

SECRETARIAT OF THE PACIFIC COMMUNITY  
STATISTICS FOR DEVELOPMENT PROGRAMME

UNFPA-SPC REGIONAL WORKSHOP REVIEWING THE 2010 ROUND OF POPULATION  
AND HOUSING CENSUSES IN THE PACIFIC  
(Noumea, New Caledonia, 21–25 May 2012)

*Experience from the Pacific – Lessons learned for 2020*

**Session 3 : HOUSEHOLD LISTING AND CENSUS MAPPING IN THE 2010 CENSUS ROUND**  
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**1. INTRODUCTION**

The role of good census mapping and accurate household listings in census is essential to improve coverage and quality of fieldwork in the enumeration phase of a Census.

**2. WHAT IS CENSUS CARTOGRAPHY?**

Administrative basis for enumeration

Sub dividing a country in to manageable areas, small pieces of land for one enumerator to cover during census known as Enumeration Area or Census Blocks.

**3. WHAT IS A HOUSEHOLD LISTING?**

Household listing is a process whereby each household including non private dwelling are identified and marked for the purpose of interview during the enumeration phase. It also forms a basis in the control of the enumeration especially in the absence of adequate and updated maps useful for estimating the number of enumerators materials needed in an area. It can be used also for estimating the time required for the enumeration and for compiling provisional results of the census. One of the main reasons is that it is useful for enumeration areas delineation.

**4. BACKGROUND**

In the 2000 round of censuses, many Pacific Island countries failed to develop good census quality management strategies, which led to many instances of “coverage” and “content” errors. Regarding coverage errors, these type of errors occurred as a result of omissions or duplications of persons or housing units in census enumeration. The main sources of coverage error were:

- incomplete or inaccurate list of dwelling units within enumeration areas;
- incomplete, inaccurate, or no census maps;
- failure by enumerators to cover all dwelling units in their work assignment area;
- duplicate counting

Without accurate census maps it is very difficult to prepare household listings, to facilitate enumerators covering all households in their respective enumeration areas, and to allow effective utilization of the resulting census data. Most National Statistical Offices (NSO) historically lacked the

technical know-how to carry out such activities due to a lack of technical expertise and financial resources. In this context, geographic information systems (GIS) and other technologies used in census mapping (GPS, Satellite Imagery) play a vital role.

PICTs need up-to-date databases of geographic boundaries such as villages, settlements, households and data collection units for the planning, and utilization of data related to census and survey activities. These boundaries and spatial locations help to identify the areas within which census interviewers/enumerators have to work, identify the location of households, and serve as basic geographic units for which to collect and report official statistics.

Major technological advances combined with lowering costs over the past 10 years including the widespread availability of personal computers, global positioning systems (GPS) and low-cost aerial and satellite imagery, have put new tools in the hands of national statistical organizations (NSOs) to collect better – more accurate, timely, and unbiased – information about their populations.

The use of GPS for census taking has a distinct advantage in allowing the linking of census records to an actual physical location. In most PICTs, as is the case in many developing countries, no exact location database of dwellings exist for census project use, and a lack of street names and numbers mean no address lists are available.

## **5. TYPES OF TECHNICAL ASSISTANCE AND TRAINING PROVIDED**

Training for most NSOs comprised of two in-country workshops:

- Training of NSO staff - 1st Mapping Workshop on GPS capture in the field (in some countries this training extended to the actual enumerators and field staff themselves (e.g. – Solomon Islands, Vanuatu).

Objectives of this training were:

- I. Train users in how to operate a small handheld GPS unit (Garmin Etrex)
- II. Obtain GPS location waypoints (coordinates) of each household, store and download waypoints
- III. Map reading: Understanding image (satellite) maps and reviewing Enumeration Area (EA) Maps
- IV. How to collect basic household data (household head, count, gender) and to fill in listing form
- V. Import GPS locations data in WGS84 format into your geo-database and Mapping Software

- Training of NSO staff– 2nd Workshop on re-delineation of Enumeration Areas

Objectives of this training were:

- I. Linking GPS, Maps, and Coordinate Systems together to compile an accurate & updated HH listing for all Households.
- II. Build layers for Geo-database.
- III. Overlay GPS points, Enumeration Area (EA) boundaries onto Satellite Imagery maps
- IV. Reviewing EA design
- V. Re-delineated EA Boundaries shapefiles of Enumeration Districts projected to satellite images of the country

The first one-week training for NSO staffs covered basic application of the eTrex Garmin GPS units, collection and download of waypoints, use of a “cheat” sheet on GPS setup, basics of ArcMap and

completion of the HH Listing form. The second two-week workshop for NSO staffs covered more specific uses of ArcMap in manipulating map datasets and delineation of ED boundaries. The one-week training of mappers explained how to use the GPS units to collect waypoints; how to systematically canvass their EDs; and how to complete the HH Listing form. They were also taught how to enter the HH sticker number in the GPS units.

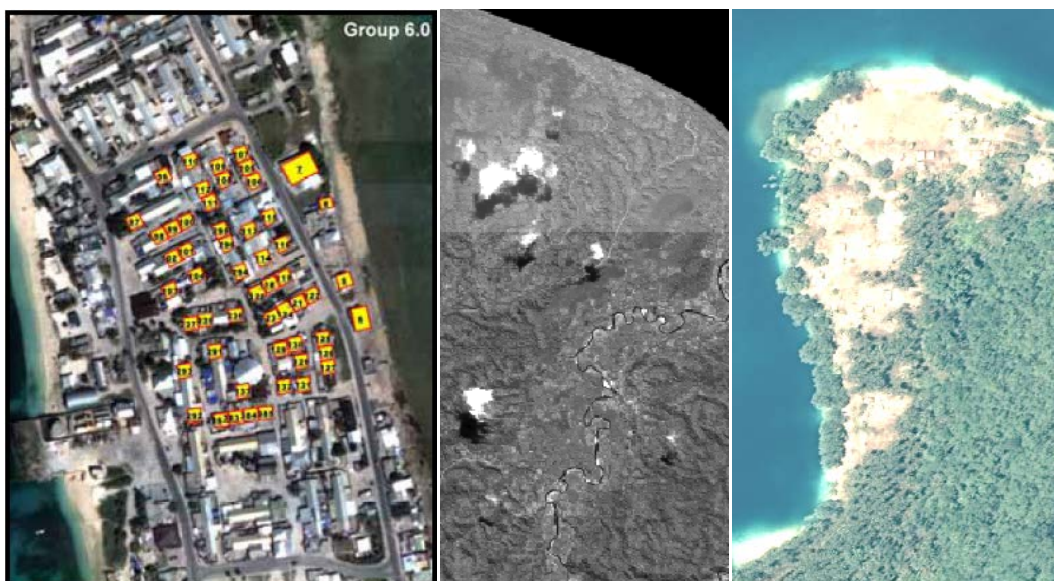
*Technical Assistance:* In some countries direct Technical Assistance was required to correct long term problems with historical maps from previous censuses. In Vanuatu EA map improvement consisted of a relatively straightforward transform of a few map features (Islands) into their proper positions. Whereas in Solomon Islands EA map adjustments involved much more work. Entire island groups were missing. Islands appeared in the wrong location. Island shapes were distorted. And most time consuming of all: EA polygons apparently had been digitized haphazardly and separately which resulted in both gaps and overlaps of the polygons. An entirely new base map had to be produced which involved manually digitizing island groups from SRTM and Landsat; - thus a very time consuming exercise.

## 6. HIGHLIGHTS/ACHIEVEMENTS

**GPS:** In the recent 2010 Census round several PICs (Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Samoa, Solomon Islands, Tuvalu, and Vanuatu) have established a geo-referenced database of GPS location of dwellings. The use of these locations is key ingredient in the planning pre enumeration phase of the census. The GPS coordinates give census management a tool to check whether enumerators have covered all households in their area of responsibility



**SATELLITE IMAGERY:** Most Pacific Island countries have acquired a lot of high resolution (less than 1 metre) Satellite Imagery for use in their Census and survey work (Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu, and Vanuatu). Some countries even have gone to the extent to obtain full coverage of their Islands such as Tonga, Samoa, RMI and FSM. Within the last few years the available geographically referenced data in the Pacific has rapidly increased. Freely available imagery at high resolution particularly in urban areas is becoming increasingly available (e.g.- Google Earth) Some Pacific Islands have harnessed the freely available imagery for use in their Household Listing and Census Mapping particularly in the GIS to aid in the EA editing and delineation process. It is widely agreed that imagery is the most cost effective method for EA layer development and database development than the use of any other method (hand drawn or GPS deployments). The reasoning for this is that more rapid identification of populated developments are possible through the use of imagery making it easier to prioritise work on specific EAs in need of further boundary investigation.



Digital **TOPOGRAPHIC LINE MAPS (TLM)** were used as another successful input into Census mapping for 2010 Census Round. The main thing about a Topographic Line Map is that important features can be extracted such as land cover, roads, settlements, buildings and other cultural features.

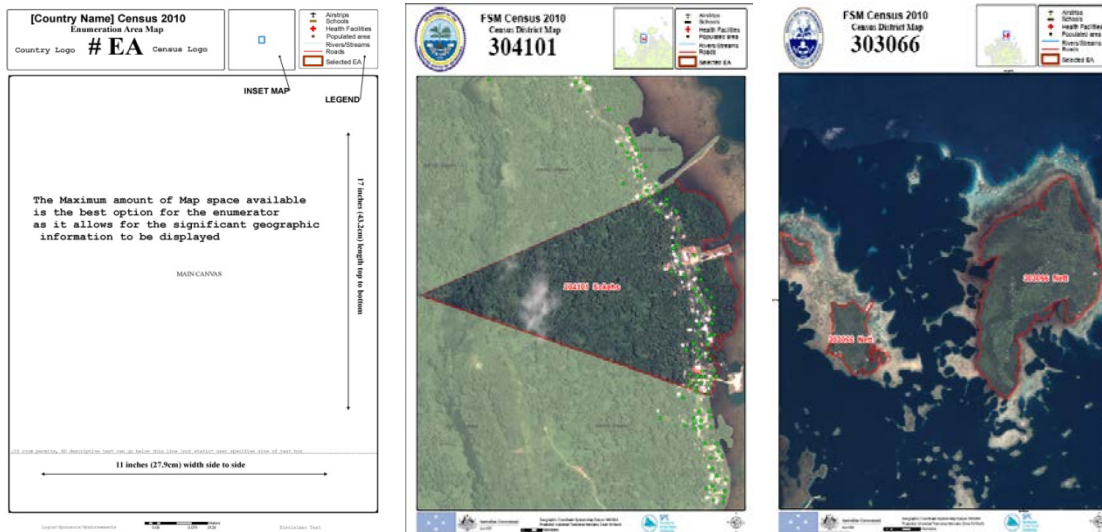


**AUTOMATED MAP PRODUCTION:** Most countries now use GIS and/or digital mapping to create series of maps for enumeration in a census. However, the production of these maps can be quite a manual time consuming process for NSOS sometimes lacking staff and resources to undertake these tasks. Average time to complete digital map production could take up to 2-3 months or longer. This is often an unacceptable time frame for most National Statistical Offices charged with production of maps.

**Constraints include:**

- ❖ Digital map data for census work is of varying quality and formats differ from Census requirements
- ❖ Time: short timeframe of census lifecycle
- ❖ High staff turnover
- ❖ Lack of skilled staff and IT literacy
- ❖ Financial Issues





As a result SPC has worked with Pacific Island Countries and Territories to develop an automated mapping application of Census Enumeration Areas allowing staff to select their geography and run an automated mapping macro to produce high quality PDF map outputs.

**CONSTRUCTION OF A GEO-DATABASE:** Most PICS in 2010 Census round established a geodatabase or collection of geographic datasets of various components (table, GPS and geographic reference and any raster dataset such as Satellite Imagery) for their Census Mapping and Household Listing exercise. The benefits of is that a GDB stores both Tabular/Spatial data is stored linked in a single centralized location and this improves management of the data and increases performance.

## 7. DATA SHARING AMONGST AGENCIES AND BETWEEN PICS

Funding of hardware sharing and GPS units for the 2010 Census round for use in household listing and Census Mapping was largely provided by United Nations Population Fund (UNPFA) starting in Fiji in 2007. UNPFA then proposed to extend the use of the GPS devices to other Pacific Island countries in conducting their Censuses.

Additionally, the cost of acquiring satellite imagery that enable using GIS applications for Census Geography such as delineation of EAs and locating dwelling structures are considerably lower than compared to just several years ago. However these costs are still not easily borne by the majority of NSOs. In this context the Pacific Island Applied Geoscience Commission (SOPAC) made available to PICS access to high resolution imagery for PICS to use at no cost. These are both great examples of data sharing arrangement between PICS and regional agencies.

## 8. WHAT DID NOT WORK SO WELL?

**THE COST FACTOR AND TIME CONSUMING PROCESS:** Like the enumeration phase of Census the household listing requires fieldworkers to cover entire population of the country and in spite of major technological advances combined with lowering costs over the past 10 years and data sharing this exercise is still run at an enormous cost in terms of staff time, resources and equipment. Although the initial financial layout required for the establishment of a GIS Office or staff member in the NSO is still relatively high it is a much more affordable exercise than say ten years ago. Furthermore, if applied during the Census using project funds the costs of the initial capital layout of the GIS infrastructure such as GPS, GIS software and Satellite Imagery can be offset against the

benefit from the technology and savings brought about by streamlining the pre-enumeration census listing fieldwork exercise

**TRAINING OF CENSUS GEOGRAPHY STAFF** provided throughout the Pacific for the 2010 Census round was not always exhaustive in some PICs nor was it necessarily long enough and required the census mapping teams of some NSOs to compromise in areas where certain topics were not covered or understood clearly. However the knowledge and capacity of most NSOs has improved vastly from the previous 2000 Census round and most NSOs now have established a form of Permanent “Cartography & Geographic Information” person or unit within the Census project.

Most Census GIS related training focused on the use of GPS capture and also in the design of EA boundaries using Satellite Imagery. Within 2 week the following topics were covered and you can see that the training covered a significant amount in a very condensed period. Normally this amount of material is covered over a period of months or more.

**PRINTING OF HH LISTING STICKERS** was a problem in some countries and in many cases required the stickers to be printed overseas or off-island which created logistical problems for HH listing fieldwork. Added to this problem was the unfortunate situation of some areas not having enough stickers for the Households being listed – in this case when stickers ran out sometimes folder labels were used instead or new ID numbers were assigned to HHs.

## 9. RECOMMENDATIONS ON WHAT CAN BE IMPROVED AND HOW?

SPC has heard from several countries of the need for development of an operational GIS and **CENSUS MAPPING HANDBOOK** for census and survey activities. The handbook (currently being compiled) should include experiences from countries which have already employed this technology in their 2010 Census.

Census Mapping of Household listing data as a **VALIDATION TOOL** for assessment of completeness of census and survey coverage. Using GPS location data collected during the household listing exercise as well as high resolution satellite imagery, the physical location of households can be linked to their respective scanned image of the census questionnaire produced during data processing. This process is known as hot-linking. This technique can show if there were serious problems with coverage of the census enumeration and to investigate individual problems compared with the census listing such as if the household was now vacant or if families had moved.

### **CANVASSING OF EAS AND WORKFLOW**

Canvassing involves going through an enumeration area to identify all buildings or structures that are used as dwelling units. Identified dwelling units from the listing should correspond to household interviews at the time of Enumeration. Many countries mentioned the need to improve workflow and found that this process was very slow and dragging the work on the field. Samoa implemented a new approach to canvassing the EA so that Enumerators can work more efficiently in the field; this strategy is well explained in their country paper and could be a recommendation for improvement in future census and survey.

## 10. CONCLUSION

Very tangible gains have been made in the past 3-5 years in the Pacific with strong adoption and sound application of new technology such as GIS, GPS and High Resolution Satellite Imagery for use in Census mapping and household listings. While there are still some stumbling blocks to be overcome along the way PICs now have well developed tools and experience essential to improving coverage and quality of fieldwork in the actual enumeration phase of a Census. Geographic information systems have changed the way in which NSOs data are collected and stored and are produced for census purposes. With the exception of very few, PICs have adopted GIS into their census mapping process and household listing in some regard and most now have developed a solid geo-referenced (GPS) database of dwelling locations, clearly delineated enumeration area boundaries and complimentary set of high resolution satellite imagery.

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