing Censuses, Revision 2*, para. 1.311 and 1.312

It is acknowledged that manual editing is a weak alternative to computer editing, partly because it is impossible to create or reconstruct an edit trail for the manual correction process.[21] Computer or automated editing reduces the time required and decreases the introduction of human error.

Editing comprises the systematic inspection of invalid and inconsistent responses and subsequent manual or automatic corrections (using "unknowns" or dynamic imputation) according to predetermined rules. Some editing operations involve manual corrections, which are corrections made manually in the office. Other editing operations involve electronic corrections using computers.[22]

Table 6.5 shows that 94% of the responding countries or areas use an editing system as part of data processing. Of the 135 responding countries or areas[23] only 8 countries or areas do not have an editing system, comprising of 6 from Europe (which use registers) and 2 from Latin American and the Caribbean.

Table 6.5 and Figure 6.2 indicate that most of the countries or areas with an editing system (70%) use or plan to use a combination of manual and automated editing. Of the total countries or areas with an editing system, 6 % use only manual editing while 20% use only automated editing. Editing is commonly done with a combination of methods in Africa, Asia, Europe, Latin America and Oceania.

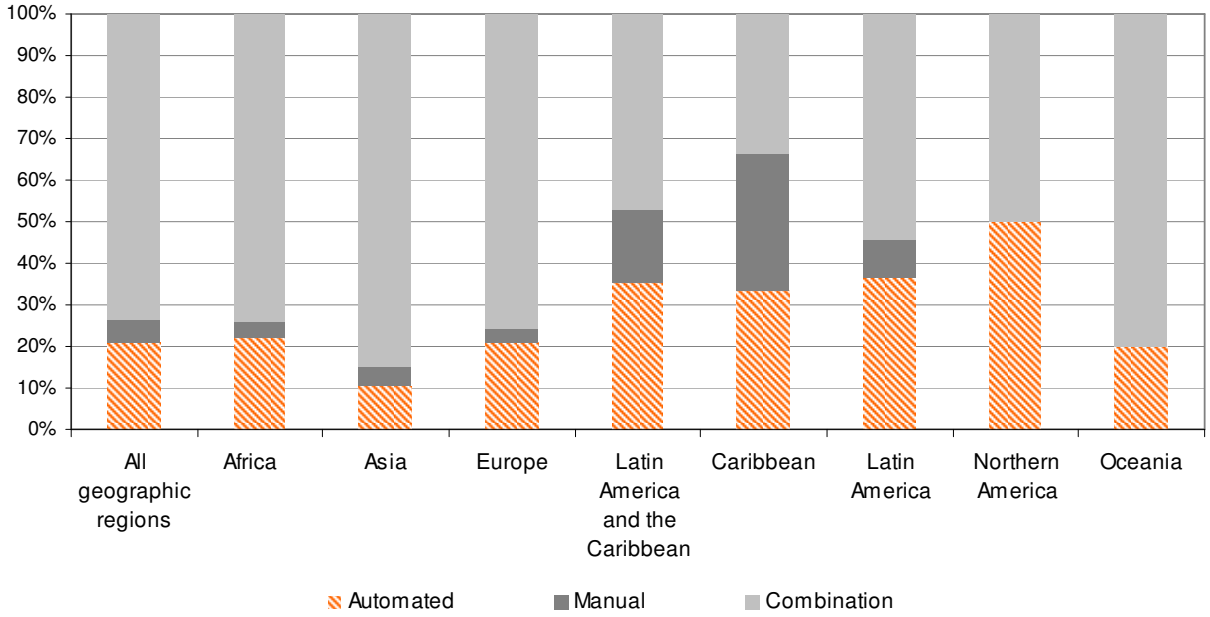
[21] Ibid, para. 109.
[22] United Nations *Handbook on Population and Housing Census Editing, Revision 1*, para. 48
[23] Three of the 138 countries or areas that responded to the survey did not provide information on whether or not they have an editing system.

**Table 6. 5. Methods of editing by geographic region**

| Geographical region | Number of responding countries | Have editing system | No editing system | Editing method | | | |
|---|---|---|---|---|---|---|---|
| | | | | Automated | Manual | Combination | No response |
| | | | | *Number* | | | |
| All geographic regions | 135 | 127 | 8 | 25 | 7 | 89 | 6 |
| | | | | | | | 0 |
| Africa | 28 | 28 | 0 | 6 | 1 | 20 | 1 |
| Asia | 39 | 39 | 0 | 4 | 2 | 33 | 0 |
| Europe | 38 | 32 | 6 | 6 | 1 | 22 | 3 |
| Latin America and the Caribbean | 21 | 19 | 2 | 6 | 3 | 8 | 2 |
| Caribbean | 8 | 7 | 1 | 2 | 2 | 2 | 1 |
| Latin America | 13 | 12 | 1 | 4 | 1 | 6 | 1 |
| Northern America | 4 | 4 | 0 | 2 | 0 | 2 | 0 |
| Oceania | 5 | 5 | 0 | 1 | 0 | 4 | 0 |
| | | | | *Percentage* | | | |
| All geographic regions | 100 | 94 | 6 | 20 | 6 | 70 | 5 |
| Africa | 100 | 100 | 0 | 21 | 4 | 71 | 4 |
| Asia | 100 | 100 | 0 | 10 | 5 | 85 | 0 |
| Europe | 100 | 84 | 16 | 19 | 3 | 69 | 9 |
| Latin America and the Caribbean | 100 | 90 | 10 | 32 | 16 | 42 | 11 |
| Caribbean | 100 | 88 | 13 | 29 | 29 | 29 | 14 |
| Latin America | 100 | 92 | 8 | 33 | 8 | 50 | 8 |
| Northern America | 100 | 100 | 0 | 50 | 0 | 50 | 0 |
| Oceania | 100 | 100 | 0 | 20 | 0 | 80 | 0 |

Note: Three of the 138 countries or areas that responded to the survey did not provide information on whether or not they have an editing system.

**Figure 6. 2. Percentage of countries or areas by method of editing and geographic region**




Imputation is the process of resolving problems concerning missing, invalid or inconsistent responses identified during editing.[24] The survey collected from countries or areas information on two types of imputation; imputing missing values in existing data records and imputing missing data records (full set of information on a person).

Table 6.6 presents information on how many of the countries or areas with an editing system apply imputation methods and about those methods of imputation. The majority of countries or areas with an editing system (103 out of 127) impute for missing, invalid or inconsistent responses. On the other hand, there are 20 countries or areas with editing systems (8 in Asia, 6 in Europe, 4 in Africa and 1 each in Northern America and the Caribbean) that do not apply imputation for any type of missing data.

About 43% of the countries or areas which apply imputation use only the automated method. Another 46 % use a combination of manual and automated methods, and about 10% apply only manual imputation to missing values. The majority of countries or areas in Africa, Latin and Northern America apply automatic imputation, while those in Asia, the Caribbean, Europe and Oceania use a combination of manual and automated imputation methods.

Table 6.7 shows that most of the responding countries or areas (70%) impute data only for missing values and around 24% do so for both missing values and records. Only about 6% of the countries or areas that apply imputation methods do so for the purpose of imputing only missing data records. Most of the countries or areas in Latin America (92%), Africa (81%), Oceania

[24] United Nations *Handbook on Population and Housing Census Editing, Revision 1*, para. 72.

(60%), Asia (67%) and Europe (65%) impute data for missing values only. It seems that countries or areas in Northern America generally impute for both missing values and records.

**Table 6. 6. Methods of imputation of data by geographic region**

| Geographical region | Number of responding countries with editing system | Applying any imputation | Not applying imputation | No response | Imputation method used | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Automated | Manual | Combination | No response |
| | | | | *Number* | | | | |
| All geographic regions | 127 | 103 | 20 | 4 | 44 | 10 | 47 | 2 |
| Africa | 28 | 21 | 4 | 3 | 12 | 1 | 7 | 1 |
| Asia | 39 | 30 | 8 | 1 | 10 | 2 | 17 | 1 |
| Europe | 32 | 26 | 6 | 0 | 11 | 3 | 12 | 0 |
| Latin America and the Caribbean | 19 | 18 | 1 | 0 | 8 | 2 | 8 | 0 |
| Caribbean | 7 | 6 | 1 | 0 | 1 | 2 | 3 | 0 |
| Latin America | 12 | 12 | 0 | 0 | 7 | 0 | 5 | 0 |
| Northern America | 4 | 3 | 1 | 0 | 2 | 0 | 1 | 0 |
| Oceania | 5 | 5 | 0 | 0 | 1 | 2 | 2 | 0 |
| | | | | *Percentage* | | | | |
| All geographic regions | 100 | 81 | 16 | 3 | 43 | 10 | 46 | 2 |
| Africa | 100 | 75 | 14 | 11 | 57 | 5 | 33 | 5 |
| Asia | 100 | 77 | 21 | 3 | 33 | 7 | 57 | 3 |
| Europe | 100 | 81 | 19 | 0 | 42 | 12 | 46 | 0 |
| Latin America and the Caribbean | 100 | 95 | 5 | 0 | 44 | 11 | 44 | 0 |
| Caribbean | 100 | 86 | 14 | 0 | 17 | 33 | 50 | 0 |
| Latin America | 100 | 100 | 0 | 0 | 58 | 0 | 42 | 0 |
| Northern America | 100 | 75 | 25 | 0 | 67 | 0 | 33 | 0 |
| Oceania | 100 | 100 | 0 | 0 | 20 | 40 | 40 | 0 |

Note: Four countries that indicated having an editing system did not provide information on the type of imputations made.

**Table 6. 7. Purpose of imputation by geographic region**

| Geographic region | Number of responding countries applying any imputation | Type of imputation | | |
|---|---|---|---|---|
| | | Imputing missing values | Imputing missing data records | Imputing missing values and records |
| | | *Number* | | |
| All geographic regions | 103 | 72 | 6 | 25 |
| Africa | 21 | 17 | 2 | 2 |
| Asia | 30 | 20 | 3 | 7 |
| Europe | 26 | 17 | 0 | 9 |
| Latin America and the Caribbean | 18 | 14 | 1 | 3 |
| Caribbean | 6 | 3 | 1 | 2 |
| Latin America | 12 | 11 | 0 | 1 |
| Northern America | 3 | 1 | 0 | 2 |
| Oceania | 5 | 3 | 0 | 2 |
| | | *Percentage* | | |
| All geographic regions | 100 | 70 | 6 | 24 |
| Africa | 100 | 81 | 10 | 10 |
| Asia | 100 | 67 | 10 | 23 |
| Europe | 100 | 65 | 0 | 35 |
| Latin America and the Caribbean | 100 | 78 | 6 | 17 |
| Caribbean | 100 | 50 | 17 | 33 |
| Latin America | 100 | 92 | 0 | 8 |
| Northern America | 100 | 33 | 0 | 67 |
| Oceania | 100 | 60 | 0 | 40 |

Note: Two countries that indicated imputing census data did not provide information on the methods of imputation.

# Chapter 7. Census Data Dissemination

A census is not considered complete until the collected information is made available to users in the form suited to their needs.[25] Recent decades have witnessed an increasing demand, by census data users, for a broad range of census products and services. Each census product, and its media of dissemination, offers respective advantages and limitations. In most instances, the various census products and services complement each other and can provide effective ways to reach out to a wide range of users in the public and private sectors. With the widespread use of microcomputers and growing access to the Internet, an increasing number of data users prefer to obtain census data in electronic media rather than in printed form. Since the cost of producing census products in various formats, for example, printed versus electronic media, can be different, it is recommended that countries consider very carefully the forms in which the census results are disseminated[26]. In this regard, user consultations are important in the process of designing the census product mix and the range of media in which it is disseminated.

## 7.1. Media of dissemination

The survey gathered information on the media used by countries or areas to disseminate census results. Countries or areas were requested to indicate all applicable media of dissemination in the following list: (i) paper publication; (ii) CD-ROM/DVD; (iii) static web pages (html, PDF, excel); (iv) interactive online database(s); (v) GIS web-based mapping tools; and (vi) other, to be specified by countries or areas. Table 7.1 shows a summary of the responses received from 135 countries or areas.[27]

A review of the information in Table 7.1 illustrates that virtually all countries or areas that responded to the survey used or plan to use a combination of print and electronic media to convey census results to users. Only one country plans to disseminate census data without using electronic media, while 5 other countries have indicated that they ceased or plan to cease dissemination via the traditional print publication. It is worth noting that all five of these countries are developed countries or areas located in Europe (Belgium, France and Italy), Northern America (Greenland) and Oceania (Australia).

Used in 130 of the 135 countries or areas, the traditional print publication remains a primary tool of dissemination. Statistic web pages were found to be the second most commonly used media, being employed in 128 countries or areas (95%). Computer-readable optical media (CD-ROM/DVD), utilized in 108 countries or areas (80%), was the third most commonly used media of dissemination. Use of the other two electronic media—online databases (53%) and GIS web-based mapping tools (59%)—was less common, possibly indicating the challenges that exist in many countries or areas, particularly those in developing regions, in utilizing new and existing technologies for the production and dissemination of census data.

[25] United Nations Principles and Recommendations for Population and Housing Censuses, Revision 2, para. 1.206.
[26] Ibid, para. 3.3.
[27] Three countries or areas that responded to the survey provided no information on this item.

The extent of use of the various media of dissemination varied considerably by region. In terms of use of the various media, the profile of the majority of countries or areas in Africa, Asia and the Caribbean closely corresponds to that of the global pattern described above. In these regions, dissemination via print publications, static web pages and CD-ROM/DVD is relatively more common than that via online databases and GIS web-based mapping tools. For instance, in Africa, at least 25 countries or areas out of the 29 that responded to the survey utilized each of the former three media of dissemination, whereas only 10 and 15 countries reported, respectively, using databases and GIS web-based mapping tools.

In contrast, developed countries or areas displayed a somewhat different pattern. Among these countries or areas, statistic web pages were the predominant media of dissemination (100%), followed by print publications (89%). Use of online databases (73%) is also a major means of dissemination; use of GIS web-based mapping tools (57%) lags behind that of the other media.

Data stored in census databases represent a rich source of information. Online access to such databases could potentially enhance the accessibility of census data to a large user base. On-demand and direct access to a census database allows fast and relatively inexpensive production of tables, especially those not produced or made available through other means. As noted above, slightly more than half of the responding countries or areas (53%) disseminate census data through online databases. However, developed countries or areas disseminate via online databases at a higher proportion (73%) than developing countries or areas (44%). Dissemination via online databases appears is limited in Asia (39%), Africa (34 %), the Caribbean (25%) and Oceania (20%).

Advances in geographic information systems (GIS) and their growing integration in statistical production systems have increased the demand for geo-referenced data as well as for tools for visualizing, analyzing, modelling and presenting spatially referenced data. As already noted, a total of 79 countries or areas that responded to the survey have reported offering census data along with GIS web-based mapping tools. Some of these countries or areas have also reported providing online interactive software applications such as CensusInfo, Beyond 20/20 and TableBuilder to facilitate access to and further processing of their census data. Furthermore, several countries or areas have reported disseminating census data through a variety of other means including mass media (radio, TV) and customized services upon request.

**Table 7. 1. Media of dissemination by region**

| Region | Number of responding countries | Print publication only | Electronic media only | Print and electronic media | Electronic media | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | CD/DVD | Static website | Online database | GIS web-based tools |
| | | | | *Number* | | | | |
| All regions | 135 | 1 | 5 | 129 | 108 | 128 | 72 | 79 |
| Developed regions | 44 | 0 | 5 | 39 | 27 | 44 | 32 | 27 |
| Developing regions | 91 | 1 | 0 | 90 | 81 | 84 | 40 | 52 |
| Africa | 29 | 0 | 0 | 29 | 27 | 25 | 10 | 15 |
| Asia | 38 | 0 | 0 | 38 | 34 | 37 | 15 | 26 |
| Europe | 37 | 0 | 3 | 34 | 23 | 37 | 27 | 22 |
| Latin America and the Caribbean | 22 | 1 | 0 | 21 | 20 | 20 | 16 | 12 |
| Caribbean | 8 | 1 | 0 | 7 | 6 | 6 | 2 | 4 |
| Latin America | 14 | 0 | 0 | 14 | 14 | 14 | 14 | 8 |
| Northern America | 4 | 0 | 1 | 3 | 2 | 4 | 3 | 3 |
| Oceania | 5 | 0 | 1 | 4 | 2 | 5 | 1 | 1 |
| | | | | *Percentage* | | | | |
| All regions | 100 | 1 | 4 | 96 | 80 | 95 | 53 | 59 |
| Developed regions | 100 | 0 | 11 | 89 | 61 | 100 | 73 | 61 |
| Developing regions | 100 | 1 | 0 | 99 | 89 | 92 | 44 | 57 |
| Africa | 100 | 0 | 0 | 100 | 93 | 86 | 34 | 52 |
| Asia | 100 | 0 | 0 | 100 | 89 | 97 | 39 | 68 |
| Europe | 100 | 0 | 8 | 92 | 62 | 100 | 73 | 59 |
| Latin America and the Caribbean | 100 | 5 | 0 | 95 | 91 | 91 | 73 | 55 |
| Caribbean | 100 | 13 | 0 | 88 | 75 | 75 | 25 | 50 |
| Latin America | 100 | 0 | 0 | 100 | 100 | 100 | 100 | 57 |
| Northern America | 100 | 0 | 25 | 75 | 50 | 100 | 75 | 75 |
| Oceania | 100 | 0 | 20 | 80 | 40 | 100 | 20 | 20 |

Note: Three countries or areas that responded to the survey provided no information on media of dissemination.

## 7.2. Microdata

Microdata are the individual records that contain information collected in a census or survey on the characteristics of each person, household and housing unit. A census microdata sample allows researchers to know, simultaneously, all the personal characteristics of every individual in the sample. Microdata-sets link household information with individual information, thus allowing researchers to know the characteristics of the individual and other household members.

The survey collected information on whether countries or areas disseminate census microdata. Table 7.2 shows a summary of the information received from a total of 131 countries or areas.[28] Among these, 77 countries or areas (59%), indicated that they disseminate census microdata. Sixty-two per cent of developed countries or areas and 57 per cent developing countries or areas reported disseminating microdata, showing no substantial difference between the two. At 79 per

[28] Seven countries or areas that responded to the survey did not provide information on this item.

cent, Latin America is the region with the highest percentage of countries or areas that disseminate microdata. In contrast, Africa is the region with the lowest percentage (37 %) of countries or areas that provide census microdata to users.

**Table 7. 2. Dissemination of microdata by region**

| Region | Number of responding countries | Disseminate microdata | Not disseminate |
|---|---|---|---|
| | | *Number* | |
| All regions | 131 | 77 | 54 |
| Developed regions | 45 | 28 | 17 |
| Developing regionss | 86 | 49 | 37 |
| Africa | 27 | 10 | 17 |
| Asia | 34 | 23 | 11 |
| Europe | 39 | 24 | 15 |
| Latin America and the Caribbean | 22 | 15 | 7 |
| Caribbean | 8 | 4 | 4 |
| Latin America | 14 | 11 | 3 |
| Northern America | 4 | 2 | 2 |
| Oceania | 5 | 3 | 2 |
| | | *Percentage* | |
| All regions | 100 | 59 | 41 |
| Developed regions | 100 | 62 | 38 |
| Developing regions | 100 | 57 | 43 |
| Africa | 100 | 37 | 63 |
| Asia | 100 | 68 | 32 |
| Europe | 100 | 62 | 38 |
| Latin America and the Caribbean | 100 | 68 | 32 |
| Caribbean | 100 | 50 | 50 |
| Latin America | 100 | 79 | 21 |
| Northern America | 100 | 50 | 50 |
| Oceania | 100 | 60 | 40 |

Note: Seven countries or areas that responded to the survey did not provide information on this item.

Most responding countries or areas indicated that, pursuant to applicable census laws and other statistical legislations, they routinely apply confidentiality rules to avoid the disclosure of identifiable personal or household information. Some of the measures reported by countries or areas responding to the survey include anonymizing microdata samples, requiring data protection and privacy contracts, and allowing access to microdata only in a secure and controlled environment. Several countries or areas that responded to the survey restrict the use of microdata only for academic, research and policymaking purposes. For instance, Mexico reported restricting access to microdata to public institutions. Similarly, Indonesia disseminates microdata only to specific government and research organizations upon special request and under a contract-based arrangement.

The survey found that countries or areas use a variety of channels to disseminate microdata to major users including researchers, policymakers, teachers, and students. Canada, Israel and the United States reported providing, at no fee, microdata samples as public use files. In several

countries or areas, microdata files are obtained by users only through special requests subject to disclosure controls, and in some cases microdata are provided at a charge.

### 7.3. Service for special requests

Most statistical organizations make a clear distinction between delivering basic census information to the public and providing more complex data for the needs of specialized users. Census publications usually contain data and tabulations of general concern, but certain data users may require specialized products that the census organization is not planning to produce as part of the general dissemination programme. In such cases, it is advisable for census organizations to establish a service to meet such specialized requests, usually on a cost recovery basis. The specialized request may be for more detailed tabulations, data on specific topics and subgroups, microdata or information consultancy whose requirements are best met through the provision of individual products or customized services.

The survey elicited information on the provision of customized services provided to users upon their requests and on whether fees are charged for those services. Table 7.3 summarizes the information supplied by 133 countries or areas.[29] In 101 of these countries or areas, users are provided customized services to their requests for complex data or some other specialized census products. All countries or areas from Latin and Northern America reported catering to special requests. Three-quarters or more of the countries or areas in Asia, the Caribbean and Europe also cater to special requests. However, only 40 per cent of the countries or areas from Oceania and 68 per cent from Africa provide customized service to census data users with special requests.

In the case where cost recovery is applied, census product users requiring customized information or product are charged. Of the 101 countries or areas that provide customized service, 74 countries (73 %) charge fees for their services (see Table 7.3). A higher percentage of developed countries or areas (88 %) reported charging fees than developing countries or areas (66 %). The prices of the products and services are generally established to cover all expenses related to production costs, marketing costs and standard agency overhead, including support. The costs usually depend on the complexity of the request and the resources and time required for completing the request. It should be noted however that the full costs of a census are usually never recovered through the sale of data.[30]

[29] Five countries or areas that responded to the survey did not provide information on this item.
[30] United Nations Handbook on Census Management for Population and Housing Censuses, Revision 1.

**Table 7. 3. Provision of customized service for special requests by region**

| Region | Number of countries responding | Cater to customized requests for data | Not cater | Of those catering to customized requests | |
|---|---|---|---|---|---|
| | | | | Charge fee | No fee |
| | | | *Number* | | |
| All regions | 133 | 101 | 32 | 74 | 27 |
| Developed regions | 43 | 34 | 9 | 30 | 4 |
| Developing regions | 90 | 67 | 23 | 44 | 23 |
| Africa | 28 | 19 | 9 | 12 | 7 |
| Asia | 38 | 29 | 9 | 20 | 9 |
| Europe | 37 | 28 | 9 | 24 | 4 |
| Latin America and the Caribbean | 22 | 20 | 2 | 13 | 7 |
| Caribbean | 8 | 6 | 2 | 2 | 4 |
| Latin America | 14 | 14 | 0 | 11 | 3 |
| Northern America | 3 | 3 | 0 | 3 | 0 |
| Oceania | 5 | 2 | 3 | 2 | 0 |
| | | | *Percentage* | | |
| All regions | 100 | 76 | 24 | 73 | 27 |
| Developed regions | 100 | 79 | 21 | 88 | 12 |
| Developing regions | 100 | 74 | 26 | 66 | 34 |
| Africa | 100 | 68 | 32 | 63 | 37 |
| Asia | 100 | 76 | 24 | 69 | 31 |
| Europe | 100 | 76 | 24 | 86 | 14 |
| Latin America and the Caribbean | 100 | 91 | 9 | 65 | 35 |
| Caribbean | 100 | 75 | 25 | 33 | 67 |
| Latin America | 100 | 100 | 0 | 79 | 21 |
| Northern America | 100 | 100 | 0 | 100 | 0 |
| Oceania | 100 | 40 | 60 | 100 | 0 |

Note: Five countries or areas that responded to the survey did not provide information on this item.

## 7.4. Archiving

Data management is particularly critical in a census operation due to the large volume of data that passes through the statistical production process. Census databases store the census data in various computerized forms in order to expand the life and usability of the data. They play a key role in enhancing the dissemination of the census results. They are also useful for combining census data together with related information from other demographic inquiries in a common format. Because of their importance in the statistical production process, plans for data warehousing should be formulated as an integral part of the overall census planning process.

The survey asked countries or areas about their use of systems for managing and archiving their census data. Responses were received from a total of 134 countries or areas and are summarized in Table 7.4. Although four countries or areas responded to the survey, they did not provide information on this item. A review of the responses reveals that the vast majority of countries or areas (106 out of 134 or 79 %) do have some kind of archiving system for storing and maintaining their census data. Nearly 90 per cent of developed countries or areas reported having

an archiving system, whereas a significantly lower percentage (74%) of developing countries or areas reported having one. A large proportion of countries or areas in the Caribbean (63%) and Oceania (60%) lack a proper archiving system.

The responses to the survey indicate that the technology used for documenting, maintaining and archiving census data varies across countries or areas. The commonly noted relational databases and information technologies include SQL Server, Oracle, Redatam, SAS, Tivoli and IHSN's Microdata Management Toolkit.

**Table 7. 4. Distribution of countries or areas having a system for managing and archiving census data by region**

| Region | Number of responding countries | Have a system for archiving census data | No system for archiving |
|---|---|---|---|
| | | *Number* | |
| All regions | 134 | 106 | 28 |
| Developed regions | 44 | 39 | 5 |
| Developing regions | 90 | 67 | 23 |
| Africa | 28 | 22 | 6 |
| Asia | 38 | 32 | 6 |
| Europe | 37 | 33 | 4 |
| Latin America and the Caribbean | 22 | 14 | 8 |
| Caribbean | 8 | 3 | 5 |
| Latin America | 14 | 11 | 3 |
| Northern America | 4 | 3 | 1 |
| Oceania | 5 | 2 | 3 |
| | | *Percentage* | |
| All regions | 100 | 79 | 21 |
| Developed regions | 100 | 89 | 11 |
| Developing regions | 100 | 74 | 26 |
| Africa | 100 | 79 | 21 |
| Asia | 100 | 84 | 16 |
| Europe | 100 | 89 | 11 |
| Latin America and the Caribbean | 100 | 64 | 36 |
| Caribbean | 100 | 38 | 63 |
| Latin America | 100 | 79 | 21 |
| Northern America | 100 | 75 | 25 |
| Oceania | 100 | 40 | 60 |

Note: Four countries or areas that responded to the survey did not provide information on this item.

# Chapter 8. Challenges and Expertise in Conducting Population and Housing Censuses

Given that census methodology is constantly changing and advancing, exchange of national experience and know-how significantly contributes to the efficiency and effectiveness of census operations and the quality and timeliness of census results.

The survey requested countries or areas to provide information on: (i) the challenges they faced in conducting their censuses and the areas in which they require assistance; and (ii) the expertise they may have and in which they could offer assistance to other countries.

In interpreting the responses, it is important to keep in mind that this information does not take into account the census dates for individual countries or areas in order to account for timing of the required assistance to the census activities for which it is needed. As a result, countries or areas whose censuses were some years away from the time of the survey may not have known what kind of assistance they would require and neither would they have received the needed external assistance. Also this analysis does not give great detail on the type of assistance required and reasons for not receiving the assistance as the responding countries or areas did not specify further on assistance required and obtained.

## 8.1. Countries or areas that require assistance in one or several phases of the census operation

Countries or areas were requested to indicate if they needed support to conduct their censuses in the 2010 round and asked to identify in which of the following phases or aspects of the census operation they required assistance: design of questionnaires, cartography, use of new technologies, funding, publicity and communication strategies, field training, data collection, quality assurance systems, data capture, data processing, data analysis and dissemination strategy.

Table 8.1 shows the number of countries requiring assistance in at least one aspect of census operation or census phase by region. Assistance is required—in at least one phase or aspect of the census operation—by 92 countries or areas. Among these, 26 in Africa (90% of the countries or areas that responded to the survey in that region), 28 (72%) in Asia, 15 (38%) in Europe, 19 (86%) in Latin America and the Caribbean, and 3 (60%) in Oceania indicated that they require assistance in at least one phase or aspect of the census operation.

Furthermore, table 8.2 shows information on the type of assistance required by countries or areas, by geographic grouping and by level of development. Assistance is required primarily on new technologies, cartography, quality assurance, and analysis and dissemination strategies; and to a lesser extent on data capture and processing, and publicity and communication strategies. A total of 64 countries or areas required assistance on new technologies, while more than 50 countries or areas required assistance in cartography, quality assurance, and analysis and dissemination strategies. Funding and assistance on data capture and processing was required by 46 countries each. With respect to new technologies, assistance was required on scanning for

data capture, GPS/GIS, online mapping tools (GIS), use of hand-held mobile technology, using telephones for monitoring and control of field operations and on the e-Census. Countries or areas that are interested in the e-Censuses include the Russian Federation and Malaysia. Jamaica is also exploring ways to conduct a more cost-effective census, and Latvia in obtaining information about the experience of other countries in using new technologies.

**Table 8. 1. Countries or areas that require assistance in at least one aspect of census operation or census phase by region**

| Region | Number of responding countries | Require assistance in at least one aspect of census operation or census phase | Do not require assistance in any census operation or census phase |
|---|---|---|---|
| | | *Number* | |
| All regions | 138 | 92 | 46 |
| Developing countries | 87 | 72 | 15 |
| Transition countries | 15 | 12 | 3 |
| Developed countries | 36 | 8 | 28 |
| Africa | 29 | 26 | 3 |
| Asia | 39 | 28 | 11 |
| Europe | 39 | 15 | 24 |
| Latin America and the Caribbean | 22 | 19 | 3 |
| Caribbean | 8 | 8 | 0 |
| Latin America | 14 | 11 | 3 |
| Northern America | 4 | 1 | 3 |
| Oceania | 5 | 3 | 2 |
| | | *Percentage* | |
| All regions | 100 | 67 | 33 |
| Developing countries | 100 | 83 | 17 |
| Transition countries | 100 | 80 | 20 |
| Developed countries | 100 | 22 | 78 |
| Africa | 100 | 90 | 10 |
| Asia | 100 | 72 | 28 |
| Europe | 100 | 38 | 62 |
| Latin America and the Caribbean | 100 | 86 | 14 |
| Caribbean | 100 | 100 | 0 |
| Latin America | 100 | 79 | 21 |
| Northern America | 100 | 25 | 75 |
| Oceania | 100 | 60 | 40 |

**Table 8. 2. Countries or areas that require assistance by aspect of census operation or census phase and region**

| Region | Questionnaire design | Cartography | New technologies | Funding sources | Publicity and communication | Field training | Data collection | Quality assurance | Data capture | Data processing | Analysis and dissemination | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| All regions | 30 | 57 | 64 | 46 | 32 | 22 | 19 | 56 | 39 | 46 | 55 | 12 |
| Developing countries | 27 | 48 | 52 | 39 | 30 | 21 | 17 | 45 | 37 | 41 | 45 | 9 |
| Transition countries | 3 | 4 | 8 | 5 | 2 | 1 | 1 | 7 | 2 | 3 | 7 | 1 |
| Developed countries | 0 | 5 | 4 | 2 | 0 | 0 | 1 | 4 | 0 | 2 | 3 | 2 |
| Africa | 12 | 20 | 21 | 14 | 12 | 5 | 7 | 14 | 15 | 18 | 18 | 5 |
| Asia | 7 | 14 | 18 | 15 | 11 | 7 | 4 | 16 | 11 | 10 | 19 | 1 |
| Europe | 2 | 7 | 10 | 6 | 2 | 1 | 2 | 9 | 2 | 4 | 6 | 2 |
| Latin America and the Caribbean | 6 | 14 | 12 | 9 | 5 | 6 | 3 | 14 | 8 | 11 | 8 | 3 |
| Caribbean | 4 | 5 | 7 | 3 | 3 | 1 | 1 | 6 | 3 | 5 | 3 | 0 |
| Latin America | 2 | 9 | 5 | 6 | 2 | 5 | 2 | 8 | 5 | 6 | 5 | 3 |
| Northern America | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 |
| Oceania | 3 | 1 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 0 |

Note that some developed countries (Belgium, Bermuda, Estonia, Greece, Latvia, Lithuania, Malta and Poland) required assistance from outside of their statistical offices and relied upon consultants for expertise on new technologies, quality assurance and on information pertaining to trans-frontier matters. For example, Belgium made use of external expertise in the collection of information on qualifications (educational attainment) obtained outside the country and also information on trans-frontier employment.

## 8.2 Countries or areas that obtained assistance from external sources

Table 8.3 shows the number of countries or areas that obtained assistance from external sources by geographic and development region. Only 46 countries or areas have reported receiving external support in at least one phase or aspect of the census operation. Among these, 16 are in Africa, 9 in Latin America and the Caribbean and 14 in Asia.

Furthermore, table 8.4 shows the number of countries or areas that obtained assistance from external sources by geographic and development region and phase or aspect of the census operation. There is a wide variation on assistance received across both geographic regions and stages of census operations. For example, for the African region, all countries or areas that required assistance on field training indicated that they had received the assistance, while only 2 of the 9 countries or areas that needed assistance for funding in Latin America and the Caribbean indicated that they had received support. A total of 23 countries or areas that required assistance on design of questionnaires indicated that they had got the assistance out a total of 30 countries

that required assistance (see table 8.2). Only 15 countries or areas indicated that they had received assistance in new technologies out of a total of 64 countries or areas that required assistance with new technologies. Only 11 countries or areas received assistance in quality assurance, and analysis and dissemination strategies. When interpreting the results, it is important to keep in mind whether or not the phase or aspect of the census in question had already taken place or not. This is because countries or areas may be reporting on activities that will take place some years in the future and therefore for which assistance has not been received.

**Table 8. 3. Countries or areas that received assistance to carryout census operations or census phases by region**

| Region | Total | On all phases or operations that required assistance | On some of the phases or operations that required assistance |
|---|---|---|---|
| | | *Number* | |
| All regions | 46 | 11 | 35 |
| Developing countries | 41 | 9 | 32 |
| Transition countries | 2 | 1 | 1 |
| Developed countries | 3 | 1 | 2 |
| Africa | 16 | 3 | 13 |
| Asia | 14 | 4 | 10 |
| Europe | 4 | 2 | 2 |
| Latin America and the Caribbean | 9 | 1 | 8 |
| Caribbean | 4 | 0 | 4 |
| Latin America | 5 | 1 | 4 |
| Northern America | 0 | 0 | 0 |
| Oceania | 3 | 1 | 2 |
| | | *Percentage* | |
| All regions | 100 | 24 | 76 |
| Developing countries | 100 | 22 | 78 |
| Transition countries | 100 | 50 | 50 |
| Developed countries | 100 | 33 | 67 |
| Africa | 100 | 19 | 81 |
| Asia | 100 | 29 | 71 |
| Europe | 100 | 50 | 50 |
| Latin America and the Caribbean | 100 | 11 | 89 |
| Caribbean | 100 | 0 | 100 |
| Latin America | 100 | 20 | 80 |
| Northern America | 100 | 24 | 76 |
| Oceania | 100 | 22 | 78 |

**Table 8. 4. Countries or areas that received assistance by aspect of census operation or census phase and region**

| Region | Questionnaire design | Cartography | New technologies | Funding sources | Publicity and communication | Field training | Data collection | Quality assurance | Data capture | Data processing | Analysis and dissemination | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| All regions | 23 | 25 | 15 | 12 | 14 | 11 | 12 | 11 | 15 | 15 | 11 | 3 |
| Developing countries | 22 | 24 | 14 | 12 | 14 | 11 | 11 | 11 | 15 | 15 | 11 | 2 |
| Transition countries | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Developed countries | – | 1 | 1 | 0 | – | – | 1 | 0 | – | 0 | 0 | 0 |
| Africa | 10 | 13 | 8 | 6 | 7 | 5 | 6 | 4 | 8 | 7 | 3 | 1 |
| Asia | 7 | 7 | 4 | 4 | 6 | 4 | 3 | 4 | 4 | 3 | 5 | 0 |
| Europe | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| Latin America and the Caribbean | 4 | 4 | 0 | 2 | 0 | 0 | 0 | 1 | 1 | 3 | 1 | 1 |
| Caribbean | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | – |
| Latin America | 1 | 2 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 2 | 1 | 1 |
| Northern America | – | 0 | – | – | – | – | – | 0 | – | – | 0 | 0 |
| Oceania | 2 | 0 | 2 | 0 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | – |

Note: A short dash (–) indicates “not applicable”.

## 8.3 Availability of expertise in countries or areas

Table 8.5 gives the number of countries or areas that indicated having in-house expertise on different areas of the census process which they could potentially share with other countries or areas. The information collected by the survey shows that a total of 88 countries or areas—64 developing, 6 transition and 18 developed countries or areas—have expertise in at least one of the different areas of the census process, 23 countries or areas in Africa, 16 in Latin America and the Caribbean, 26 in Asia, 17 in Europe and 3 in Oceania have in-house expertise in at least one area of the census process that they could share with other countries or areas. In Northern America, 3 countries have expertise which they could share with other countries or areas.

Furthermore, table 8.6 gives the number of countries or areas that indicated having in-house expertise by aspect of census operation or census phase and region. It is worth noting that one or more countries or areas in each region of the world has indicated having expertise in each one of the specified census phases or aspects; the exception being the Caribbean region, where no one country or area declared to have expertise in new technologies, and also publicity and communication strategies. Notable phases or aspects of the census in which many developing countries or areas could provide assistance to others are questionnaire design, field training, data collection and cartography. These findings show that there are numerous possibilities for realizing South-South collaborations. Other aspects of the census where countries could share their expertise include advice on improving the regulatory framework of the census, automated planning and operation, control and monitoring of field working, census management, e-Census,

program governance, integrated census methodology, project management, sampling, and use of registers.

**Table 8. 5. Countries or areas that declared to have expertise to share by region**

| Region | Total | On all phases and operations | On some of the phases or operations |
|---|---|---|---|
| | | *Number* | |
| All regions | 88 | 7 | 81 |
| Developing countries | 64 | 3 | 61 |
| Transition countries | 6 | 0 | 6 |
| Developed countries | 18 | 4 | 14 |
| Africa | 23 | 1 | 22 |
| Asia | 26 | 3 | 23 |
| Europe | 17 | 1 | 16 |
| Latin America and the Caribbean | 16 | 0 | 16 |
| Caribbean | 8 | 0 | 8 |
| Latin America | 8 | 0 | 8 |
| Northern America | 3 | 2 | 1 |
| Oceania | 3 | 0 | 3 |
| | | *Percentage* | |
| All regions | 100 | 8 | 92 |
| Developing countries | 100 | 5 | 95 |
| Transition countries | 100 | 0 | 100 |
| Developed countries | 100 | 22 | 78 |
| Africa | 100 | 4 | 96 |
| Asia | 100 | 12 | 88 |
| Europe | 100 | 6 | 94 |
| Latin America and the Caribbean | 100 | 0 | 100 |
| Caribbean | 100 | 0 | 100 |
| Latin America | 100 | 0 | 100 |
| Northern America | 100 | 8 | 92 |
| Oceania | 100 | 5 | 95 |

**Table 8. 6. Countries or areas that declared to have expertise to share by aspect of census operation or census phase and region**

| Region | Questionnaire design | Cartography | New technologies | Publicity and communication | Field training | Data collection | Quality assurance | Data capture | Data processing | Analysis and dissemination | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| All regions | 58 | 46 | 26 | 25 | 46 | 50 | 25 | 29 | 40 | 29 | 15 |
| Developing countries | 47 | 35 | 15 | 16 | 39 | 38 | 15 | 22 | 28 | 21 | 7 |
| Transition countries | 2 | 1 | 0 | 0 | 1 | 3 | 2 | 1 | 1 | 0 | 1 |
| Developed countries | 9 | 10 | 11 | 9 | 6 | 9 | 8 | 6 | 11 | 8 | 7 |
| Africa | 18 | 15 | 8 | 4 | 16 | 15 | 4 | 7 | 11 | 8 | 0 |
| Asia | 20 | 17 | 5 | 11 | 16 | 16 | 8 | 10 | 11 | 10 | 4 |
| Europe | 6 | 7 | 6 | 6 | 4 | 8 | 5 | 3 | 7 | 4 | 4 |
| Latin America and the Caribbean | 9 | 4 | 3 | 1 | 7 | 7 | 5 | 5 | 6 | 4 | 3 |
| Caribbean | 4 | 1 | 0 | 0 | 4 | 3 | 1 | 3 | 4 | 2 | 0 |
| Latin America | 5 | 3 | 3 | 1 | 3 | 4 | 4 | 2 | 2 | 2 | 3 |
| Northern America | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Oceania | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 3 | 1 | 2 |

## Chapter 9. Conclusions

Under the 2010 World Programme on Population and Housing Census, the United Nations Statistics Division (UNSD) is mandated to support national efforts to carry out population and housing censuses. UNSD works to strengthen national capacity for planning and carrying out population and housing censuses through the provision of international census guidelines and technical assistance. Moreover, as an integral component of its mandated activities, UNSD monitors progress in the implementation of national censuses, facilitates the international exchange and sharing of knowledge and information on census taking, and fosters regional cooperation, including South-South cooperation.

This analysis provides a good opportunity to analyze country implementation of the 2010 round of population and housing censuses at the mid point of the decade. This information, which was provided by the countries or areas, indicates their experiences in terms of the methods that they have used or plan to use for the various phases of the census. The analysis gives a mid-decade snap-shot of country implementation as well as the methods used. As each round of censuses witnesses more innovations than the preceding one, the 2010 round is no exception. Based on the information that countries have provided, it is emerging that countries or areas are becoming more innovative in terms of how they compile their census data and also in the technology that is being used in all phases of the process.

The mid-point of the 2010 census round is also an opportunity to see which countries have already conducted their censuses and which ones have postponed them, as well as the challenges that they may be facing in implementing their censuses. Available information shows that compared to the 2000 round, the 2010 has many more countries or areas conducting their censuses.

What follows is brief summary of highlights from the analysis.

In terms of the source of data for the total population count, the majority of countries or areas are using the traditional census, although some are developing and implementing alternative methods for compiling census statistics. In 83 per cent of the 138 countries or areas that responded to the survey, the traditional census is the main source of data, particularly in Africa, Latin America and the Caribbean and also in Oceania. As has been indicated in the report, a sizeable number of countries or areas are relying on alternative sources to generate their “census” data. For example, administrative registers are used as a main source in 15 countries or areas mainly in Europe and to a lesser extent in Asia. It should be mentioned, however, that countries or areas that rely on alternative methods—rather than the traditional census—as the main source of census data use extensively additional sources to augment their census data collection.

The results of the survey also show that the majority of responding countries or areas—122 (88%) out of the 138 that responded—use maps and/or satellite imagery, and/or aerial photography as a basis for demarcation of enumeration areas. Digitized maps, not combined with other types of maps or images—used in about 60 per cent of all the countries or areas that responded to the survey—are the most extensively utilized census maps for demarcating census

enumeration areas. Eleven per cent of the countries or areas that participated in the survey use only sketch maps. Both aerial photography and satellite imagery are commonly used as a basis for census mapping, with the latter's use growing across the world.

Global positioning system (GPS) and geographic information system (GIS) technology is used in 102 of the 138 countries or areas for various census related activities, primarily for delineating enumeration areas, monitoring census operations and other applications during and after field work. A few countries or areas have reported employing GIS technology for geo-referencing, analyzing and disseminating census results.

The findings of the study show that although the traditional face-to-face interview is the most commonly used mode of data collection for the 2010 census round, there is an increase in the number of countries or areas that are using non-traditional modes of enumeration and compiling the data. Other methods include use of the Internet, telephone interviewing and also of registers. The study also shows that a substantial number of countries or areas use more than one mode of enumeration. It is observed in the study that use of non-traditional modes of enumeration and compiling census data varies by geographic region. This may be because use of these methods entails some pre-requisites that may not be feasible for many countries or areas to fulfill. For example, use of the Internet may not be feasible for most of the developing countries due to the complexity of the setting up and operationalizing the required system for its use.

According to the study, the vast majority of countries or areas (91%) evaluate their censuses with more undertaking a post-enumeration survey (PES) (77%) than demographic analysis (47%). Also, about one-third (31%) of those that evaluate their censuses use a combination of PES and demographic analysis. Of those countries or areas undertaking a PES, 93 (97%) evaluate coverage errors while 71 (74%) evaluate content errors. Furthermore, one quarter (26%) of the countries or areas who evaluate their censuses use the results to adjust the census figures; about 40 per cent of those countries or areas are in Africa. The results of the study show that the majority of countries or areas (75%) publish census evaluation reports to provide information on the quality of census results.

In terms of methods for data capture, the survey shows that more countries or areas are replacing manual data entry with more technologically advanced data capture methods including optical capture methods (optical mark reader [OMR], optical character recognition [OCR], intelligent character recognition [ICR]), personal digital assistants (PDA) and the Internet. However, despite the growing use of advanced data capture methods, manual data capture is still commonly used in 41 countries or areas (30% of responding countries or areas). Among these, in 36 countries or areas, manual data entry is used as the sole data capture method.

According to the study, optical data capture is the most commonly used method with around 50 per cent of the countries or areas using OCR, OMR or ICR, either in combination with other methods or by itself. In 35 countries or areas, the use of the Internet is being explored, mostly as an additional method of data collection. PDA technology is used for data capture in 13 countries or areas, mostly in combination with other methods.

Coding is undertaken as part of census data processing in 90 per cent of the countries or areas; of those more than half use a combination of coding techniques consisting of manual, computer-assisted and automatic coding. The study also shows that 94 per cent of the countries or areas employ an editing system for correcting invalid and inconsistent responses; most of these countries or areas (70%) use a combination of manual and automated editing. Among the countries or areas with an editing system, 70 per cent impute data only for missing values, 24 per cent impute for both missing values and records, while 20 countries or areas (16%) do not apply any type of imputation.

The results of the survey indicate that the traditional print publication, despite its cost of production, remains one of the principal tools of dissemination in all regions of the world. Several developed countries or areas have indicated, however, that they have ceased or plan to cease dissemination via print publications and rely primarily on electronic media which are relatively more economical and allow further computer processing of data.

The analysis of responses from countries or areas shows that the extent of use of online databases lags behind that of print and other electronic media despite the potential of such databases to provide a rich source of information relatively inexpensively. The results also show that census microdata are disseminated in 77 (59%) of the countries or areas that responded to the survey. At least 60 per cent of the countries or areas in Asia, Europe, Latin America and Oceania disseminate microdata whereas only 37 per cent of those in Africa do so. The survey further confirmed the importance that national statistical offices attach to maintaining the confidentiality of microdata as most responding countries or areas indicated that they routinely apply confidentiality rules to avoid the disclosure of identifiable personal or household information.

The results of the analysis show that customized services are provided for users requesting complex data or some other specialized census product in 101 out of 133 (76%) countries or areas that responded to the survey; in nearly three-quarters of these countries or areas such services are charged.

The majority of responding countries or areas (79%) have an archiving system for storing and maintaining census data. However, several countries or areas in Africa, Latin America and the Caribbean and Oceania lack a proper archiving system.

The findings of the study indicate that close to 70 per cent of the countries or areas in each region of the world, except Europe and Northern America, require some support to conduct their censuses. Assistance is required primarily on new technologies, cartography, quality assurance, and analysis and dissemination. Concerning new technologies, assistance is required mostly on optical scanning for data capture, GIS, PDA and use of hand-held mobile technology for monitoring and control of field operations. Information on the challenges that national census organizations face is important as it provides a basis for UNSD and other relevant organizations to reorient their technical assistance and statistical capacity-building activities to ensure proper and timely support to countries, while that on expertise is useful for fostering South-South cooperation.

The potential for realizing South-South cooperation in census operations is significant; 23 countries or areas in Africa, 26 in Asia, 16 in Latin America and the Caribbean and 3 in Oceania have declared expertise in at least one area of the census process which they could share with others. At least 30 developing countries or areas could potentially provide assistance to others in each of the following areas of the census process: questionnaire design, field training, data collection and cartography.

In conclusion, it should be said that to get an accurate picture of the methods that countries or areas have used for the 2010 census round, it is important that another study be undertaken at the end of the census decade. The results of such a study would not only provide an accurate account of the experience of countries or areas, but it would also provide useful information on good national practices in census taking. Such information is valuable as input into the development of international census guidelines and also the revision of existing ones.

## Annex 1. Questionnaire on the 2010 World Population and Housing Census Programme

Country: _____

1.Do you plan to have (Have you undertaken) a census* for the 2010§ census round?

☐ Yes

☐ No (please specify the reason): _____

## I. METHODOLOGY AND PLANNING

2.If you plan to have (or have already undertaken) a census, specify the main methodology used (the main source of data used for the total population count):

☐ Traditional census (full field enumeration)

☐ Administrative register(s)

☐ Rolling census

☐ Other (specify) _____

3.In addition to the main source of data specified above, indicate whether other sources were or will be used to provide data on specific census topics (*Check all applicable boxes):*

☐ Full field enumeration

☐ Annual or other regular sample survey (specify) _____

☐ Ad-hoc sample survey(s) specifically conducted for the census

☐ Administrative register(s)

☐ Other (specify) _____

4.What is the reference date for the census for the 2010 round *(or of the census nearest to 2010 if more than one is conducted during the census round)*?

_____

(Day/Month/Year)

5.Specify the period of enumeration (if applicable):

From __ _____ to _____

(Day/Month/Year) (Day/Month/Year)

6.Will/was the census (be) conducted as originally officially planned or is/was it delayed?

☐ On schedule

☐ Delayed (Specify: postponed from __ _____ to ____ ___

(Day/Month/Year) (Day/Month/Year)

- If delayed, give reason(s) _____

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* "A population census is the total process of collecting, compiling, evaluating, analysing and publishing or otherwise disseminating demographic, economic and social data pertaining, at a specified time, to all persons in a country or in a well-delimited part of a country" (United Nations *Principles and Recommendations for Population and Housing Censuses, Revision 2*, United Nations publication, Sales No. E.07.ZVII.8, paragraph 1.4). While the majority of countries produce these comprehensive statistics by conducting a traditional census (with full field enumeration), in other cases, they are derived from registers of population and vital events, other administrative sources, sample surveys, or from a combination of these methods.

§ According to Resolution 2005/13 of the United Nations Economic and Social Council (ECOSOC) on the "2010 World Population and Housing Census Programme", Member States are urged to conduct a population and housing census at least once during the period from 2005 to 2014.

7.Indicate the current stage of the census activity for the 2010 round (*Check all applicable boxes)*

- ☐ Planning
- ☐ Mapping
- ☐ Pilot/Pre-testing
- ☐ Enumeration
- ☐ Data processing
- ☐ Data dissemination
- ☐ Data analysis
- ☐ Data evaluation
- ☐ Other, or not applicable, (specify) _____

## II. CARTOGRAPHY

8.What type of census maps were (will be) used for demarcating enumeration areas (EAs)?

- ☐ Sketch maps
- ☐ Digitized maps
- ☐ Aerial photography
- ☐ Satellite imagery
- ☐ Other, or not applicable (specify) _____

9.Did you (Do you plan to) use GPS/GIS technology for census mapping?

- ☐ Yes
- ☐ No
- ☐ Not applicable

- If yes, specify how you have used or plan to use it _____

## III. ENUMERATION

10. Was (Will) a pilot census or dress rehearsal (be) organized before the population census?

- ☐ Yes
- ☐ No

- If yes:
  a. Specify the date of the dress rehearsal or latest pilot census: _____ (Day/Month/Year)

  b. What was (will be) the size of the dress rehearsal or latest pilot census? ____

  c. What aspects of the census were (will be) tested in the dress rehearsal or latest pilot census? _____

11. What method of enumeration was (will be) used in the census? ***(If more than one method was/will be used, number all applicable boxes in order of importance)***

- ☐ Face-to face interview
- ☐ Self-enumeration (questionnaire)
- ☐ Self-enumeration (Internet-based)
- ☐ Based on registers
- ☐ Other (specify) _____

## IV. DATA PROCESSING

12. Which method was (will be) used for data capture? ***(If more than one method was/will be used, number all applicable boxes in order of importance)***

- ☐ Manual data entry
- ☐ Optical Mark Recognition (OMR)
- ☐ Optical Character Recognition (OCR)
- ☐ Intelligent Character Recognition (ICR)
- ☐ Personal digital assistant (PDA)
- ☐ Internet (online data collection)
- ☐ Data from administrative registers (including linking between databases)
- ☐ Data from existing sample surveys (example: Labour Force Surveys)
- ☐ Other (specify) _____

13. What software package (if any) was (will be) used for data entry?

_____

14. Was/will coding (be) undertaken as part of census data processing?

- ☐ Yes (specify the variables to be coded) _____
- ☐ No

- If yes, is the coding:
  - ☐ Manual using code books?
  - ☐ Computer-assisted?
  - ☐ Automatic?
  - ☐ A combination of methods? (Specify) _____
  - ☐ Other? (Specify) _____

15. Does your office have an editing system as part of the data processing?

- ☐ Yes
- ☐ No

- If yes:
  a. Is the editing method
     - ☐ Automated?
     - ☐ Manual?
     - ☐ A combination of automated and manual?

  b. Do you impute any data? *(Check all applicable boxes)*
     - ☐ Yes, impute missing values in existing data records
     - ☐ Yes, impute missing data records (full set of information on a person)
     - ☐ No

c. Is the method of imputation
- ☐ Automated?
- ☐ Manual?
- ☐ A combination of automated and manual?

16. If there is an automated editing and imputation system, what software is used for this purpose? _____

## V. EVALUATION

17. Was (Will) census evaluation (be) conducted?
- ☐ Yes
- ☐ No

- If yes, what method of evaluation was (will be) used? (*Check all applicable boxes*)
  - ☐ Post enumeration survey
  - ☐ Demographic analysis
  - ☐ Other (specify) _____

18. If a post-enumeration survey was (will be) used:
   a. What was (will be) the sampling rate (proportion of the population to be approached)? _____

   b. What was (will) the post-enumeration survey (be) used to assess? *(Check all applicable boxes)*
   - ☐ Coverage error
   - ☐ Content error
   - ☐ Other (specify) _____

19. Was (Will) census evaluation (be) used to correct census figures?
- ☐ Yes (please give more details): _____
- ☐ No

## VI. DATA DISSEMINATION

20. In what formats were (will) census results (be) disseminated? (*Check all applicable boxes*)
- ☐ Paper publication
- ☐ CD-ROM/DVD
- ☐ Static web pages (html, PDF, excel)
- ☐ Interactive online database(s)
- ☐ GIS web-based mapping tools
- ☐ Other (please specify) _____

21. Do you disseminate micro data?
- ☐ Yes
- ☐ No

- If yes, explain _____

22. What is:

a. The smallest geographical level at which the data are disseminated?

_____

b. The minimum size of population for which data are disseminated?

_____

23. Do you have a service to cater to individual requests for census data that is not available through other means?

☐ Yes
☐ No

- If yes, explain _____

24. Do you charge a fee to provide data for individual requests?

☐ Yes
☐ No

- If yes, explain _____

25. Do you have a system for managing and archiving the data?

☐ Yes
☐ No

- If yes, explain _____

26. Do you publish an official report on the census evaluation and the quality of census data?

☐ Yes
☐ No

## VII. BUDGET

27. Estimated total cost of population and housing census, in USD million: _____

| **Cost of the census for the 2010 round. Breakdown by main activities/ phases (in %)** | |
|---|---|
| **COST BY ACTIVITY** | (%) |
| General preparation, services, logistics | |
| Pilot micro-census | |
| Cartography/Mapping | |
| Publicity and information | |
| Enumeration (including training) | |
| Printing of questionnaires | |
| Transportation of material | |
| Post-enumeration evaluation | |
| Data processing, checking, coding | |
| Data analysis | |
| Equipment | |
| Publication, dissemination and documentation | |
| Other (specify) | |
| Total | 100% |
| **SOURCE OF CENSUS FUNDING** | (%) |
| National budget | |
| External development partners | |
| Other sources (e.g., loans) | |
| Total | 100% |

## VIII. CHALLENGES AND AREAS OF EXPERTISE

28. For the census for the 2010 round of censuses list areas that have presented or are likely to present challenges, i.e., areas that may potentially require external assistance. List also areas of expertise which are a particular strength of your organization, i.e., areas where you may be able to offer assistance to other countries (check all that apply)

| | **Challenging areas requiring external assistance** | | | **Areas of expertise where assistance could be provided to other countries** | |
|---|---|---|---|---|---|
| | Assistance obtained | Assistance required | Please specify: | | Please specify: |
| Design of questionnaires | ☐ | ☐ | | Design of questionnaires ☐ | |
| Cartography/Mapping | ☐ | ☐ | | Cartography/Mapping ☐ | |
| Use of new technologies | ☐ | ☐ | | Use of new technologies ☐ | |
| Funding sources | ☐ | ☐ | | Publicity and communication strategies ☐ | |
| Publicity and communication strategies | ☐ | ☐ | | Field training ☐ | |
| Field training | ☐ | ☐ | | Data collection ☐ | |
| Data collection | ☐ | ☐ | | Quality assurance system ☐ | |
| Quality assurance system | ☐ | ☐ | | Data capture ☐ | |
| Data capture | ☐ | ☐ | | Data processing ☐ | |
| Data processing | ☐ | ☐ | | Data analysis and dissemination strategy ☐ | |
| Data analysis and dissemination strategy | ☐ | ☐ | | Other (to be specified) ☐ | |
| Other (to be specified) | ☐ | ☐ | | | |

## Annex 2. Some applications of GPS/GIS and digital mapping as reported by countries

1. **Use of digital maps for:**
    a. Preparation and demarcation of enumeration areas:
        i. Preparation of enumeration areas, census districts and state maps.
        ii. Digitizing maps with boundaries of enumeration areas and road networks.
        iii. Automatic demarcation of enumeration areas. Map of enumeration areas will be available in portable computers (PDF format) of enumerators and/ or map will be printed.
        iv. Digital maps showing the location of the target communities in each region. Also to point features and to map boundaries.
    b. Enumeration:
        i. Enumerators use the maps as guidelines in the field.
        ii. To locate dwellings and to identify buildings; give to enumerators and supervisors to assist with enumeration; show population and dwelling distribution by area; track growth in population, dwellings.
        iii. Collect attribute data on social services and infrastructure.
        iv. Identifying enumerated area boundaries when it is not clear or cannot be identified using natural or man made boundaries.
        v. Monitoring and supervision.
    c. Dissemination:
        i. Dissemination through thematic maps.
        ii. Digitizing census maps, and after the census the data collected for various administrative levels will be linked to the maps.

**2. Use of GIS**
    a. Use GIS to build information to display the result of censuses and surveys.
    b. GIS is used for map production or digitization.
    c. The GIS software is also used to update, store and produce lower order enumeration areas and higher order supervisory maps for the census.
    d. The GIS system is planned to work through agreements with other institutions, which provide the vector mapping; will also work on creating a data dictionary, data model, following the recommendations of the United Nations (will work for using Map Info software package, MapXtreme and Spatialware). Regarding the use of GPS by Magellan program, a country will adapt the GIS and create a module for data extraction.

3. **Use of GPS**:
    a. GPS was used to capture the centre coordinates of villages and towns and the coordinates of all social facilities within a locality. Also to capture location of households and dwelling units.

b. GPS will be used to collect geometric features (points, lines and polygons) to update enumeration areas.
c. Positioning of localities and basic infrastructure.
d. Use GPS to build information for census mapping, especially for areas that the satellite imagery is not available.
e. GPS is used to pick coordinates of centres of communities and settlements to be incorporated into the digitized maps.
f. GPS is used to collect geo-points e.g. villages and points of references; determine the location of new villages (other features e.g. rivers)
g. To take the necessary boundary coordinates as well as man made and natural features.
h. Systematically identify the geographical coordinates of all localities (villages, neighbourhoods, villages, camps) and position them on base maps in order to establish enumeration areas.
i. Coordinate of each household to be captured using National Address Database (GeoDirectory).
j. To demarcate boundaries at pre-enumeration phase, specifically in areas without addresses; insert visible land marks into maps used by field enumeration staff to improve orientation in the sampled cells.
k. Using GPS will allow connection with the digital maps of EA.
l. Using GPS, enumerators collect location coordinates of houses missing on the maps; collected geodata is sent to the geodatabase during the field work.
m. GPS assists field staff to get to their assignment areas and confirms where they are on the ground in comparison to maps; and ensures housing units are in the right geographic boundaries for tabulation.
n. Ensure the location of the enumerator and the units that need to be collected.
o. The GPS is used to collect additional landmarks and some points where EA boundaries are imaginary for ease of identification during enumeration. GPS will also be used to collect coordinates of all occupied dwelling units (households) during enumeration.

**4. Use of satellite imagery and aerial photos**

a. Overlay spot satellite imagery with administrative boundaries and then demarcate the enumeration areas within Local Government units and edit the demarcation after field verification. Digitized village locations and flags for each enumeration area. These activities generate enumeration area database, village database and flag database. Printed enumeration area maps show satellite imagery background, administrative boundaries, enumeration area boundaries, villages and flags.
b. To make enumeration area (EA) maps by overlapping the background map data with data on demarcation of the enumeration districts. The EA maps show the enumeration district number, demarcation of the enumeration districts, and so on which municipalities delineate when they make EA maps.

5. **Integration of multiple tools**:
    a. With digital maps from the previous census, the latest satellite imagery and aerial photographs, the GIS system is being used to digitize all administrative units and EA boundaries.
    b. Using GPS technology in the demarcation of the polygonal areas and using GIS technology to delineate census sectors.
    c. Geometric features collected in the field by use of the GPS are incorporated into the GIS.
    d. The mapping is built on the UTM coordinate system[31] - WGS84[32], so the information in urban areas will be referenced to the coordinates that take the edge of each block. In rural areas the survey data will be accompanied by the capture of point coordinates with the help of GPS.
    e. Enumeration areas digital maps will be associated (linked) with the digital cadastral plans and orthophotos, which will enable better quality of EA maps. Digital geo-referenced borders of EA will be implemented in GIS Register of territorial units. Using GPS will allow connection with the digital maps of EA.
    f. GPS's were used to capture the centre coordinates of villages and towns and the coordinates of all social facilities within a locality. Administrative boundary coordinates were also captured. These coordinates were compiled in databases and assisted in the on-screen office delineation (digitizing) of the administrative boundaries using a GIS tool.
    g. A country developed a specific tool called Geobase, allowing it to digitize vector maps of urban areas and input attribute data on the backdrop of aerial photos or satellite images. Geobase reads point coordinate files from GPS/GIS and depicts terrain objects. This feature has been extensively used for the update of existing maps of various sources and also for collecting geospatial data not available in existing imagery. These maps are used for demarcating urban EAs. Furthermore, these maps are migrated to a geospatial database management system with an integrated, seamless, continuous and countrywide geospatial database. EA maps are then produced from this database.
    h. Use of PDAs during enumeration.

**6. Spatial Analysis**

a. Spatial analysis and applications for dissemination of census information.

[31] UTM: Universal Transversal Mercator is a cartographic reference system, one of the most common systems used for large-scale mapping around the world.

[32] WGS 84 is the World Geodetic System of 1984, a standard for use in cartography, geodesy, and navigation (e.g. WGS 84 is the reference coordinate system used by the Global Positioning System.).