

UTILIZATION OF CENSUS DATA: GIS MODELLING

1996 CENSUS

INTRODUCTION

The 1996 Census was modelled closely on the 1986 Census in terms of its methods and procedures. However it was also more ambitious than the previous census in its scope and coverage. For the first time, in addition to the traditional questions there were questions on money earning activity of the household, land tenure, household waste disposal and household durable items. One section was devoted to questions on disability in an attempt to collect benchmark data on Fiji's disabled population. The questions on school attendance, educational attainment and economic activity, while being fairly similar in content to the 1986 Census questions, were developed further in order to provide more accurate and relevant data on the major issues of education and employment.

Census information will remain the main and most comprehensive source of information until the next census. There has been an accelerated demand for specific information as a result of the many researches demanded by different organizations. The requirements are many and they differ according to their own specifications.

This presentation will focus on the GIS modelling of the 1996 Census data. It begins with a very brief summary of the uses of census data and followed by the presentation of some of the selected maps extracted from the *Social Atlas*. Some limitations of the GIS technology are briefly discussed and followed by some proposals for future activities.

UTILIZATION OF CENSUS DATA

Census information is considered by Bakker (Bureau of Statistics: 1998) as a gold mine. The Fiji Islands Bureau of Statistics (FIBS) is sitting on a very rich gold mine of data, which is not fully utilized. A large amount of the public coffer was utilized to pay for the operations of the census of 1996 and all other censuses for that matter. Therefore we need to justify the utilization of this large chunk of public funds by disseminating as much information to the public as possible from the census.

The 5-year development plans require comprehensive information to plan accurately and efficiently for the next five years in order to improve the living standards of people. In the absence of these comprehensive information, census information has been filling these gaps. Information on housing types and the availability and sources of water and the land tenureship are all important information that reveals the socio-economic situation and standard of living of the people of Fiji. This information is important as it reveals the current situation in order to make accurate future plans for improvement.

Funding agencies require a proposal that is based on the true facts and figures. Researchers require special information for the area being researched. Regional development plans either for water or sewerage or any other services require accurate information at regional level or very small geographical units in order to plan accurately and efficiently.

The 1996 census of population is considered to be the most comprehensive as far as evaluation and data analysis is concerned. The traditional format of disseminating information via tables and the analytical reports in one or two volumes has been complemented by the innovation of current computer technology.

The 1986 census attempted to disseminate census information on various volumes on different subject area. These are the General Tables Volume, followed by the Small Area Data, the Economic Activity, the Fertility and Mortality, the Housing, the Internal Migration and the Analytical Report. However with the exception of the Analytical report all the other volumes contain tables without any analysis of the data.

For the 1996 census of population it was decided that more in-depth reports on the following subject areas were to be pursued:

- i. Internal Migration
- ii. Housing
- iii. Fertility

In addition to the above the analytical reports were to be published in two volumes. Volume 1 was to include the general analysis of the Demographic characteristics and more in-depth analysis of the Mortality characteristics of the people of Fiji while Volume 2 was to include other socio-economic analysis particularly on Economic activity, Education and Religious characteristics of the Fiji community.

UTILIZATION OF CENSUS DATA: GIS MODELLING

The adoption and use of the GIS technology is a very recent introduction to the FIBS. It was in a similar conference as this that one of my senior officers attended and was impressed with the use of GIS in census operations. This was the 14th Census Conference held in Seoul in 1993 where GIS featured prominently in the country presentations (Bureau of Statistics, 2000). Our country representative returned with high recommendations and persuasions for the incorporation of GIS in our census operations. Hence the beginning of GIS with the initial **digitizing** of Census

Boundary maps and finally with the dissemination of data in **statistical map format**.

The popularity of GIS is in its demonstrated utility for a very broad range of applications, (Davis. B. 1990). It is holistic, integrated and multi-disciplinary and can play a primary role in accomplishing the planning, inventory and analysis of proposed scenarios according to user's purpose.

Amongst its broad operations and uses, this technology is a useful tool in the production of an informative Census Report. It provides a new dimension and approach to what was once a Statistical report presented in tabular form. One such system produced is the *Topologically Integrated Geographical Coding and Referencing* (TIGER) files. This was produced to Accompany the 1990 Census by the US Geological Survey in association with the Bureau of Census, (Longley. P. et.al. (ed.) 1995). These files are based upon lines that form both a description of the street network and also set of boundaries for the representation of Census block boundaries.

GIS is a very powerful tool in analyzing statistical information more specifically for the layperson that sometimes find it very difficult to read statistical table. GIS systems according to Antenucci, et.al (1991), processes both graphic and non-graphic data. It also has the capability to store non-graphic attributes or geo-referenced data and link them with the graphic map. Its cartographic, data management and analytical capabilities allow efficient storage, data manipulation, easy processing and interactive graphic manipulation. These are amongst many other operations of the technology. These however, are not new concepts (Campbell et.al., 1995) but the speed and flexibility has produced an innovation that has prompted considerable interest.

After all the teething problems with the implementation of new technologies, GIS is paving a new pathway to provide the FIBS with the much needed marketing and user pay strategies. To date, we have an established GIS unit that has had the initial task of refining the 1996 Enumeration Area (EA) boundaries. Having completed the basis of Census data, (the digitized EA boundaries linked to its statistical information), the unit embarked on producing the Social Atlas based on the 1996 census information.

SOCIAL ATLAS:1996 CENSUS

The social Atlas as the publication is known contains a collection of maps representing different information gathered from the census. The primary objective of the atlas was to present comprehensive census information on maps in addition to the traditional tabulations and charts reporting system. The FIBS is aware that we need to drift with the flow of globalization in all areas of development more specifically with computer technology and one of which is Geographic Information System.

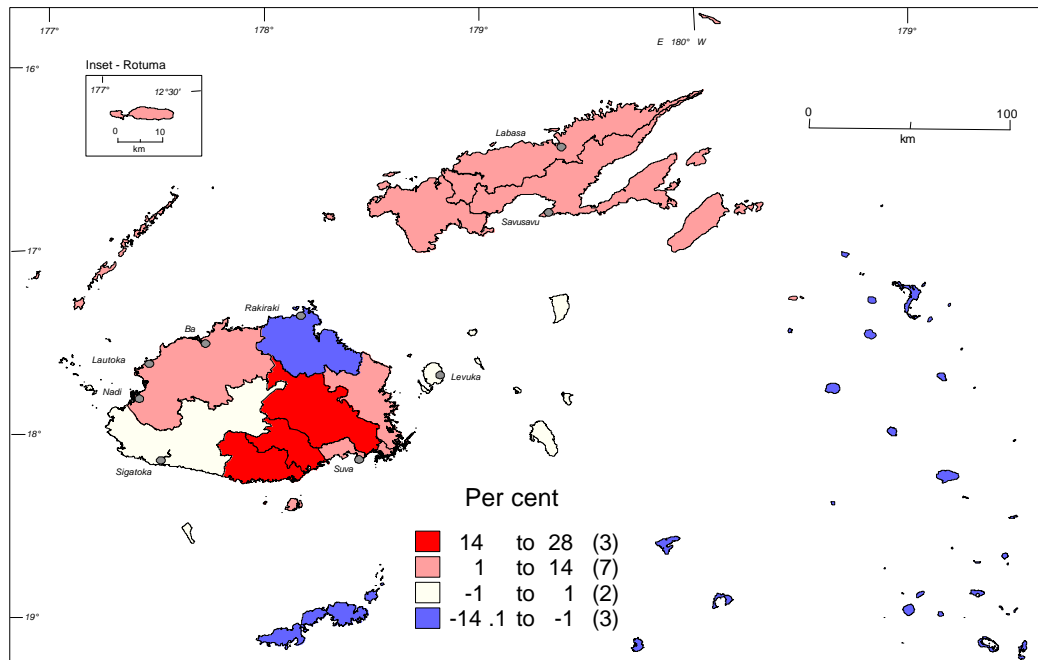
One of the major strengths of GIS is its spatial analysis capability. This helps:

- urban planners and cadastral agencies acquire detailed information on land measures and resources in municipalities
- civil engineers plan road routes and estimate construction costs
- police identify location of crime
- commercial interests for potential markets and sales outlet
- planners identify regions where additional schools and hospitals are needed and many more that have spatial related information.

SOCIAL ATLAS: 1996 CENSUS

The following section will briefly describe some of the selected Social atlas maps using census information.

MAP 1: POPULATION CHANGE 1986 - 1996

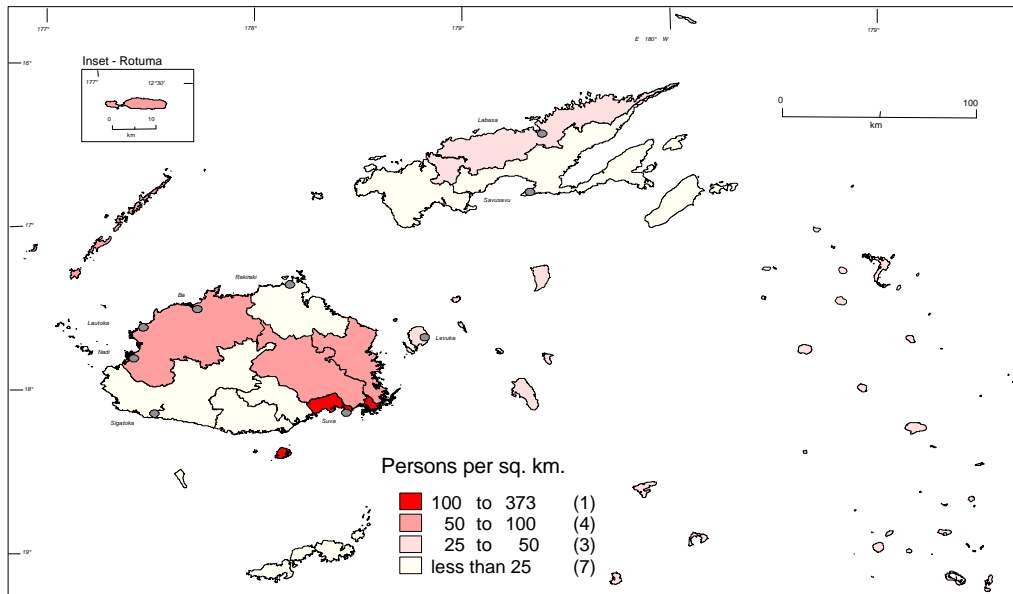


This map displays the population changes by provinces between the censuses of 1986 and 1996. By observing the different colors of the map one is able to distinguish very quickly the provinces that were either experiencing increases or decreases in population. Three provinces of Naitasiri, Namosi and Serua were recording increases of between 14 % to 28% whilst Kadavu, Lau and Lomaiviti and Ra recorded decreases of between 1% to 14 %. More analysis could be carried out to examine the reasons of the changes in population between the two censuses but that is outside the scope of this paper.

The provinces of Kadavu, Lau and Lomaiviti are islands that are further away from the center of the commercial and

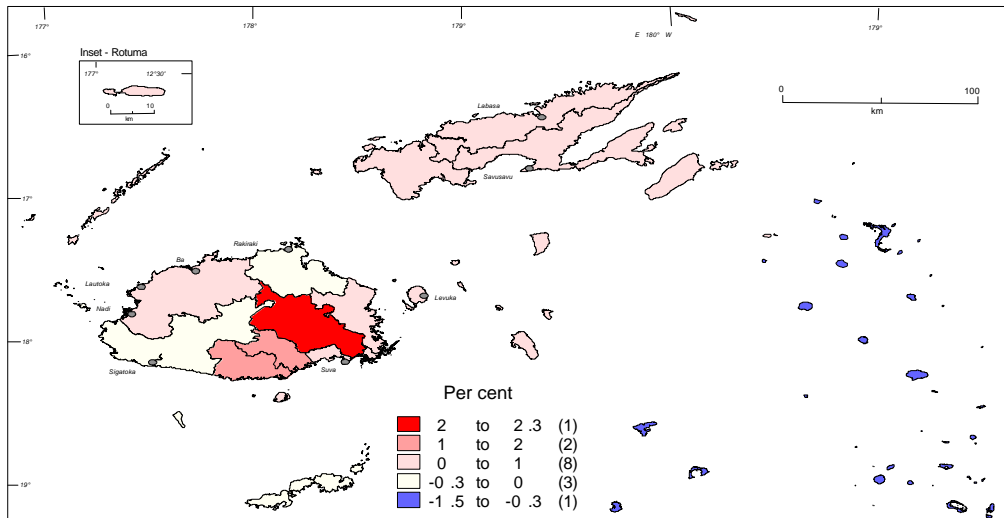
administrative activities thus will be attracted to the pull of the center. The province of Ra on the western side of Viti Levu had its provincial boundary lost in favour of neighbouring Tavua tikina in the province of Ba.

MAP 2: POPULATION DENSITY



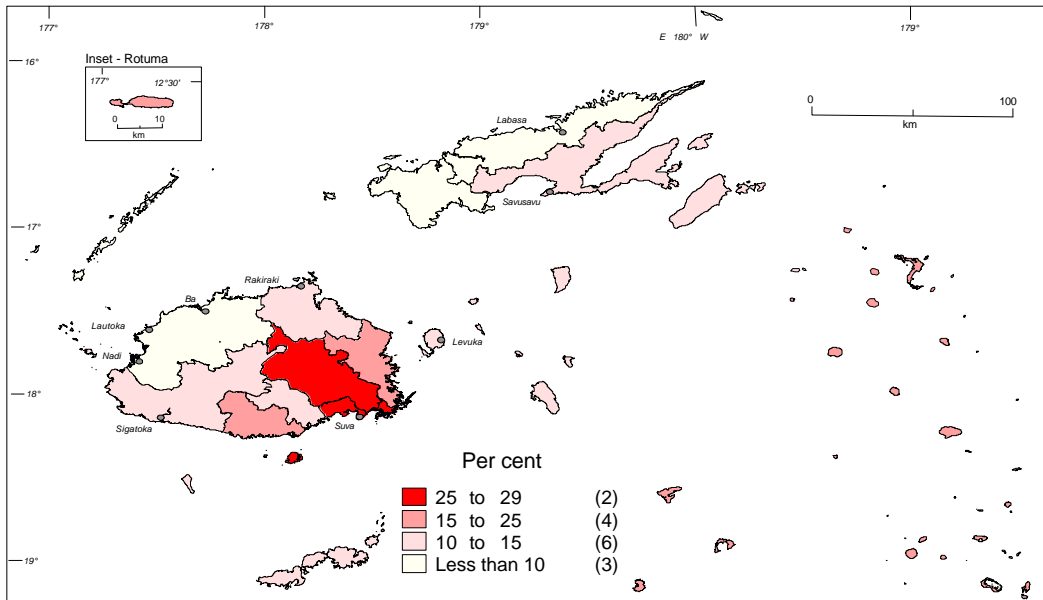
The map on population density clearly displays the most populous province when compared to the remaining provinces. Rewa province with the smallest land area and the site of Suva city has a population density of 100 to 373 persons per square kilometer. Naitasiri, Tailevu and Ba provinces are next in high density, all these provinces have more than one urban areas. The lowest density was experienced by those provinces that are predominantly rural in character.

MAP 3: GROWTH RATES 1986-1996



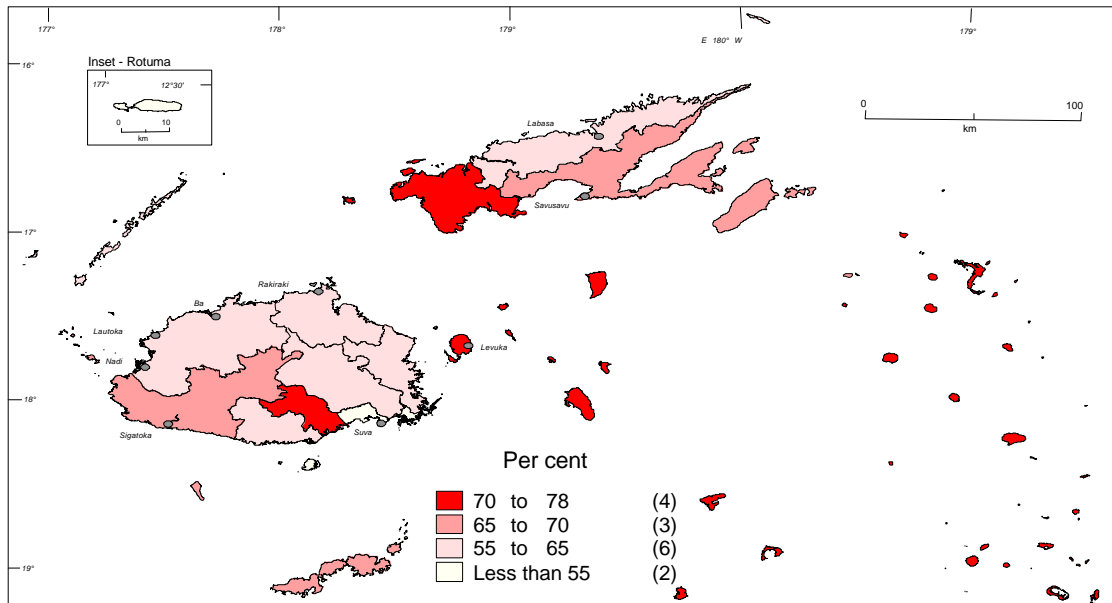
The national average growth rate of 0.8% recorded between 1986 and 1996 was the lowest ever recorded in the last 5 decades. There is variation in growth rates amongst the fifteen provinces with Naitasiri province recording the highest growth rate of between 2% to 2.3%. Negative rates of growth were recorded in the provinces of Lau, Kadavu and Ra. Eight out of the fifteen provinces recorded low growth rates of between 0% to 1%

MAP 4: RECENT MIGRATION 1991 - 1996



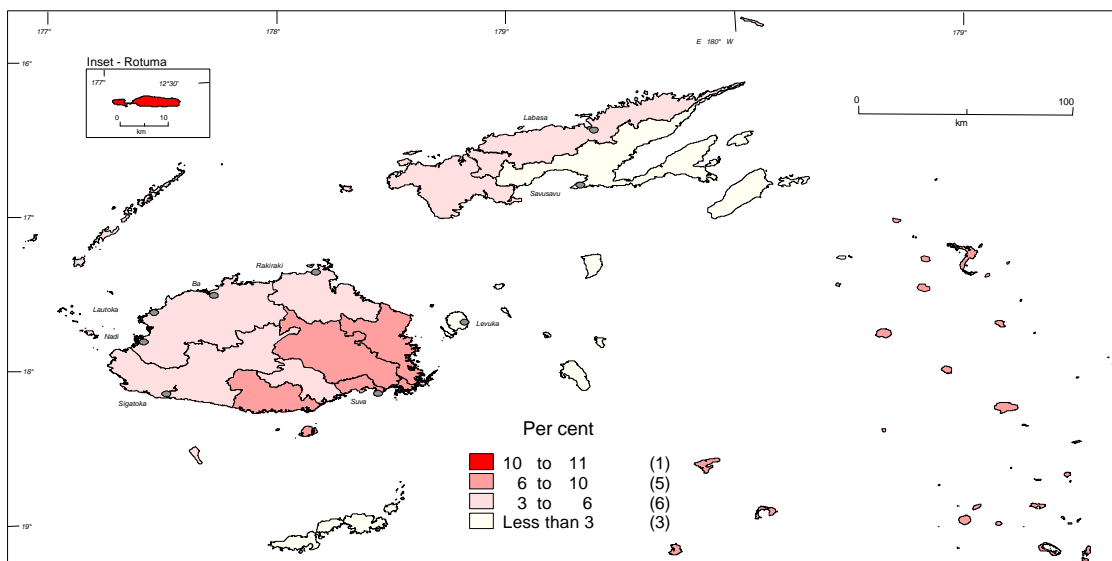
During the census of 1996 more than one quarter of the population aged five years and above recorded in the provinces of Naitasiri and Rewa were recent migrants. In other words these people were enumerated in areas other than where they were residing in 1991. This information is collected in order to measure the degree of mobility. The Lami/Suva/Nausori corridor is located in these two provinces.

MAP 5 AND: LABOUR FORCE.



Map 5 illustrates the distribution of the provincial population by labor force. The percentage of labor force is noticed to be highest between 70% to 78% in provinces that are predominantly rural. The probing question concerning subsistence activity has contributed to the high proportion of labor force in rural areas.

MAP 6: UNEMPLOYMENT



Unemployment is seen to be high around 6% to 10% in the provinces of Naitasiri, Rewa, Tailevu and Serua.

FUTURE ACTIVITIES

The Social Atlas produced by the Bureau of Statistics is only the beginning of the many activities planned for the GIS unit. Preparation is already underway to publish a social atlas for the urban areas of Fiji. It is already half way through the preparation of the Suva Atlas with information at the ward and enumeration area level.

The Suva Atlas would be followed by a similar one containing all the other major urban areas of Fiji. It was originally planned to publish one single urban atlas but this was discovered to be voluminous and cumbersome hence two sets of urban atlases for Suva and Other urban respectively.

Plans are already underway to incorporate the list of villages and be able to provide information at the village level. This activity will require plotting in the villages to the exact georeference location. There will also be a need to create a database and thereafter link the two to provide available census information at the village level.

In addition to the above we are also proposing to put available GIS information on the web so that information is available to a much larger audience. We would also wish to improve our customer services by creating an interface that will link all databases in the Bureau, however we will start with the Census database because that is the most demanded information in the organization.

LIMITATION

While much has been discussed on the advantages, let us consider some of its drawbacks that is worth considering when implementing GIS technology and acquiring data, Antenucci et.al (1991).

1. System to buy
 - There will be multiple contracts to be signed for various components of the software and hardware system.
2. Cost-effectiveness
 - Emphasis should also be placed on the design, creation and maintenance of database.
 - Data conversion is often an enormous task requiring digital space and time.
 - Database is by far the costliest facet of GIS implementation when acquiring and converting information
3. Quality Control
 - Explicit quality control must be exercised throughout the building and maintenance of the GIS database. Without this being conducted, the integrity of data will not be assured.
4. Compatibility with other systems and data
 - A uniform standard for the computer hardware and software need to be established to allow flexibility in networks and data sharing
5. Expectations
 - It is vital to identify what is needed to be accomplished and how it functions before making the commitment to develop a GIS system.

6. Staff Training
 - Qualified staff(s) is needed to operate the system
 - More in-house training and refresher course to be taken

Davis et.al (1990) also highlights data problems that is worth noting:

1. Areal coverage and scale
 - Incomplete map and areal coverage. This misleads users in terms of map shape, size and location.
 - Inconsistent data and scales. Scales inconsistency often results in quality inequity forcing the smallest scale to become the basemap and data set for the project site.
2. Classifications (coding system)
 - Need to assess the accuracy and validity of the classification scheme and quantitative analysis (ground truth).
 - Need to ascertain the credibility of results
3. Time
 - Timeliness is a critical factor. Old data are not only useless but are often misleading and counter-productive.
4. Data Quality
 - This is critical especially with spatial accuracy, coverage, data transfer method and labelling accuracy.

REFERENCES

Bureau of Statistics, 2000. *A Study of the Level, Direction and Characteristics of Interprovincial Migration Based on Census Data*. Government Printer, Suva.