

Building on an Experience, the Participation of Inegi in *Procede* - A Case Study in Mexico

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1. INTRODUCTION

After twelve years of participation in a nationwide program to provide rural land registration in Mexico, INEGI has been able to build up expertise in several fields of geographic, geodetic, mapping and cadastral knowledge. The use of very modern technologies related to land surveying also streamlined INEGI's methodologies, reduced the time spent on field works, enhanced accuracy and reduced error margins for the data captured under uniform standards. Meanwhile, the setting up of a network of IT centers for mapping production and development of large databases, as well as their integration, access and exploitation by Geographic Information Systems, are key components of the Spatial Data Infrastructure in Mexico (*Infraestructura de Datos Espaciales de México*, IDEMEX).

1.1 National Context

Mexico is a land of contrasts, with a history and a future, with regions enjoying of good quality public services, well designed access and roads —e.g., some municipalities located in the northern and central part of the country— that live in harmony with rural areas and irregular urban settlements deprived from any public service, fully immersed in an urban sprawl pattern and its subsequent social and economic dilemmas.

In order to materialize projects that may reduce the existing social gap, it is necessary to rely on information that reflects the different faces of the country. Therefore, INEGI, the government agency responsible for producing and coordinating Mexico's statistic and geographic information, supplies products and services that support other agencies and institutions in their decision-making process, so that they can make proper decisions in benefit of large sectors of the population.

Our country features a heterogeneous geography and a great potential in natural resources that is evident in its extraordinary biologic and ethnic diversity. The area, including the continent and the islands, is approximately two million square kilometers. Besides, Mexico has an exclusive economic zone of over three million square kilometers.

¹ Transl. Note: *ejido*: in Mexico, agricultural land expropriated from large private holdings and redistributed to communal farms. The ejido is a system in which peasant communities collectively own agricultural lands.

Mexico ranks among the ten most populated countries of the world. In 2000, the results of the *XII Censo General de Población y Vivienda* (XII General Census of Population and Housing) carried out by INEGI showed that over 97 million people lived in Mexico, 51% women and 49% men. Furthermore, the census also showed that Mexico is a country with a high percentage of young people, as 43% of its population is under 20 years old.

Mexico is a country with high urbanization levels, 75% of its population lives in urban centers and concentrates mainly in seven metropolitan regions. In contrast, only 25% of the population lives in rural areas. The economically active population amounts to little more than 44% and 16 million are involved in agriculture and livestock-raising activities.

This diversity of elements from the physical and natural environment result in a population pattern that does not match the characteristics of the land since, for example, water resources are concentrated in the south and southeast, but population—because of social and economic reasons—conglomerates in the central area of the country.

1.2 The Historical Development of Farming in Mexico

The history of Mexico and its evolution have affected the geographic, social, political and economic integration of the country. Even before the conquest, several pre-Hispanic civilizations had diverse forms of land control and land access. During the colonial period, farming featured the adaptation of aboriginal land rights to the legal framework brought by the conquerors that considered, among others, small properties and community property. Land for common use was considered as community property and received the name of *ejidos*.

The lands of aboriginal communities were divided in four areas: the urban settlement, the *ejido*, the parcels and a portion for paying taxes or community expenses. This division rarely became a reality, since the areas allocated did not allow the performance of community land and social functions.

During the second half of the 18th century, the Crown granted land to a privileged sector and thus gave rise to the “*hacienda*” (big ranches), a form of land property that later on became preponderant. The duality between small properties and large properties consolidated ever since in the history of farming in Mexico. By the end of that century, the fathers of the independence, motivated by the unequal farm land tenure, voiced the first expressions of dissatisfaction. Voices rose to demand land for the Indians, tax exemptions and debts relieve.

At the beginning of the 20th century, there was a constant strain between the people and the *haciendas*. *Hacienda* owners were abusing their power. Inequality, demands for justice, resistance to land tenure concentration, and defense of popular rights triggered the revolutionary fight tinted with a farm zest. Article 27 of the 1917 Constitution launched the land reform when it provided that land should be reconveyed to the people. Because half the country became *ejidos* or rural communities, it is evident that the efforts made to redistribute land were huge. 3 million peasants were benefited, 26,000 *ejidos* were created and land was reconveyed to 2,000 communities.

Land distribution was carried out at the same time that other processes were evolving and producing an impact, mainly the demographic explosion that resulted in increasing number of small properties. In the early 90's, Mexico witnessed the rising of a new legal farming framework aimed at fostering larger investments and capitalization that may result in increased rural production and productivity.

History, therefore, determined three types of land tenure in Mexico: private land; social land, that includes the ejidos and the rural communities; and fiscal land, owned and exploited by the State in its three levels of government. In figures, it is 74 million hectares of privately owned land, over 103 million hectares of social land, and any remaining land is fiscal land.

1.3 Procede, Program for granting land rights and land plots registration *(Programa de Certificación de Derechos Ejidales y Titulación de Solares)*

The new land reform published on Feb. 26, 1992 established the *Procuraduría Agraria* (Farm Public Prosecutor Office), responsible for the defense of *ejidatarios* and *comuneros*² rights. The same law also established the *Registro Agrario Nacional* (National Farm Land Registry), for social land tenure purposes. This legal provision lists the Registry's objectives, including that people should be allowed to decide the purpose and boundaries of their land.

The concepts explained above became operative in the PROCEDE, *Programa de Certificación de Derechos Ejidales y Titulación de Solares* (Program for Granting Land Rights and Land Plots Registration), the main purpose of which is to provide security of tenure by granting certificates of parcel rights and common use rights, as well as titles to the land plots, in favor of each and every individual member of the *ejidos* which are distributed across the country who would apply for them. It is worth mentioning that the program is not mandatory, and that titles and/or certificates are granted at no cost.

The program is focused on social properties that account for 29,942 farm cores with a coverage of over one hundred million hectares, which benefit approximately 3.8 million peasants.

The implementation of PROCEDE requires integrating efforts from several public bodies and institutions, some mandated by law and others by the program's technical requirements. The public institutions directly involved in carrying out the Program are: the *Procuraduría Agraria*, the *Registro Agrario Nacional* and the INEGI (*Instituto Nacional de Estadística, Geografía e Informática*, National Institute of Statistics, Geography and Informatics), all under the coordination of the State Secretary for Land Reform.

² Transl. Note: *Ejidatario*, INEGI defines them as people living in the ejido. *Comunero*, the law defines them as individuals member of a rural community, with rights on the lands allocated and on communal lands.

1.4 The Role of INEGI in Procede

INEGI's capacities in geographic matters include the responsibility for establishing the rules, policies and techniques to develop mapping and cadastral information projects; for planning, organizing, management and supervising activities related to the cadastral mapping of *ejidos*; and for coordinating the building and consolidation of a digital mapping system in order to manage and update geographic information and georeferenced statistical data.

INEGI's capacities, together with its technical and organizational expertise, are elements that greatly fostered INEGI's role in PROCEDE, as the institution in charge of operative technical tasks, that is, the identification, delimitation and geographic location of land in the farm cores. Also, the development of cartographic products to support the issuing of legal documents than provide security of tenure.

INEGI uses the *Normas Técnicas para la Delimitación de las Tierras al Interior del Ejido*, (Technical Guidelines to Set Land Boundaries inside the Ejido). These Guidelines set all the criteria to standardize procedures as well as minimum requirements to carry out technical operative tasks and computer processing of data in the Program. Besides, the Guidelines define mapping characteristics. These Guidelines are based on geographic standards published by INEGI.

In order to perform these activities, state-of-the-art technology available at that time was used. Two approaches to capture information in the field were implemented: a direct capture with GPS equipment and total stations, and an indirect capture with aerial photographs and photogrammetric stations. Method selection and application mainly depends on features such as: vegetal cover density, *ejido* owners' requests, availability of aerial photographs, and the average size of land parcels.

GPS technology drove to changing of the Reference Geodetic System, so as to make the surveying technique consistent with the reference system. Besides, in 1933, the *Red Geodésica Nacional Activa* (Active National Geodetic Network) was established. So far, this network holds 16 continuous tracking stations distributed across the country that work 24x7. INEGI's website provides free access to data from these stations.

In order to proceed to the computer processing of data captured and to produce the mapping of social property, 32 linked centers were deployed across the country. They are responsible for the automated mapping production. Additionally, these centers are currently building the *Base de Datos de la Propiedad Social* (Social Land Property Database).

These large information bank supports decision making in benefit of several programs that foster rural development. This is so because the bank includes data on natural water features such as water currents and bodies, land use information such as cropland, land for housing purposes, land exploited collectively, and areas dedicated to public service. Finally, the bank also holds infrastructure information such as federal or state roads, power lines, bridges, wells, etc.

PROCEDE's results are materialized in the issuance of tenure certificates and titles that, since they provide for land rights and land use, they also identify and solve unresolved issues related to land tenure inherited from previous generations. This is a significant contribution to social peace in rural Mexico.

The expertise built up during the development and implementation of PROCEDE resulted in other countries' willingness to learn and know the action plans that were instrumented, mainly in areas associated with surveying approaches and map production. Consequently, INEGI has provided consultancy services to experts and officers from different countries, e.g., China, Jamaica, Peru, Guatemala, Honduras and El Salvador.

INEGI's participation in PROCEDE has allowed the development of a significant intellectual asset and large amount of information; the accumulation of technical expertise thanks to the development of standards, approaches and software; the creation of a geodetic infrastructure with over 82,000 geodetic vertexes spread in the field; the development of a social land property database of approximately 25,000 farm cores with data from over 7.4 million cards listing the characteristics of the rights and land of individuals.

The integration of this database facilitates its use by institutions that apply public land policies to plan land integration and land administration. To support all of the above, INEGI has developed the *Sistema de Información Geográfica de Núcleos Agrarios* (SIGNA, Farm Cores Geographic Information System) that allows running queries, examining, and making a comprehensive use of the statistic and geographic information obtained in field works. It also provides information broken down by entity member of the federation. That information is related to the plot boundaries of farm cores, as well as to social and economic data from each member of such cores.

PROCEDE has also fostered, besides providing security of tenure to *ejidatarios* and *comuneros*, the possibility of creating and encouraging a land market in the country. It should be outlined that this last feature has not materialized across the country. There is still a need to consolidate mechanisms that may introduce this feature into land administration policies and programs in order to allow an increasing amount of social properties to slowly enter the land market.

All of the above becomes even more relevant when the Mexican Law provisions are taken into account. The Law provides for 2,451 municipalities in the country, the legal capacity to carry out the cadastral inventory of privately owned land and for defining land administration policies. This is consistent with one of the purposes for designing and building the IDEMEX, that is, achieve uniformity in data to be managed.

1.5 How PROCEDE Integrates Into Mexico Spatial Data Infrastructure (Idemex)

The globalization process and the impact of Information and Communication Technologies (ICT) have favored the sharing of compatible geospatial data and their integration into local, national, continental and world infrastructures.

IDEMEX is the initiative put forth by Mexico to organize, manage and share geospatial data. This initiative is integrated under a uniform policy framework so that, thanks to the use of communication technologies, the interoperability of Information Systems can be achieved.

The IDEMEX can be defined as a set of policies, technologies, standards and human resources dedicated to the compilation, management, access and distribution of geospatial data and to provide guidance towards the knowledge required for intelligent decision making.

So far, Mexico has solutions that provide for the integration of cadastral datasets into different layers associated to spatial datasets considered in IDEMEX. This offers land information users the chance to build topologic relationships between geographic objects and to overlap topics. Then the vertical and horizontal integrity of data becomes possible, and this leads to information, the processing and analysis of which is translated into a wider and more comprehensive knowledge of geographic spaces.

In order to make access to land tenure information easier, INEGI has suggested the creation of the *Clave Única del Registro del Territorio*, CURT (Identification Number of Land Registration). This ID will give access to all cadastral data contained by IDEMEX, will provide a single and efficient code number to every portion of land and will allow the sharing of information in every document created by different government agencies.

One of the institutional flows to disseminate the information contained in IDEMEX is materialized in the development of IRIS (*Información Referenciada geoespacialmente Integrada en un Sistema*, Geospatially Referenced Information Integrated into a System) that encourages and facilitates the use, analysis, interpretation and integration of national geographic and statistical information, as well as of cadastral data, thus contributing to learn and study land characteristics in order to foster decision making based on technically supported elements.

The comprehensive exploitation of SIGNA and IRIS allows the development of a great variety of products to support analysis and decision making, such as: maps, thematic atlas, statistics and tables to help define the typology of farm cores. Below, we present a characterization of social property and of the legal persons living in that land:

On average, nationwide, 68% of land in farm cores is devoted to common use, especially to collect wood and graze cattle in extensive production systems. The parceled area accounts for almost 31% and concentrates farming activities; only 1% corresponds to human settlements and is used for housing and for self-consumption backyard food production.

As to the declared use of *ejidos* in rural communities, 65% of parceled land is for agriculture, followed by 21% and 11% for cattle or farming and livestock respectively; the remaining 3% is mining areas, natural protected areas and water reserves.

Land used for human settlement is predominantly occupied by housing, that amounts to 77%; vacant plots account for 18%; public services land, 3% and the remaining 2% holds areas for industrial, commercial, development reserves and mixed use.

As to water resources, parceled areas confirm that, nationwide, agriculture mainly relies on rainfall rather than on irrigation systems. Likewise, land for common use is predominantly used for grazing in arid areas. This comparison allows inferring that, in order to decide land use, farmers heavily consider land quality.

If characterization is made based on legal persons, over 50% have a land parcel while 23% have two parcels and the remaining 21% have three or more parcels, being 1.2 parcels the nationwide average.

1.6 Challenges for the Program

The development of PROCEDE and the integration of its data into IDEMEX allow seeing both positive aspects and areas of opportunities. Among the former, we can mention:

- The program's accomplishments were reached thanks to the close collaboration of the several actors involved, a fact that has fostered institutional strengthening by the training and education of participants and the transfer of technology.
- So far, the program has progressed to survey a total of 82.6 million hectares, which represent 4.9 million parcels and 2.5 million plots. This has resulted in the production of 7.4 million maps. Technical surveys have supported the issuance of rights certificates and titles in 24,920 farm cores.
- In order to ensure reliable and uniform results, ad hoc technical standards were developed and applied with close monitoring. Adopting this approach provides grounds for achieving the interoperability of cadastral systems. The technology, procedures and standards used guarantee reliable results; this minimizing uncertainty as to property boundaries and, therefore, any potential conflicts.
- The creation of a historical dataset and its integration into IDEMEX contributes to an enhanced knowledge of Mexico Geography and to better decision making in matters related to social property.
- Putting together all the above factors has resulted in exploitable data and also in timely benefits for legal persons.

Besides, some areas of opportunities can be recognized and should be considered to enhance the usefulness of data created by the program. Among these opportunities, we can mention:

- Considering that land information is not valid forever, and changes due to social and natural dynamics, updating mechanisms and plans are required to keep data within a time frame not older than 5 years.

- It is indispensable to further promote and foster the benefits derived from being part of the program, so than people living in the farm cores not yet in the program would request their participation. This will result in the registration of all social properties.
- It is necessary to develop and strengthen the publishing and disseminating mechanisms of all information produced by the program, so that it can be known and used.
- In order to capitalize on the expertise of the technical staff involved in the program and to contribute to the professional practice of the activity, focus should be made on promoting certification of professional competence. It should also be guaranteed that use and interpretation of cadastral data are appropriate and consistent along time.

Considering the historical background, the of the acquired expertise, the trends of information technology and the sensitivity required to solve dilemmas in the field, we may summarize the challenges this country will face in geographic and cadastral matters as follows:

Based on the premise that a partial image of a country does not provide for policies for an efficient land administration, it is necessary to move forward and integrate public and privately owned land information, so as to contribute to a comprehensive and sustainable Land Administration.

The main challenge is to integrate data produced by the different Unidades Productoras de Información Geográfica across the country into IDEMEX, so as to accomplish a better knowledge of the country reality that, by geospatial analysis and geomatic applications will support intelligent decision making towards the development of large-scale projects of national interest. This, together with the security of tenure fostered by PROCEDE is a contribution to social peace in Mexican lands.

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