Maps

A new approach to mapping the world: Visualizing facets of international health

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Maps usually represent land area. When one thinks of the world, a picture resembling a land area map comes immediately to mind (*see* map 1). Land area is undeniably important; its availability influences our ability to meet the basic needs, most importantly, of food and shelter. However, land area maps fail to inform us about many important aspects of our life. For example, land area does not map issues such as degrees of health, wealth, violence, work and other aspects that enhance our understanding of how different parts of the world relate to one another.

Cartography can depict territory in units other than square kilometres. Our website *www.worldmapper.org* provides a series of maps that cover many other important facets of human existence. In these maps, the size of each country has been changed to represent the variable that is being mapped, rather than the land area for that country. Thus, on the population map (*see* map 2) India occupies an area roughly 10 times larger than Mexico, because the former has a population roughly 10 times larger than that of the latter. Similarly, because Bangladesh and Pakistan have similar populations, these countries are shown as having similar sizes. Such world maps enable the reader to compare and contrast various countries with reference to a range of variables.

Changing the size of countries on a map is not a new idea. What is original in our maps is the algorithm used to create these. This algorithm, developed by Mark Newman and Michael Gastner at the University of Michigan, USA, allows countries to be expanded and shrunk while preserving their boundary shapes and relative positions as far as is possible. This is crucial to the readability of our maps. The other noteworthy aspects of this algorithm are the quality of the cartograms created and the speed with which these are produced. Its speed has enabled us to undertake a large world mapping project which will result in 365 maps.

The maps have several other features. Each country retains its colour on every map. Also, each of the 12 geographical regions of the world (poorest to richest: Central Africa, Southeastern Africa, Northern Africa, Southern Asia, Asia Pacific, the Middle East, Eastern Asia, South America, Eastern Europe, North America, Western Europe and Japan) has been allocated a colour on a rainbow scale, with the poorest region at one extreme and the richest at the other. This assists the reader in interpreting the relationship of the mapped variable with affluence; for example, the vast majority of deaths from malaria occur in the 3 poorest regions. Of course, there are large variations within each region, country and even town, which are not captured by these maps.

Our world maps show the proportion of the world total of each variable found in each country. Such mapping obviously requires good-quality data from every country. Most of these have been sourced from United Nations agencies. However, wherever data are missing, estimates have been used. These estimates have some limitations. A pertinent example is that of data about refugees. During a war or natural disaster—major causes of displaced populations—disruption of the government often makes accurate recording of numbers difficult. We thus found that data from the United Nations High Commissioner for Refugees lacked numbers for countries including Afghanistan, Iraq and Somalia. In such situations, we have used the best estimates, arrived at by national governments, international agencies or, at times, by the team making a particular map.

The 8 key Millennium Development Goals (MDGs) have acted as an impetus for constructing datasets with greater scope and accuracy. Such data are necessary to monitor in 2015 whether we have achieved those goals. In conjunction with Newman and Gastner's algorithm, it is the availability of these data that have facilitated this mapping project. Three of the 8 goals are directly related to health: to reduce child mortality, to improve maternal health, and to combat HIV/AIDS, malaria and other diseases. During the year 2006 we will produce maps with focus on health, illness and mortality. These maps will cover the following subjects: numbers of midwives, nurses, pharmacists, dentists and physicians; health service quality, hospital beds, affordable drugs and condom availability; the prevalence of HIV, tuberculosis, malaria, cholera, diarrhoea, trachoma, polio, influenza, yellow fever and diabetes; and life expectancy and child mortality.

The other 5 MDGs are more loosely related to health. Their focus on poverty, hunger, education, gender equality, environmental sustainability and 'partnership for development' all have bearings on the health of populations. Our maps also cover many topics related to these goals, under the categories of production, work, income, poverty, wealth, housing, education, pollution and depletion.

A selection of these maps will be reprinted in the forthcoming issues of the *Journal*. All our maps are available for free at our website: *www.worldmapper.org*. Accompanying each map is a downloadable poster that can be printed in A4, A3 or any other size. In addition, technical notes about the poster and data are freely available, as are the data used to make the maps. The website also provides additional information and articles about the mapping project. We hope that these maps will prove useful to those working towards improving the health of human populations.

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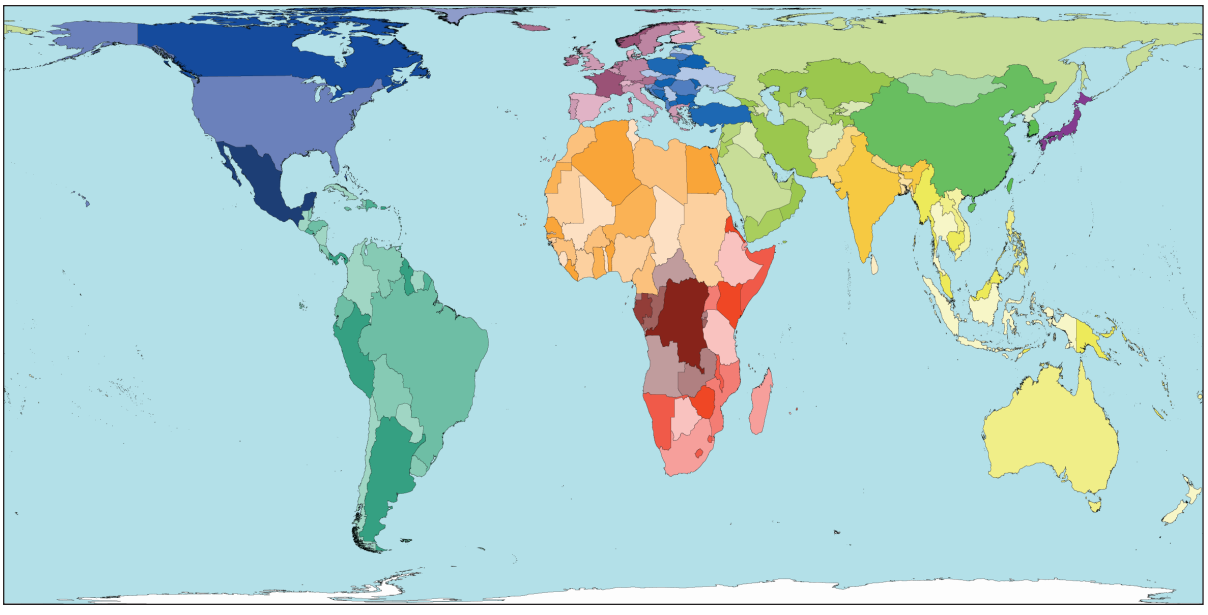
REFERENCES

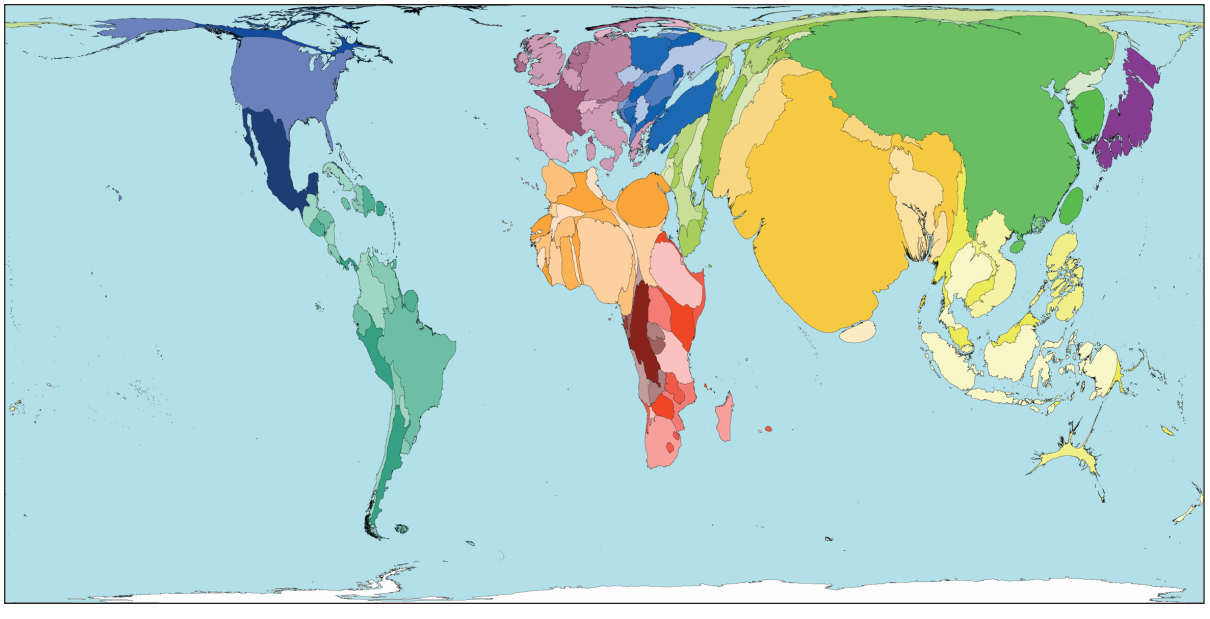
1 Gastner MT, Newman MEJ. Diffusion-based method for producing density equalizing maps. *Proc Natl Acad Sci USA* 2004;**101:**7499–504. (available free from: *http://aps.arxiv.org/abs/physics/0401102/* or via the Worldmapper website: *www.worldmapper.org*

2 United Nations' Millennium Development Goals website. *http://www.un.org/millenniumgoals/*

3 Worldmapper website. *www.worldmapper.org*



In Map 1, **each territory's size is drawn according to its land area. The total land area of the 200 territories included in the map is** 13 056 million hectares (1 hectare=100 m x 100 m). India, with a land area of 297 million hectares (2.3% of the world's land area), is the seventh largest country, with the other large countries being the Russian Federation (1689 million hectares), China (933), Canada (922), United States of America (916), Brazil (846), Australia (768), Argentina (274) and Kazakhstan (270). The land areas (in million hectares) of other countries (besides India) in South Asia are: Pakistan 77; Nepal 14.3; Bangladesh 13.0; Sri Lanka 6.5; Bhutan 4.7; and the Maldives 0.03.



In Map 2, **the size of each territory is shown proportional to its population (2002 mid-year estimates). The total world population in the year 2002 was estimated as 6242 million. India's population (1050 million) was exceeded only by that of China (1295 million). Other countries with large populations were: USA (291 million), Indonesia (217 million), Brazil (176 million), Pakistan (150 million), Russian Federation (144 million), Bangladesh (144 million), Japan (128 million) and Nigeria (121 million).** If the world's population were to be equally dispersed over land area, it would amount to 0.48 persons per hectare. However, this shows a wide disparity among the 12 regions taken into consideration, being the highest in Japan (3.5), South Asia (3.4) and East Asia (1.3), and the lowest in the Middle East (0.15), Northern America (0.2) and South America (0.2). In South Asia, population densities in Bangladesh (11) and the Maldives (10) exceed those of India (3.5), whereas those in Sri Lanka (2.9), Pakistan (1.9), Nepal (1.7) and Bhutan (0.5) are lower.

Source: http://www.worldmapper.org