And when there is no Information?  
The case of São Tomé & Principe
“Health for All”
Changing the paradigm of healthcare provision
in S. Tomé & Príncipe

Case Study of Instituto Marquês de Valle Flôr Intervention in São Tomé & Príncipe
1988 – 2008
Project “Health for All”
Geographical Information System
Project “Health for All”
Geographical Information System

Background
Background

Accessibility to healthcare

- Public health
  - major concerns for developing countries
- Disease
  - important factor for ensuring a healthy population
- Access to health care

Measuring health care accessibility can thus help to shed light upon the performance of healthcare systems in and between countries, thereby facilitating the development of evidence-based health policies.

M. Black, et al., 2004; S. Ebener, et al., 2005
Background
Health Inequalities

Relationship between Health and Places

• Personal characteristics
  individual behaviours, and psychosocial and biological factors, ...

• micro- and mesosocial environmental aspects
  social networks, social support, proximity of facilities, labour conditions and health care access, ...

To find which determinants are influencing health outcomes is necessary to open the “black box” of places

Macintyre & Ellaway, 2000; Benzeval & Judge, 2001
Background

Health Inequalities

To solve Health Inequalities:

• identify obstacles to health and health care access
  Specially by the poor, socially excluded and geographically isolated

• identify the social determinants of place and its impact upon health equity

Key to improving health care systems

However:

health care systems are not always able to provide more and better health for their populations

  – political, economic and social instability
  – action is not taken to modify environmental health determinants.
Geographical Information Systems (GIS)

Powerful tool to:

- Identify what facilities should be used by a particular population
- Identify what area should be served by a facility
- Identify regional discrepancies within a country or region
- Allow data to be processed at different scales
- Can carry out spatial and temporal analyses
- Explain patterns and trends of demand/use
- Permit the identification of indicators revealing the social, economic and environmental structure of places where health risks are present
Modelling health care accessibility:

• Requires large quantities of data from different sources
  • location of health centres
  • district where the population is based
  • distance between health care units
  • demand for the health care units
• Requires account to be taken of the heterogeneity of the environment, in order to obtain results that are as accurate as possible

However
The availability and quality of the data fed into any GIS model have a direct influence upon the results, and consequently upon the quality of the decision taken as a consequence of them

M. Black, et al., 2004; Santana, 2005
Background
Accessibility Models

Straight Line Distances

Buffers

Cost Distance

Møller-Jensen & Kofie, 2001

Swindell, 2006

EC - GEM, 2008
Background

Cost Distance Model & Scale

Local Studies

Vector Model

Regional Studies

Raster Model

Legend:
- Health Units

Accessibility (minutes)
- < 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- > 60
Project “Health for All”
Geographical Information System

Methods & Sources
Objectives:
Prepare a Geographical Information System (GIS)
To evaluate the health system in São Tomé and Príncipe (STP)

Problem:
Lack of information
Methods and Sources

Sources

GIS-STP:

- Review of the scientific literature
- Geographic and alphanumerical data collected from the relevant authorities
  - Health Ministry
  - National Institute for Statistics of São Tomé (INE-STP)
  - UNICEF
  - United Nations Development Project (UNDP)
  - World Health Organization
  - World Bank
  - Portuguese Institute for Development Support (IPAD)
  - IMVF
- GPS survey of the Health Units and water supply and sanitation infrastructures;
- Printed maps and charts
Methods and Sources
Geographical Data

• São Tomé and Príncipe maps

Administrative Map, 1997

São Tomé Topographic Map, 1961

Príncipe Topographic Map, 1947
Methods and Sources
Geographical Data

• São Tomé and Príncipe maps
• Google Earth
Methods and Sources

Geographical Data

• São Tomé and Príncipe maps

• Google Earth

• GPS field survey
Methods and Sources

Geographical Data

- Gradient contours
  - Measured points
  - Water Network
  - Districts
  - Population Centres
  - Road Network
  - Health Units
Methods and Sources
Geographical Data

- Gradient contours
- Measured points

- Water Network
- Districts
- Population Centres
- Road Network
- Health Units
Methods and Sources
Geographical Data

- Gradient contours
- Measured points
- Water Network

- Districts
- Population Centres
- Road Network
- Health Units
Methods and Sources

Geographical Data

- Gradient contours
- Measured points
- Water Network

- Districts
  - Population Centres
  - Road Network
  - Health Units
Methods and Sources
Geographical Data

- Gradient contours
- Measured points
- Water Network
- Districts
- Population Centres
- Road Network
- Health Units
Methods and Sources
Geographical Data

- Gradient contours
- Measured points
- Water Network

- Districts
- Population Centres
- Road Network
- Health Units
Methods and Sources
Geographical Data

- Gradient contours
- Measured points
- Water Network

- Districts
- Population Centres
- Road Network
- Health Units
Methods and Sources
GIS Implementation

Data:
- São Tomé & Príncipe maps
- Google Earth
- GPS field survey

GIS Tools:
- Add x,y Data
- Georeferencing
- Editor
- 3D Analyst
- Spatial Analyst

Legend:
- Dados Iniciais
- Temas
- Funções
Methods and Sources

Euclidean allocation

Problem:
no administrative boundaries smaller than the district

Solution:
Euclidean allocation method
Methods and Sources

Euclidean allocation

Problem:
no administrative boundaries smaller than the district

Solution:
Euclidean allocation method
Methods and Sources

**Euclidean allocation**

**Problem:**
no administrative boundaries smaller than the district

**Solution:**
Euclidean allocation method
Methods and Sources

Accessbility Model

Data:
- slope
- road network
- water network

Model:
Walking speed, on or off road, depending on the gradient of the terrain and the river network

Hiking Function (Tobler, 1993)

\[ V = \exp^6(-3.5 \times \text{Abs}(S+0.05)) \]

- \( V \) - velocity (km/h)
- \( S \) - slope (degrees)

Out of the road: \( V \times 0.6 \)
Project “Health for All”
Geographical Information System
GIS-STP served different objectives:

- create a profile of the country
- find evidence of spatial inequalities as regards health indicators
- assess the IMVF’s initiatives
- gauge Health Centre accessibility
GIS-STS results

Country profiling

• Altimetry
GIS-STP results
Country profiling

- Altimetry
  - Road Network

- Main road network does not enable travel around the whole island
- 117 km of fixed road outside the towns and villages of São Tomé
GIS- STP results

Country profiling

- Altimetry
  - Road Network
  - Population Centres and Urban areas

- most of the agglomerations developed because the physical conditions were propitious for human settlement
The area of the city has increased 5-fold over the last 30 years, in the expanding “oil stain” pattern, influenced by the existing road network.
• Altimetry
  • Road Network
  • Population Centres and Urban areas
• Urban Areas
• Types of agglomeration

• Most of the agglomerations resulted from large agricultural estates (17% pop.)
• Most of the population (36.1%) live in *luchan*, much more than live in *Cities*. 
GIS-STP results
Country profiling

- Altimetry
  - Road Network
  - Population Centres and Urban areas
- Urban Areas
- Types of agglomeration
- Distribution of the Population

- Água Grande and Mé-Zoxi have the greatest population densities, at district level as well as town level.
Results of GIS-STP
Population Health Indicators

• Population on the poverty threshold

In 2000, 54% of the population of São Tomé was below the poverty line.
• Most serious cases are found in the districts of Lobata and Lembá.
Results of GIS-STP  
Population Health Indicators

- Population on the poverty threshold
- Cholera

- The worst affected areas were the districts of Água Grande and Mé-Zochi, particularly the areas of Cantagalo and Lembá.
Results of GIS-STP
Population Health Indicators

- Population on the poverty threshold
- Cholera

- the worst affected areas were the districts of Água Grande and Mé-Zochi, particularly the areas of Cantagalo and Lembá.
Results of GIS-STP
Profiling the IMVF’s initiatives in the country

- Population covered by catchment area of IMVF Primary Health Care units

- Each IMVF health unit has a target population of 4,415 inhabitants on average.
- Largest number of users: Trindade (10,834 users)
Results of GIS-STP  
Profiling the IMVF’s initiatives in the country

- Population covered by catchment area of IMVF Primary Health Care units
- **Number of users per doctor**

- Considering the total number of IMVF Health Units, there is one doctor for every 1645 users
- Reproductive Health Unit (Água Grande): 270 users per doctor
Results of GIS-STP
Profiling the IMVF’s initiatives in the country

- Population covered by catchment area of IMVF Primary Health Care units
- Number of users per doctor
- **Number of users per nurse**

- Considering the total number of IMVF Health Units, there is one nurse for every 1412 users
- M.Graça Hospital (Príncipe): 128 users per nurse
Results of GIS-STP
Profiling the IMVF’s initiatives in the country

- Population covered by catchment area of IMVF Primary Health Care units
- Number of users per doctor
- Number of users per nurse
- Patients attended by a doctor per 1000 inhabitants by Health Unit catchment area

- Best ratio: Guadalupe Health Centre (25.6/1000 inhabitants)
- Worst ratio: Santa Margarida Health Station (0.06/1000 inhabitants)
Results of GIS-STP
Profiling the IMVF’s initiatives in the country

- Population covered by catchment area of IMVF Primary Health Care units
- Number of users per doctor
- Number of users per nurse
- Patients attended by a doctor per 1000 inhabitants by Health Unit catchment area
- Patients attended by a nurse per 1000 inhabitants by Health Unit catchment area

- Best ratio: Lembá Health Centre (13.5/1000 inhabitants)
- Worst ratio: Praia Gamboa Health Station (0.2/1000 inhabitants)
Results of GIS-STP
Health Care Accessibility

- Walking Accessibility to the Hospital

- Population less than 1 hour: 12,476 inhabitants (9,4%)
Results of GIS-STP
Health Care Accessibility

• Walking Accessibility to the Hospital

• Walking and Motorised Vehicle Accessibility to the Hospital

• Population less than 1 hour: 124,782 inhabitants (95%)
Results of GIS-STP
Health Care Accessibility

- Walking Accessibility to the Hospital
- Walking and Motorised Vehicle Accessibility to the Hospital
- Walking Accessibility to IMVF Health Units (time)

- Population less than 1 hour: 65,000 inhabitants (49.5%)
Results of GIS-STP
Health Care Accessibility

- Walking Accessibility to the Hospital
- Walking and Motorised Vehicle Accessibility to the Hospital
- Walking Accessibility to IMVF Health Units (time)
- Walking and Motorised Vehicle Accessibility to IMVF Health Units (time)

- Population less than 1 hour: 128,512 inhabitants (98%)
Project “Health for All”
Geographical Information System

Impacts on the Assessment Project
Impacts of GIS-STP on the Assessment Project
Project “Health for All”

Geographic Information System (GIS):
• use disparate information to glean a better idea of health inequities
• cross-referencing indicators with environmental aspects that could explain them

However:
the lack of information constituted a problem

Results of the implementation of the GIS-STP
• positive
• the main aim was achieved

Assess the results of the IMVF’s intervention in health care in São Tomé & Principe
Thank you!
claudiampcosta@gmail.com