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**Geospatial information services based on official statistics****Mexico's expertise on geospatial information services based on official statistics****Note by the National Institute of Statistics and Geography (INEGI) of Mexico<sup>1</sup>***Summary*

This paper presents Mexico's experience and benefits from linking environmental and socioeconomic data to location attributes and providing geospatial information services based on official statistics. This paper shows how the development of both disciplines, geospatial information and official statistics, in constant interaction provides value to statistics' producers and final users, including policy makers. The availability of environmental and socioeconomic georeferenced data enables more informed decision making and, thus, better public policies.

This paper is presented for discussion to the Conference of European Statisticians seminar on "Geospatial information services based on official statistics".

<sup>1</sup> Late submission due to technical error in document processing system.



## I. Background

1. The National Institute of Statistics and Geography of Mexico (INEGI) is a single organization in charge of the production of statistical and geographical information.
2. Since 1983, Mexico hosts the areas of statistics and geography in the same national institution, thus allowing the development of both disciplines in constant interaction, as well as valuable feedback and benefits between the producers of official statistics and the final users of such integrated data. Thanks to the close integration of geospatial data and statistics users are better informed and may, thus, be capable of developing better public policies as well as taking faster and accurate decisions, for example in disaster risk management situations.
3. In 2006, the Constitution of Mexico gave autonomy to the Institution by creating the National Statistical and Geographical Information System (SNIEG), declaring that its data shall be considered official data and that a public agency, with technical and managerial autonomy shall be responsible for the production of these data.
4. In 2008, the Law of the National Statistical and Geographical Information System (LSNIEG) named INEGI responsible for the regulation and coordination of the SNIEG and responsible for regulating the collection, processing and publication of information.
5. The SNIEG provides society and the State high quality and timely information that can aid in achieving national development. It produces information, disseminates it in a timely manner, promotes the knowledgeable use of the information and preserves the information. It has four Subsystems whose objectives are to produce, integrate and disseminate information on their respective areas. The four subsystems are: (i) the Economic Subsystem; (ii) the Socio-demographic Subsystem; (iii) the Government and Justice Subsystem; and (iv) the National Geographical and Environmental Information Subsystem (SNIGMA). All the subsystems include:
  - (a) An Executive Committee who coordinates the Subsystem, collects the information for the Annual Programme from the institutions that participate in the Subsystem and supervises the execution of the Programme;
  - (b) State Units that are in charge of producing statistical and geographical information; and
  - (c) Several Technical Committees that are in charge of producing and revising technical norms, methodologies and other projects and processes required for the System.
6. There are eight technical committees in SNIGMA focusing on:
  - (a) Housing;
  - (b) Climate change information;
  - (c) Land use, vegetation & forestry resources;
  - (d) Basic geographic information;
  - (e) Cadaster and land registry;
  - (f) Water information;
  - (g) Energy sector; and
  - (h) Emissions residues and dangerous substances.
7. Since its autonomy, INEGI has the responsibility to create technical standards for the National Statistical and Geographical Information System and promote the use of these

technical standards. We have so far nine technical standards of the statistical field and nine technical standards from the geography field, which are based on international geospatial standards.

8. These geographic standards include:

(a) Geographic Addresses: sets the components constituting the Geographic Address to identify any property, which must be integrated in a structured, standardized and consistent form in administrative records;

(b) National Geodetic System: defines the Geodetic Reference Frame to be used in the country for the location of any geographic data set;

(c) Positional Accuracy Standards: sets the positional accuracy values to be used for the geographic location of points on the surface of the national territory;

(d) Geographic Metadata Generation: describes the provisions for the homogenous documentation of geographic data and products;

(e) Generation, capture and integration of cadaster and register data in order to promote their harmonization and homogeneity;

(f) Use of the Catalog of Undersea Feature Generic Terms: standardizes the official use of the terms and definitions of the undersea generic features;

(g) Authorization of aerial surveys and geographic explorations: It establishes the provisions to capture aerial photographs with imagery within the national airspace;

(h) Technical Standard for the generation of Digital Elevation Models with geographic purposes.

9. The Geographic Addresses, for example, are used at the Economic Census -National Statistical Directory of Economic Units (DENUE), at Censuses of Population -National Housing Inventory, at Social Programs Georeferencing, and at digital mapping postcodes, etc.

## II. Georeferencing statistical information

10. Mexico's Geostatistical Framework is the national system that allows the georeferencing of statistical information from censuses and surveys to their corresponding location, at different levels of disaggregation (32 states, 2,457 municipalities, and 299,662 localities, and 2'220,103 geostatistical blocks). In the National Geostatistical Framework, the Topographic Map of Mexico and the integrated Mexico's Cartographic Database the ultimate level of disaggregation is the physical address (i.e. the geographic location of exterior numbers of each country's localities formed by blocks). The Cartographic Database is the database where all updates provided by the Federal Government and National Institutions are made, and it shows a homologation of catalogues in a single Cartographic base established to support the planning of various institutional projects.

11. The Digital Map of Mexico is an adaptable, user-specific platform with an built-in system of international standards, free to download and use, not requiring additional commercial software licenses—which allows the visualization and analysis of geographic and georeferenced statistical information offering 208 vector data layers, with more than 71 million geographic objects and four raster layers covering the whole country. It includes, for example: Limits, Geodesy, Water Infrastructure, Geographical names, Hydrographic, Terrain Data, Hydrographic Features, Roads, Orthophotos, Cadaster of Social Property Surface and Groundwater, National Road Network, Reefs, perpetual snow and salt, Climates, Areas of Nature Protection, Mangroves and Wetlands, Physiography, Geology,

Floors, Land use and vegetation, Fango, Flood Sandy and Marshy, Satellite Images, Cartographic Framework Geostatistical Codes, Geographical Addresses, Sense of Roads, Localities, etc.

12. Our Census Operational Process has four modules:

- Module 1: Operational planning;
- Module 2: Mapping module;
- Module 3: Monitoring progress and geographical coverage; and
- Module 4: Closure.

13. The Operational Planning Module is based on the Digital Map of Mexico. This web application optimizes the operational planning of the event by assigning control sections of graphic form, and managing operating figures and graphical assignment of weekly work with a systematic visual monitoring of control sections, with a constant data backup every 15 minutes.

14. The Mapping Module, also based on the Digital Map of Mexico, is a local/mobile Cartographical application, made to capture the georeferenced phenomena, as well as map updates detected in the census operation in a GIS type tool of a particular purpose. At the end of the process, all the cartographic updates made on the field are verified *in-situ*, so they can be updated definitely at the Cartographic Database. Some applications of this module are:

- To create and modify the mapping efficiently, easily and quickly to collect information in an accurate and complete way (merge or split blocks, roads, rural localities-creation, service-creation, or modifying services);
- To allow the capture of land data, blocks, services, and roads to keep updated those databases that require it;
- To integrate correctly the information generated;
- To assist in field operational stages of the census, facilitating data collection.

15. The Monitoring, Progress and Geographical Coverage Module is a tracking system with web application that allows the integration of information and facilitates the monitoring of progress and geographical coverage by using the tools that allow a better analysis of the integrated information. It displays in a graphical form the advance and coverage of the census by blocks, basic geographical regions (AGEB) and localities. The packages are integrated consistently, so that once it reaches the central server, the system is updated with a delay of minutes.

16. The Closure Module allows users to perform, among others, spatial analysis: users can create influence areas and make crossings with other layers of information and download it on Keyhole Markup Language (KML) and quantify the information in the analysis area.

### **III. Analysis tools and projects DENU, INV and Environmental System**

17. The fact that INEGI integrates in a single organization the production of both statistical and geographical information gives us the opportunity to offer additional analysis tools, as some projects developed on the Digital Map of Mexico like the National Statistical Directory of Economic Units (DENU), the National Housing Inventory (INV) and the Environmental Statistics System.

18. DENUÉ is an up-to-date directory of all the economic units in the country that materializes the effort to create a national economic register, generated by the information collected by Economic Censuses, providing identification and location data of more than 4.9 million of economic units of all sectors of economic activity - except the agricultural and forestry activities - that the census found active in national territory.

19. The data provided by DENUÉ allows the identification of the economic units by the type of juridical organization (individual or legal entity), by its economic activity and/or by its size (stratum of employees); as well as locating them in the Mexican territory by regions, localities, blocks and streets. The DENUÉ also provides the geographical coordinates for the location of establishments, so they can be visualized in cartography.

20. INV provides population indicators, number of properties and their characteristics, information down to block level in urban cities and information of urban infrastructure in cities of 5,000 inhabitants or more. This information comes from the 2010 Census.

21. The third version of the Inventory is now available on INEGI's web page, including 5 housing inventory indicators, seven housing characteristics indicators, seven population indicators and fourteen environmental condition indicators.

22. The National Housing Inventory can be linked to DENUÉ and uses Google Earth Enterprise.

23. The Environmental Statistics System contains statistical information on drinking water, sanitation and urban solid waste, at the state and municipality levels, displayed as tables, graphics and maps; as well as some points of interest like landfills (including photographs and "Street view" for these).

#### **IV. INEGI at International Organizations**

24. INEGI co-chairs the United Nations initiative on Global Geospatial Information Management (UN-GGIM), which aims to play a leading role in setting the agenda for the development of global geospatial information and to promote its use to address key global challenges. It provides a forum to liaise and coordinate among Member States, and between Member States and international organizations. This responsibility is shared with Member States of United States and China.

25. UN-mandated regional bodies are established in the Asia-Pacific, the Americas, the Arab States, Africa and Europe. INEGI leads the regional body of UN-GGIM for the Americas, a Committee of 38 country members of the continent, including the Caribbean region.

26. INEGI also Co-Chairs the Expert Group on Integration of Statistical and Geospatial Information, which objectives are:

(a) To provide a forum for coordination and dialogue among representatives of both statistical and geospatial communities with a view to developing a global statistical-geospatial framework as a standard for the integration of statistical and geospatial information;

(b) To propose work plans and guidelines to advance the implementation of a global statistical-geospatial framework so that there is increased information to support social, economic and environmental policy decision making, including at the sub-national level;

(c) To address various technical, institutional and information policy issues related to implementation of a global statistical-geospatial framework, especially issues related to confidentiality; and

(d) To pursue the implementation of the statistical-geospatial framework in the 2020 Round of Censuses with the understanding it would apply to other initiatives including other censuses, such as agriculture censuses, economic censuses, etc., and global initiatives such as the Post-2015 Development Agenda and Big Data.

27. The National Institute represents Mexico at the Group on Earth Observations (GEO), is member of the Executive Committee for 2016, co-chair of its Chapter for the Americas (AmeriGEOSS) and leader of the thematic initiative of GI-18, which aims to integrate the geospatial information and the earth observations for the implementation of the Sustainable Development Goals.

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