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The Census Mapping Retrospectives and Some Futuristic Views by 2001 AD†

Retrospect

THE Indian Census is one of the oldest among the world; the oldest probably is of the U.S.A., Britain and the Ireland. In passing, it is pointed out that a navigator (Hydrographer) estimated the population of Ireland in 1790 as one of the preliminary estimates worked out during early navigation charting. Similar census activities ancillary to voyages and exploration are documented in manuscripts and museums. However, the ancient history of the Indian sub-continent has enough evidence that the census of population was a somewhat routine exercise with intermittent periods as per the needs of military, revenue and economic development at those periods. Consequently later, in the history of India the counting of heads of persons was also not new as reflected up to the Mughal periods. The advent of the British in India projected the census taking at measurable scale. It is so interesting that the world's loftiest mountains had been fixed between 1845-1850 and the local or experimental censuses were exercised in India's certain areas during 1853-1868 and up to 1875 coinciding with surveys during colonial activities. These were not censuses, in true sense of the term, but definitely, these were preludes to the understanding of the geography, region and the feed-back to embark upon the national census later. It is quite well known that non-synchronous censuses in parts of India were undertaken, which became synchronous by 1971 with exceptions of full count and coverage in the following decades.

Significantly, it is well known that J & K was enumerated in 1961 and NEFA (Arunachal Pradesh) on sample basis in the same year; Sikkim was fully enumerated in 1981. Assam was missed in 1981 and J & K could not be censused in 1991 yet. In other words, it is only in 1971, the whole of India was first-time censused and stock of people taken on modern lines and the synchronicity as a whole is broken since then due to gaps and non-census on reasons of disturbed conditions.

Excluding the pre-censuses in Bombay territory (1864), Punjab (1868), Central Provinces (1866), Oudh (1869) and the lower provinces of Bengal (1869), the 1872 was the year for the first national census at least in a major way in India. Since it could not cover all the

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geographical areas, the 1881 census ushered an era of the Census coinciding with the completion of the first full settlement operations of the country, excluding mountainous and hilly tracks and some areas elsewhere in the country at isolated levels. However, the village-list was now available at that time which opened the listing of villages for the census and enumeration. This provided a good root in the planning of the census as per the procedure followed till 1951. Gradual changes in content occurred for re-orientations for needs of the country till this period as described by Srivastava (1981) and this gives how the questions, nomenclature in wording of the questions for enumeration since the first to the 1981 have changed.

The 1961 census under the leadership of Prof. Asok Mitra, the then Registrar General and the Census Commissioner, India broke a new ground in the procedures of the census operations from several stand-points; the one of the concerns, being the planting of seedling of modern geographical work as a preparatory measure for the Indian Census which is the concern of this paper at this stage.

Development of Census and Cartography

The 1961 census conceived in the realm of census and cartography into two broad ventures, i.e., (i) to conduct the census as a procedure and integrate geographical merits for preparations before launching the counting of population and (ii) the post-census researches of multi-dimensions and preparation of the Census Atlases both at national and State/UT levels.

(i) Geographical principles of preparatory work for the entire nation was executed in terms of fixing of location codes of rural/urban areas before delineating the enumeration areas. Since it was an innovation for the country as a gigantic task, one can imagine the dispersal of the raw materials from hand to hand as carried out without employing special cartographers. It was the band of Patwaris, municipal clerks and all others were trained as part of pre-census training and the work was done in the form of notional maps both for rural/urban areas to earmark enumeration areas (EAs) and house-listing. One can imagine as well the number of such maps (raw in nature) prepared for the conduct of the census. For interest, the notional maps were a million in 1961; 1.20 million (1971), 1.28 million (1981) and 1.32 million (1991).

(ii) Just after the completion of census in each decade the detailed population data were mapped in the form of Census Atlases, first time in the history of the India Census in 1961, so exhaustively by dedicated band of workers, Geographers, Statisticians, non-geographers under the leadership of Late Miss P. Sengupta. Here, it is most relevant to note that the desirability of the Census Atlases was recognised and initiated by the Pan American Institute of Geography and History in the Santiago Consultation in October 1950 by its resolution No. 74 and it was the adventurous mind of Asok Mitra who took first large scale initiative in India to produce, not one all India Census Atlas but for the States/UTs, on a concerted standard content on sound, sometimes complex geo-cartographical methodologies. Other countries to follow were Japan (1965) and Britain (1980). Even the non-census statistics at

the reference level of 1961 were also correlated to project the demographic situation in an integrated manner in mapping, which no other country could achieve and embark upon further to execute such ventures at national level. This programme has become, since then, an integral part of the census activities (Roy, 1982). Such scientific works have been recognised as effective tools in assessing population data and global environmental change on the aegis of the International Social Council - Programme on human dimensions of global environmental change.

The 1971 Census

The author of the present paper succeeded Late Miss P. Sengupta in 1969 and had the opportunities to go through the deliberations of the Censuses, specially the 1961 achievements, and planned to enrich the 1971 Census Mapping on a platform which was full of ethos and pains of great work and positive results before the public, academicians, administrators and alike. There were many areas where the census needed careful consideration of research to satisfy users and bring about a radical change in the Cartography of the Census. The question was how to start for more big finish and reorientation. The 1961 census documents provided me a great boost and the philosophy of geography which was inherited by training, was to change and moulded, to a situation for application. The horse (1971 census) was running and this was to be caught and trapped to the self-aspirations to do more and keep in tune to the time and demands.

This vigour provided an opportunity to refine, initiate and add to the treasure, a bench mark for utilitarian geography i.e.; Census Geography which was not a subject to be taught in the universities. Still it is lacking in one or the other way.

The preparatory work schedule for the 1971 Census was given a fresh look. The up-dating excluding the notional maps of all jurisdictions ranging from village to urban were conducted on scaled maps largely and retained to develop census map-documents, so that some of the misgivings and confusions to the users could be removed and the Census Literature were made readily matched with the Census Statistics and dated maps to reference of the census.

Three well defined programmes based on the up-dating; village identification, urban spread and rural-urban dualism were planned as a bench mark for the entire country. These programmes are well known which are, (i) jurisdictional maps of districts/tahsils, taluks and equivalent levels as contained in each district Census-handbook in the form of precise and scientifically cartographed map materials. About 3000 sheets of maps were executed in the 1971,1981 and preparations are under way on written guide-lines and training for the 1991 Census. It may be worthwhile to inform that the 1991 preparatory work was judged and matched with the map documents at RAJ Level with the preceeding 1971 and 1981 censuses so that the map content synchronicity, merger of areas or new creation of micro administrative levels during 1981-91 are not missed in any way. It is hoped that 1991 district census handbook maps will provide opportunities to users to study as far as possible with the previous levels for recasting of data, if need be, by users, institutions and other agencies at the level of 1991. These are the only maps which are available freely in published form with

village boundaries, location codes having parity with Census documents, infra-structure, transport, population sizes of villages, urban spread and location of PHCs, dispensaries, rest-houses, schools and educational institutions at one place for utilization.

Urban Maps

Concomitant to the above materials the urban maps of land uses were specially initiated since 1971 census for assistance of urban planning with broad land uses in 12 main and 37 sub-groups attached with the State/UT, level town Directories (Roy 1977). In working out such maps of towns having 50,000 and above population are considered. The 1971 census published about 400 towns, 1981 (527) and the spade work for such maps of about similar number have already been done for the 1991 programme. The utility of such census cartographic materials may yield comparability between censuses of urban spaces of this population size for research, analysis and space dispersal characteristics. To remove certain doubts of the delineated boundaries for users, the peripheral villages with their codes and boundary reflections were added in the 1981 and this will continue in the same manner in 1991 maps.

SUAMaps

The concept of SUA (Standard Urban Areas) since evolved in 1971 of a composition of urban core of 50,000 population and surrounding rural spaces (villages) on the consideration of/economic connectivities linkages and with individual urban areas. Such map documents are now so important in the contemporary situation that the industrial policies are now being considered with relevance to such maps, in accordance to the Government of India, Press note 22(1988) dated 20 September to the entrepreneurs to take a safe guard to protect ecological balance and establishment of industries at specific locations. As far as cartographic inputs are concerned the maps were elaborated more in 1981 giving particular attention to rural/urban mosaic, landscape ecology with reference to forests, scrub, arability and built-up patterns. Here it may be noted that to popularise the utility of such maps and their contents the 1981 Census Atlas Volume printed all the 12 million cities SUAs in colour besides all those published in the State/UT level, Part II-A'S.

Post-Census Cartographic Researches

The Census Organization devotes to a considerable extent both financial and manpower to develop techniques and methodologies for Census Cartography and Census thematic mapping according to the Tabulation Plan. As pointed out earlier, the preparation of Census Atlases is one of major concerns of the Census professionals in the execution of such projects, divided into national and State/UT volumes. This system provides manifestation of mapping demographic variables at State/UT, urban locational, tahsil / taluk etc., giving a complete composition of the administrative levels.

The maps of jurisdictional areas were compiled as Administrative Atlases in 1961 for Rajasthan and Orissa; and completed for all States/UT in 1971. The programme was dropped due to lack of funds in 1981 but 4 state volumes were published. The 1991 will now have no Administrative Atlas due to high cost, but it is useful to revive the programme.

As part of the 1961, ten State/UT and one national volume were published. In the 1971 decade two national volumes and 30 State/UT volumes were published, giving concentration to bring out demographic situations in them. The 1981 decade similarly published two national volumes and 30 State/UT Census Atlas volumes. Besides, to commemorate the centenary of the Indian Census (1872-1971)-a special publication of the Atlas, popularly known as the Census Centenary Atlas (1872-1971) comprising 124 plates in three parts with comprehensive documentation and interpretation of the maps was published. Part 1 of this publication contained administrative boundaries with changes in spellings (1872-1971), selected maps of the earlier census (1901-31) in 33 plates, and 57 plates of demographic mapping (1901-71) on the set-up of 1971 census duly recast of the census data at this level are the special features.

It may be remarked in view of statistics of coverage of themes in the Census Atlases during 1961-81, that the thrust of Atlases were demanded to demographic orientation. The 1961 programme which mapped 169 plates in State/UT volumes and 181 Themes in the national volume contained mapping in a major way besides population with the non-census data at point prevalence to correlate various perspectives, The latter censuses due to lack of non-census data availability on time, the structure and thrust were laid down primarily on the census of population data. However, to reduce cost of rising prices in printing, cross-classification of data was planned to project themes to enable the users to obtain maximum exposition of demographic correlations on issues and areal levels (Roy, 1989).

Special Mapping of Migration Issues

In addition to the Census Atlases, migration issues in its totality was mapped, interpreted and data compiled in 2 volumes in 1971 and 1981 with exhaustive mapping. This brought India exclusively important in the realm of migration mapping among the countries of the world. The special feature of this programme has been to compare the internal migration problems and patterns with special reference to distribution of migrants, pattern of in and out migration, duration and residence, mobility in terms of intra and inter-district and intra and inter-state migrations and migrants classified by reasons of migration. The mapping models are based on both iconic and distributional systems integrating the issues for national perspectives.

Special Mapping of Regionalisation and Development

The Census of India took the lead by the initiative of Dr. Asok Mitra who first time evaluated the levels of regional development in a classical system and indicated the state of critical population of India with intensive mapping and analysis of the issues as a Report of the Registrar General to the nation. This study still remains a reality and a model to tackle regional disparities. As is well known, this study classified the nation into seven regions, 31 sub-regions and 89 divisions as per the 1961 data, both census and non-census at matching points of time and the results are the bench mark reference of the achievements of districts as levels of development in them (Mitra, 1964).

No sooner the study was completed, it revolutionised the thinking in the country's scholarships which gave birth to a lot of sub-national studies by scholars, compensating many micro-level studies. In addition, the Census of India again with the foresightedness of

TABLE 1 : COMPARATIVE STATISTICS OF THE COMPOSITION OF CENSUS ATLAS CARTOGRAPHY 1961-81

<i>Major Groups of themes</i>	<i>Number of themes in State /UT. Volumes</i>			<i>Number of themes in the National Census Atlas Vols.</i>		
	<i>1961</i>	<i>1977</i>	<i>1981</i>	<i>1961</i>	<i>1977</i>	<i>1981</i>
1. Orientation and Physical	11 (6.51)	8 (5.80)	9 (8.82)	12 (6.63)	10 (11.24)	9 (9.68)
2. Demographic Structure	36 (21.30)	45 (32.61)	40 (39.22)	40 (22.10)	45 (50.56)	45 (48.39)
3. Economic Issues	78 (46.18)	53 (38.40)	21 (20.59)	78 (43.09)	13 (14.61)	11 (11.82)
4. Socio-cultural and Regional	44 (26.04)	32 (23.19)	32 (31.37)	51 (28.18)	21 (23.59)	28 (30.11)
Total	169 (100.00)	138 (100.00)	102 (100.00)	181 (100.00)	89 (100.00)	93 (100.00)

Brackets show % ages.

N.B. The programme of Census Atlases of 1991 series need to be projected at the I.A.S.P. Forum for a general consensus and theme selection where other scholars may be invited also to broaden the programme to suit the present need of perception on the issues.

Dr. Mitra initiated an INDO-USSR collaboration to work out economic regionalization of India with the partnership of scholarship of (Late) Miss Sengupta and Ms Galina Sadasyuk (1968), with intensive mapping technology and data generation; these authors once again enriched and nourished the ideas of Dr. Mitra in developing over and under-population and population-vis-a-vis resource and economic regions which was a revival of Blache views of over and wider-population. Such inundation was crucial during early plan periods of heavy unemployment which is continued till now. It could also delineate Indian geographical limits into dynamic, prosperous and problem regions for correct perception for development planning.

This census tradition of initiating novel ideas and synthesis of mapping technology, further, brought out in another results through a model on regionalization known as "Regional division of India - Cartographic analysis" (RDI) in 30 State/UT wise volumes with intensive maps linking the macro, meso, micro, and sub-micro areas of the country for various needs of planning and development analyses on definite parameters. The correlation between physical, soils, climate, lithology, forest and population distribution linking various levels of geographic spaces up to the villages of variable character could present in an orderly and rational way. Their mapping to bring out vivid viability in terms of area-population-density of the whole of India was never rated before over the world in the design as developed and recorded for baseline reference for areas of inequalities in the "Regional Divisions" for the evaluation of census data. The advantages of this can be derived for environmentalists, ecologists, demographers for general analysis and to streamline SRS/vital statistics development in such frames in future years. In addition, the population dispersal, future urbanization and tackling of disparity problems by planners to bring prosperity and reduce regional development gaps in industry, agriculture and alike in such regions are most demanding to investigate and application without any prejudice and orthodoxy of disciplines. The long outstanding issue whether planning from above or below is now settled into reality with the literature and mapping system in this gigantic exercises (Roy, 1988-90). Now the time is awaiting to link these regions of 4 tiers with the national informatic system for development diagnosis and solutions. With these scientific mapping and synthesis technologies ranging from levels of development through economic regionalization to the regional divisions of India executed at the Census of India platform during the last four decades (1961 -90) provide a great feed-back to assess various dimensions of population evaluation and the state of demographic situations to consider options, alternatives and their solutions in geographic spaces systematized to step forward and to adopt most candidly the frames for development (Roy, 1992).

A Time of Broad Views by 2001 AD

The science of census mapping of India has upheld a great tradition and fulfilled its commitment and looks ahead to the 21st century. It is now the time, exclusively speaking from the point of view of technologies in census mapping developed so far, to foresee ahead. No doubt that a new society and novel aspirations in our populations are being ejected with tomorrow. Hunger, disease, over-population are radiating in many ways. The key-factor is definitely - population and development in the demographic diversity (Bose, 1991). It is the

census data which throbs, once in-ten years and people probably forget the issues, to once again watch for the results of the next census. This is a global phenomena because neither the actual count or the projected or estimated population serve the legitimate policy making at a desired level due to changes in policies and even unstable democratic situations.

As far as the population data sets are concerned, the shocks are felt by all particularly scholars and a feeling arises like, "Strangers in a strange land" as soon as the census data is declared at every decade. The mapper or the mapping technology combining rational and imagination tries to project the data, say census data and the results are so forceful which demand a dynamic approach to synthesise data and space for meaningful enquiry. So far, the Indian Census has produced thousands of maps in volumes of the census. It has been helping manifold in researches, planning, interest, reviews and re-reviews. So far the Indian Census has been producing maps by traditional system with marginal mechanization limited to processes of printing and production. The decade of 90s needs two most important faces leading to the 21st century at least in the mapping system. The printing technology has come to a stage at the private sector which can assist in developing novelties of techniques and models specially in the census mapping with the input of computerization and automation. This should come in a vigorous way in the census.

The up-dating which has been manual and paper mosaiced and retained safe, should be fed on computers along with the census based data at all levels to cross-classify, adjust and to compare the validity of area and population even at the EA level from census to censuses. "This is very important because the components, say, in a very limited way of an urban area, are missed or not usually known to a user or planner where merged and why merged or bi-furcated, accept the census and the census records of up-dating. A sample of Kochi (Cochin) UA is cited for perception in this regard.

Kochi UA (Kerala) in 1991 has 20 components made up of corporation, OG (1), municipality (5) and census town (13). In terms of RAJ, several rural (1981) components are declared urban in 1991 (Nanda, 1991). In this process the spellings more or less of all the components of Kochi UA are changed than the previous census. A settlement (OG of 1981), probably merged into either Kakkanad or Vazhakkala (CT) of 1991. How a lay-man user who may be concerned with this area of research, own survey or an administrator for development can know unless it is really brought out the proceeding situation with the present It is, therefore, most important now with dilutions in the changing situations over the country to be very clear in ones mind with the literature at hand to probe into the situation for meaningful investigation. Considering such issues for the future in mind the idea of Geocoding was evolved for users benefit for a rational use of data (Roy, 1988). The updating which is in itself a great geographic exercise between Censuses will be benefited most as a futuristic strategy by the role of Geocoding in the Census. The anomalies as noted above in the case of Kochi and other areas in the country may be eliminated by this process in future Censuses.

Geocoding for Population and Surveys

As a point made to adopt Geocoding for population and surveys above may need a little elaboration. It is a system based computer processing of preparatory work of the census of

population helping house-listing and enumeration in defined areas popularly known as "Enumeration areas" (EAs). It is well known that the Indian Census has a norm of enumeration per enumerator as of 125 households and 130-150 households in urban and rural areas respectively. It has been more or less achieved through the Census of 1961-1991 at least, but several problems related to enumerators own limitations of getting time on the one hand and rapid sprawling on the other cause a lot of inconvenience to enumerate population within the reference period of the Census. In addition, the mounting demand of data at time series by EAs and equivalent levels with reference to present day EAs, specially of urban areas in the country, the concern of evolving Geocoding has become most important. The example as noted from Kochi urban agglomeration in the foregoing discussion is most characteristic in general. So far, there is no mechanism adopted in the Census of India to identify the preceding census EA in relation to the present census.

The Geocoding process with reference to Indian situations may be a logical answer. The entire logic in this process depends on an automated census cartography based on feeding the field-maps oriented to scaled maps by digitization under computer. As is well known that the rural areas (villages) are merged full or part to another; tahsils and equivalent levels and even districts are redefined and similarly the urban area delineation for the census are as well changed due to sprawling and out-growth development during the census. The administrative processes for change go on from time to time during the inter-census period and even at the eve of conducting of the census. Although the census takes into account such phenomena during the cartography of census preparatory work, yet the spatial details are so intense that all map-work remain outside the fold of record management. This record management can be well brought into the digital format of relevance and mode under computer to give an opportunity of transformation of various maps to connect the EAs of the preceding census. If this mechanism is built in, the census may be capable to preserve the past EA levels to the tune of the present of data delivery and precise census taking. This referencing system may get a scientific feed back to the location coding and projecting EA maps of rural and urban for canvassing of Schedules in a more definite way. It may also assure and guide the enumerators and the census managers at various levels to handle the situations to avoid misenumeration.

In addition, the data by EAs can be compared in intra and inter E A terms with attributes of population in space and time. Further, the Geocoding process will provide to perceive and interpret micro level data connecting the existing administrative levels from macro to micro and vice-versa by computers, being retrieval qualities assured under the system. It may also enable to create grid reference population data. The system, further, may ensure long term and short term data/map out puts with much economy of time. Undoubtedly, Geocoding when applied in the Indian Census may provide EA maps independently or in mosaiced pattern of other EAs within a defined administrative region for data analysis, re-survey of choice and options for institutional surveys like one of the NSSO or other agencies. There will not be any chance to miss the EA's account of the Census for future up-dating and preparatory work of forthcoming census. It is, therefore, felt that the Geocod-

ing need to be created with reference to the 1991 census, for the coming 2001 AD Census. A futuristic commitment to this procedure in the computer age may be most rewarding.

Re-orientation of Census Atlas Programme of the 90s

The scientific trajectory as a futuristic strategy on the other hand is also desirable in the cartography of Census Atlases programme because the demands of the lay-man, scientific community and others are now need-based. The Indian Census Atlas mapping for the 90s may require a lot of reorientations by developing techniques to focus human problem besides mapping *in-situ* of the census data sets. Deductive qualities of census data and derivation on hunger, disease, areal/location growth, malnutrition, population and pollution now need to be integrated in mapping various levels by emphatic techniques and critical examination of issues. This is the time that the regionalization technologies which are already developed in the Census can be used to focus regional as well as administrative set-up mapping to provide comparison at these two levels for exposition of the population data transformed into regional frame to pin point weakness of disparities for amelioration. Further, population data needs to be related with the impacts of geosphere and biosphere system researches to create consciousness through mapping in the Indian context and if this is marginally achieved, it will open research avenues to elaborate detailed techniques further in India. Experimentation need to be started right now: Indeed, it will be possible by conceiving Methodologies and simulating correlational data along with of the censused data. In this context, the values and goals of the Indian Census data as defined to human problems and solutions may set a guide line to create ramifications of mapping in the realm of Indian Census Atlases for the future. In this relevance, issues in the field of population for the 90s vis-a-vis mortality, fertility and family planning status can also be of immense feed-back to reorient theme selections of Census Atlas Programme (Premi, 1990). However, the comparability of mapping from the preceding Census to the present at Sub-national and below levels should be made as one of the prime goals for assessment of demographic situations on maps.

Envoz

To close the views at this stage of futuristic deliberations, it is noted that the population is now the biggest political issue at the national and global level. A lot of political decisions of population vis-a-vis industrialization and to check pollution and hazard are an international phenomena for growth. Although, Indian Census is one of the best in the world from the point of view of regularity, publication and creation of expertise giving a great feed-back to demographic, socio-cultural and socio-economic developments and researches, yet the internationalization of census data has not been formulated at the CIR level (Centre for International Research) which have covered about 125 countries capturing UA and rural cell data for global use in the light of the above present day situation. This is mainly due to the fact that automation and computerization of Indian Census data by Geocoding at such levels are not readily introduced so far. It is the time that the Indian Census may plan to create urban/rural cell data to enlarge large scale mapping and hence enhancing the gamut of

demographic assessments of qualities of Indian population for multi-dimensional investigations.

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