

United Nations Statistical Division
Workshop on Census Mapping with GIS

**ESRI Experience in the Use of GIS for
Census Mapping Applications**

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And

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ESRI

- Founded in 1969 (38 Years)
- Privately Owned
- Zero Debt
- Focused Strictly on Geographic Information Systems (GIS)
- Modern evolving technology (i.e. ArcGIS)
- Ranked as one of the Top Software Companies in the World
- Sustained 20%+ annual growth
- 220 000+ Clients of ESRI software
- 130+ countries use ESRI software
- Over 1 Million Users Globally



ESRI Distribution Network

- 50+ Distributor
- More than 1200 Sub-Distributors/ Business Partners



GIMS (Pty) Ltd

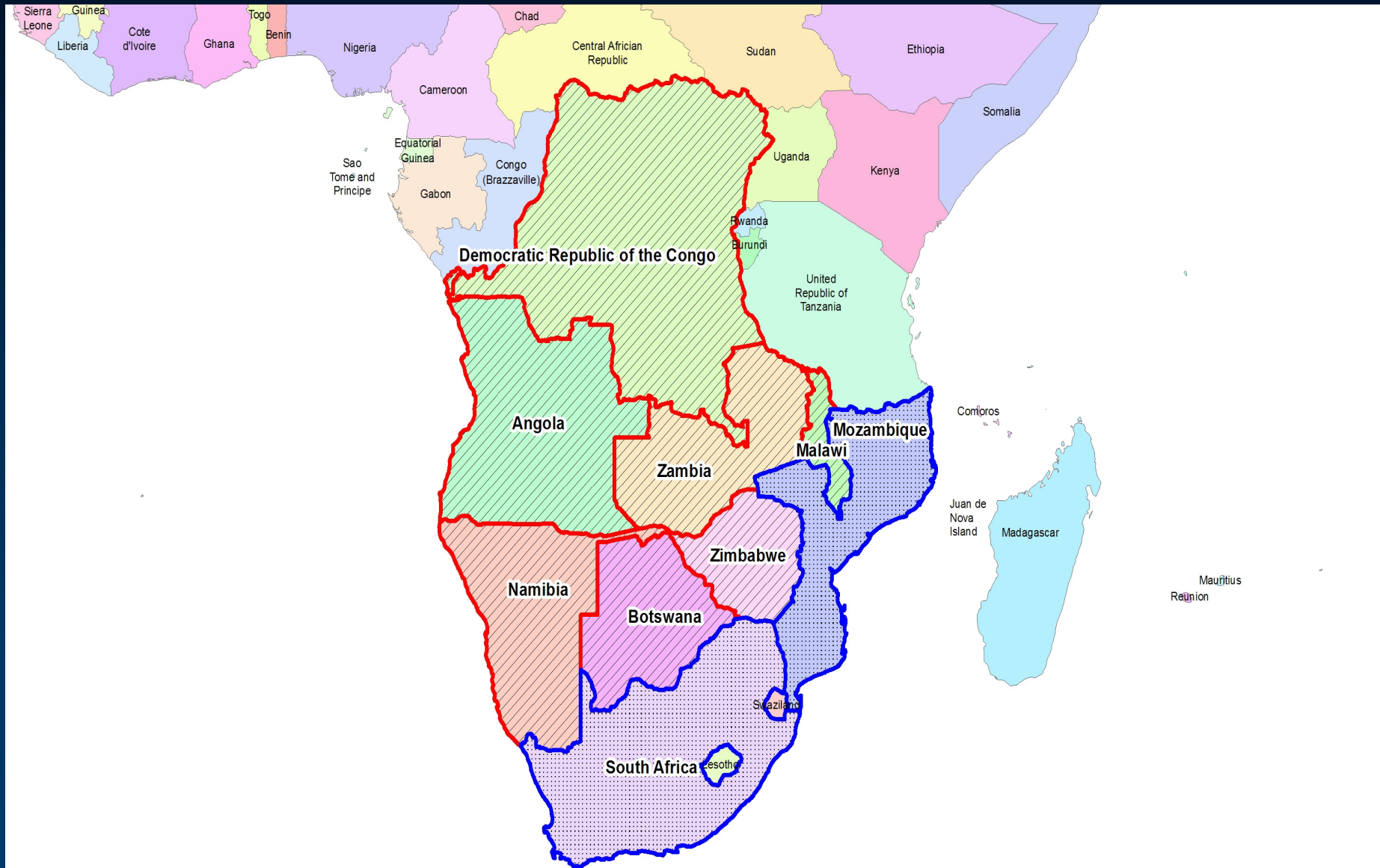
ESRI Southern Africa Distributor

- Company Formed 1989
- Authorised Distributor
 - ESRI
 - ERDAS Imagine
 - Trimble (BP)
 - GARMIN
- Sales
 - Software
 - Hardware (Plotters, GPS, scanners, etc)
- Training (7 ESRI Accredited Trainers)
 - Instructor Led (11)
 - Virtual Campus
 - Mobile Training Center
- Application Support
- Professional Services
- 25% of Business in Africa



GIMS (Pty) Ltd

Sub-Distributors Distribution



Kelly & Kelly

Sub-Distributors



- Company Formed 2000
- Authorised ESRI Sub-Distributors
- Sales
 - Software
 - Hardware (Plotters, GPS, scanners, etc)
 - Consultancy
- Training (ESRI Accredited Trainer)
 - Instructor Led
 - Virtual Campus
- Application Support
- Professional Services
- 30% of Business Outside Zambia

Outline

- GIS Technology for Census Mapping
 - Pre-Enumeration – Data Design, Collection, and Preparation
 - Enumeration – Conducting the Census
 - Post-Enumeration – Data Analysis, Dissemination
- Presented with examples from work around the globe
- Useful tools for Census Mapping with GIS

Benefits of using GIS for Census Activities

- Benefits in both effectiveness and efficiency for:
 - data creation/collection
 - geodatabase development
 - digital mapping
 - data analysis
 - web mapping
 - GIS web services
- These include:
 - productivity gain and time savings
 - cost savings/cost avoidance
 - greater credibility and authority of map products
 - better service
 - increased accuracy
 - improved consistency
 - income generation
 - improved analysis
 - improved policy-making
 - improved data sharing
 - improved outreach

Source: United Nations, DESA - Statistical Division,
Handbook on geographic information systems and digital mapping, 2000

Census Mapping

GIS is the platform

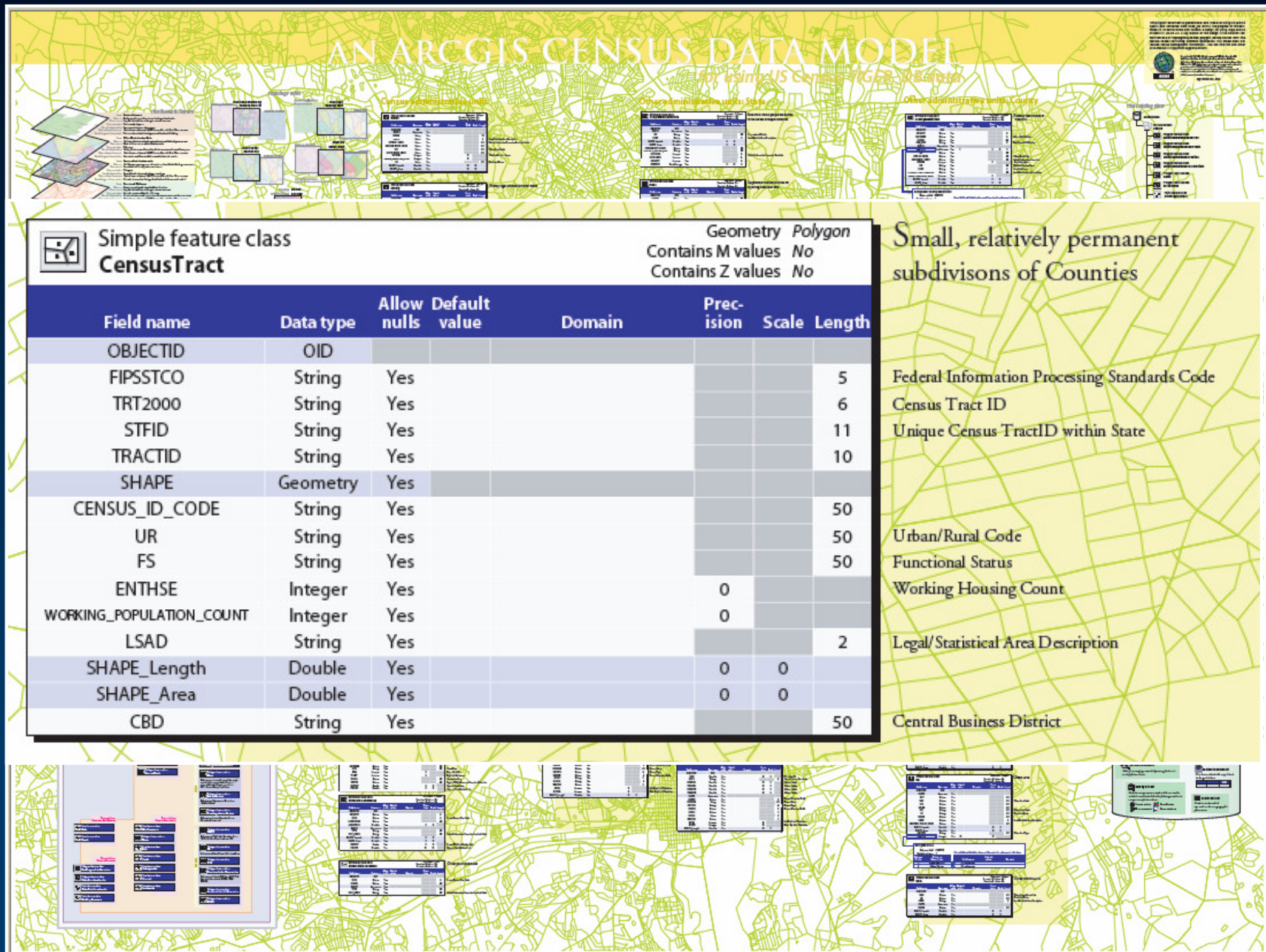


Pre-Enumeration

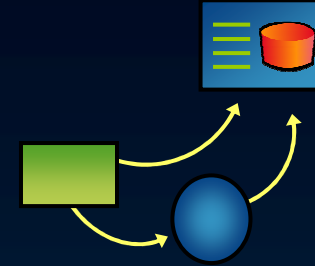
Data Design, Collection, and Preparation

- Data Design
 - Census Data Models
- Development of Census Geographies
 - Defining Enumeration Areas
 - Coding Schemes

Census Model from ESRI Support Center



Geodatabase Development

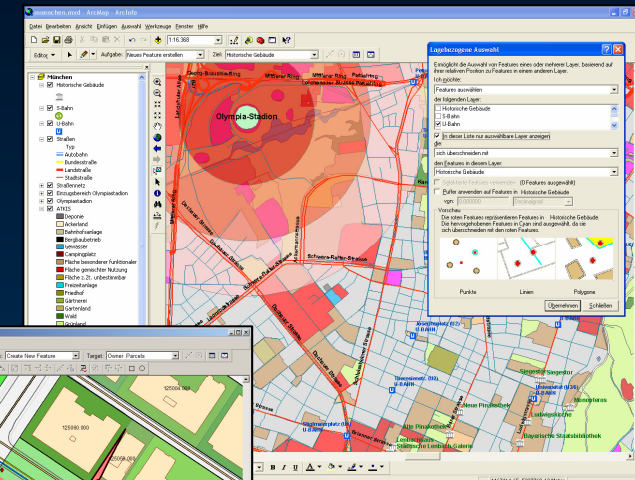


- Scanning, georeferencing, and vectorization of existing paper maps to develop digital datasets;
- Conversion of existing digital maps and datasets into the desired data structure;
- Updating of digital datasets since the last census activity to ensure that new settlements and roads are included and obsolete settlements are omitted from the enumeration activities; and/or
- Collection of aerial or satellite imagery followed by digital feature extraction and ground-truthing with GPS to ensure proper georeferencing of the images.

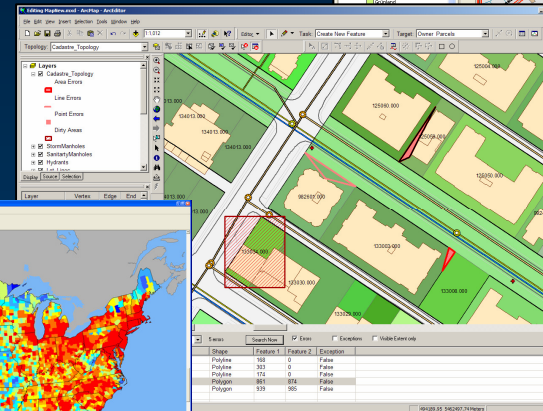
ArcGIS Desktop

Authoring and Using Geographic Knowledge

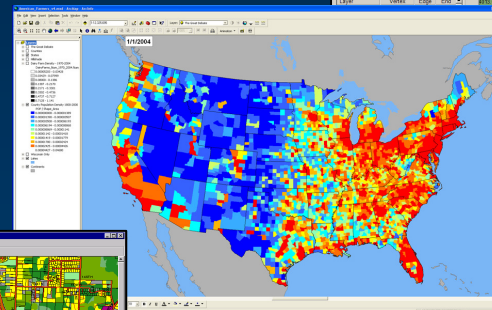
ArcInfo
(Geoprocessing/Analysis)



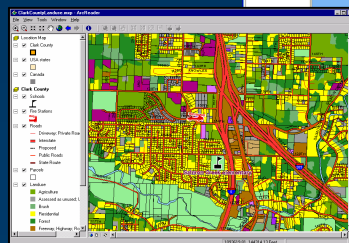
ArcEditor
(Create/Manage)



ArcView
(Use)



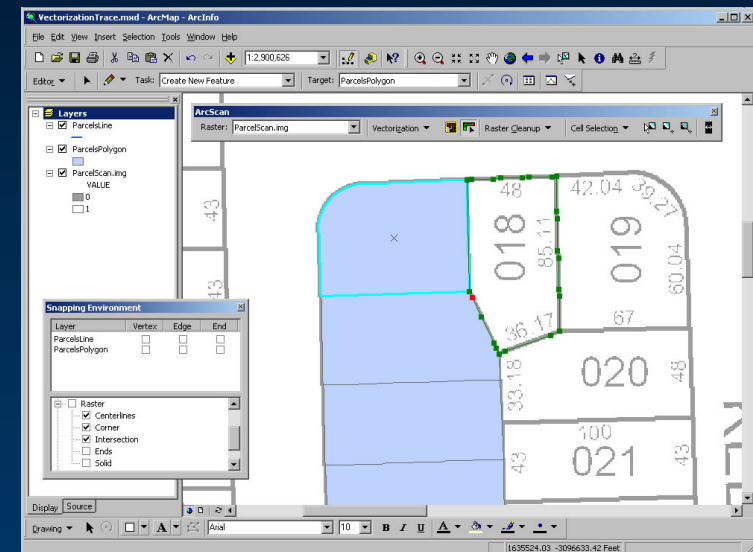
ArcReader
(View)



Common, Scalable Family of Products

ArcScan for ArcGIS

- Automate the conversion of scanned paper maps to vector form
- Reduce the time and expense in creating GIS data
- Eliminate the tedious need to digitize the data by hand
- Easily clean up scanned maps

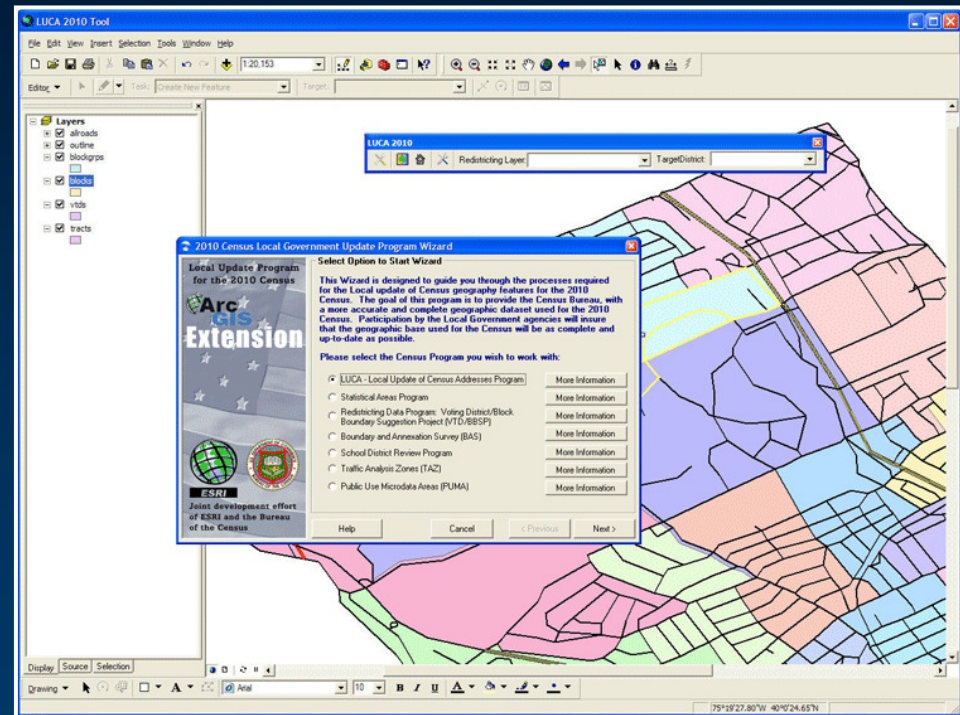


Districting for ArcGIS

- Updated for Version 9.2 of ArcGIS Desktop
- Create defined groupings of geographic data
 - census tracts, districts, ZIP codes, and precincts
 - by creating a districting plan
- Functionality
 - Redraw political boundaries
 - Set up sales territories
 - Define voting, school, and fire districts
 - Analyze population densities, housing breakdowns, income and race statistics

Local Update of Census Addresses (LUCA)

- A new extension for ArcGIS
- Built with CityGate GIS
- Part of the US Census Bureau's LUCA program
- Replicates the task and technical functionality of the census Master Address File/Topologically Integrated Geographic Encoding and Referencing (MAF/TIGER) Partnership Software (MTPS)
-
- To be delivered later this year to 40,000 US local governments

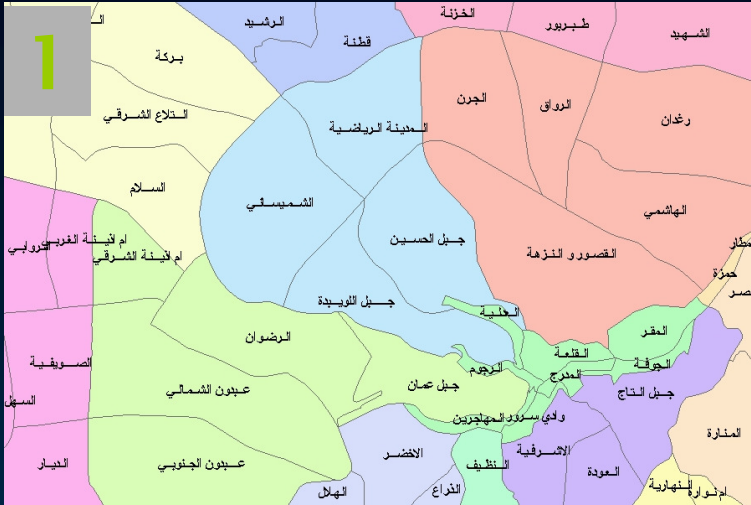


The Hashemite Kingdom of Jordan – Department of Statistics (DOS)



Images courtesy of David Rain, Ph.D., GWU

Department of Statistics, Royal Hashemite Kingdom of Jordan, with cooperation from USAID Amman, ESRI, and InfoGraph - a Jordanian GIS firm



District boundaries of part of Amman city are converted to digital form using center lines on cadastral maps from the Jordan Land & Survey Department



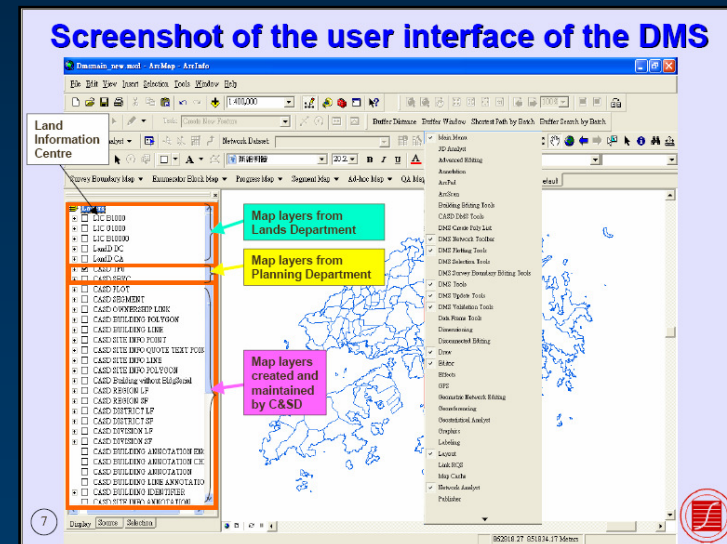
Building numbers and land parcels from municipal government



Source of street names

Hong Kong - Census and Statistical Department (CASD) Government of the Hong Kong Special Administrative Region of the People's Republic of China

- Digital Mapping System (DMS)
 - Updating the sampling frame
 - linking the spatial data and textual records of buildings/structures to facilitate the updating process and delineating boundary segments,
 - Allocation of assignments
 - Itinerary planning
 - Production of tailor-made and up-to-date maps of good quality to support fieldwork operation
 - Data compilation from several agencies:
 - Lands Department
 - Planning Department
 - and the Census and Statistics Department



Enumeration

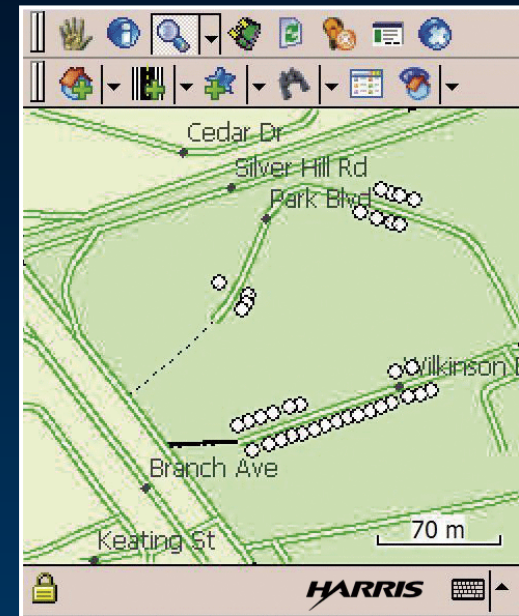
Conducting the Census

- Perhaps the biggest new opportunity for census work in 2010...

Enumerators enabled with Mobile Computing Devices that include GIS and GPS

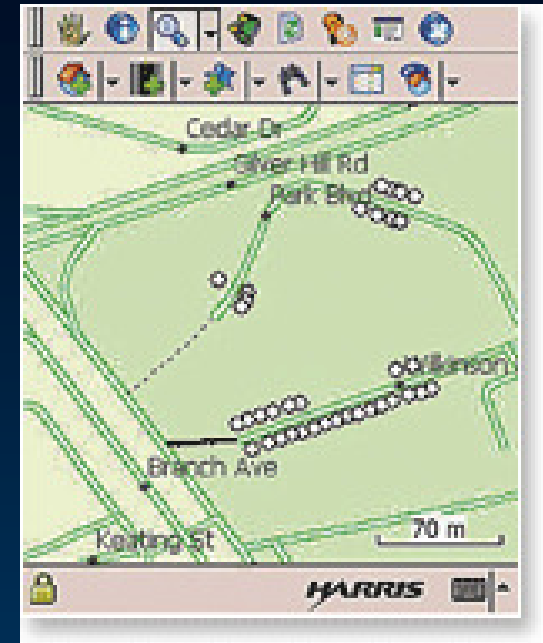
US Bureau of the Census

- Using ArcPad mobile GIS platform
- Field Data Collection Automation (FDCA) project for the 2010 Decennial Census
- Harris Corporation selected by the U.S. Census Bureau
- FDCA program supports census field enumerators
 - GPS-enabled mobile devices
 - ESRI's ArcPad software selected
 - performance, productivity, enterprise GIS integration, and customization options



ArcPad

- Perform reliable, accurate, and validated field data collection
- Integrate GPS, rangefinders, and digital cameras into GIS data collection
- Share enterprise data with field-workers for updating and decision making
- Improve the productivity of GIS data collection
- Improve the accuracy of the GIS database and make it more up to date

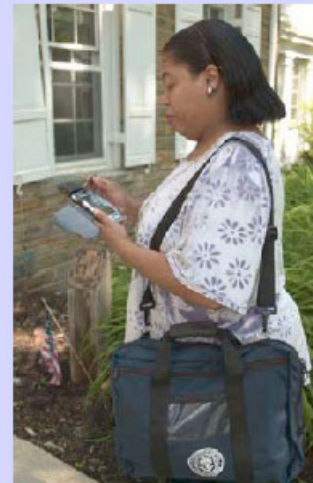


US - Census Bureau - Preparing for 2010 Census

A paperless census?

MCDs in the 2010 Census

- The Census Bureau plans to use a small, hand-held computer for field data collection in the 2010 Census.
- This will allow for:
 - Paper Reduction
 - Processing efficiency
 - GPS Coordinate Capture

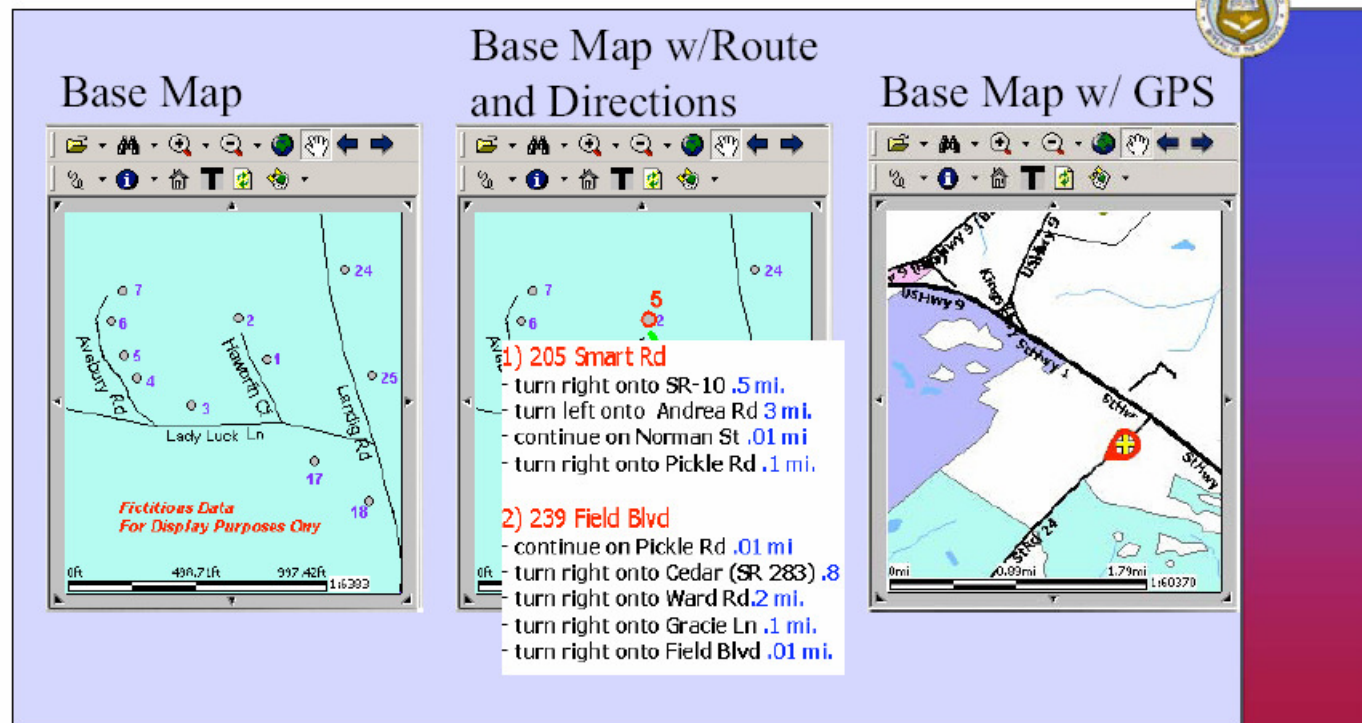


USCENSUSBUREAU

Helping You Make Informed Decisions

US - Census Bureau - Preparing for 2010 Census Mobile Computing Devices (MCDs) with GPS and ArcPad

ArcPad Maps From Sussex Co Test



Base Map

Base Map w/Route and Directions

Base Map w/ GPS

Fictitious Data For Display Purposes Only

1) **205 Smart Rd**

- turn right onto SR-10 .5 mi.
- turn left onto Andrea Rd 3 mi.
- continue on Norman St .01 mi
- turn right onto Pickle Rd .1 mi.

2) **239 Field Blvd**

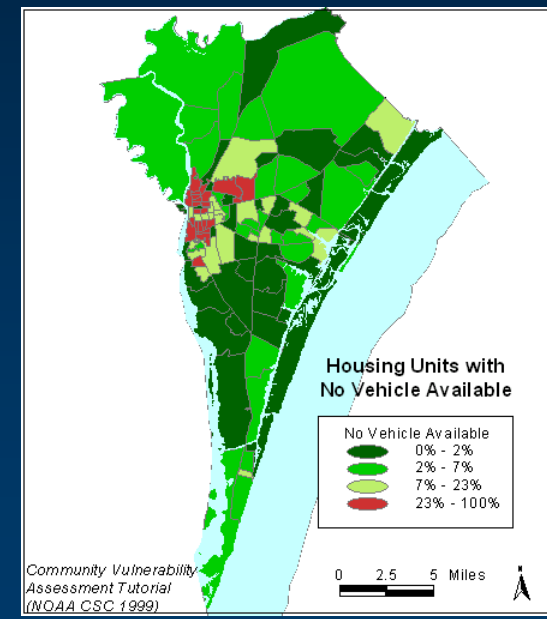
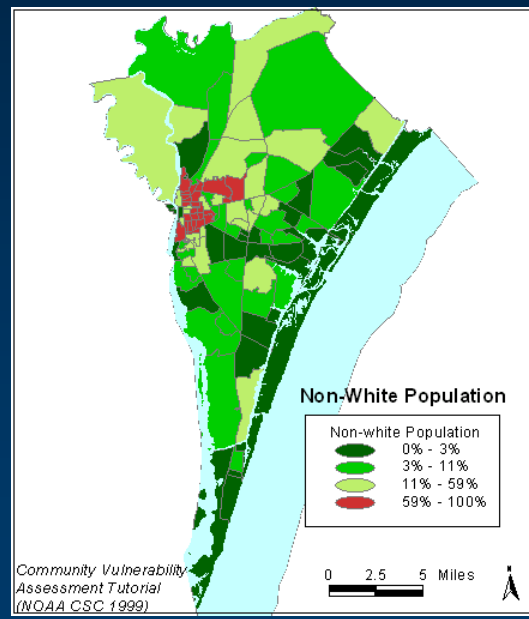
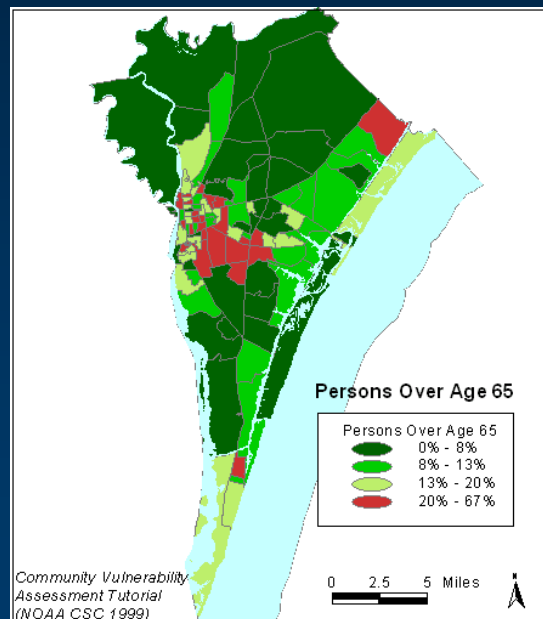
- continue on Pickle Rd .01 mi
- turn right onto Cedar (SR 283) .8
- turn right onto Ward Rd.2 mi.
- turn right onto Grace Ln .1 mi.
- turn right onto Field Blvd .01 mi.

USCENSUSBUREAU

Helping You Make Informed Decisions

Post-Enumeration Data Analysis

- Analysis of the results with Desktop GIS, such as ArcGIS Desktop products
- Development of maps for dissemination to the public



Source: NOAA Coastal Services Center – Community Vulnerability Assessment

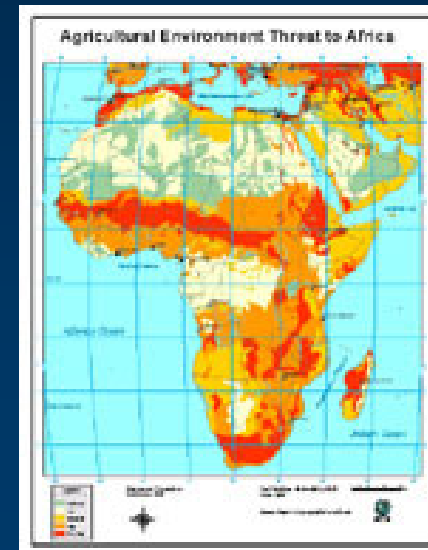
Post-Enumeration Data Dissemination

- Web Mapping and GIS Services
 - Web browsers
 - Geovisualization applications
- Database and Mapping Application on CD
 - Free, embeddable mapping application
 - Free data viewer



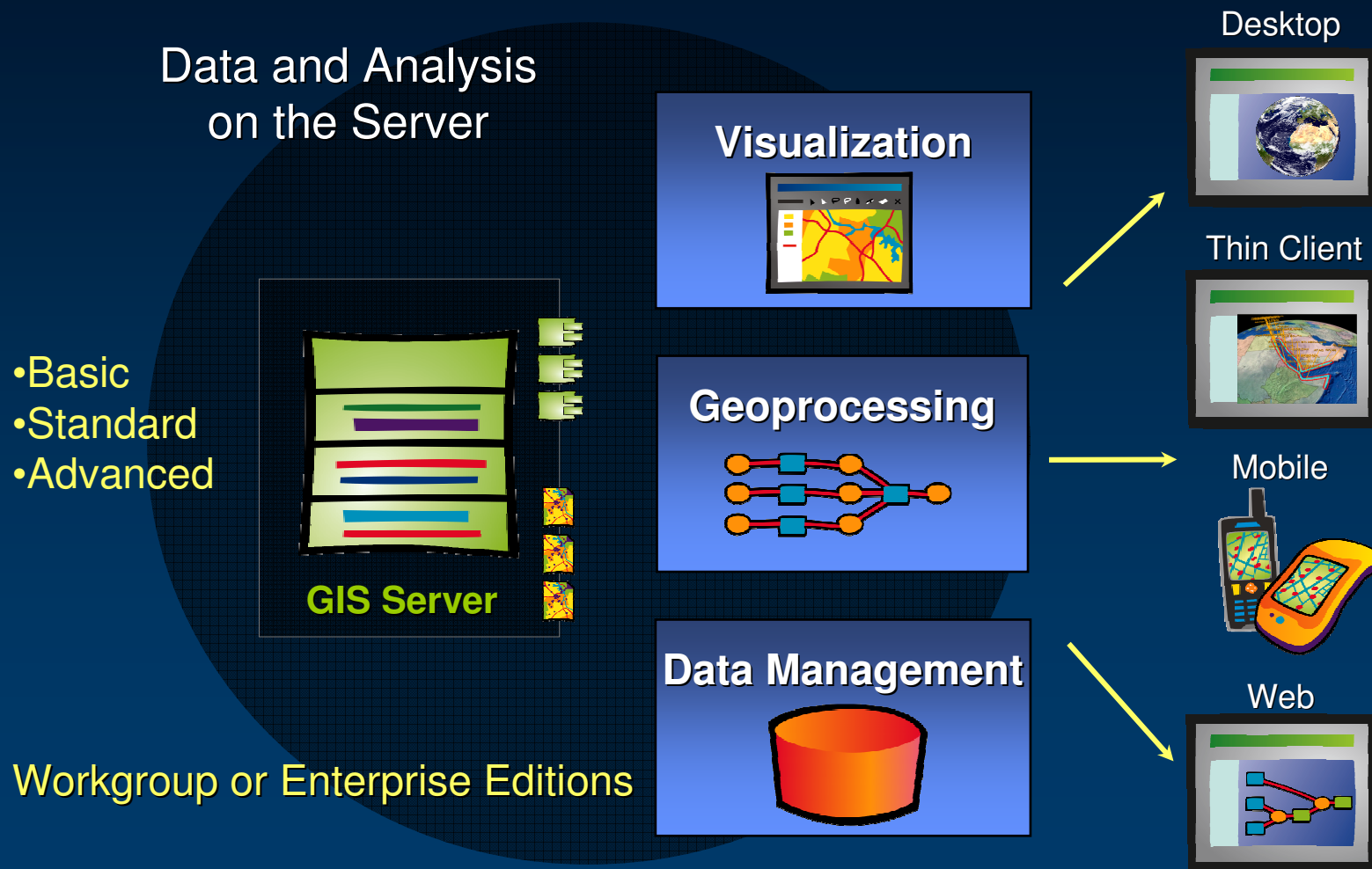
ArcReader

- Free and Easy-to-use
- Using ArcReader, anyone can view high-quality maps created using the ArcGIS Publisher extension
- Key features:
 - GIS Deployment
 - Map Viewing and Navigation
 - Data Query and Exploration
 - Map Printing
 - Configurable and Customizable



ArcGIS Server

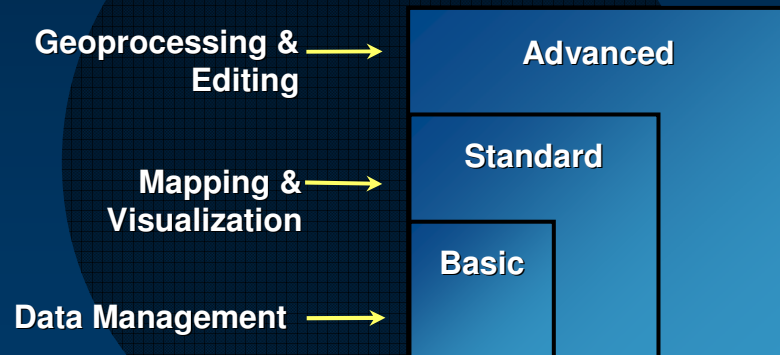
Deploying GIS for Integration



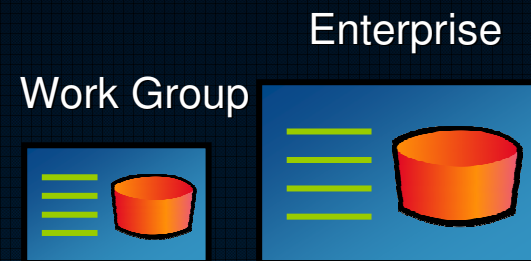
ArcGIS Server – Licensed by Functionality and Capacity

More Affordable And Flexible

Three Levels of Functionality



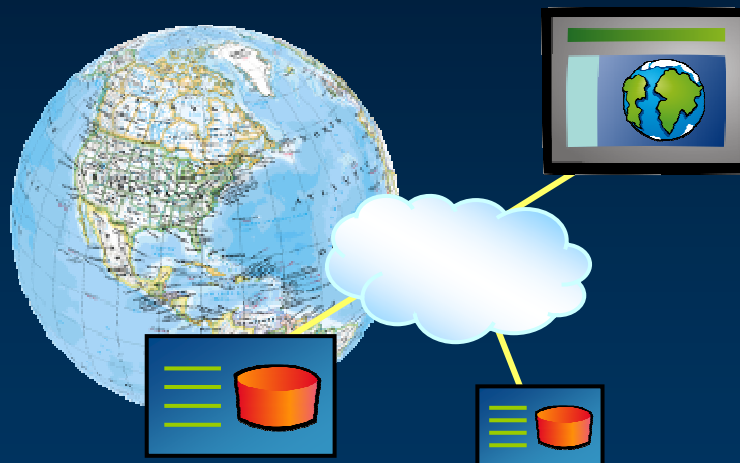
Scaled by Capacity



ArcGIS Explorer

GeoBrowser for Geographic Information

Visualization



**Integrates
Multiple Services**

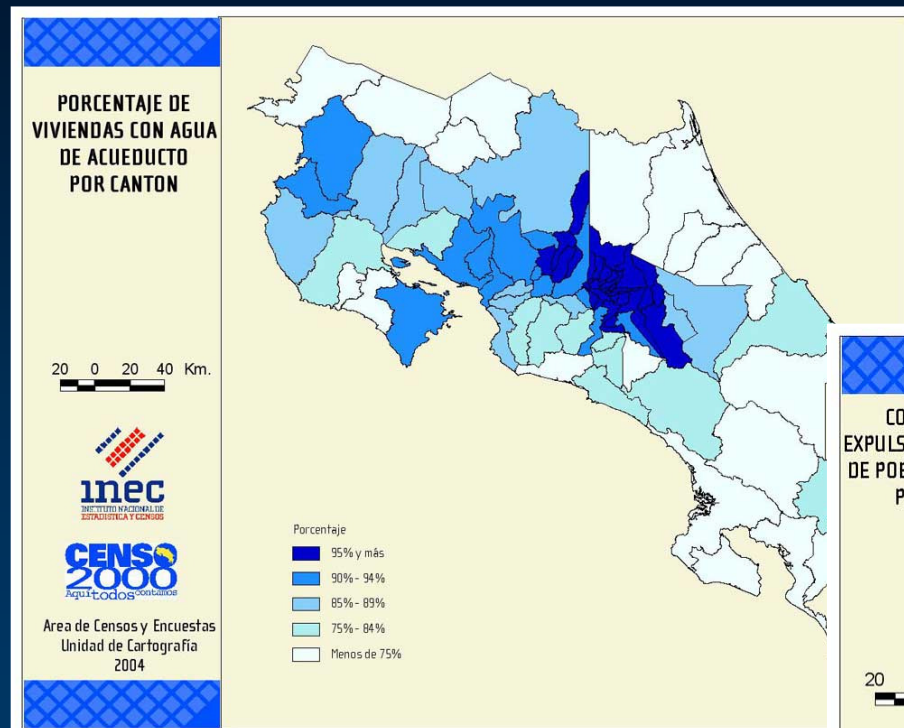
Mapping



Analysis Tasks

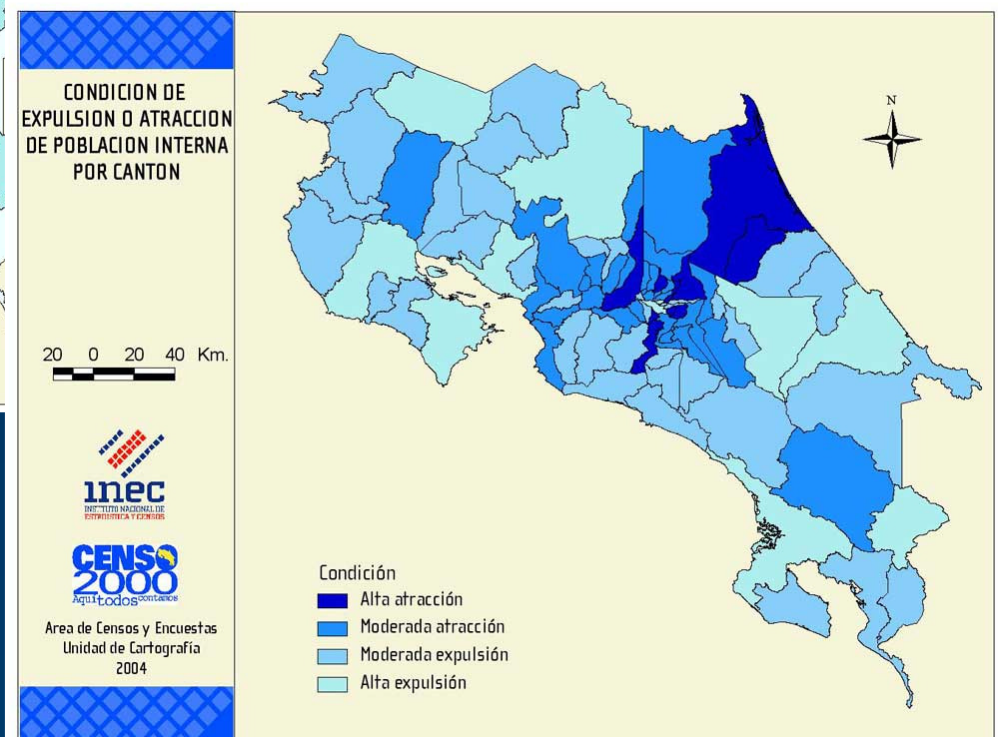
Costa Rica – INEC

- Map Distribution from Website



Percentage of Population
with clean water

Internal Migration
of Population



Costa Rica – National Office for Census and Statistics (INEC) www.inec.go.cr

INEC COSTA RICA - Microsoft Internet Explorer

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Address <http://www.inec.go.cr/> Go

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COSTA RICA

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[Inicio](#) > [Servicios del INEC](#) > [Cartografía](#)

Unidad de Cartografía

Servicios

Servicios

El INEC tiene una Unidad de Cartografía que produce y actualiza la cartografía utilizada en censos y encuestas; también cuenta con Sistemas de Información Geográficos (SIG).

Los principales productos a disposición de los usuarios son los siguientes:

- Mapas en papel de todas las provincias, cantones, distritos y segmentos del país, de los cuales se pueden obtener copias heliográficas (ver lista de mapas en este apartado).
- Mapas digitales de Provincias, Cantones, Distritos y Segmentos censales.
- Mapa temático digital de distritos que conforman el Área Metropolitana y la Gran Área Metropolitana de Costa Rica.
- Mapas temáticos derivados de variables censales en formato digital o en papel.

US - Census Bureau

Address  <http://www.census.gov/geo/www/maps/>

U.S. Census Bureau


[Cartographic Products](#) | [Geography](#)

U.S. Census Bureau Maps and Cartographic Resources

- [WHAT'S NEW](#) - Lists the most recent products or services.
- [MAP PRODUCTS](#) - Links to publicly available printed maps and free, downloadable maps in Portable Document Format [PDF]. Ordering information for printed maps and PDF maps on CD-ROM and DVD is also provided.
- [BOUNDARY FILES](#) - Provides access to generalized, digital files suitable for use with a Geographic Information System (G.I.S.) as a base for medium to small-scale thematic mapping.
- [ON-LINE MAPPING](#) - Links to two mapping applications derived from Census Bureau base map data - American FactFinder, State & County QuickFacts, and the TIGER Map Server.
- [RELATED SITES](#) - Lists other resources on the Bureau's Web site.
- [CONTACT](#) - Send us questions and/or comments. Answers to Frequently Asked Questions (FAQs).
- [SITE MAP](#) - Site layout in text-only form.

*Source: U.S. Census Bureau
Geography Division
Cartographic Products Management Branch
Created: September 12, 2001*

US - Census Bureau Cartographic Boundary Files

Address  <http://www.census.gov/geo/www/cob/index.html>

U.S. Census Bureau

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Cartographic Boundary Files

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Boundary Files](#)

[Descriptions
and Metadata](#)

[Technical
Information](#)

[Boundary Files
Site News](#)

Welcome to the U.S. Census Bureau's Cartographic Boundary Files Web Site. The boundary files available here are selected [generalized extracts](#) from the Census Bureau's TIGER geographic database and are designed for use in a Geographic Information System (GIS) or similar mapping system. **These are not map images.** They have been developed for various internal Census Bureau projects and have been made available here to the general public on an "as is" basis.

Cartographic Boundary File Formats

The cartographic boundary files on this site are available in the following formats:

ARC/INFO EXPORT (.e00) format
ArcView Shapefile (.shp) format
ARC/INFO Ungenerate (ASCII) format

Select a link at the upper left of the page to continue...

US - Census Bureau American Fact Finder

- Thematic Maps (Data)
- Reference Maps (Boundaries)

The screenshot displays the U.S. Census Bureau American Fact Finder website. The top navigation bar includes links for Main, Search, Feedback, FAQs, Glossary, Site Map, and Help. The left sidebar contains a 'Maps' section with links to POPULATION FINDER, FACT SHEET, PEOPLE, HOUSING, BUSINESS AND GOVERNMENT, ABOUT THE DATA, DATA SETS, DOWNLOAD CENTER, and MAPS. The MAPS section is expanded, showing 'Thematic Maps (data)' and 'Reference Maps (boundaries)'. The main content area is titled 'REFERENCE MAPS' and includes a description: 'Reference Maps show selected geographic boundaries for a... Boundary selections are available for geographic areas for which access to Reference Maps, choose from the selections below.' Below this, there are radio buttons for selecting a boundary grouping: 2005 Cities and Towns (selected), 2000 Census Tracts and Blocks, 110th Congressional Districts, 2000 Metropolitan Areas, 2002 Economic Places, and 2000 American Indian Areas. A text input field for 'State' and 'ZIP code' is present, along with a 'GO' button. The right sidebar shows a map of the United States with a legend for 'Data Classes' (Total Persons) and 'Features' (Major Road, Street, Stream/Waterbody). The map is color-coded by population density, with a legend showing ranges from 51,500 to 364,575. The map also includes a 'Click map to:' field and a 'Zoom' control.

U.S. Census Bureau
American Fact Finder

Main Search Feedback FAQs Glossary Site Map Help

Thematic Maps
You are here: Main Data Sets Data Sets with Thematic Maps Geography Themes Results

Change...
• Data Classes
• Boundaries and features

Reposition on...
• A street address or ZIP code
• A latitude and longitude
• The selected geography

Quick tips

Legend

Data Classes
Total Persons
515004 - 2987085
3504909 - 6437193
7642884 - 12831970
18089808 - 23507783
36457549 - 36457549

Features
Major Road
Street
Stream/Waterbody

Items in gray text are not visible

TM-M1. Total Persons: 2006
Universe: Total population
Data Set: 2006 Population Estimates
United States by State

Note: For information on errors stemming from model error, sampling error, and nonsampling error, see: <http://www.census.gov/popest/topics/methodology>

Click map to: Identify - geo name and data value

Zoom: U.S. View Street

Display map by: State

U.S. Census Bureau

Main Search Feedback FAQs Glossary

POPULATION FINDER
FACT SHEET
PEOPLE
HOUSING
BUSINESS AND GOVERNMENT
ABOUT THE DATA
DATA SETS
DOWNLOAD CENTER
MAPS

• Thematic Maps (data)
• Reference Maps (boundaries)

Main Reference Maps

REFERENCE MAPS

Reference Maps show selected geographic boundaries for a... Boundary selections are available for geographic areas for which access to Reference Maps, choose from the selections below.

Select a boundary grouping:

☒ 2005 Cities and Towns ☐ 2000 Census Tracts and Blocks
☐ 110th Congressional Districts ☐ 2000 Metropolitan Areas
☐ 2002 Economic Places ☐ 2000 American Indian Areas

Select a state or enter a ZIP code. Click 'GO'.

State: ZIP code: GO

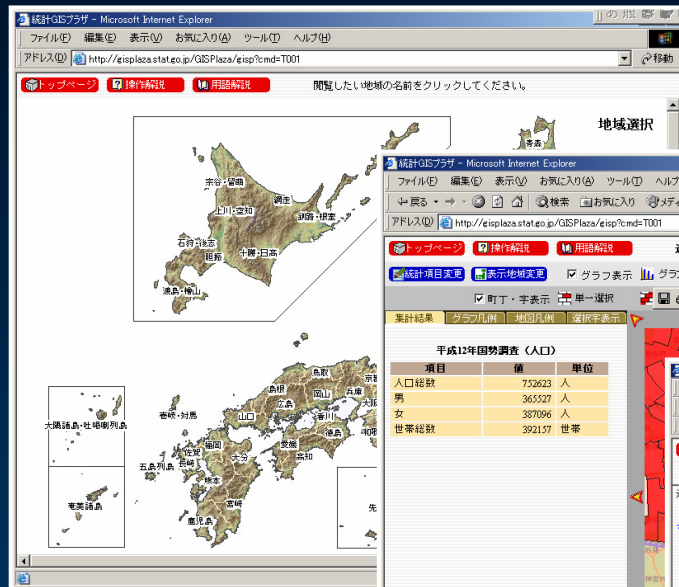
Working with Reference Maps

Japan - Statistics Bureau, Ministry of Internal Affairs and Communications

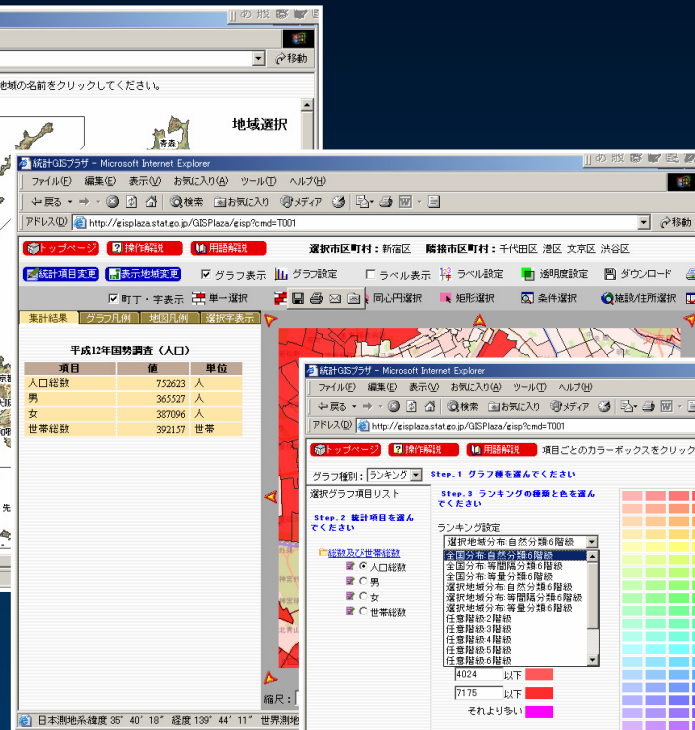
- Statistics GIS Plaza
- <http://gisplaza.stat.go.jp>



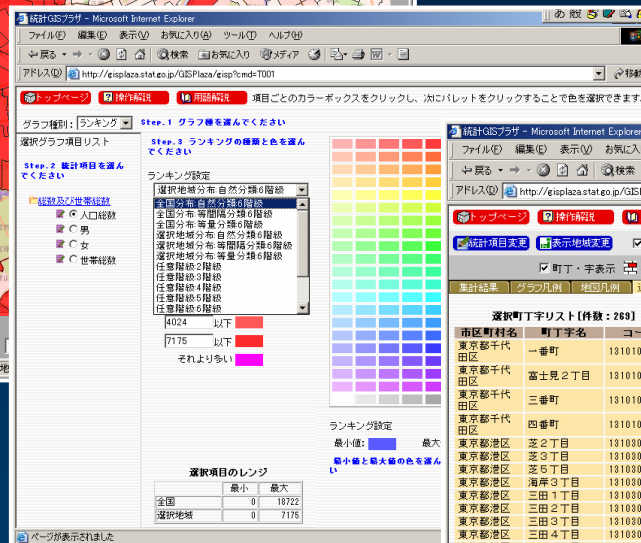
Japan - Statistics Bureau, Ministry of Internal Affairs and Communications



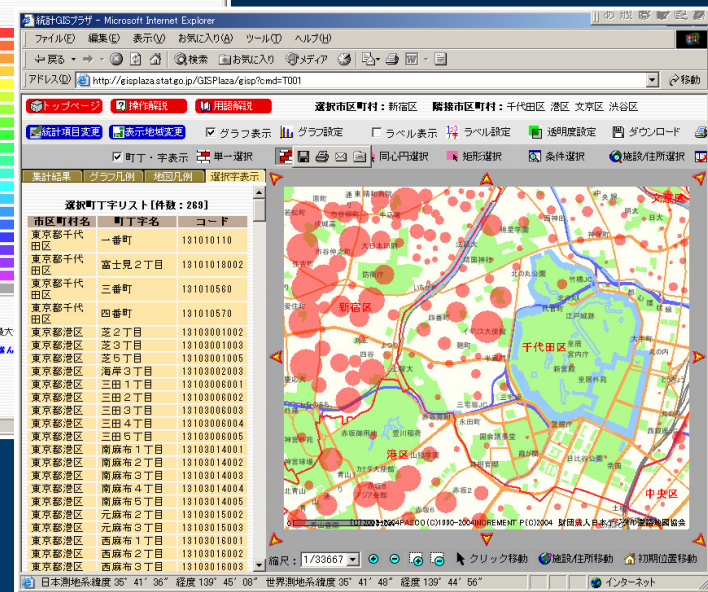
Area Selection



Cadastral Map

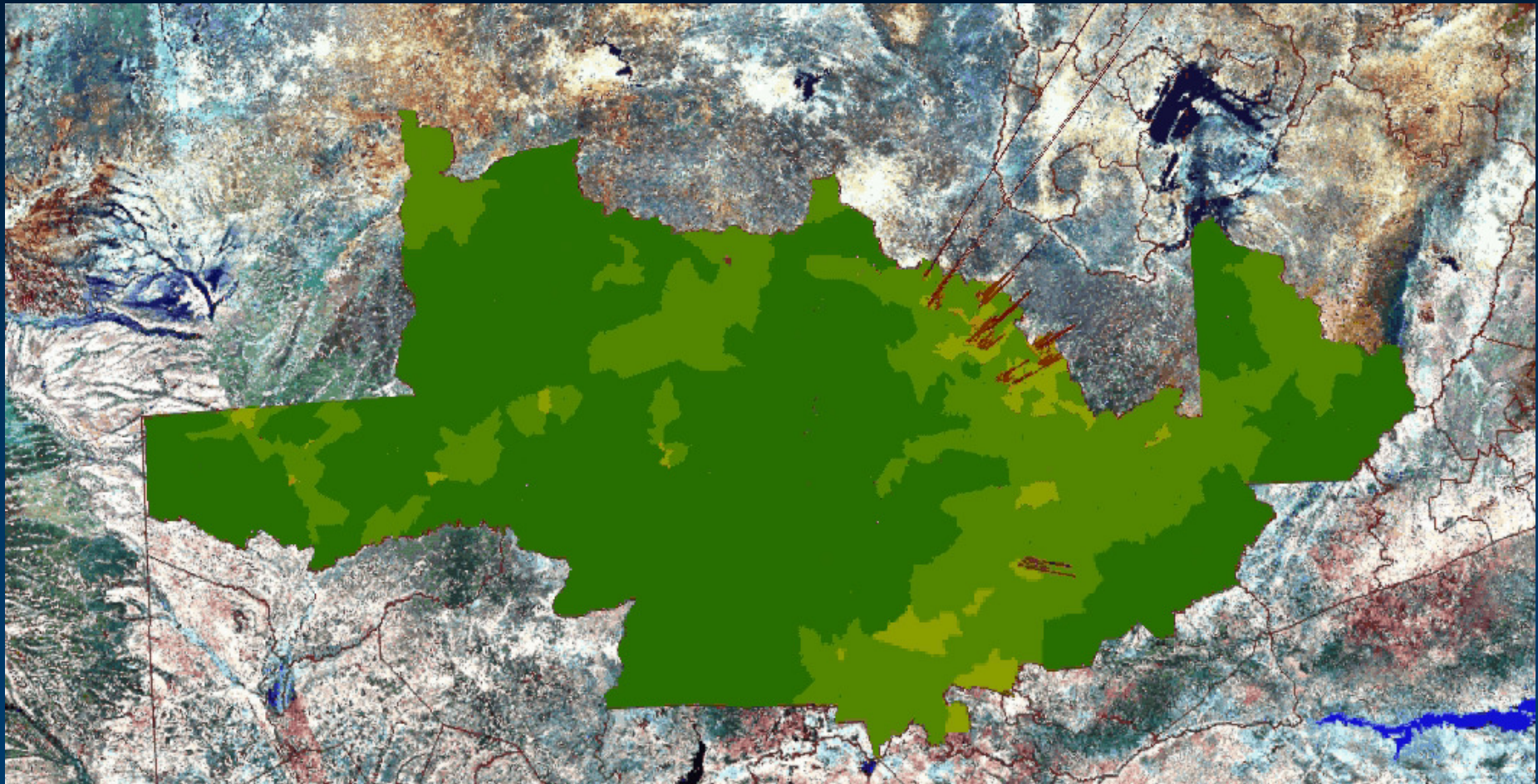


Graph Settings



Graph and Map

Zambia – Sensus data depicting the population density per area



Recommendations for the 2010 Round

- Consider **appropriate GIS technology** for each phase of the Census

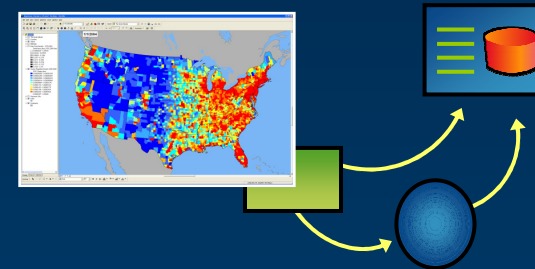
- **Mobile GIS**

- Integrates with GPS
- Field data collection
 - Geographic location verification
 - Navigation



- **Desktop GIS**

- Data collection and preparation
 - Automated raster-to-vector conversion
 - Imagery integration
 - Development of enumeration areas
 - Allocation of assignments
- Data analysis
 - Strong cartographic tools
- Data Dissemination with free data viewers



- **Server GIS**

- Data dissemination
 - Web map publishing
 - GIS Services (geocoding, gazetteer, etc.)
 - GeoVisualization tools

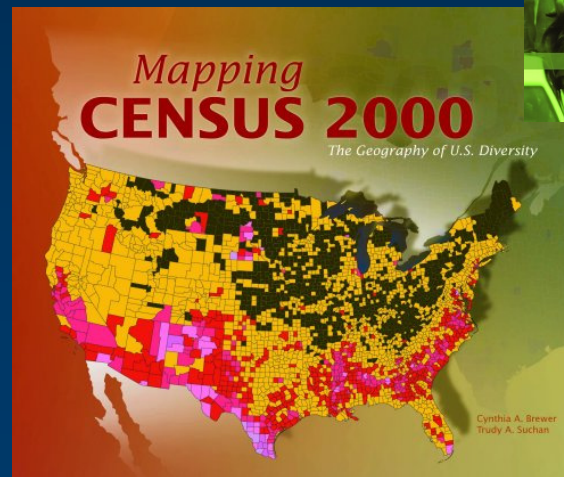
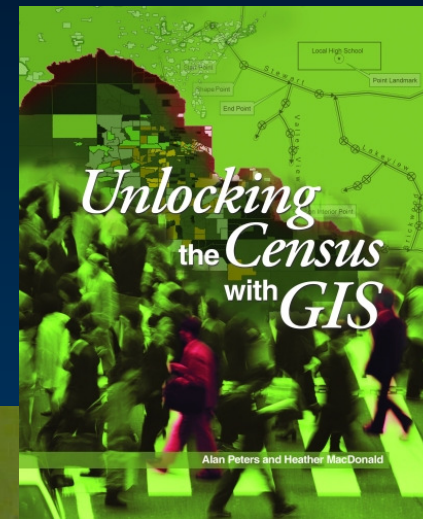


Recommendations for the 2010 Round

- Consider the benefits of using GIS and imagery in areas of **complex geography**
 - Rural areas
 - Informal settlements
- **Adapt best practices** to suit specific census requirements
- Partner with the **private sector**
 - Builds the geospatial component of your local, knowledge economy
 - Work jointly on coding efforts with telecom, postal service, etc.
 - Value added solutions – higher demand for census data

Literature related to Census Mapping

- ESRI Press:
 - *Unlocking the Census with GIS*
 - *Mapping the Census 2000*



Support GIS Day!



GIS Day: November 14, 2007

An Opportunity to Share Your Knowledge

***Let's make sure that everyone counts!
..and is counted!***



Source: World Resources Institute



Source: Robert Ford, LLU

Thank you!



ESRI



Kelly+Kelly

Management Consultancy
and Training
Quality Systems

GIS Mapping and Analysis
ESRI Business Partner