Mapping out social change in South India

A geographic information system and its applications

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La carte du changement social en Inde du sud.

Un système d'information géographique et ses applications

Résumé:

L'Inde et son milliard d'habitants possèdent un riche recensement plus que centenaire, qui reste une source sous-exploitée pour l'étude des dynamiques socio-spatiales actuelles. L'article résume les étapes d'un projet de géomatique appliqué aux quelque 75.000 villages de l'Inde du sud.

L'apparition de la technologie des SIG dans un pays comme l'Inde bute sur de multiples problèmes (scientifiques, institutionnels et techniques). La localisation géoréférencée des villages a, par exemple, demandé des efforts considérables, en relation directe avec la rareté et la médiocre qualité des fonds cartographiques disponibles sur papier. De même, l'exploitation systématique de la statistique censitaire a mis en évidence ses faiblesses et ses lacunes, nécessitant des corrections de tous types. L'article fait le récit de ces problèmes pratiques et théoriques, ainsi que des solutions trouvées à la question de la restitution de l'information constituée grâce aux médias modernes.

En conclusion, nous présentons des exemples d'applications cartographiques de cette riche base de données et quelques outils géostatistiques qui permettent désormais d'aborder de manière renouvelée l'étude du changement socio-spatial. Les exemples choisis concernent des sujets aussi varié que la géographie du pèlerinage de Sabarimala, le système des soins en Andhra Pradesh, l'effet de l'urbanisation sur les villages tamouls, la discrimination sexuelle au Tamil Nadu, l'irrigation en Inde du sud ou encore les mesures d'autocorrélation spatiale.

Mots-clés: Inde, Inde du sud, Tamil Nadu, Kerala, Karnataka, Andhra Pradesh, Sabarimala, discrimination sexuelle, système de soins, urbanisation, SIG, cartographie, géostatistique

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Summary:

India, the population of which recently reached the one-billion mark, enjoys a rich and ancient census apparatus that remains an under-utilized source for the study of contemporary socio-spatial dynamics. Our paper summarizes the stages of a GIS project applied to the 75.000 localities of South India.

The emergence of GIS technology in a country like India comes up against many scientific, technical or institutional problems. The georeferencing of villages, for instance, required considerable effort because of the unavailability of reliable printed maps. Similarly, systematic examination of the census data has underlined their shortcomings and called for corrections of all kinds. This article chronicles some of these concrete and theoretical difficulties, as well as solutions found to make the collected information available to a large number of potential users.

By way of conclusion, we present some of the cartographic applications of this rich database, as well as some geostatistical tools that can be fruitfully applied in a renewed approach to the phenomenon of socio-spatial change. Illustrations given here come from various fields of interest: geography of Sabarimala pilgrimage, health care in Andhra Pradesh, impact of urbanization on Tamil villages, sexual discrimination in Tamil Nadu, irrigation in South India or spatial autocorrelation measurements.

Keywords: India, South India, Tamil Nadu, Kerala, Karnataka, Andhra Pradesh, GIS, cartography, geostatistics.

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1. INTRODUCTION

If we call to mind in the preliminary remarks to this article the fact that the *modus operandi* of research has to do both with the imperatives of scientific inquiry and with the relative fortuity of available information, it is because while investigating material for a new study concerning the decline in the birth rate in India, the first author discovered virtually by chance the existence of a previously unpublished database which, as it contained information that could be employed in research on fertility in India, was to serve as a source for the projects described here. In fact, several years subsequent to the undertaking in 1991, the administration of the Census of India decided to make a large part of the results available to the public in a digital format. Among the results were files containing information relating to villages and towns that were later chosen for publication in the *Census Handbooks* by district.[1] This new form of diffusion of results of the Census of India itself represents a small revolution in a country where statistical information is undoubtedly as rare as it is difficult to access and, for this reason, is very dear from all points of view.[2]

Taking this potential statistical windfall into consideration, the constitution of a large regional data bank was foreseen, to be built up by collecting primary data so as to avail of a base including all the villages and towns of the chosen states, namely, Andhra Pradesh, Karnataka, Kerala and Tamil Nadu, to which the districts of the Union Territory of Pondicherry were added. A few days later, an equally fortuitous discussion with a few colleagues intrepidly setting about an Indian geographic information system (GIS) led to a broadening of the approach to the spatial dimension: if it were possible to georeference these census units, one would avail of a formidable tool for examining the results of the last Indian census. In this way, beyond the study of the spread of the fertility decline in South India, the data and the techniques henceforth available would make it possible to conceive of an exhaustive approach to the socio-economic situation in South India, from both a statistical and a spatial point of view.

This initiative did not take place in an adventitious scientific environment. Rather, it is understandable in terms of a progressive development of ideas, techniques and needs that

[1] The *District Census Handbooks* are published on the occasion of each decennial census in English and Hindi for each district in India (466 in 1991). Their publication occurs very belatedly, often just prior to the following census, and the 1991 census did not depart from this rule, notwithstanding the new information contained.

[2] An illustration of these remarks is the recent introduction of an Indian web site very rich in statistics of all types (www.indiastat.com). Users must, however, pay relatively dearly for access to data that are for the most part taken from government statistics and are thus supposed to be in the public domain (such as statistics from the Census of India).

developed in the course of the 1990s. Figure 1 recapitulates this situation in the form of a chart summing up the environment of this period. Three main phenomena come together: the technological advance of geographic information systems in the last ten years,[3] the increasingly wide circulation of micro-level data and renewed interest in spatial questions. The first two phenomena have led to the confluence of new processing tools and new data: the data from the Indian census of 1991, henceforth available in computer format, could also be used on the micro-level for cartographic or statistical purposes. This represented an innovation in India, where cartographic productions are very limited in number and almost never venture below the level of the district.

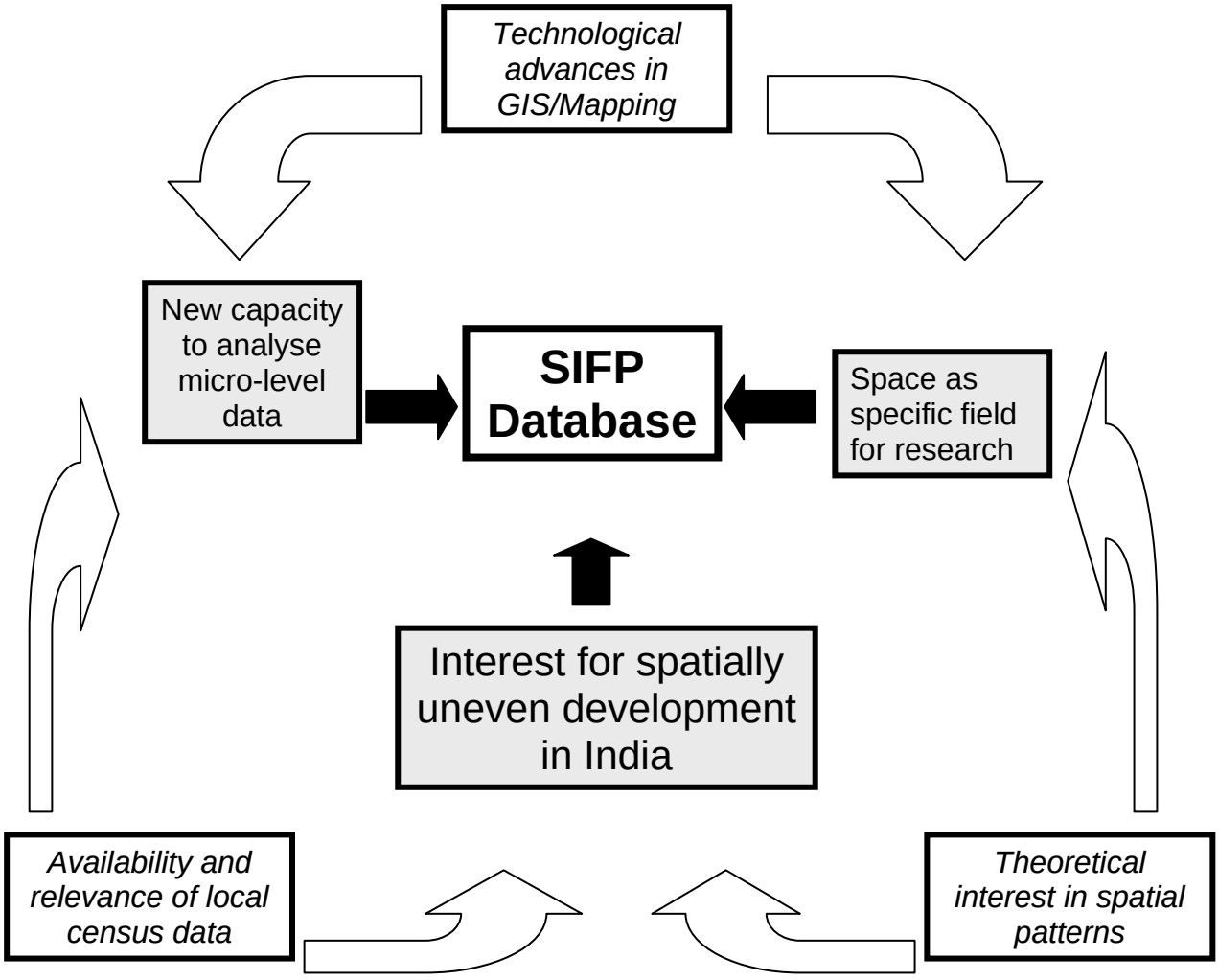

Figure 1 : Technological, theoretical and scientific environment of the SIFP project

[3] For general presentations of the application of GIS in the spatial analysis of social data, see in particular Martin (1996) and Longley and Batty (1996).

The GISs have gradually become more widely available, having become less costly and above all more easily accessible for non-specialists in India. The concurrence of the development of GISs and the renewed interest in spatial phenomena (illustrated, for example, by the new economic geography) has led to the consideration of questions that were in the past more or less theoretical and inaccessible for purely technical reasons. GISs, by making cartography and spatial analysis more easily accessible, have made it possible for long-standing or new questions to find application support. In countries such as India, this provides in particular the opportunity to closely analyze inequalities in economic and agricultural development, and even to disaggregate large-scale datasets which observers examine in order to discover the exact geographic contours of social change. The rapidity and the vigour of contemporary transformations contribute, in fact, to the continuous redrawing of the map of India.

The SIFP thus represented a logical outcome, around of research themes, the existence of previously unused data and the advances in the technology of spatial processing (computer-assisted cartography, GIS, geostatistics, etc.) that is still only in its inception. The impulse given by the theoretical reflection on questions of fertility, notably the debate between the structural factors in fertility decline and the mechanisms of diffusion that occur together with it (see Casterline, 2001), was certainly central, but the extension to other applications derived from economic or geographic discussions has proved to be just as logical, enriched by individual initiatives that are at times removed from the initial demographic issue, as the following illustrations will show. The French Institute of Pondicherry, with a long tradition in the cartography of vegetation in South India, was the ideal site for such a project and all the participants owe much to its support, whether direct, in the form of financial support to researchers and students, or indirect, by providing to all a place of encounter and development.

This volume retraces the main stages of the SIFP project and its diverse avatars, illustrating our topics with numerous maps and documents. Rather than restricting ourselves to the concrete results of the analyses, we have chosen here, in order to make the material more instructive, to present the successive technical phases in greater detail. They bear witness to the difficulties already forgotten by those who design models in the affluent countries, with a wealth of old, and often systematic, spatialized databases, but these very difficulties await all projects concerning the developing countries. While it is true that the statistics may often be lacking or seem to remain under-utilized for manifold technical