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# Method for the classification of countries according to health-related indicators

Y. Verhasselt<sup>1</sup> & B. Mansourian<sup>2</sup>

*A taxonomic approach using cluster analysis and principal component analysis has grouped the countries of the world in eight clusters, in an initial attempt to propose a worldwide spatial classification based on the following health-related indicators: (a) those directly related to the health status of the population; (b) those measuring the provision of health care; (c) those linked to population characteristics; and (d) those reflecting economic parameters. The cartographic representation was based on demographic maps which display the area of each country in proportion to its population size.*

Several taxonomic approaches have been developed for grouping the countries of the world into coherent classes. For example, the World Bank has used income-related criteria whereas the Club of Rome has defined world regions in terms of natural resources. The United Nations uses economic parameters to identify subregions in each of the five continents.

WHO has structured its operations around six geopolitical regions which have common working interests, even though Member States might possess very different socioeconomic characteristics. From the point of view of health-related information, this diversity suggests that it might be instructive to search for similarities between countries at the intra- and interregional levels. A step in this direction has been taken by exploring systematically the data published principally by the World Bank. The grouping of countries has been achieved by means of principal component analysis and cluster analysis. Several alternatives have been tested and led to the selection of a world map which is offered as a working proposal for classification.

## Methods

The cartographic representation has made use of demographic-base maps (Fig. 1) which display the area of each country in proportion to its population size. This type of mapping enhances the relative population weight of individual countries and de-emphasizes their spatial magnitude.

The sources of data were obtained from publications such as the *World Bank Development*

*Report, the United Nations Statistical Yearbook, World Health Statistics Annual and FAO Statistics.* Though far from perfect, the consistency and reliability of data within these sources are higher than with other (non-UN system) publications.

The statistical analysis was carried out using principal component analysis (from the SPSS package) and cluster analysis (by courtesy of Professor Kaufmann, Free University of Brussels). Application of the principal component analysis on all the available variables (twenty-three of them) resulted in five components with Eigen value over one. In order to attenuate the influence of certain economic variables, a second principal component analysis was undertaken with fourteen variables which are more directly related to health status, yielding four components. A hierarchical and non-hierarchical cluster analysis was performed to obtain a spatial grouping of countries and a categorization of regions according to the values of health-related indicators (in effect, a world health map).<sup>a</sup>

## Health-related indicators

Notwithstanding the limited accuracy of the available indicators, especially for developing countries, and the lack of others such as effective coverage with safe water, the types of data used fall into four broad categories:

(a) indicators related directly to the health status of the population, e.g., crude death rate, infant mortality rate, life expectancy, nutritional variables;

(b) indicators measuring the provision of health care, e.g., number of physicians, number of nurses and other health personnel, number of hospital beds, health expenditure by the government;

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<sup>1</sup> Institute of Geography, Free University of Brussels, Brussels, Belgium.

<sup>2</sup> Office of Research Promotion and Development, World Health Organization, 1211 Geneva 27, Switzerland. Requests for reprints should be sent to this author.

<sup>a</sup> More details are given in *Mapping health indicators* (unpublished document, WHO/RPD/MAP/87).

Fig. 1. Demographic-base map of the world.

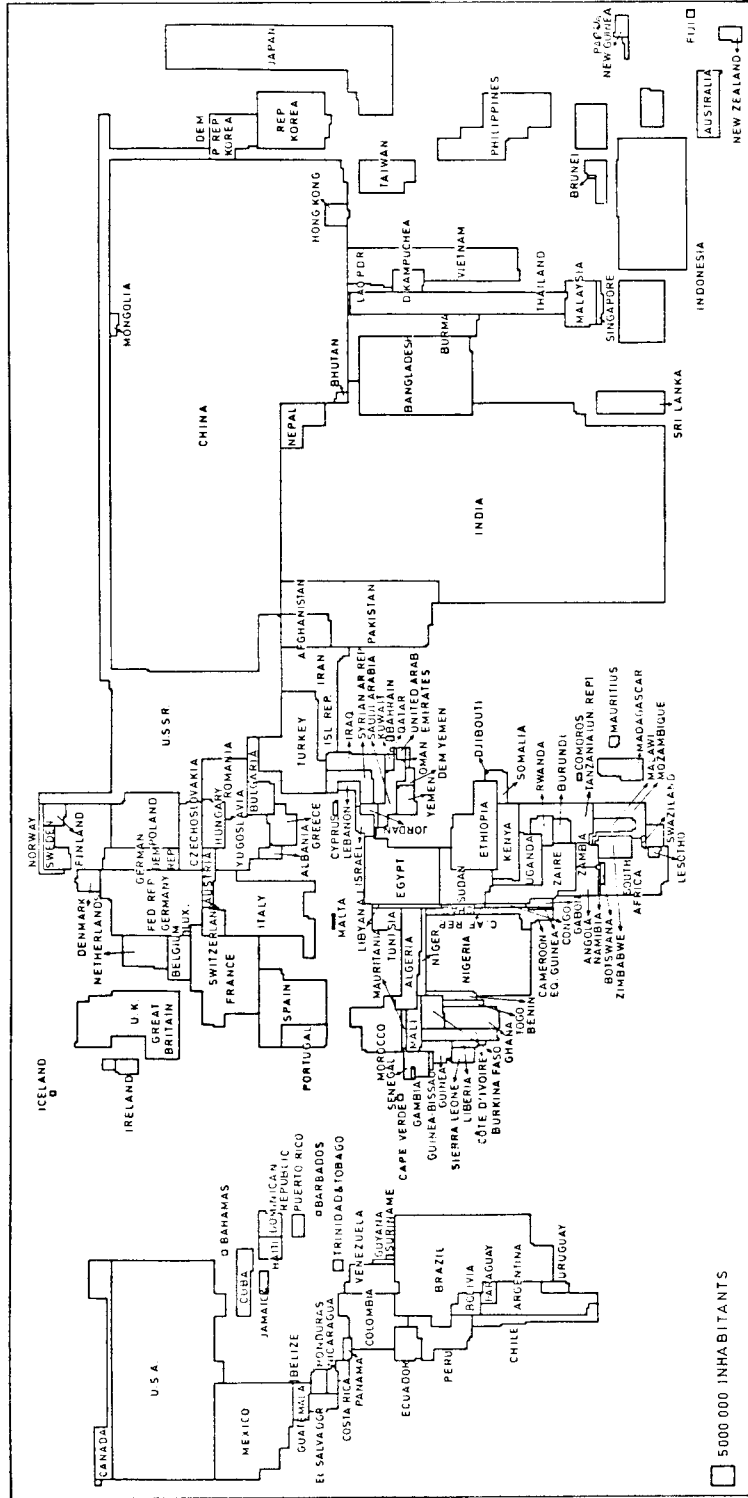
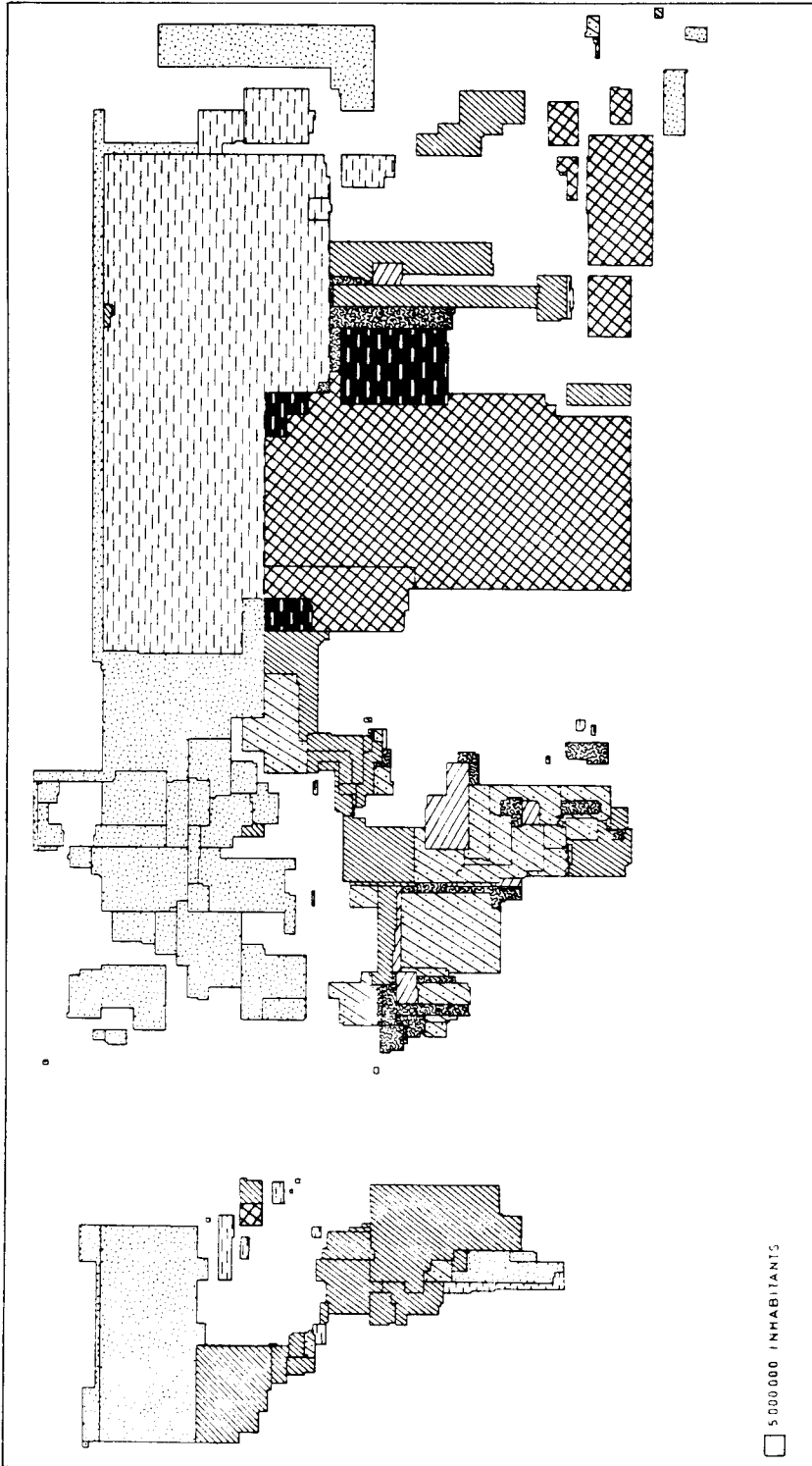


Fig. 2. Non-hierarchical cluster analysis based upon four components: the countries of the world are divided into eight groups (see text).



(c) population characteristics, e.g., crude birth rate, sex ratio, aging of population, natural increase and population growth rate, population density, degree of urbanization, literacy rate;

(d) economic parameters, e.g., percentage of labour force in the primary sector, in the secondary sector, in the tertiary sector, annual energy consumption, gross national product.

The spatial distribution of these indicators has been mapped systematically.<sup>b</sup>

## Results

Several classifications based on hierarchical and non-hierarchical cluster analysis were obtained. The clustering represented in Fig. 2 would appear to offer a good working hypothesis for a possible classification. The resulting map gives eight clusters, a configuration which seems realistic.

The first cluster contains North America, Argentina, Uruguay, Europe (except Albania and Turkey), Japan, Australia and New Zealand. In the second cluster are the following territories: Cuba, Jamaica, Puerto Rico, Costa Rica, Chile, China, Democratic People's Republic of Korea, Republic of Korea, Hong Kong, China (Province of Taiwan), and Singapore. Most of the countries which form cluster three are situated in Latin America, Africa (north and south), western and south-east Asia, and Oceania (Fiji and Solomon Islands). India, Pakistan, Indonesia, and Haiti form a separate cluster. Several African countries are grouped with Burma and Lao People's Democratic Republic. Cluster six is to be found mainly in Africa. Another cluster is composed of a few African countries and Democratic Kampuchea. Afghanistan, Nepal and Bangladesh form cluster eight; the stability of this cluster is remarkable throughout all the cluster analyses. Another stable cluster is formed by the industrialized countries.

Amongst all the possibilities arising from the cluster analysis, this map (Fig. 2) seems the most appropriate for offering a worldwide spatial classification based on health-related indicators.

## Conclusion

Despite the obvious imperfections of the data base, the analytical methods and the cartographic representation have been instructive in the exploration of several classification patterns. The map which is proposed offers a realistic working proposal. It might be useful to repeat the work with more reliable data.

## Résumé

### Méthodes de classification des pays selon les indicateurs liés à la santé

Une approche taxonomique utilisant les analyses par grappes et l'analyse par constituant principal a permis de grouper les pays en huit grappes, lors d'un premier essai en vue d'une classification spatiale des pays à l'échelle mondiale, basée sur les indicateurs liés à la santé: a) directement liés à l'état de santé de la population; b) mesurant la prestation de soins de santé; c) liés aux caractéristiques de la population; et d) reflétant les paramètres économiques. La représentation cartographique a été basée sur des cartes démographiques dans lesquelles l'aire figurée de chaque pays est proportionnelle à la taille de sa population.

La première grappe se compose de l'Amérique du Nord, de l'Argentine, de l'Uruguay, de l'Europe (à l'exception de l'Albanie et de la Turquie), du Japon, de l'Australie et de la Nouvelle-Zélande. Dans la deuxième grappe, on trouve les pays suivants: Cuba, Jamaïque, Porto Rico, Costa Rica, Chili, Chine, Chine (province de Taïwan), Hong Kong, République de Corée, République populaire démocratique de Corée et Singapour. La plupart des pays qui composent la troisième grappe sont situés en Amérique latine, en Afrique (septentrionale et australe), en Asie de l'Ouest et du Sud-Est, et en Océanie (Fidji et îles Salomon). L'Inde, le Pakistan, l'Indonésie et Haïti forment une grappe distincte. Plusieurs pays d'Afrique sont regroupés avec la Birmanie et la République démocratique populaire lao. La sixième grappe est principalement constituée de pays d'Afrique. La septième se compose de quelques pays d'Afrique et du Kampuchéa démocratique. La huitième compte l'Afghanistan, le Népal et le Bangladesh; la stabilité de cette dernière grappe est remarquable tout au long de l'analyse. Les pays industrialisés forment également une grappe stable.

Malgré les imperfections manifestes de la base de données, les méthodes d'analyse employées et la représentation cartographique obtenu ont jeté quelques lumières sur l'exploration de plusieurs modes de classification des pays. La carte proposée constitue un point de départ réaliste. Il pourrait être utile de reproduire ce travail en utilisant des données plus fiables.

<sup>b</sup> See footnote a, page 81.