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GIS Based Dissemination of Census Data in Trinidad and Tobago: a Caribbean experience[*]

Prepared by

Harold Wall
Geographic Information Systems Manager (CSO)
Asst. Regional Census Coordinator (CARICOM 2001 Regional Census)

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CENTRAL STATISTICAL OFFICE
MINISTRY OF PLANNING AND DEVELOPMENT
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GIS BASED DISSEMINATION OF CENSUS DATA IN TRINIDAD AND TOBAGO: A CARIBBEAN EXPERIENCE.

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Geographic Information Systems Manager (CSO)

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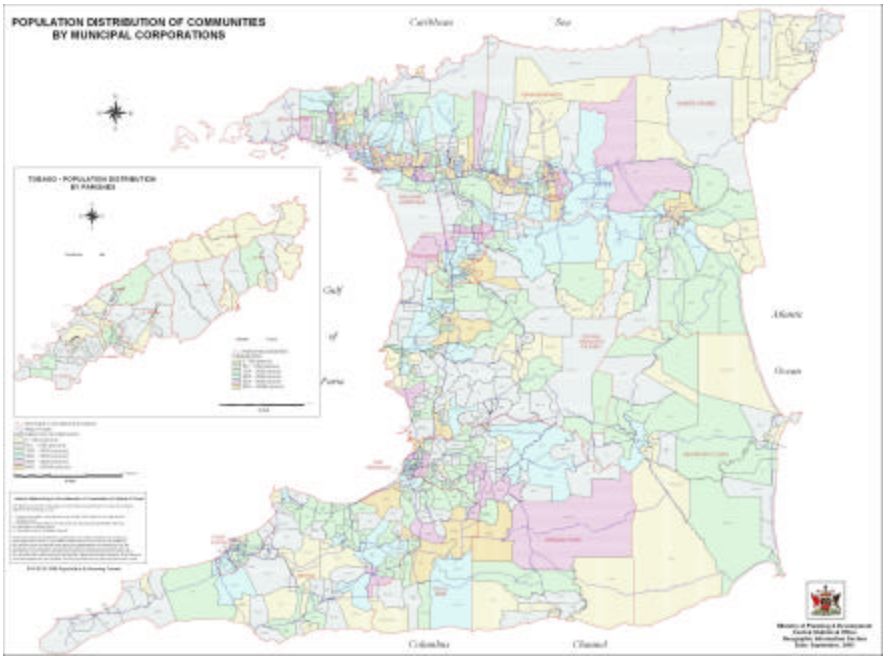

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GIS BASED DISSEMINATION OF CENSUS DATA
IN TRINIDAD AND TOBAGO: A CARIBBEAN EXPERIENCE.

INTRODUCTION

Geographic information forms an essential component of Government held information. Its collection is usually a long term, large scale and capital-intensive. In order to function effectively, the Government of Trinidad and Tobago collects and maintains large amounts of geographic information on a regular basis. Government is mandated by Acts and Regulations not only to collect information through Censuses, but also to use it for day-to-day operation of public administration. Government manages and processes the information on behalf of the wider community.

The Government implements its policies through the various Government Ministries. Subsequently, it is important that the methods used for policy formulation and decision making are transparent, methodological and professional, using the most current information available. If this is not adhered to, then the adhoc planning decisions that would inevitably ensue may be considered by the population to be unreasonable and politically biased. Consequently, it is important in a democratic society, that the delivery of services which is important in ensuring the well-being of the state, be conducted in an efficient manner using best practices available. To improve the public management of resources it is recommended that the timeliness of Census data be encouraged.

Traditional decision-support techniques usually lacked the ability to simultaneously take into account multiple socio-economic indicators in the location of major social infrastructure. This shortcoming is reflected in the inefficient location of Health Facilities, Police Stations, Fire Stations and Schools and other social infrastructure in relation to population distribution and density. The traditional method used for site selection of social infrastructure has shown inconsistencies with the social demographics, flaws in urban and rural planning and has created serious environmental problems for the transporting public. This has severely affected the delivery of social services to the ones considered most vulnerable. This lack of informed decision-making may also show the Government's inability to demonstrate insightful physical planning initiatives.

The Government of Trinidad and Tobago has articulated a vision for the country becoming a developed nation by the year 2020. By 2020 it is envisioned to be a fully developed nation in terms of a strong economy, a high level of human development, high standard of living (enjoyed by the population), improvements in the quality of the social, legal institutional structures and also quality governance at both the national and sub-national levels, as well as the state of the environment. In order to realize its vision for 2020, the Government has focused attention on the institutionalising of a National Geographic Information System (NGIS) and the early planning of the 2010 Population and Housing Census with a view to execute it a cost efficient manner.

It is now generally recognized that socio-economic planning without the relevant timely census data-sets would be an exercise in futility. It is to be noted that excellent spatially referenced information means information that is current, complete, accurate, affordable, accessible and integrated. This ensures economic and social development and leads to good Governance through informed decision making by policy makers. An effective NGIS is composed of 80% current attribute data.

TRINIDAD & TOBAGO – A BRIEF OUTLINE

The twin island of Trinidad and Tobago lies in the Caribbean Sea approximately 11 kilometres east of the Venezuelan coastline, it is 5127 square kilometres. Trinidad is the second largest island in the English-speaking Caribbean and is approximately 105 kilometres long and 77 kilometres wide with an area of 4,828 square kilometers. The island is mostly flat, with its highest peak in the north of the island reaching a height of 940 metres. The island of Tobago lies northeast of Trinidad and is 51 kilometers long and 18 kilometres wide with an area of 300 square kilometers.

The Population of Trinidad and Tobago taken from the last Census in 2000 was 1,262,366 persons with a density of 246 persons per kilometer Square. This reflected a 4.01% population increase over the 1990 Census. The de-facto method of the 2000 Population and Housing Census was used to canvass approximately 2,500 Enumeration Districts (ED) through face-to-face interviews.

The first structured Population and Housing Census was implemented in 1946 and the country has since successfully completed five decennial National Censuses from 1960 to 2000. However, according to Fraser's history of Trinidad and Tobago[1], the first Population count was taken in 1733. The 1733 census revealed a population count of 2,813 persons. By 1801 the Population had increased to 24,229 persons.

The 1946 Census developed and used spatially delineated, numbered EDs to canvass and collect socio-economic and demographic data at the household level. ED data were then aggregated and information was disseminated at the national administrative level of Counties. The coded three digit EDs, used from the 1946 Census paved the way for historical geographic comparisons to be made between subsequent Censuses. These EDs were designed to accommodate an enumeration workload of 100-200 households. They were not designed at the time, to be homogeneous with respect to any social characteristics or economic status. Their spatial size varied widely depending on their density and urban/rural status. However, physical changes in EDs over decennial censuses, caused by new roads, highway construction, river re-alignment, gated communities and new housing developments, required occasional boundary revision and amended workload allocation.

CONSTRAINTS & CHALLENGES

Since then, EDs have evolved and are now identified by a five digit code. The last two digits are reserved to accommodate subdivisions during the inter-censal period. They are normally subdivided internally, after a census, due to population growth or combined as a result of substantial population decline. The ED identification and geographic locations have been basically maintained (somewhat) and have become the nucleus of present day GIS spatial operations and dissemination strategies. Based on this approach, it has become spatially possible for historical comparisons and trend analysis to be achieved at all administrative levels, using ARCGIS and ARCVIEW software.

It is to be noted that most if not all CARICOM countries, Trinidad and Tobago included, never established a permanent mapping unit at their Statistical Departments, as part of continuous institutional strengthening. Most countries relied heavily on assistance from their resident Lands and Surveys or Urban Planning Departments. Consequently, most countries commenced their mapping programs just a year or so before a census. St. Lucia and Trinidad and Tobago established permanent Mapping/GIS units after their 1991 and 1990 Population and Housing Census respectively.

[1] Colony of Trinidad & Tobago, Census Album, 1946

In 1992 the Central Statistical Office (CSO) of Trinidad and Tobago delineated the boundaries of EDs, from hand-drawn sketch maps, onto the Lands and Surveys, 1/25,000 national Cadastral sheets. These 38 Ward sheets were subsequently manually digitized and edge-matched, forming a comprehensive digital map layer of Trinidad and Tobago at 1/25,000 scale.

One major drawback that faced the commencement of the ED boundaries digitizing was the elimination, as far as possible, of all imaginary boundary lines, and to rectification/regularization of all contiguous ED boundaries. This had to be done to ensure that there were no omissions and/or duplications of all census canvassing areas. This meant that each one of the approximately 2500 EDs (1990 census) had to be reviewed, verified and field check before preparing to digitize. Paradoxically, these ED maps were free-hand-drawn sketch maps and were not drawn or aligned to any known scale. Moreover, they were only updated prior to a Population Census, as there was no permanent mapping unit existing at the CSO.

To make matters even more complicated, the national cadastre was more that 30 years old. These maps were originally produced by the British Government, Directorate of Overseas Surveys (DOS) in 1960 and were the only up-to-date paper maps available for the country. Moreover, the two islands were at different coordinate systems, Trinidad using a Universal Transverse Mercator (UTM) and Tobago using Cassini, world projections. At the time, this prevented the two islands being represented on one map. These topographic maps were not digital and there were no digital maps available locally or internationally.

In 1991 the United Nations Development Program (UNDP) donated a desktop computer, digitizer and the GIS software ARC INFO 3.0, to assist with census mapping. At the time this software version was not as user-friendly as present day ARCVIEW or ARCGIS software and did not carry a Graphic User Interface (GUI). This also proved to be somewhat of a challenge as persons in the department had to read the voluminous manuals and implement functional type-written commands and scripts. No one at the department was formerly trained. Consequently, buy-in was required from finance/administration departments to ensure GIS development. This was quite difficult as they were not actually able to see the finished product and were quite comfortable with existing and proven methods. This proved to be a major setback to GIS development at the CSO department and only became accepted when spatial social analysis was achieved using current census data.

GIS implementation in the CSO at the time, had been mainly tasks at an operational level e.g. to replace paper maps with digital ones. This however, never utilised the true power of a GIS. What we did then was to digitally convert an old way of doing things; but we did not fully change the method of thinking required in properly keeping abreast with the latest information technology. Modern statistical techniques, software and theories, have generally, been developed to assist in the reduction of large amounts of primary and secondary data into manageable information, but the human resources were not in place.

The development of strong relational database software and modern technology, has opened the door, once again, for improved GIS software to be used for spatial and aspatial analysis and effective reporting that can lead to informed decisions that directly affect people lives positively on the ground, rather than just the formulation of utopian plans. The linking of the census data (attribute data and administrative maps) has been hampered by the lack of up-to-date National topographically referenced base maps in the Caribbean. This has been a debilitating factor in the delivery of the GIS technology over the years. One major problem that GIS can solve is to unravel the complex databases that have confused users of census and surveys data, by providing a visual element that offers popular user appeal and can provide an ideal starting point for information discovery. This can replace traditional tabular based information retrieval strategies with one based on visualisation and new knowledge discovery.

COMMUNITY PROFILING

At the CSO, all major and minor roads have been digitized. EDs, through an address-matching procedure, were aggregated to form Communities. Data from the 1990 and 2000 Censuses were then linked to the digital spatial layer of communities. This method of dissemination proved to be a more user-friendly way and reflected an improved acceptance of information to the public, planners and researchers.

The method used for the delineation of community boundaries in Trinidad and Tobago was to collect and analyse data from the following sources:

i. Data from the Map comment form used on the Labour Force,
ii. Addresses of respondent from the Labour Force and Special Listing Visitation Records,
iii. Field visits to problem areas and the
iv. Population Census Visitation Records

Each ED was assigned a community name based on information collected from sources above. All contiguous EDs with the same community name were then aggregated and delineated to form the boundaries of the respective community.

EDs with more than one community names i.e. EDs that are rural in nature and had ribbon-type development stretching along a road and/or EDs with Housing developments in them, were further analysed using individual household addresses from Visitation Records to identify and use the dominant name or both. These communities were then geographically coded into a four digit code to reference administrative areas. Consequently, data integration from various social surveys were now able to impact on the planners for an improved understanding of social ills by visualizing spatially, in relation to other social infrastructures/facilities, such as proximity analysis to schools, hospitals and Police Stations etc.

CONCLUSION

For Caribbean countries, the census continues to be the most dependable and feasible source of socio-economic data. Its ability to provide comparable data at the community/village level on a variety of characteristics being its most valued advantage. Ironically, Statistical Departments in the region thought it more practical to coordinate the necessary technical, administrative and financial resources for a single major national operation like the population census, than to develop and maintain efficient, continuously operated statistical systems that will provide vital information on a continuous basis.

Therefore, until such time as most countries have developed the capability to organize and maintain an efficient population register, or other informed statistical systems for providing relevant information that, in combination with this, yield data for small areas on designated characteristics of the population, the census will continue to play an important role as the only major source of socio-economic and demographic data. Data produced by Census is a primary source of information needed for effective development, planning and monitoring of population, socio-economic and environmental trends. Though stored in databases, this data has a spatial component inherently associated with it.

The census database contains a lot of attribute information which can be linked to spatial units by spatial referencing. Relating the spatial component along with the non-spatial attributes of the existing corporate data enhances user's understanding and gives new insights into the patterns and relationships in the data that would otherwise not be found. Caribbean Governments are all attempting to move towards more efficient and effective delivery of goods and services to their citizenry. Because of the complexity of modern society however, the tasks involved in achieving these objectives are both onerous and time consuming.

In addition, in many developing countries such as Trinidad and Tobago, the rapid growth of communities and the diverse conflicting demands for access to the limited available resources, make it especially difficult and challenging to adequately address the needs of all stakeholders in these communities.
Existing systems are no longer adequate for the provision of current and reliable information to decision-makers and policy makers. This leads to delays in identifying problems, making decisions, and ensuring that available resources are optimally utilized to provide goods and services to stakeholders.

Consequently, improper management issues are of overwhelming concern since they affect timely delivery of census information. Issues of efficient and timely deliverables from a holistic project management perspective of census activities are lacking. We have proven to be very competent with the enumeration activity of a census, but have shown our inability to actively manage the timeliness of data processing and data dissemination. Technology has improved exponentially over the past 40 years, which begs the question of "Why then are we still unable to deliver census data on-time? The following table pertaining to Trinidad and Tobago clearly indicates that improved management skills and methods have to be developed to improve the efficiency and timeliness of Census data or it becomes irrelevant, when finally released, to the purpose for which it was meant to serve. The table explains.

Census Year	Year last document Published	Lag Time	Population Increase
1960	1963	3 Years	---------
1970	1973	3 Years	103,114
1980	1984	4 Years	148,720
1990	1995	5 Years	133,942
2000	2006	6 Years	48,633

The average decennial Population Census increase of approximately 100,000 persons does not warrant the lag time shown. Technology can help but strategic management issues will always be a problem if the timeliness of the result is not envisioned by management to be a priority for the users of census data. GIS activities and analysis cannot take place if the data is not available. Moreover, the impact of the Census tardiness affects the accomplishments and relevance of a statistical GIS unit.

The Central Statistical Office, Geographic Information Section has successfully redrawn all EDs to scale, showing the location of all buildings and their landuse, linked all data sets from the 1990 and 2000 Population and Housing Census data to a Community and Municipal boundary file. The section has also completed a 2000 Community Census Map Album and a 2004 Agricultural Census Album. Preparations are on-going for a 2007 Household Budgetary Survey and the Continuos Sample Survey of Population and of course the 2010 Population and Housing Census.