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Dissemination of Census and other statistical data through Web maps

Abstract:
The core of this chapter deals with the roles Web maps may play in the dissemination of Census and other statistical data: geographical interfaces for finding and retrieving the data, Web maps as means of presentation and Web maps for on-line analysis and exploration of the data. These functions are illustrated with examples from the Netherlands and for the Philippines. But, before that, a worldwide inventory is presented of the currently existing websites of national statistical organizations and their functionalities and characteristics, including their cartographic aspects. A last section deals with the pecularities of the hard- and software requirements for making it possible for Web maps to function in the various ways presented. These requirements, but also a lacking awareness of the potential roles of Web maps in the dissemination of Census and other statistical data, are the explanation why many national statistical organizations are not yet making, or allowing, use of Web map tools.

1. Introduction: the WWW as a means of geostatistical data dissemination

A Census is usually understood as the process of collecting information on the official count of the human population of a specific administrative area of interest or country as a whole (Redido-Cusi, 2002). Such a survey, that has become one of the Government's mandates in many countries, is often conducted every 5 or 10 years by some kind of national statistical organization (NSO) [1]. Census data are collected at the household level, enumerating its individual members, as well as the respective social, economic and housing conditions. As, in principle, every household is enumerated, the result is the most complete and accurate demographic and socio-economic dataset of a particular territory you can think of. However, Censuses are not taken in every country in the World. In the Netherlands, for instance, the Census has stopped, in order to protect the privacy of the individual citizens. In countries without a Census, the necessary statistical data on the population are collected by NSO's in various other ways. Use can be made of municipal registries or of sample surveying techniques. In this way, almost every country in the World -whether it conducts a Census or not- has some kind of NSO that collects statistical data and also makes these data available to their users. These users may be government officials, scientists, planners, teachers, students or, for instance, private companies looking for markets.
Until recently, Census and other statistical data were only disseminated on paper and mostly in textual or tabular form. Quite often the help of an official of the NSO was required to find the data the user needed. Since a number of years, however, the data can also be made available in digital form, i.e. on diskette, CD-ROM or other data carrier. The obvious advantage to the users is that they may import the data directly into a computer environment for analysis and, with the help of interactive search facilities, it may be easier to find the data required. However, problems that remained were the necessity to contact the NSO's to identify and order the data products and, most importantly, the fact that the time-lag between the collection of the statistical data and their publication could still be considerable.
In this respect, the recent rise of the World Wide Web (WWW) as a possible means for data dissemination has two very big advantages over other electronic means like diskettes or CD-ROMs. These advantages may be summarized under the headings accessibility and actuality (van Elzakker, 2001). Accessibility means convenience in accessing the whole lot of data anytime and from anywhere (as long as there is Internet access). Actuality refers to the potential of making the data available to the user immediately after their collection. That is why many NSO's are now making serious use (or are planning to make use) of the WWW as a means of statistical data dissemination.

As said, Census data are collected at the household level. One attribute of each household is its address, or location in geographical space. Normally, because of reasons of privacy, data are not made available for individual households. The data can be made available for enumeration areas (in which a number of households are living together) and for several higher levels of aggregation, up to the national level. In countries without a Census, demographic and socio-economic statistical data are often also made available for administrative units at various levels of aggregation. However, in these countries the geographical level of detail is often less than that in countries with a Census. But in both cases the statistical data do have a clear geographic component. And this

makes it possible for Census geographers to analyze spatial patterns, trends and anomalies. In this process maps have always been and still are invaluable tools to get insight into and overview of the statistical data (a question like “Where do most elderly people live?” cannot be answered as quickly and as efficiently in any other way). In the past, maps could not be used to their full potential in Census geography. It was not so easy and very time-consuming to produce paper maps and hence they were quickly outdated or gave a wrong impression to the user. Therefore, Census data were not often disseminated in the form of paper maps and the statistical reports mainly contained text and tables. But because of the development of more and more user-friendly GIS and cartographic software statistical maps can now be generated much more easily and quickly. And, for analysis and presentation, many of the statistical data that are acquired in digital form (e.g. on diskette or on CD-ROM) are imported directly into this kind of software that is installed on the computers of the users. Nowadays, data can also be downloaded from the Internet for this purpose.

But users do not necessarily have to install the GIS or cartographic software themselves. They may also get access to, insight in and overview of geostatistical data through Web maps, i.e. maps that are displayed, generated or disseminated through the WWW. Traditional and new functions of map displays, coupled with the advantages of accessibility and actuality of the Web, make them very powerful tools indeed for on-line Census and other geostatistical data analysis. An illustration of this potential was provided in the Netherlands in May 2002 when a cartographic representation of the results of the elections (another kind of statistical data) was adjusted and immediately disseminated through the WWW as soon as the results from the individual municipalities were gradually made available during the evening of the election day (*URL 1*). And, besides actuality, one aspect of the accessibility of Web maps -as compared to e.g. paper maps- are the costs of dissemination: once the hard- and software configuration and the Internet connection are there, it is much cheaper to use the WWW than to have the maps printed and distributed. As an illustration, the printing costs for a recently published paper colour atlas of 66 pages of Census data for Omaha (USA) were over US$ 70, excluding labour and distribution (Peterson, 2002).

2. Overview of existing NSO websites in the World

Table 1 contains the results of a worldwide inventory of websites of NSO's in different countries. Partly because of the volatility of the WWW medium this printed list can never be complete, nor up-to-date [2]. For every country, one organization is selected that primarily provides Census data (population and housing) and other statistical data (such as economy, labour, employment) for the country as a whole. The task of disseminating Census data was used as the first criterion for the selection of an organization in countries where there are more agencies that provide statistical data at a national level.

Table 1: Functionalities of websites of national statistical organizations (source: Redido-Cusi, 2002).

Table 1 shows whether or not the listed websites have the following functionalities and characteristics:

- **Language** - Which language of communication is used on the website: the *official national language*, the *English language* and/or any *other language(s)*?
- **Keyword search** - If the website provides a keyword search mechanism, information may be found more easily.
- **Census data retrieval format** - Data may be presented to users in different formats: *textual*, *tabular*, *chart* and *map*.
- **Data download capability** - Websites with this functionality allow users to download data (be it texts, tables, charts or maps) in a digital format that can be imported or interpreted directly by another software (e.g. a spreadsheet or GIS package).
- **Census data retrieval cost** - In many countries in the World, Census and other national statistical data are considered public property and may, therefore, be obtained *free* of charge. In other countries, *registration* (or subscription) may be *required*, or *other methods of payment* are applied to cover some costs of infrastructure and/or dissemination (e.g. the costs of acquiring statistical reports on paper).
- **Geographical differentiation / levels of aggregation** - This part of Table 1 shows at which administrative levels the NSO is disseminating its data through the WWW.
- **Individualized output of Census data** - Most websites supply the data in preconceived ways, be it in textual, tabular, chart or map format (see 'Census data retrieval format' above). But some websites allow users to individually prepare the desired data output on-line. Tailor-made *tables*, *charts* and *thematic maps* are possible types of individualized output in static form. The *interactivity* function identifies the possibility for the user to interactively adjust the current static way of representation (e.g. changing the legend of a thematic map display).

- **Geographical or map interface for Census data retrieval** - This functionality refers to the availability of a Web map interface to define the geographical extent of the required data (e.g by clicking on the area of interest or by drawing a box around it).

In this inventory, 121 websites of NSO's were identified and analyzed (see Figure 1). At the time of the inventory (October 2001), 5 of these websites were inaccessible. It is not surprising (but regrettable) that countries with the lowest numbers of Internet users, e.g. those in Africa (van Elzakker, 2001b) do not have a NSO with a website.

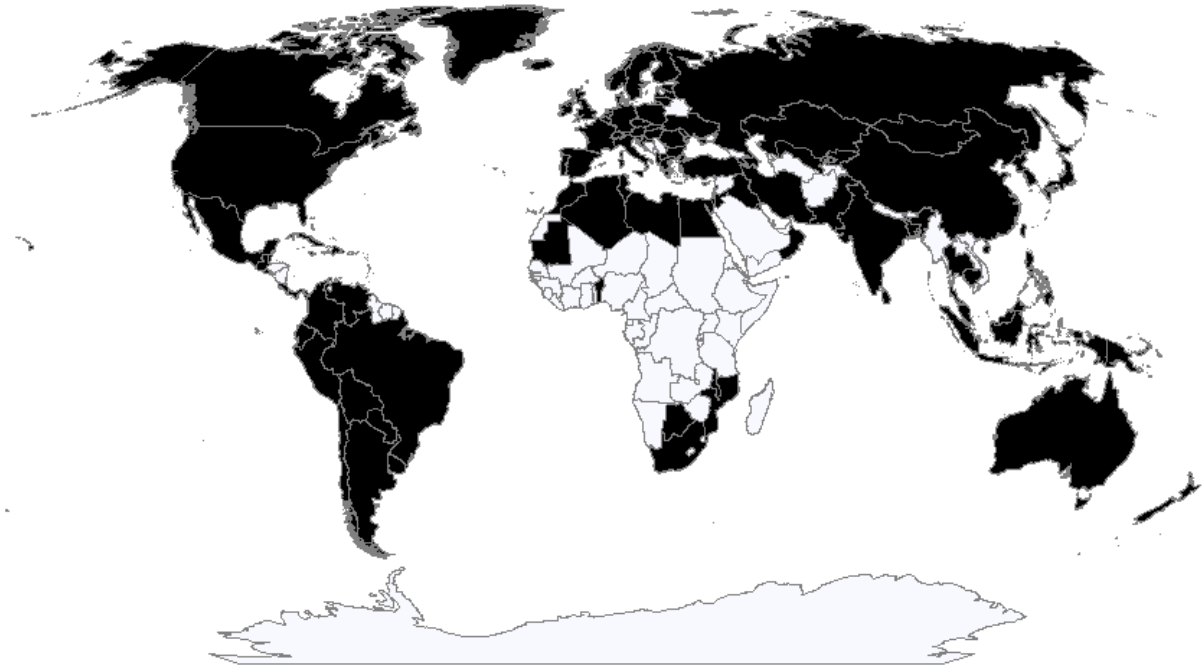

Figure 1: Countries with a national statistical organization with a website (source: Redido-Cusi, 2002).

In the context of this Chapter we are most interested in the cartographic functionalities of the NSO websites. It appears that in only 19% of the websites the data can be retrieved in the form of a thematic map. The tabular retrieval format is still most common. Only 16 websites (14% of the total) allow on-line access to the databases for users to prepare individualized output and in only 4 of these 16 websites this output may be in the form of a thematic map (possible at the sites of Israel, the Netherlands, Sweden and the USA). These countries also provide users with the possibility for interactive cartographic visualization. Finally, only 18% of the NSO websites possess a map interface as a utility to find and select the geostatistical data required. This situation may partly be explained by the hard-, soft- and brainware required. And, as indicated before, it should also be realized that tabular data may be imported in other software packages for cartographic analysis and presentation. This kind of software (e.g. GIS software) may be available at the local computer configuration of the user , but - outside the NSO websites- there are also some cartographic data viewers available on the WWW (see e.g. *URL 2, URL 3* and *URL 4*). However, it is obvious that many NSO's still have to discover the potential usefulness of Web maps in the dissemination of Census and other statistical data.

3. The role of Web maps in the dissemination and use of Census and other statistical data

Before we will present the different roles Web maps could well play in the dissemination and use of statistical data, it is good to consider, in general, the different kinds of maps that exist on the Web. In Kraak & Brown (2001), Web maps are differentiated on the basis of their dynamic and interactive potential (see Figure 2).

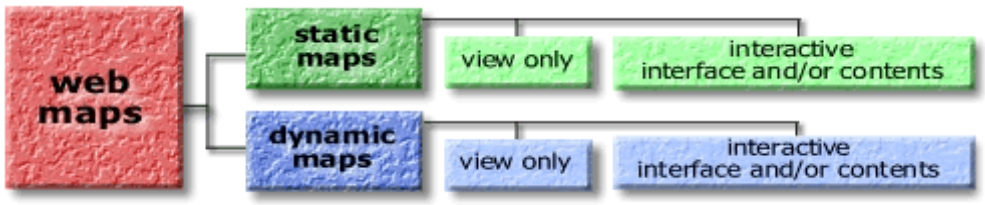

Figure 2: Classification of Web maps according to Kraak & Brown (2001)

Many maps found on the WWW still are static view only maps, i.e. map images that may be retrieved and disseminated fast and easily but, just like paper maps, cannot be adjusted to the individual needs of the user. However, static maps can also be interactive. So-called 'clickable' maps may function as an interface to other data. For geostatistical data dissemination by NSO's, this role is discussed in more detail in Section 3.1 below. But interactivity may also mean that the Web map user has the option to zoom and pan, to switch layers on or off, or even to change the way of representation.
The same possibilities may exist, next to view only, in the case of dynamic maps. The WWW is a convenient and suitable platform to display dynamic processes via animations (*URL 5)*. And as statistical data on the one hand are also related to processes (e.g. commuting) and, on the other hand, are often changing rapidly, this way of representation has a lot of potential for users of NSO data too. A possible analysis of time-series is facilitated by the continuity in Census themes and the care taken in matching old enumeration units to present ones.

The classification in Figure 2 has recently been challenged by Langer (2002), who added another dimension. He agrees that Web maps can be differentiated into static and dynamic ones and, simultaneously, into interactive and non-interactive maps. But, in conjunction with recent hard- and software developments, he thinks it is important to make another distinction between preconcieved Web maps that already exist in terms of contents and appearance (and can only be retrieved as map files) and map displays that do not exist before they are generated by the user from the data(base) directly. This can be understood in terms of GIS functionalities (interactive visualization, combining data sets, doing buffer operations, etc.), or in adding one's own data, annotating existing data, or processing them as required. This goes beyond the simple interactivity of a clickable map, or even that of changing representation modes, changing the number of classes or the classification method, selecting the layers required or the colours preferred. Extended GIS functionalities will be a big incentive for professional users indeed, and, therefore, also one of the keys to success of a NSO website. In all this, an important factor for the users of Web maps is, of course, the time it takes before the requested data are rendered or before the required procedures or analyses have been executed.

In addition to the classification of Web maps as shown in Figure 2, and as extended by Langer, an understanding of the possible roles of Web maps in the dissemination and use of statistical data may also be supported by considering various map use goals as positioned in the so-called 'map use cube' (see Figure 3) (van Elzakker, 2000). MacEachren & Kraak (1997) recognized four map use goals that are positioned in the cube: to explore, to analyze, to synthesize and to present geographical data. But, in fact, Web maps may occupy any position in the three-dimensional space defined by the cube's axes, depending upon what a user does with the map and for what purpose. For the sake of clarity, however, in this chapter we will only consider two broad categories of map use goals. In Section 3.2 we will deal with the possibility NSO's have to *present* known Census and other statistical data to a large audience by means of preconceived map displays. Both static and dynamic maps may be presented to the users in this way, but usually the interaction with these maps is only limited and users have to accept the maps others produced for them.

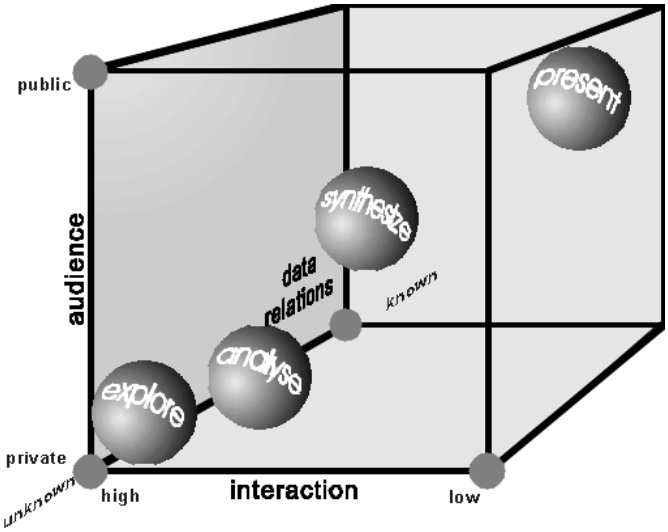

Figure 3: Goals of map use arrayed in the map use cube (source: MacEachren & Kraak, 1997).

In the opposite (left hand bottom front) corner of the map use cube individual users may create individual maps to suit their private needs. Here, we are usually not dealing with preconceived maps, but with unique, one-off displays (directly generated from the database) that may be thrown away after using them to explore unknown statistical data in order to discover spatial trends or anomalies. The WWW may very well support the required high level of interaction with the data and maps and allows individual users to select and change ways of representation, data classification, level of aggregation and apply various GIS functions. This potential role of web mapping in the *exploration* and *analysis* of Census and other statistical data is discussed in Section 3.3 below.

3.1 Web maps as geographical interfaces for finding and retrieving Census and other statistical data

When users are looking for certain Census or other statistical data, they will have to specify the data they need, in relation to the purpose for which they want to use them. Of course, they will have to select the topic(s) or subject(s) they are interested in (e.g. number of inhabitants, housing density, average annual income). At the same time, they may want, or have to, specify the year(s) in which the data are collected. And users will often also want to make some geographical choices. First of all, they may be interested in data for a specific area only, either, for instance, for a country as a whole, or for one or more areas at a lower administrative level (e.g. province, district or municipality).
Of course, geographical areas may be selected by typing in the name in a box on the web page or by letting the user select a name from a drop-down list. However, potential users may not know the exact spelling of the names of the administrative units (if that spelling is fixed, which is not always the case) or even they may not know the geographical names at all ("What is the name of the southern most province in the Philippines?"). Therefore, it is very useful to add a map window to the web interface in which the user specifies the data required. On such a map, users may click the administrative unit(s) in which they are interested. This is the approach that has been followed in the development of the user interface of the prototype of a website for the National Statistics Office in the Philippines (Redido-Cusi, 2002) (see Figure 4).

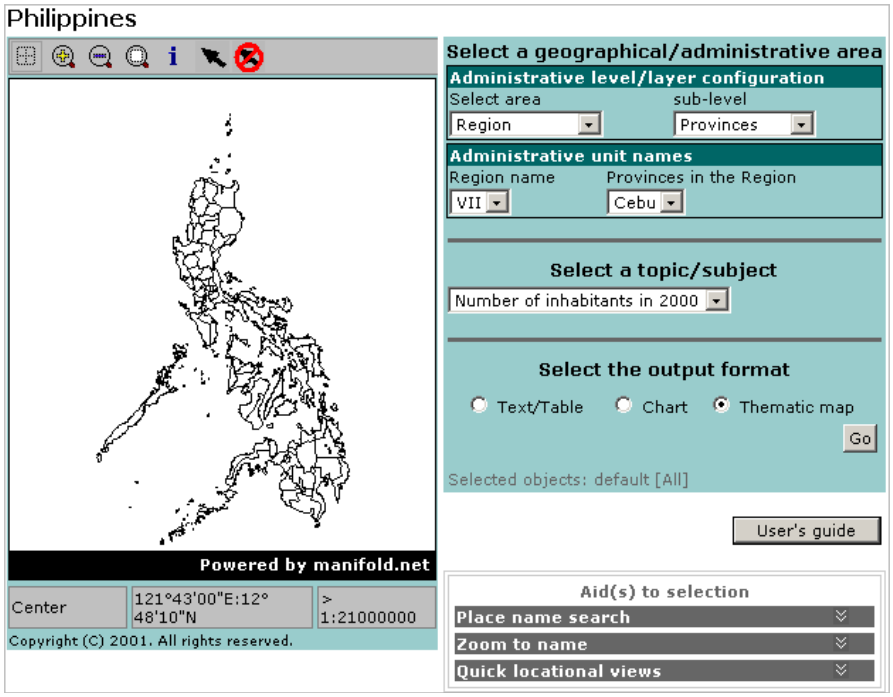

Figure 4: Opening page of the (prototype of the) NSO Philippines website (URL 6).

There are four main sections on this opening interface. The one on the left is a Web map with a toolbar of icons at the top. The right hand side of the page is divided (by horizontal lines) into three sections: for the selection of the geographical / administrative area in relation to the level of aggregation, for the selection of topic / subject and for the selection of output format. The 'Administrative level / layer configuration' pane influences which map layers are displayed on the left. The pane contains two drop-down lists. On the left is a hierarchical list of the different administrative and legislative levels, and on the right the list of its corresponding lower aggregation levels. This is important, because the users may want to have or analyze the data for different aggregation levels (e.g. "For this particular province, I first want the data per district, and later on I want to have them per municipality"). Per default, all lower-level administrative units within the chosen area are selected. However, one can also select an individual administrative unit by first activiting the arrow button ('select object tool') in the toolbar of icons and then click the unit of concern in the map. The object selected will be marked red and only one object can be selected at the same time. Readers are invited to experiment with the interface of this prototype through the website that accompanies this book (or *URL 6*).

So, the Web map interface of the prototype of the website of the Philippines is based on the selection of administrative units. But, administrative boundaries are usually just arbitrary and artificial. Therefore, users who are particularly interested in discovering spatial patterns and making geographical comparisons, may be helped more, in stead of clicking on (an) administrative unit(s), by an additional functionality with which a rectangular box may be drawn on the Web map interface to define the area of interest. This added functionality is provided by a particular section of the website of the Netherlands' Central Bureau of Statistics (CBS) (*URL 7*). The main purpose of this section of the CBS website is to provide and allow cartographic visualization of statistical data at the lowest levels of aggregation in the Netherlands ('wijken' and 'buurten'; the more than 500 Dutch municipalities are subdivided into xxxx 'wijken' and each 'wijk' is subdivided into a number of 'buurten'; there are more than 10,000 'buurten' in total in the Netherlands). About 50 socio-economic statistical parameters can be queried for all these administrative units and the data can be made available in the form of maps, tables or diagrams. Also this website has been developed in the framework of a MSc thesis research project (Spee et al, 2001). Figure 5 shows the opening page of this website, with a Web map interface.

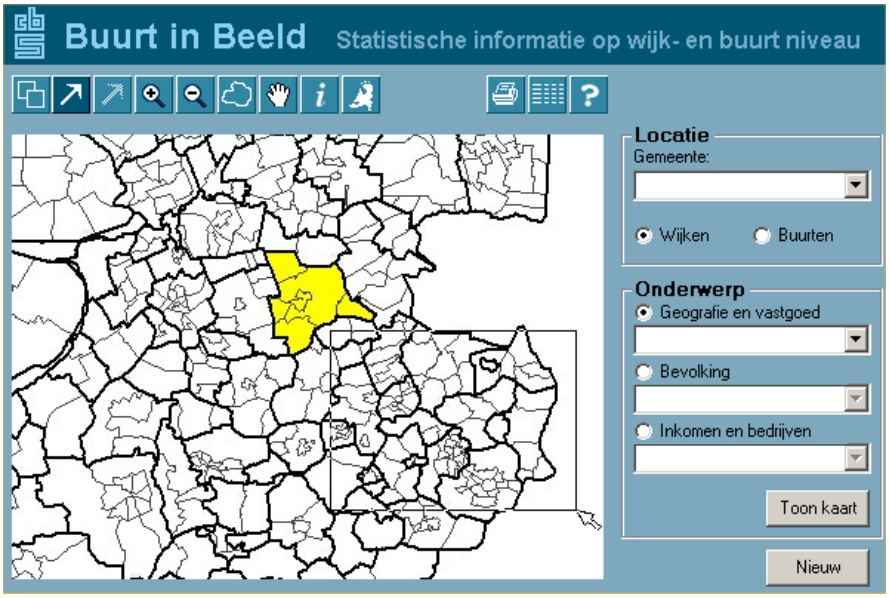

Figure 5: Opening page of the website 'Buurt in Beeld' of the Netherlands' CBS (URL 7).

This interface allows the user to select a subject (drop-down lists 'Onderwerp') and the level of aggregation ('Wijken' or 'Buurten') at which they want to analyze the data. There are three ways of selecting the geographical area of interest: municipalities ('Gemeente') may be selected from a drop-down list or in the clickable map and it is also possible to draw a box in this Web map interface.

3.2 Web maps as a means of presentation

When the data required are specified in the ways described in the previous section, users will be helped if they may retrieve them in different formats (e.g. as text, tables or charts). For users with a geographical interest (e.g. in educational or research settings) the direct availability of statistical Web maps as a means to *present* spatial patterns or anomalies will be extremely useful, not only because it saves time, but also there is no need for them to construct the maps themselves with software they may not have access to or do not know. Normally, the maps are preconceived in the sense that the NSO has constructed them beforehand (or is constructing them in 'real-time' with pre-defined algorithms) according to the grammatical rules of the cartographic language. These rules dictate the optimal ways of cartographic representation of different kinds of data for answering different questions. The resulting Web maps are of a 'view-only' nature, but may be supplied with pop-up legends, a locator map and printing and downloading facilities. An important and useful aspect of the functionality would also be the possibility to compare maps (maps of the same area for different themes, counted at the same time, or maps for the same area with the same theme at different times). This would require the functionality to allow to have two maps displayed simultaneously on the monitor screen. If that is not possible, the alternative would be to have single maps that compare the two situations (e.g. percentage change of unemployment according to the 1990 and 2000 Censuses). Time-series could also be presented as a dynamic series of view-only Web maps. This functionality is not yet available in the prototype website of NSO Philippines, nor in the 'Buurt in Beeld' website (although there are plans to add time-series of data in the latter). But both sites do offer the possibility to present the statistical data by means of two appropriate thematic map types: choropleth maps (see Figure 7) and proportional point symbol maps (see Figure 6).

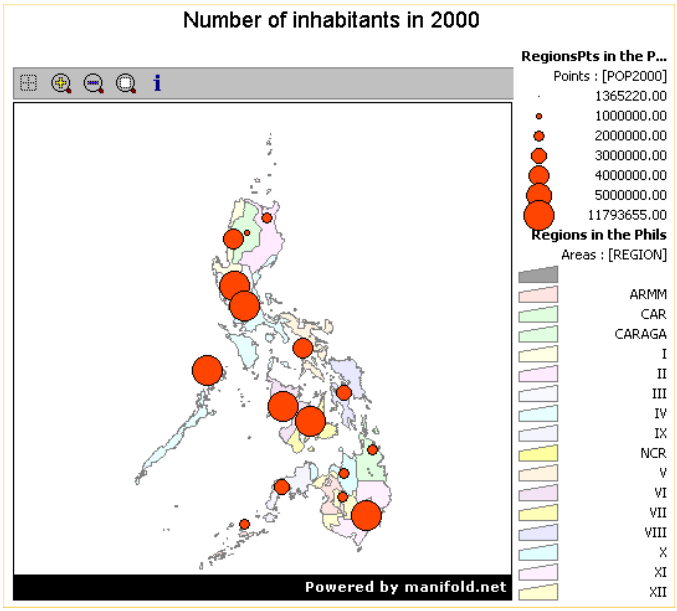

Figure 6: Proportional point symbol map for presentation from the (prototype of the) NSO Philippines website (source: Redido-Cusi, 2002).

These are the two thematic map types that are most often used to represent Census and other statistical data. A choropleth map is used to show relative quantitative figures (such as the percentage of population being illiterate) and a proportional point symbol map to show absolute quantitative data (such as the number of inhabitants). Metadata in both databases take care that the cartographically correct way of representation will be used for a particular topic. In future, this functionality may be extended by offering some more thematic map types (like dot, chorochromatic and isoline maps and cartograms).

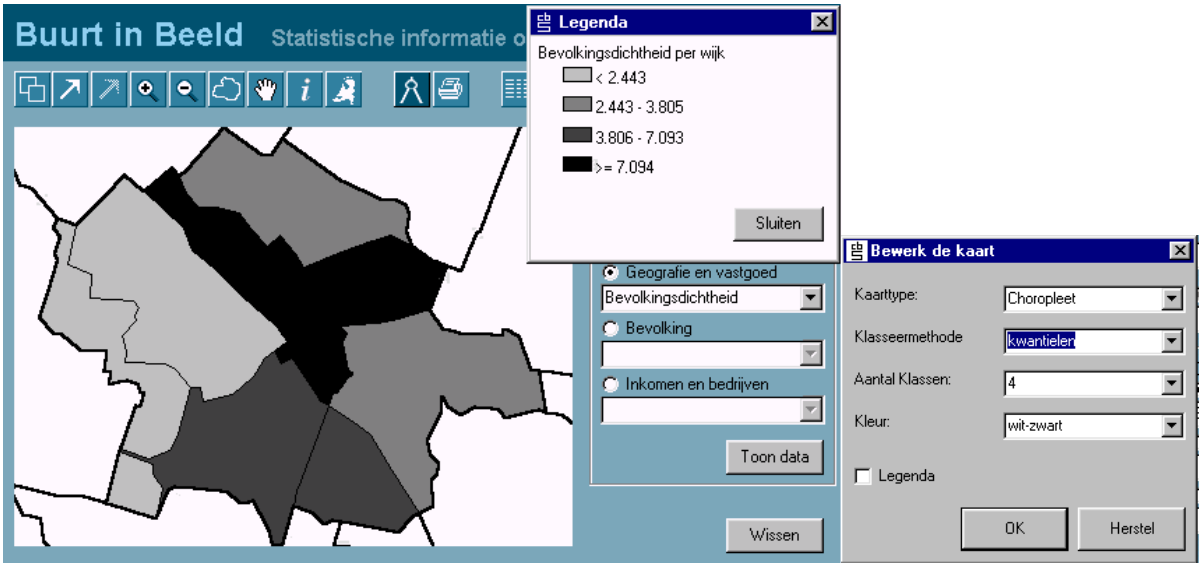

Figure 7: Choropleth map generated by the website 'Buurt in Beeld' of the Netherlands' CBS with some possibilities for adjustment (URL 7).

3.3 Web maps for on-line analysis and exploration

The preconceived statistical Web maps for presentation, as described in the previous section, may appear as static or dynamic view-only map displays. However, in order to be able to further *explore* and *analyze* the data behind the maps, many users will want to have a possibility to interact with the map displays. In the Philippines' prototype, the interactivity is still limited to some zooming and panning and the 'object info tool' (that displays the name of the administrative unit clicked and the corresponding data value in a separate window). Some more

interactivity is offered by the 'Buurt in Beeld' site. On this site -in addition to the functionality that is also offered by the Philippines' prototype- the user may deviate from the default cartographic representation and change map type (from choropleth to proportional point symbol map, or the other way round), change data classification method (quantiles, equal intervals or standard deviation) and number of classes (2-9) and choose another colour palette (see Figure 7). In addition, the Dutch site allows the retrieval of an orientation / location map inset.

A step further is that users do not just adjust the default map displays that are offered to them. We are referring to a situation in which they are really interacting with the data and are generating the displays (not just maps, but also other, possibly hyperlinked, graphics) themselves with the help of visualization tools that are offered to them through the same website that provides access to the data. These visualization tools may just be one part of a whole suite of GIS functionalities that may be offered to the users on-line. All these functionalities together, and even the visualization tools alone, would definitely stimulate and contribute to a better insight into, and overview of, the spatio-temporal aspects of Census and other statistical data, and increase their use and usability. At the same time, however, all these extended functionalities do have their consequences for the hard- and software required. And this may be one of the reasons why the potential for on-line exploration and analysis of Census and other statistical data has not yet been exploited by NSO's.

4. Hard and Software requirements

For the different roles that Web maps play, as described in the previous section, of course different kinds of services are needed from the NSO websites. This will have implications for the hard- and software required. As the general set-up of web services has been discussed in detail in other parts of this book (see Chapter ???) and in Köbben (2001), this section will be brief and concentrated on the specific needs for the functionalities described in Section 3.

4.1 Requirements for Web maps as geographical interfaces

The addition of a map window to the web interface requires little or no extra efforts. It suffices to store suitable view-only maps. The images are preconceived and stored on the server as graphic files. Since the maps are for on-screen viewing, low resolution maps with Web Safe colours are needed. To offer a selection of any geographical area by name only requires the addition of HTML form objects to capture the user's input and some means of server-side processing of this input. This may vary from simple server scripts, using ASP or Perl techniques, to on-line database interaction using server-side applications. In the examples 'Buurt in Beeld' (*URL 7*) and NSO Philippines (*URL 6*) the possibility to click on administrative units is realised by functionalities of the specific WebGIS used. It can however be achieved much simpler by using standard HTML formatting in a so-called 'clickable map', i.e. overlaying the view-only map with 'sensitive areas' that react to mouse events (as explained in *URL 8*).

4.2 Requirements for Web maps as a means of presentation

The use of Web maps to *present* spatial patterns or anomalies, as discussed in Section 3.2, requires in its most basic form the same 'view-only' maps as described in the previous paragraph. The graphic format and the resolution and colour space of the files should be suited to user needs and possibilities. If the maps need to be printable, additional versions could be offered using higher-resolution images, stored in formats devised for high-quality printing (e.g. Adobe's PDF).

For mapping applications this basic set-up severely limits the flexibility. Only static maps are possible, with no interactivity other than the clickable maps mentioned earlier. To overcome the limitations, many solutions are available, which could be realised at the client-side or at the server-side, or a combination of both. However, one has to realise that most of these solutions require extensions to the standard client-server functionality. This undermines the platform-independence and makes the information less generally useable.
One such technique, that is often applied in today's Web mapping, is the use of the Macromedia Flash format and its browser plugin (see e.g. *URL 9*). It offers resolution-independent vector graphics, zoom and pan capabilities, and interaction and animation possibilities (e.g. for the dynamic representation of time series), and is supported by a large user-base and matured authoring environment. As an alterative, Scalable Vector Graphics (SVG) is a relatively new graphics file format and Internet development language. It basically offers the same

possibilities as Flash (see *URL 10* for a good example), but has the added advantage of being an open, non-proprietary format and is fully supported by the World Wide Web Consortium.

4.3 Requirements for Web maps for on-line analysis and exploration

If NSO's wish to enable further possibilities to interact with maps, some kind of *mapping application* is needed that dynamically constructs maps out of the available data according to the user's specifications. There is a wealth of possible solutions available to build such applications, ranging from cheap, build-it-yourself solutions to full-blown on-line GIS systems. Nowadays, most GIS software vendors are marketing solutions for mapping and GIS functionality on the Web, based on their 'local' products. Whatever solution is chosen, all require significant investment in either development time, money or both. The 'Buurt in Beeld' site uses a custom-made plugin, made with Microsoft's Visual Basic and ESRI's MapObjects, a collection of embeddable mapping and GIS components. The NSO Philippines website uses a commercially available WebGIS solution called Manifold (*URL 11*). This is more of an out-of-the-box solution, where one can convert an existing set of GIS data and maps into a working website using a few commands only.

5. Conclusion

In this chapter, the potential roles of Web maps have been discussed for the dissemination of Census and other statistical data. Web maps may be used as an interface to find and retrieve the data required and as unique tools in exploring and analyzing the data in order to get insight into their geographical characteristics. Finally, Web maps may also be used to present spatial patterns, trends and anomalies, which cannot be derived from other presentation formats like texts, tables or charts. However, the analysis of current websites reveals that not many NSO's are making use already of these promising potential roles of Web maps. This may be partly due to the fact that NSO's are not fully aware of the possible functions of Web maps. Hopefully, this chapter will contribute to increase that awareness. Another reason may be that, so far, NSO's nor the users of the data collected by these institutes possessed the means to quickly and easily generate map displays. Nowadays, however, the Web, together with the other hard- and software developments, is gradually making it possible for NSO's and their customers all over the world to benefit from the potential roles of Web maps in the dissemination of Census and other statistical data. In the end, this will not only lead to a more efficient use of the data collected, but to an increase in the use of these data as well.

Notes

1. National statitistical organizations (NSO's) may have different names in different countries in the World. For example: Central Bureau of Statistics, National Statistical Office, Census Bureau, National Institute of Statistics and Censuses, etc. In this chapter, the generic abbreviation NSO will be used to denote these kinds of organizations with the task to execute the Census and/or to collect and disseminate statistical data at national and lower levels.
2. A more up-to-date version of *Table 1* can be found on the website that accompanies this book. Through the map interface on this website (and on the accompanying CD-ROM) some additional information can be obtained as well.

URL's

URL 1 Dutch election maps made available to the users on election day *http://www.omroep.nl/nos/specials/nederlandkiest/paginas/output/uitslag_dyna.html*
URL 2 DDViewer (CIESIN Demographic Data viewer) *http://plue.sedac.ciesin.org/plue/ddviewer/*
URL 3 Cartographic Data Visualizer *http://www.kinds.ac.uk/kinds/AboutKINDS/JANUS/cdv.htm*
URL 4 Descartes *http://allanon.gmd.de/and/java/iris/*
URL 5 Example of a dynamic Web map: deaths from cholera in London, July 19 to October 2, 1866 *http://www.geog.qmw.ac.uk/gbhgis/gisruk98/index.html#cholera*
URL 6 Prototype of the website for NSO Philippines *http://kartoweb.itc.nl/manifold/*
URL 7 The 'Buurt in Beeld' (the neighbourhood pictured) section of the Netherlands' CBS website *http://www.cbs.nl/nl/cijfers/buurt-in-beeld/index.htm* (only works in an Internet Explorer browser with ActiveX enabled)

URL 8 Clickable map of Dutch provinces (with technical explanation)
http://kartoweb.itc.nl/webcartography/workshop%20Webcartography/fig6_4/index.html
URL 9 Intermaps - making maps smarter *http://www.intermaps.com/*
URL 10 Vienna - social patterns and structures *http://www.carto.net/andi.n/about_vienna_svg.html*
URL 11 Manifold System *http://www.manifold.de*

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