Ministério do Planejamento, Orçamento e Gestão
Instituto Brasileiro de Geografia e Estatística - IBGE

2007 Censuses

Innovations and impacts on the brazilian statistical and geographic information systems

Rio de Janeiro
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Preface

The Brazilian Institute of Geography and Statistics - IBGE presents, in this publication, a view of the 2007 Censuses, which encompass the 2006 Census of Agriculture, the 2007 Population Count and the National Address List for Statistical Purposes (CNEFE, in Portuguese). They were conducted in an integrated way in the year 2007.

This document describes the integrated operation of the 2007 Censuses and presents a description of their characteristics, as well as of technological and management innovations introduced, difficulties faced and lessons learned. It also deals with the structural effects on the Institute and its organization.

The technological and methodological innovations introduced in the 2007 Censuses constitute a landmark in IBGE history and will exert significant influence on the institute's future activities, since the acquired experience will be applied to the planning of the 2010 Demographic Census and to future statistical and geoscientific surveys conducted by IBGE.

All those who have participated in Census 2007 have contributed to pave the way for the future IBGE.

Eduardo Pereira Nunes
President of IBGE

Introduction

The Brazilian Institute of Geography and Statistics - IBGE, a public institution under the responsibility of the Ministry of Planning, Budget and Management, has as its mission to portray Brazil by providing the information required to the understanding of its reality and the exercise of citizenship, through the production, analysis, survey and dissemination of statistical information – of either demographic and socioeconomic nature – and of geoscientific information – of geographic, cartographic, geodetic and environmental nature.

Within these duties, IBGE conducts Demographic and Agricultural Censuses and Population Counts in accordance with international standards and norms. The combination of two major areas of knowledge in its structure – statistics and geosciences – allows IBGE to optimize the use of resources and maximize the level of contributions from each area of the Institute for the conduction of census activities, which are recognized as the main project integrating different areas of the Institute.

The institution presents, in this publication, a view of the 2007 Censuses, which encompass the 2006 Census of Agriculture[1], the 2007 Population Count and the

[1] The reference period of the Census of Agriculture was the year 2006.

National Address List for Statistical Purposes (CNEFE, in Portuguese). All these surveys were conducted in an integrated way in the year 2007.

This document highlights the innovations introduced by the 2007 Censuses and describes their effect on the production of statistical and geographic information in Brazil. It is organized into two major sections: the first one deals with the integrated operation of the 2007 Censuses, and reports their characteristics, the innovations introduced, the difficulties faced, the lessons learned and the immediate effect on the operation; the second section deals with structural effects on the Institution and its organization, its regular survey procedures and scope of action, including the technological advances reached. Final remarks, selected bibliographical references and annexes also constitute the report.

2007 Censuses: an integrated census operation

The objective of this cooperative operation was to update population estimates and information about economic activities of agriculture performed in the Country by individual producers and agricultural companies. The combination of surveys was made easier by the use of hand held computers, Personal Digital Assistants or PDAs – equipped with Global Positioning System - GPS in field operations and by the use of CNEFE.

Figure 1 below shows an image of the model used by IBGE. Further details about the equipment and its use are described in the item on data collection.

Censuses are data collecting operations of the utmost importance for the creation of public policies and for the decision-making process concerning private and governmental investments. In terms of the Census of Agriculture, statistics help make a comprehensive portrait of the agricultural activity, and at the same time it reveals important aspects of Brazilian rural life. The Population Count provides updated population figures of the municipalities

Figure 1: PDA used in Censuses 2007.

covered and more accurate estimates for the other municipalities. The Count highlights the demographic changes which have occurred in the Country since the last Demographic Census, which was conducted in 2000.

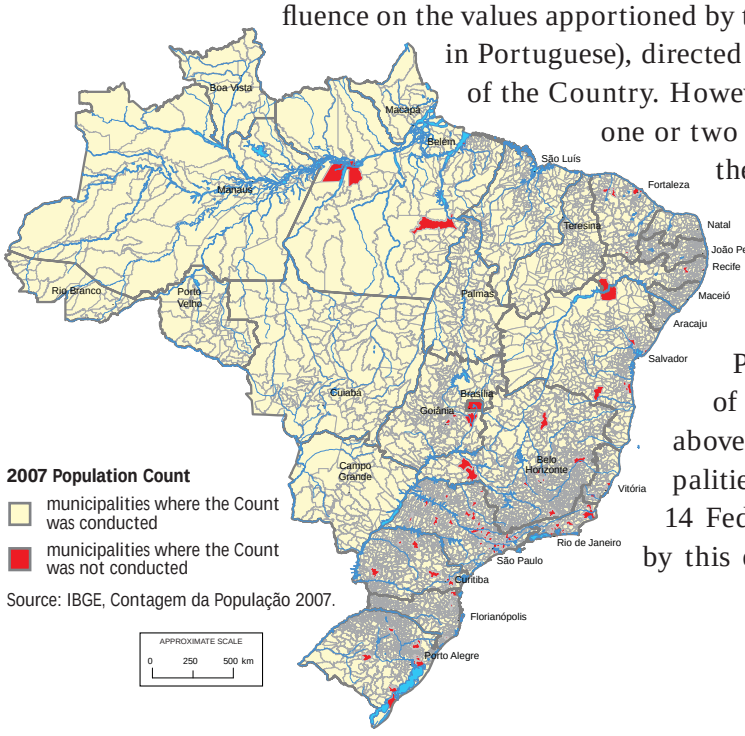
The National Address List for Statistical Purposes - CNEFE was one of the innovations brought by the 2007 Censuses. A previous list elaborated using registers of units surveyed in 2000 was the basis for the field operation which was aimed at updating the address registers of each residential and non-residential unit in the Country, including those in rural areas. From these areas were collected geographic coordinates of agricultural holdings and also of health, teaching, religious establishments and of households.

In the realm of the 2007 Censuses, the address list helps increase the speed of data collection, guides the enumerator in the field work, besides offering new tools for collection and control. Indeed, the list represents an effective element in the conduction of IBGE continuous surveys, and society benefits from a more accurate register which allows the combination of statistical data from several different sources, such as health and education, for example, with the aggregated information by census tracks produced by IBGE.

Coverage of the 2007 Censuses

The decision of conducting the Census of Agriculture and the Population Count as an integrated operation was the only way possible to have both surveys, considering the limited financial resources directed to these activities. Having them done separately would have been about 40% more expensive, possibly resulting in expenditure beyond the amount budgeted by the government at the occasion.

Considering the financial constraints of 2007 Censuses, it was necessary to restrict the coverage of Population Count to Brazilian municipalities with up to 170 thousand inhabitants, a group in which total population figures exert direct influence on the values apportioned by the Municipal Participation Fund (FPM, in Portuguese), directed to municipalities located in inner parts of the Country. However, since in some Federative Units only one or two municipalities would be excluded from the Count coverage for having over 170 thousand inhabitants, IBGE decided to include them in the survey. So, besides municipalities with up to 170 thousand inhabitants, the 2007 Population Count also covered a group of 21 municipalities with a population above this figure. A list of these 21 municipalities can be found in Annex 1. As a result, 14 Federative Units were completely covered by this edition of the Population Count: Acre,



Alagoas, Amapá, Amazonas, Maranhão, Mato Grosso, Mato Grosso do Sul, Paraíba, Piauí, Rio Grande do Norte, Rondônia, Roraima, Sergipe and Tocantins.

In order to better understand the coverage of the Population Count, it is necessary to take into consideration that Brazil has 5,564 municipalities[2] and that the population limit of 170 thousand inhabitants was based on municipal estimates for 2005. From this overall number of municipalities, 5,414 had less than 170 thousand inhabitants, and, with the 21 other ones included in the Count, totaled 5,435 municipalities surveyed, representing 97% of the Brazilian municipalities. Only 129 municipalities, in 13 Federative Units, that is, 3% of the total in the Country, were not surveyed. A list with these 129 municipalities can be found in Annex 2.

These 5,435 municipalities represented, in 2005, approximately 110 million persons, that is, about 60% of the estimated population in the Country and about 28 million households, reaching 57% of the total number of households in Brazil.

The Census of Agriculture was planned with the objective of investigating about 5.7 million agricultural holdings in all the Brazilian municipalities.

Chart 1 below shows a summary of the main aspects of the 2006 Census of Agriculture and the 2007 Population Count.

Chart 1 – Scope of the 2007 Censuses during planning stage

Universe	Census of Agriculture: all the National Territory Population Count: municipalities with up to 170 thousand inhabitants plus 21 municipalities with a population above 170 thousand inhabitants
Number of units	Census of Agriculture: approximately 5.7 million agricultural holdings Population Count : about 28 million households and 110 million persons
Number of municipalities surveyed	Census of Agriculture: 5,564 municipalities (see Note 2) Population Count: 5,435 municipalities
Number of census tracks	162,770 census tracks included in the 2007 Censuses, out of the 249,068 existing census tracks in the territorial base of Brazil
Hired staff	90 thousand persons (collection, supervision, support and administration)
Training program	Distance-learning and course attendance Didactic and pedagogical assistance with the use of recorded and printed class material totaling over 3 million pages
Technology	Mainframe computer About 3,500 microcomputers connected nationwide A communications network formed by 500 points for ADSL access (commuted networks of public telephony), 700 points of satellite access and 4,624 points for dialing access (via Modem) all connected to the IBGE network About 82,000 hand held computers equipped with GPS
Working units	27 State Units 1,200 computerized data collection stations, among which are more than 500 IBGE agencies Over 5,000 data collection stations

[2] In fact, there are 5,562 municipalities. The two other ones refer to the district of Fernando de Noronha, which belongs to the State of Pernambuco, and to Brasília, the Federal District. Both are considered units for the planning of survey activities at municipal level.

2006 Census of Agriculture

The Census of Agriculture is the main and most comprehensive survey about the productive structure of the Brazilian agricultural sector. It is a long survey of national coverage; its results are used for studies, analyses and prospects in this sector, and constitute the main source of information for the several levels of government to elaborate and monitor politics of allocation of public resources and the spatial arrangement of the Brazilian rural territory.

The 2006 Census of Agriculture presents new data about the Brazilian agricultural activity, after a decade of great changes in the agricultural scenario, since the last survey, conducted in 1996. As a consequence, it makes up for the absence of updated information about economic, social and environmental aspects of agricultural activity, and provides elements for the planning of public policies aimed at the inclusion of population and regions to the model of sustainable and integrated development of this activity and of the Country itself. Besides, this census results represent a continuation of the time series which started with the 1920 Census of Agriculture.

The Brazilian agricultural scenario has gone through several changes in the last ten years. The agricultural sector has become more modern, has increased its activities and contributed to the generation of significant results in the trade balance. These changes have raised several important issues; however, it is important to point out that the transformations which have occurred in the Country's agricultural activity can only be understood if based on a complete and updated portrait of this new reality, which the census activity can provide.

Within this context, the Census of Agriculture provides a group of data comparable to results of previous censuses, and measures the contribution the agricultural sector has given to the development of the nation for almost a century, once the first survey of this sort was conducted 86 years ago. (1920-2006).

The 2006 Census of Agriculture offers updated information about the agricultural activity and the alternative practices for dealing with the soil and with natural resources, the agricultural production in special areas (hydrographic basins, biomes, resettlements of barrages, rural workers' settlements, Indian

Figure 2 - Irrigated soybean crop.
Embrapa

lands and environmental reservations); agricultural household and pluriactivity. Other items investigated were the occurrence of women in charge of agricultural activities, the level of schooling of the rural producer, the use of electricity and other sources of income related to activities conducted in rural establishments, such as those related to tourism and handcraft.

The information in the Census of Agriculture is also useful for the ministries in charge of public policies aimed at the reduction of regional and intra-regional inequalities. The objective of improving the life conditions of vulnerable population in the rural area, through actions directed at the protection of the low-income population, reflects the governmental strategy to achieve social and environmental development.

Programs which fulfill this demand include measures relative to education, training and qualification of rural workers, measures which ensure credit for the settlement of persons, legalization of land possession, incentive to local production arrangements and support to extractive communities of the Amazon Region, among others.

The reference period of the Census of Agriculture was year 2006, from January 1st to December 31st; the Census reference date was December 31st, 2006.

The survey universe is formed by agricultural holdings which performed activities related to agriculture, aquaculture, livestock, aviculture, beekeeping, sericulture, vegetable extraction, silviculture, processing and manufacturing of agricultural products in agricultural units. The Census provides information about the number of agricultural holdings; what they produced; how many persons were employed in agriculture; the main activities developed and the methods applied, besides other relevant pieces of information to the creation of an updated profile of the Brazilian agricultural sector. The sections and variables of the Census of Agriculture questionnaire are described in Annex 3.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Figures 3 to 7 - Several agricultural holdings.

2007 Population Count

The 2007 Population Count was conducted by IBGE together with the Census of Agriculture. It is important to mention that Brazil has a memorable history of regular Demographic Censuses. The history of General Censuses in Brazil starts in the 19th century, more precisely in year 1872. IBGE has worked on regular edi-

tions of the Demographic Census since 1940 (the last one was conducted in 2000) and has investigated an enormous group of data which help form a comprehensive profile of the Country's social, economic and demographic status. Its results are used to analyze the annual growing trend of the population, and also to evaluate the factors accounting for the Country's demographic dynamics, as, for example: birth, mortality and migration rates.

In 1996, there was the first edition of Population Count conducted all over Brazil.

The Population Count has received this name because it is much simpler than a Demographic Census. It is planned to be done in the middle of a decade, and aims to update annual population estimates by means of data which reflect the latest demographic changes in the National Territory.

Throughout history, the pattern of population distribution in the Brazilian territory has gone through deep changes, with the continuous creation of new occupation borders. The 1998 Constitution of Brazil grants IBGE the legal obligation of providing, annual estimates for municipal resident population. This Constitutional device was regulated by Complementary Law no. 59, of December 22, 1988. Besides, according to Article 102 of Law no. 8433, of July 16, 1992, IBGE is supposed to publish in Brazil's Federal Register, up to August 31st each year, a list with annual population estimates for states and municipalities, and, up to October 31st, the Institute has to send this report to the Brazilian Court of Audit (TCU), which uses IBGE municipal population data to establish the criteria for sharing the Municipal Participation Fund - FPM. This fund currently encompasses resources amounting to approximately 23.5% of the total Tax on Industrial Production - IPI and Income Tax - IR, which are collected by the Union and apportioned to the municipalities.

Assortment of IBGE

Figures 8 to 11 - Posters of the 1950, 1970, 1991 and 2000 Censuses.

Indeed, since the 1990 years, the Population Count has been an essential instrument for IBGE, as it enables the Institute to fulfill the demand for demographic information of several sectors of society. However, financial restrictions imposed by the government prevented the conduction of the 2005 Population Count. Inevitably, as times goes by, there are growing differences between figures in the 2000 Demographic Census and the current ones, as a consequence of this time gap. In these cases, smaller municipalities, the ones which are in greater need of FPM, were the most affected ones, due to possible inaccuracies in population estimates.

At last, the demand from parliament members and mayors more sensitive to damages suffered by these municipalities has influenced the government decision to permit the inclusion of resources in the IBGE budget for 2006, in order to conduct the 2007 Population Count, which will help IBGE update its system of projections and estimates for the last three years of the current decade.

The reference date of the Population Count was the night from March 31st to April 1st and, in this survey, variables related to the type of household, sex, age, family ties with the head of household, and migration were investigated.

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Figure 12 - Announcement of the launching of the 2007 Censuses for circulation in newspapers.

National Address List for Statistical Purposes - CNEFE

The 2007 Censuses, similarly to previous ones, represent an opportunity for the renewal of IBGE projects. One of the main innovations introduced by the census operation is the National Address List for Statistical Purposes - CNEFE, which had been previously created based on registers of units surveyed in the 2000 Census and was updated by the field work in the 2007 Censuses.

One of the objectives of the address list is to improve the survey, the treatment and the dissemination of statistical information. In a national statistics bureau such as IBGE, addresses are frequently used in the regular conduction of surveys. Either in the data collection period, during which the interviews are done, or monitoring period of this task, or even during the sending and control of receipt of postal questionnaires, the Address has an essential role, although not very evident several times.

This way, the creation of CNEFE is extremely important not only to the institution but also to society. For IBGE, this initiative helps increase the efficiency of

the planning and supervision stage of data collection in the 2007 Censuses. In a near future, this will allow IBGE to conduct postal household surveys. Society as a whole will benefit from a more precise register for geocoding, that is, the identification of the census track in which an address provided by the user is located; this combination – address → census track will allow the connection of information from several sources, such as health and education, for example, to information produced by IBGE at census census tracks level[3].

Considering the 2007 Censuses, the use of CNEFE has contributed to decrease the time spent in questionnaire filling in, and, in addition, to offer better guidance and directions to enumerators in the field. Besides, CNEFE influences the development of new mechanisms of data collection quality control.

Due to the inexistence in the Country of an officially accepted model for the registration of addresses, the development of an internal pattern, even if a preliminary one, is the starting point in the creation of an official address list. Two sources of information were used as the initial step: a comprehensive list of addresses collected at the time of the 2000 Demographic Census and the address creation guidelines of the Brazilian Postal Service Company - ECT.

After the analysis of this material, the Institute established a pattern of addresses in accordance with instructions of the Brazilian Postal Service Company, including the singularities observed in the analysis of the address list of the 2000 Demographic Census. It is worth mentioning the treatment of addresses of areas in which there was not an organized structure, that is, in which the localities were not easily identified. This situation, which is common in rural areas and in low-income settlements[4], forces the use of a descriptive element in order to clearly identify the address.

The update of the address list will depend, to a great extent, on the possibility of incorporation of addresses used by institutions such as municipal governments and public service providers (energy, water, communications, etc). The confirmation of this interchange will depend on the use of common patterns for the construction and update of address lists. Consequently, the discussion, improvement and wide dissemination of a pattern to be published are essential for the good performance of CNEFE. The formation of a work group, at least at federal level, to deal with this issue must be carefully considered.

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[3] An census track is a cadastral control unit for census formed by a continuous area; it is located in a single urban or rural region, limited by area size and/or number of households or of agricultural holdings, whose perimeter encompasses the territory limits legally defined and established by IBGE for statistical purposes.

[4] A low-income settlement (slums and similar areas) is a community consisting of at least 51 housing units (shanty houses, etc), occupying or having occupied, lately, property of other persons (public or private); in general, houses in a low-income settlement are built in a confused and concentrated manner, and the inhabitants of such a place suffer due to the scarcity of essential public services.

Territorial Base preparation

The data collection operation of 2007 Censuses encompassed 162,770 census tracks, from a total of 249,068 which form the Territorial Base. This base is formed by a group of data and registers which guide the division of the territory into smaller areas, called census tracks. Its preparation takes into consideration, besides the operation of census data collection, the necessity to fulfill the demand of municipal governments and of the private sector for further information which may influence the decision-making process of public and private investments.

The division of census tracks follows pre-established quantitative criteria, considered the ones which first fulfill the condition, described in Chart 2 below:

Chart 2 – Quantitative criteria for census tracks in urban and rural areas

Status	Number of households			Number of holdings			Duration of the collection period (days)		Maximum area of the census track (km^2)
	Minimum	On average	Maximum	Minimum	On average	Maximum	Count	Agric.	
Urban									
Urban Area	250	300	400	-	-	-	30	-	-
Non-urban area	150	200	250	100	150	200	45	-	-
Rural	150	200	250	100	150	200	45	60	500

Many times, the changes of municipal limits make it necessary to define, exceptionally, census tracks which are below the pre-established sizes, with the objective of keeping current results comparable with those from previous censuses. The same has been done, in some cases, in order to allow comparability with limits of special collecting areas (Indian lands, environmental reserves) and of hydrographic basins.

The priority of IBGE was the update and digitization of the Territorial Base of all the 5,564 municipalities for the Census of Agriculture and of 5,435 municipalities for the Population Count. The review works of the Territorial Base included the update of the so-called special areas (Indian lands, low-income settlements, rural settlements, environmental protection areas), of municipality maps, of localities and census tracks, of road network and hydrographic networks, of the toponyms and of the geographic limits of each census track and its internal components (such as streets, blocks, etc).

IBGE started the elaboration of Territorial Base maps in digital media during the preparatory step for the 2000 Census, and continued this work for the 2007 Censuses. According to the structure of the National Cartographic System, IBGE is in charge of the production of systematic land mapping of the Country in the

scales 1:25,000 or lower, a task which is divided with the Army Directorate of Geographic Service (BRASIL, 1997). This means that IBGE is the producer of topographic mapping used as basic input for the generation of rural maps which form the Territorial Base. However, as for urban mapping in cadastral scales – 1:2,000 to 1:10,000, the production of these inputs is not done by the Institute, but by public state and municipal institutions and by private companies.

The production processes of the Territorial Base of rural and urban areas differ a lot due to the characteristics of the inputs used.

For rural areas, the process is supported by the systematic topographic mapping available in IBGE and in the Army Directorate of Geographic Service. The municipal maps elaborated represent natural, physical and artificial elements of municipalities, such as rivers, roads, localities and municipal limits, combined with toponyms, localities, rural properties, specific areas, and others. These maps are the bases for the creation of municipal statistical maps, with the addition of the census tracks grid, which is associated to files presenting census tracks descriptions.

The production process applied in the 2000 Census was maintained for the Rural Territorial Base of the 2007 Censuses. It was based on the update of municipal maps. In the planning of the 2000 Census, the priority was the field update of maps of municipalities with over 25,000 inhabitants. This way, for the 2007 Censuses, there was the need to update all the maps through field and office activities, which started with the use of information originated in the 2000 Census.

The activity of cartographic update in the planning of the Territorial Base analyzed the need of improvement of information about the 5,564 Brazilian municipalities, with the selection of those which lacked a small or big amount of information since the end of the 2000 Census. The complementary approach uniting office and field information generated updated municipal maps. This analysis indicated the municipalities whose territory had faced changes, in political, administrative or physical respects or even for the improvement of the quality of the cartographic base. The quantity and quality of information presented led to the division of municipalities into two major groups:

- municipalities of which data would be updated in the field (which needed more precise information about positioning of elements, about the beginning of new population groups and about the existence of major constructions with change of the locality headquarters); and
- municipalities of which data would be updated only with office information, considering the slight changes to be effected in the municipal map.

Based on documents generated by many IBGE surveys, and on others coming from regional institutions, important information was incorporated to municipal maps in the office. Field update was done in order to obtain confirmation and better accuracy of physical data of the land, with the use of GPS technology. The

inputs used were properly registered to form and maintain databases and metadata bases which constitute the Digital Municipal Maps.

The cartographic update activity, of either office or field type, was put into operation using Semi-automatic Cartographic System - SisCart for data acquisition and entry, and generated information from:

- office surveys - through the use of field notes taken in previous censuses and in internal IBGE surveys, and through descriptive memorials of rural census tracks, and documents of sectorial institutions enriching municipal maps in all the 5,564 Brazilian municipalities.
- field surveys - (GPS) conducted in 2,016 municipalities, which were considered priority updates in relation to the lack of information in their territories, either for inclusion of new information or change of political and administrative boundaries.

The effort for updating the territorial base in the rural area was aimed at improving the mapping which took place in 2000. To reach this objective were used vector files in several graphic formats, containing information more compatible with municipal mapping, such as names of roads, boundaries of Conservation Areas, Projects Settlement and for Indian Lands and others. These data are produced by sectorial institutions, such as: National Institute of Colonization and Agrarian Reform - INCRA; Brazilian Institute for the Environment and Renewable Natural Resources - IBAMA; National Indian Foundation - FUNAI, among others.

The information obtained (coordinates of point and line elements and those corresponding to complementary office information) were included in the Digital Municipal Map with representation associated to the precision of information. The digital map which results from this work has a hybrid shape, corresponding to a raster base over which are placed vector information, structured in a Geographic Information System - SIG environment related to the rural census track grid and to the grids generated in the updating stage. Figure 13 shows an example of a rural census track grid, whose area is in gray, with field updates in magenta color and office updates in green.

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Figure 13 - Example of a rural census track map.

Note: Field updates are in color magenta red and office ones are in green.

Urban localities are based on cadastral mapping, in scales from 1:2,000 to 1:10,000, produced by public organizations (municipal governments and others), concessionaries of water, sewer, electricity and telecommunications services, and other producers of mapping in cadastral scale. These maps, which present varied geometry, updating level and computer platforms, contribute to the elaboration of maps of Brazilian

cities, towns, villages and communities. Locality Statistical Maps - MLE present basic urban features, streets, hydrography, buildings and intra-urban divisions, such as: sub-districts, boroughs, low income settlements, etc, over which census tracks are represented.

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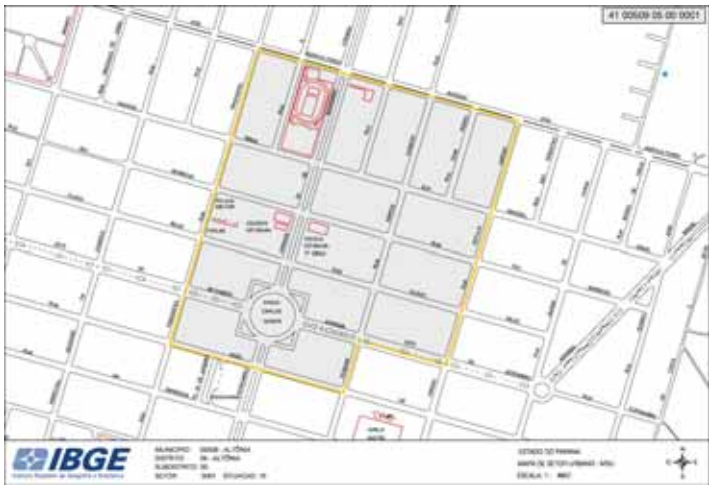

Figure 14 - Example of an urban census track map.

The production of MLE's is done with a system called Urban Census Track Maps - MSU (Figure 14), based on the MicroStation platform and enriched with a series of resources which increase the speed of specific tasks, such as data editing, correction and consult. This way, the preparation of the Urban Territorial Base implies the conversion of maps from different environments to the MicroStation environment, from the several coordinate systems to the Universal Transverse Mercator (UTM) and to the SAD 69 Geodetic System (1969 South American Datum) (FORTES, 1995) and an updating process analogue to that of the rural localities, with both field and office activities.

New technologies, such as the use of GPS equipment and of orbital images, the establishment of partnerships with municipal governments and local institutions, and the work of field recognition which involves the research of updated geographic names and is conducted by IBGE collecting unit, are essential factors for the monitoring of this process. It is the update of the Urban Territorial Base which encompasses steps of investigation, selection, register and incorporation of the graphic and alphanumerical assortment of correction and updates: (Locality Statistical Map) and (Census Track Registers Frame), respectively. The most often applied processes are:

- field processes, especially with the use of GPS;
- office processes of several groups, formed by maps, digital and/or conventional cadastres, relative to the increase of urbanization density related, for example, to the presence of new locality addresses, new constructions, etc; and
- research, analysis and representation of changes in intra-urban division and fragmentation of the urban space.

For the release of results, the grids relative to the political and administrative division in Brazil and to the division of census tracks are analyzed in GIS environment (Arcview/AtlasGis) and made available as geographic coordinates and UTM in vector shape (ESRI..., 1998). This way, although the Territorial Base has been created in CAD environment (Computer Aided Design), the polygons of legal and

institutional territory structures are turned into a GIS platform, enabling analyses which associate the territory to statistical data.

The technological innovations introduced in the 2007 Censuses, especially the use of handheld computers equipped with GPS, justified, according to IBGE, the generation of new Territory Base products:

1. maps of 70,095 rural census tracks and 92,685 urban census tracks in PDF format;
2. a description of rural and urban census tracks in PDF format;
3. rural census tracks maps in JPG format;
4. 70,085 images taken from Google Earth and georeferenced by Geobase; and
5. municipal and census tracks grid in vector shape, encompassing the urban perimeters and isolated urban areas[5] of all the 27 Federative Units, with approximately 77,000 polygons.

The first two products initially planned for PDA were provided in printed paper, considering that the two following products (items 3 and 4) used the potentialities of the PDA to help guide enumerators during data collection in the census tracks under their responsibility (Figure 15).

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Figure 15 - Satellite image on PDA screen.

On the other hand, the fifth product, the municipal and census tracks grid, allows the management of the collecting operation, almost at real time, from the headquarters of IBGE, in Rio de Janeiro. Figure 16 shows the visualization of coordinates collected with PDA/GPS by the enumerators working all over the Country, allowing the visual monitoring of the operation.

Figure 17 represents the digital municipal grid of the Country.

A detail of the utmost importance in the generation of the products mentioned is related to the geodetic system of reference adopted in digital mapping. This system constitutes the first layer of georeferenced information in relation to which all the others are positioned. This way, it was essential that all the coordinates involved in the 2007 Censuses project be referenced in relation to a single national, precise and consistent geodetic system. In this respect, for printed maps, the work was continued using SAD 69, a system adopted in Brazil in 1979, once all the Territory Base maps were already based on this system. However, since February 25, 2005, Brazil has had a new official system of coordinates, the Geo-

[5] Areas with urban characteristics, at least 1 km away from effectively urban areas in cities or villages.

Figure 16 - Example of collection visual monitoring.

Note: In this example, agricultural holdings visited by the enumerator are represented by green circles over a Google image, with the of census tracks shown in yellow.

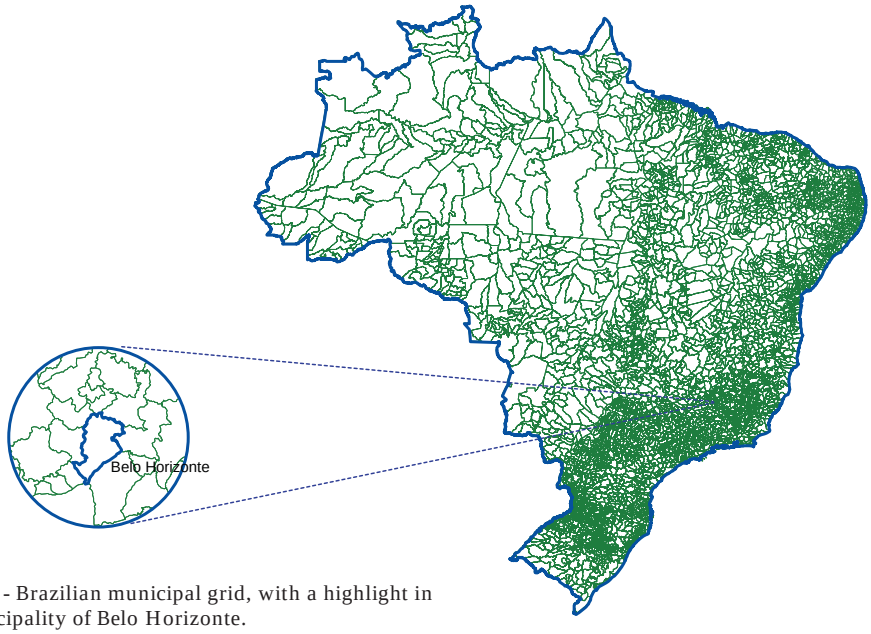

Figure 17 - Brazilian municipal grid, with a highlight in the Municipality of Belo Horizonte.

centric Reference System for the Americas - SIRGAS2000, a continental, geocentric and modern system which is totally compatible with GPS (SISTEMA..., 2007). This way all the digital files in the Territorial Base loaded in the PDA were converted to SIRGAS2000, so that the coordinates provided by GPS could be visualized directly over the maps of the census census track without any additional changes.

Recruitment and training of field staff

In a country of continental dimensions such as Brazil, an operation as big as the census requires persons who know, in detail, the methodological aspects, the technical contents and the operation procedures which are vital to the success of the enterprise. Therefore, staff recruitment and training constitute essential steps for the quality and the success of a census operation, considering the challenges involved and the standardization of concepts and of procedures at national scale which censuses require.

When field work started, on April 16, 2007, over 60 thousand enumerators and over 10 thousand supervisors began to cross all the National Territory in order to visit about 30 million occupied households and 5.2 million agricultural holdings[6]. The whole census operation involved approximately 90 thousand persons, among contracted workers and civil servants from the Institution.

In order to conduct the census operation for three months, IBGE contracted, by means of a Simplified Entrance Test, about 86 thousand enumerators and census agents responsible for tasks related to the supervision of field and the organization and administration of collection stations. The organization of a Simplified Entrance Test for the 2007 Censuses was under the responsibility of a Recruitment Committee.

The recruitment program to select over 68 thousand enumerators was divided into two parts. The first one consisted of a basic- knowledge exam about the 2007 Censuses and about the work to be done, besides overall knowledge of the Portuguese language, mathematics and general information. At the moment of enrollment, each applicant received a booklet containing overall information about the 2007 Censuses, as, for example, some of the main concepts approached by the surveys and necessary procedures for the conduction of satisfactory data collection. The applicants approved in this stage went to the second part of the recruitment process, which consisted of a training program involving knowledge of the census operation and of the work to be done, as well as of PDA handling. At the end of the training program, a final test using the PDA measured the performance of trainees and, through the PDA, automatic correction was done, indicating the list of candidates who had passed and would be contracted to do census collecting activities for the 2007 Censuses.

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[6] Figures obtained from the survey

Figures 18 a 21 - Training of ACM's and ACS's and of enumerators in Alagoas.

Alberto Jorge Cavalcanti Ferreira

The recruitment program of about 18 thousand enumerators was done simultaneously to that of the enumerators and followed the same procedures. Because of the complexity of the activities supposed to be developed by these agents, the minimum level of schooling required was high school, and, besides Portuguese, the tests included computer science, logic, and general knowledge of administration and management routines.

In order to prevent the evasion of enumerators, due to lack of technical knowledge, the selection process had as a priority the recruitment of applicants who lived in places of difficult access and distant areas (for example: slums, indigenous areas, very small municipalities, rural areas, etc.). A legal device in the recruitment documentation demanded the creation of an enrollment unit to select applicants among the dwellers of these localities. Community leaders also cooperated to encourage applicants' participation.

Concerning training, the main challenge faced by IBGE was related to the short period of time left to train about 90 thousand persons all over the Country.

In order to achieve this goal, the objective of the training program was to standardize the performance of all the participants of census activities. The training priority was to prepare them for the interview, fill out the electronic questionnaires correctly, use the PDA for data collection and work as instructors and disseminators of knowledge in several different steps of the training program of enumerators.

The strategy planned to reach these objectives involved the occurrence of preparatory courses (either course attendance or distance learning), with support from a combination of technologies which included videos, Intranet/Internet, and the use of manuals and other printed material. Besides these aspects, training was complemented with a pedagogical-didactic reinforcement through folders and videos distributed among disseminators so as to guide them pedagogically in terms of the application of didactic methods and the use of class resources during the training for the 2007 Censuses.

For the training period, groups with IBGE civil servants and persons contracted to perform census activities were formed, as shown below:

- Group of specialists (GE) - formed by 41 technicians responsible for the methodological, technical and operational development of surveys. This group taught the group of trainers all the technical and operational contents of the second part of the training program;
- Group of trainers (GF) - formed by 332 professionals, civil servants from the Institute, with knowledge of the technical and operational project of the surveys; they were responsible for training those who would work as instructors in the third part of the training program;
- Group of instructors (GI) - formed by 1,549 professionals experienced in training instructors; they were recruited in the Institute to train other servers and persons contracted to work in the censuses;
- Group of ACMs and ACSs (GA) - formed by about 18,000 municipal census agents (ACMs) and supervisors (ACSs) contracted to perform administrative tasks and work on the supervision of the collection unit. From this group, 11,300 persons were selected to work as enumerators instructors; and
- Group of enumerators (GR) - formed by approximately 68,000 enumerators.

This step of the census operation of 2007 was structured in a way as to present the technical contents and procedures for data collection presented in census manuals. The project also included administrative instructions concerning the hiring and paying of contracted persons, as well as guidelines for the use of computerized systems to monitor data collection, for the use of PDAs and for the review of the territorial base.

The content of distance-learning classes was made available on the Institution's intranet, through a virtual environment for support to teaching-learning activities in order to facilitate teacher-student integration. Distance learning classes offered operational content relative to: the Territorial Base, the use of PDA and the Personnel Administration System (hiring mode) - SAPC. The content proposed, with the exception in what concerns PDA, reflected the knowledge and experience already available in the institution about the census operation.

Assortment of IBGE

Figure 22 - Distance learning course: use of PDA.

In general terms, the planning of distance courses included the choice of strategies relative to tutorship, to the development of operational training and to activities aimed at professional qualification. A Group of Tutors was created to work on distance training. This group was formed by approximately 30 IBGE technicians who were taught the operational content related to the Censuses, that is, Territorial Base, use of PDAs and the SAPC staff management system (hiring mode).

The target public of tutors was the group of internal instructors (Specialists, Trainers and Instructors) who formed the chain training structure which was part of the attendance training stage. The implementation of the Group of Tutors included the following activities: an internal selection program to recruit applicants for the tutoring position and the establishment of a Tutor Training Plan.

Distance training in the realm of the 2007 Censuses reached 1,922 IBGE servants, both from the headquarters of the institute, and from State Units, being 41 from the Group of Specialists (GE), 332 from the Group of Trainers (GF) and 1,549 from the Group of Instructors (GI).

Attendance classes were offered through a system of successive training, a method very often used in the training of a big number of persons. Several groups of professionals were trained; members of these groups worked as instructors in the following phase. In order to eliminate problems relative to content throughout successive knowledge transmissions, multimedia resources were used, such as video-classes, in order to help training activities in the classroom. The tests conducted at the end of each step of the technical work were done with the use of the PDA.

Part of the operational training, for administrative and management functions, also done by means of attendance classes, were aimed at preparing trainees to perform management functions during collection and at the organization of collection stations in all the 5,564 municipalities.

Media and publicity

The media plays a very important role in censuses, and, as well as the publicity about the census operation, consists of a powerful way to influence, encourage and inform the population. Together, media and publicity show how important it is to open the door of a house or the gate of an agricultural property and take part in the census process.

In this respect, the Communications Department was extremely important, since professionals from this group created publicity material before the launching of the survey. When the Censuses began, the population had already been informed about the data collection, due to the broadcast of information in almost all possible means of communication.

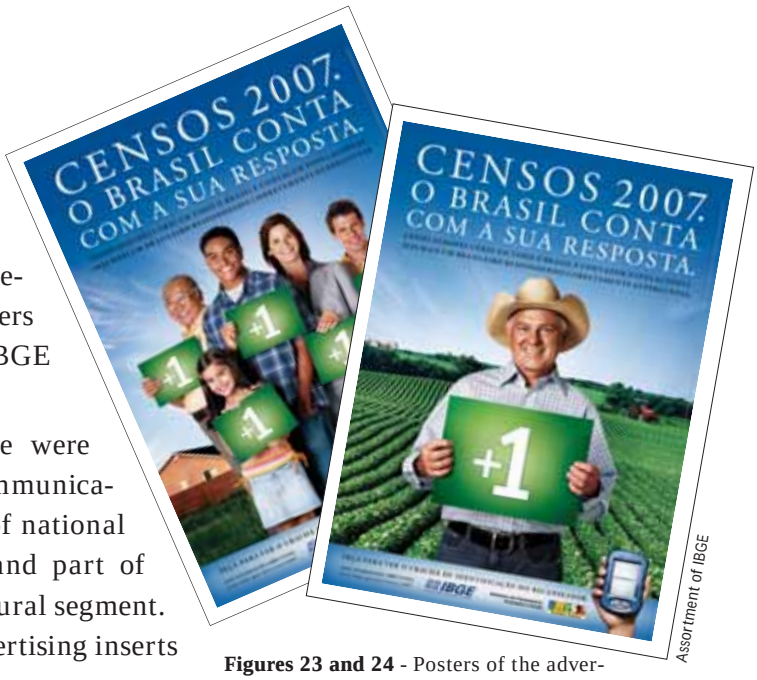
When the publicity campaign began, it was observed that the PDA had a very strong visual appeal; it soon became a symbol to identify the IBGE's enumerators.

With this image and with the slogan: "2007 Censuses: Brazil counts on your answer", the campaign helped mobilize the population to welcome the enumerator and to answer the survey questions correctly.

The publicity pieces created to disseminate information about the 2007 Censuses were: 60 and 30 second films for television (one for the Population Count and one

for the Census of Agriculture), one and two- page advertisement for magazines, 30 and 60 second spots and a 60-second jingle for the radio and one-page advertisement for newspapers, and finally, posters which were distributed among all the IBGE units located all over the Country.

Between April and July 2007 there were 80,942 advertising inserts in the communication media all over the Country, some of national coverage, other of regional coverage, and part of them directed specifically to the agricultural segment. Chart 3 below shows the number of advertising inserts by means of communication:



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Figures 23 and 24 - Posters of the advertisement campaign of the 2007 Censuses.

Chart 3 – Number of advertising inserts by means of communication

Means of communication	No. advertising inserts	Means of communication	No. advertising inserts
Total	**80 942**		
National TV	51	National magazines	4
International TV	10 602	Magazines for the agricultural sector public	20
TV for the agricultural sector public	219	Newspapers in capitals	55
Radio	69 915	Newspapers for the agricultural sector public	76

Publicity pieces were broadcast in 12 different TV channels, 24 magazines, 101 newspapers and 549 radio stations. In the period September 3-10, IBGE had a 30-minute official announcement in five open TV channels: the purpose, in this case, was to improve data collection in 11 capitals, by inviting persons who had not yet participated in the survey. This announcement was broadcast in Manaus, Maceió, Teresina, São Luís, Porto Velho, Natal, Palmas, Boa Vista, Campo Grande, Cuiabá, João Pessoa and in nearby municipalities which were within the reach of TV channels in the capital. These cities were chosen because they had a big number of households which had not been visited by the enumerator, especially households with absentee dwellers and household in which the dweller refused to speak to the IBGE enumerator.

A campaign aimed at society was created to inform about the end of the 2007 Censuses: it included television films, advertisements in magazines and several banners for the Internet. Publicity pieces were shown in the period November 19-28, in nine open television channels seen al over the Country (78 inserts), four national

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Figure 25 - Announcement of the 2007 Population Count for national circulation magazines.

circulation magazines (four inserts). In the period December 21-30, with the release of the Population Count Results and of the Census of Agriculture preliminary results, the campaign was advertised in 20 web sites, through banners which directed the users to the IBGE website.

Besides informing the conclusion of the 2007 Censuses, the closing campaign brought a thank you message to society, mentioning that Brazil counted on the participation of its population to obtain the 2007 Censuses results which started to be released in October 2007.

Municipal Census Commissions: participation of society

Municipal Census Commissions - CCMs consisted of an instance of participation of municipal communities in IBGE census operations. They represented an important communication channel between IBGE and the representatives of organized municipal society. The CCMs worked on the 2007 Censuses as partners of IBGE, and joined efforts from different segments of local society in order to monitor and provide support to the census activity. These commissions were coordinated by IBGE with the participation of the Executive, Legislative and Judicial Powers of the municipalities and local community groups.

Between August and October 2006, a total of 5,555 Municipal Census Commissions were created. Each CCM was formed by at least five members, and was expected to have six meetings since the moment which preceded the collection until the release of the first results of the Population Count.

The anticipated formation of CCMs for the 2007 Censuses had the objective of allowing the solution of problems, in due time, in order to avoid damage to the data collection, or generate questioning of the results.

The Management System for Municipal Census Commissions - SCCMs was created in order to grant visibility to the work of the Commissions. The SCCM stored the standardized electronic forms so that each person in charge of a CCM could register the content of the meetings. This system allowed total transparency by exhibiting on the 2007 Census web page the proceedings of the meetings held in each municipality and the professional data and photograph of each member registered as a collaborator of IBGE in the census operation. There were 57,000 persons working as CCM members all over the Country. Their work is registered in 28,799 proceedings[7] available on the site: <http://censos2007.ibge.gov.br/ccm_atas.php>, and can be seen by all the Brazilian society.

[7] Number of proceedings in the system up to 11.06.2007.

Campo Mourão: Devair Jesus de Souza
Marituba: Maria Ivone Maciel/Márcio Flexa

Figures 26 and 27 - Meeting of the CCM's in Campo Mourão (PR) and Marituba (PA).

In addition to Census Commissions in municipalities, state commissions in some states were also formed; these ones monitored and helped the activities of the 2007 Censuses.

Commissions allow the development of solid partnerships, considering the convergence of objectives to be reached. Thanks to them, in most places, proper infrastructure to conduct the operation was obtained even in the municipalities which did not have IBGE agencies, showing the involvement of society. In some municipalities, the necessary cooperation was not offered, either due to lack of interest of local administrators or by the lack of tact, of IBGE staff, to conduct the meetings.

2007 Censuses Forum

With the objective of encouraging the exchange of information about the 2007 Censuses, the institute created a forum on the IBGE website (http://www.ibge.gov.br/forum_censos2007).

Being divided into 22 themes, subdivided into 17 topics, with a moderator for each topic, the forum encompasses operational and administrative issues, publicity, promotion and dissemination strategies, computer science, training, territorial base, coordinate points collected and so on.

The forum, created in February 2007, was used by IBGE servants and by the ACM's and ACS's, in a total of 6,628 users and 6,373 messages sent until October 2007.

The forum is a tool which allows the participant to send public or private messages relative to the topics available in a place organized for this purpose. From the moment of registration, users can interact with each other by creating topics or sending questions/replies about existing topics in a simple and fast manner.

Although the forum is an effective communication tool, it is important to highlight that it was not used to its full potential because this kind of device is rarely applied by the Institution. In order to turn the use of the forum into a

custom, it is necessary to have frequent access to the verification and sending of messages, and this way, an effective work activity incorporated to the everyday routine of each servant.

It will also be necessary to improve the behavior of moderators in the forum, so that they can: guarantee messages are properly written, alert users about the off-topic content of messages and delete messages if necessary, and, especially, not leave messages unanswered.

Finally, it is important to highlight that the 2007 Censuses Forum, in a general way, contributed significantly to the exchange of information and to clear doubts, and that a tool with these characteristics will also be adopted in the 2010 Census and in other IBGE activities.

Data collection

Data collection for the 2007 Censuses started on April 16, 2007. It is important to mention that, in the 2006 Census of Agriculture, data were collected from all the agricultural holdings which existed in the Country at the occasion. Information about them was related to economic activities developed from January 1st to December 31st, 2006. The Population Count was conducted in the municipalities with up to 170 thousand inhabitants and in the 21 additional municipalities included in the survey, covering all the dwellers of private (permanent and improvised) and collective housing units on the reference date: the night of March 31st to April 1st, 2007.

In this stage of the survey, enumerators collected information through direct interviews, with listed questions from a questionnaire which was filled out in a handheld computer (PDA).

Maria Ivone Maciel/Márcio Flexa

Figure 28 - Census in settlements in Benevides (PA)

With the objective of helping the collection work in some State Units, special groups were sent to work as area and sub-area coordinators and as Municipal Census Agents.

Data collection was planned to be conducted in a period of 3.5 months, from April 16 to July 31, 2007. However, several problems which occurred in this stage of the operation caused changes of these dates, in all the municipalities, such as:

- obstruction of the data communication system for transfer of information from the 2007 Censuses central system in IBGE headquarters, in Rio de Janeiro, to each one of the 82.5 thousand PDAs. This prevented the beginning of data collection, in the first week, from occurring as planned in all municipalities;

Maria Ivone Maciel/Márcio Flexa

Figura 29 - Census in Santa Izabel (PA).

- some computerized collection stations, which had a connection system with the central system of IBGE only through a dial telephone system, faced serious communication difficulties due to the low-quality of these services, and led to the urgent search for alternative forms of communication. In the municipalities in which local solutions were not found, IBGE rearranged PDAs to neighboring municipalities, to transfer these PDAs and the data questionnaire from the Population Count, the Census of Agriculture and, mainly, of the addresses relative to the census track under the responsibility of the enumerator. During this period, the work of the enumerator was halted for one or more days, always when there was a need of an alternative type of connection;
- a similar problem occurred in some Computerized Collection Stations, which had a satellite antenna of unsatisfactory performance;
- enumerators giving up in the first few weeks of data collection due to lack of identification with the activity performed, a situation which was made worse by the communication problems faced. Because of that, there was the necessity of conducting a complementary entrance test, including training during collection, for approximately 4,000 positions in several municipalities of nine states.
- the inadequate functioning of data entry to the Management and Collection System of Indicators made it difficult to observe the problems and the adoption of correction measures in due time;
- as a consequence of these previous problems, there was a delay in the functioning of the Supervision System, which prevented the census tracks from being supervised during the collection period, the moment when coverage problems could be avoided. These coverage failures, in general, were only observed in the advanced stage of collection. Because of that, in several municipalities, there was the need of coverage review, causing a one-month delay in the data collection period; and
- other management and operational problems also affected some states and municipalities and were also responsible for delays.

Supervision of collection of the 2007 Censuses was done through a computerized system, with the use of a handheld computer (PDA). It is worth mentioning that supervision is an essential step in the field operation, mainly to be conducted during

the collection process, because it allows the control and the coverage and quality of information, at a moment in which there is still time to promote corrections.

At this stage, technical and operational decisions were made in order to:

- detect the invasion of the limits of census tracks or of municipalities;
- control the route covered by the enumerator, checking the inclusions, exclusion and changes of addresses, through the comparison of previous registers of addresses with the census track map and with the situation found in the field;
- check the address registrations in order to detect possible omission or duplicity of data;
- avoid overenumeration or underenumeration of persons and households, observing inclusions, changes and exclusion; and
- evaluate the quality of information collected through verification indicated by the data analysis of quantities and values out of the predefined parameters and repetition of interviews, observing the correct application of concepts and procedures.

It can be said that data collection took place, in most municipalities, between May and September 2007 and advanced in some of them until the month of October, when the last coverage reviews were completed. The decentralized collection[8] of Census of Agriculture questionnaires was also extended beyond the expected period.

In relation to the structuring of field groups, the IBGE State Units, responsible for the execution of data collection, had the following work structure:

- a technical coordinator, responsible, in the realm of the Federative Unit, both by the Census of Agriculture and by the Population Count;
- area coordinators, responsible for the operation in an area of the state formed by a group of agencies;
- sub-area coordinators, responsible for a group of municipalities or by part of a big municipality; these areas are usually subject to an agency;
- municipal census agents, responsible for the works of a municipality or by part of a medium or big municipality; and
- supervisors, responsible for a group of up to 10 enumerators from the same municipality.

Besides the aforementioned functions, State Units also had coordinators for administration, computer science, territorial base, training, release and municipal census commission, besides assistants to the technical coordinator.

[8] In a decentralized collection the filling out of the questionnaire is interrupted because it is impossible to obtain data in the establishment itself, and, therefore, collection is completed in an establishment located in another municipality.

Major supervisors were selected among members of IBGE staff, and municipal census agents and other supervisors, among members of the temporary staff.

However, it is worth mentioning a significant difference in relation to the 2000 Demographic Census: the use of handheld computers for the collection of information by enumerators, which allowed them to perform transmission of data collected to the central IBGE computer, soon after the conclusion of interviews. If there had not been so many communication problems, the censuses would have been finished in due time.

PDAs and electronic questionnaires

Throughout the years, IBGE modernized its collection processes and, in particular, its censuses. Several innovations were introduced; however, all of them included the use of paper questionnaires, from which data were later transferred to computer processing and consistency analyses.

The use of mobile technology contributed to make the process more practical, light, effective, fast and safe. From this moment on, the questionnaires are presented virtually on the screen of the portable PDA equipment, with the answers written on the screen itself, or selected from different options. The use of PDAs allows these answers to be analyzed and checked during the interviews, to be stored and transmitted to subsequent centralized processing.

This digital equipment had been previously used in other IBGE surveys. However, it was the first time the Institution used the PDA in a census operation. The PDA, being widely employed, brought several advantages to data collection, among which can be mentioned:

- immediate evaluation at the moment of data collection, allowing the correction of information at the moment of the interview;
- the filling out of all the compulsory questions, avoiding the lack of answers due to forgetfulness or mistake by the enumerator;
- optimization of the filling out of data through automatic skips in the questionnaire, avoiding to cover several items


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Alberto Jorge Cavalcanti Ferreira


Maria Ivone Maciel/Márcio Flexa

Alberto Jorge Cavalcanti Ferreira

Figures 30 to 34 - Census in Pará and in Alagoas.

about which, sometimes, there would be no reply; that can optimize time use by the enumerator and the informant; and

- the non-necessity of the transportation of a big amount of paper questionnaires and of the handling of these same questionnaires in data capture centers, achieving information precision and better processing time.

Besides all these advantages, handheld computers, equipped with a receiver for GPS signals allowed the georeferencing of all the units visited in the rural areas, as well as the monitoring of the geographic coverage.

GPS georeferencing in data collection

The use of GPS equipment and PDAs represented, undoubtedly, one of the most important innovations in the 2007 Censuses. By allowing the access to quality coordinates adequate to a wide range of uses, the introduction of GPS created the necessary conditions for the development of a big number of innovative applications. As a result of impressive technological development, this equipment can, in a short period of time and at low cost, provide an operator who has little technical knowledge with precise coordinates, in a type of operation which used to involve complex calculations and procedures.

Four major processes have been developed for the use of GPS, as shown below:

- access to coordinates of spots in the urban census track perimeter during the pre-collection operation;
- access to coordinates of the units visited during data collection in rural census tracks;
- use of coordinates obtained during data collection in distance-supervision procedures; and
- use in the field of the coordinates obtained for positioning and guidance of the enumerator.

The collection of coordinates in the rural area was done in each existing unit, whereas in the urban area, it was limited to obtain the coordinates of spots in the perimeter of the census tracks. The choice was not to collect household coordinates in urban areas, due to constraints in the use of GPS technology, especially in terms of what concerns interruption of the signs sent by satellites.

Follows some more information about each one of the uses previously mentioned:

Pre-collection was one of the several preparatory activities in the Censuses. It was aimed at the recognition of the census track by the supervisor, before the beginning of data collection, in order to provide support to the enumerator. In spite of the effort for the improvement of cartographic information, the Territorial Base was not sufficiently updated in the years preceding the 2007 Censuses. This way,

by requiring that the supervisor go over the census track under his responsibility on the days preceding the collection, there was also a last opportunity for update and identification of inconsistencies, especially in the boundaries which defined the census track limits.

With this objective, IBGE has conducted this pre-collection operation since the 2000 Census. In order to guarantee that, in a short period of time, over 10,000 supervisors cover their areas, each supervisor was instructed to capture; obtain coordinates from specific determining positions in each census track, by means of GPS. By requesting from the supervisors the obtaining of point coordinates limiting each census track with GPS, the monitoring of the work can be done in a simple way. Once getting the coordinates requires the movement over the census track, the data obtained serve as proof of the presence of the supervisor in the area indicated. According to the instructions received, the first spot obtained by the supervisor is associated to the initial spot of the census track defined in a document which presents the description of the census track, and can be identified in the map. This way, by marking the coordinate on the census track map, it is possible to confirm the completion of the operation.

During collection itself, coordinates from all the households and agricultural holdings in rural areas were obtained. Considering the difficulties of building a list of addresses in the rural areas, similar to that of urban areas, these coordinates functioned as an alternative address, making it easier to return to the unit georeferenced and registered. It also made possible to visualize the progress of collection, in the map of each census track.

Although coordinates are easily obtained, some specific situations may turn this process difficult or even impossible. Units located in deep valleys, or in areas with dense vegetation may turn the identification of coordinates impossible. In order to inform the enumerator about the possible loss of quality of the coordinate obtained, the system displayed a quality indicator which prompted the enumerator into looking for a better position. In case the difficulty remained, the enumerator should register this problem through an option available in the system. Considering agricultural holdings, the coordinates were supposed to be collected, preferably, in the place itself, or at the entrance of it.

The use of GPS also made it possible to monitor the evolution of collection by means of the visualization of coordinates obtained, superposed on orbital images, especially in more remote rural areas. The comparison of the coordinates obtained with signs of residential or agricultural occupation detected in the image (Figure 35) represented a real effective and low-cost supervision mechanism in rural areas. Comparison also made it possible to observe, in the office and after collection, inaccuracies due to census track invasion and their correct spatial distribution.

Figura 35 - Example of material available for supervision.

Note: The red spots represent geographic coordinates obtained from units (households, agricultural holdings, teaching establishments, etc), found during the movement along the census track, whose area is represented in yellow. The areas located in the east part of the census track, with intense agricultural activity, had no coordinates obtained, a fact which can indicate the enumerators' omission of registers of establishments installed there and which should have been visited, registered in the PDA and of which information should have been collected in the 2007 census questionnaires. This simple visualization can indicate the need of supervision in the referred census track for correction of the information collected and inclusion of items omitted.

The availability of a GPS receiver in the PDA helped IBGE develop a software to better guide the movement of the enumerator in some rural areas, especially in the North and Central West Areas.

In order to give support to the 2007 Census operations, IBGE used the geoprocessing software Geopad and customized it to fulfill the demands of field work. The software was then called IBGE Mobile Gis, and it allowed the enumerator to identify their position in the rural area, their working census track and the distance covered in the field.

Being installed in the PDAs, the software included spatial information, such as maps in shapefile format and orbital images in JPG format, georeferenced in a simple and dynamic way. It worked through basic commands such as move, zoom in and zoom out, in the location of the census track, in the identification of its boundaries the access ways and significant elements in the territory.

New functionalities are being incorporated to the program for use in future surveys, especially in the 2010 Census.

Application software for collection and supervision

The entry of data for the census was done according to three types of digital documents filled out by the enumerator, as follows:

- Address List Form - the first document to be filled out in data collection; it guided other answers in the questionnaire, for the Census of Agriculture and for the Population Count;
- Census of Agriculture Questionnaire - always filled out when the visited unit was an agricultural holding; and
- Population Count Questionnaire - always filled out when the visited unit was identified as an occupied residential household.

Each census track was under the responsibility of a enumerator. His/her personal identification and information about the census track were registered in the handheld computer (PDA).

The fields to be filled out in the PDA during the collection must follow the order previously defined for each type of questionnaire. During the filling out of questionnaires in the field, information registered went through a validation process through a data evaluation process in order to:

- validate possible expected values for the fields;
- validate the consistency of information, according to fields previously filled out in the questionnaire itself;
- validate the consistency of information according to parameters defined in internal tables (values pre-defined by IBGE);
- validate the consistency of data in the questionnaire, at the end of the filling out process; and
- validate the consistency of census track data, at the end of collection in all the census track.

The supervision system installed in the supervisors' PDA encompassed procedures for the following activities:

- before the beginning of the collection (pre-collection) - getting to know the census track, verification of the address list, determination of the coordinates of four perimeter points from each urban census track;
- during the collection - generation of reports with a summary of overall data of census tracks and reports of management collection indicators, flagging alert messages relative to parameters of each one of the surveys for each census track. The supervision of the route and the coverage of the census track and reinterviews were done through this software;

- at the end of the collection - the end of PDA supervision took place after the conclusion of collection in each census track, according to the following procedures; checking of the existence of messages generated by management collection indicators; comparison between the map of the census track and the registers in the enumerator's PDA so as to evaluate collection coverage and detect possible mistakes; the end of supervision requests; and
- decentralized collection in the Census of Agriculture - a stage included in the system of supervision to cover cases in which the collection could not be done in the municipality in which the agricultural holding was located;

It is worth mentioning that the initial problems detected in the system of transmission and connection of the PDAs with the central network in the collection software, also occurred to the supervision system, causing delay in the supervision process.

As a consequence, the stability of collection and supervision systems was only reached at a point of the field work when collection was already advanced in a significant number of census tracks. The solution adopted to control this difficulty was to reduce the number of supervision requests, and stop them permanently in the second part of September, when the collection review work was already in progress.

It is important to mention that, in spite of the difficulties faced, the supervision process of the Population Count reached significant results, which can be seen from the number of census tracks supervised, with at least one supervision request completed, out of a total of 118,849. This represents vast material to evaluate this operation and prepare for the 2010 Demographic Census.

Management systems

The System for Management of Data Collection Information - SIGC, of the 2007 cooperative operation, was conceived to achieve three main objectives:

- allow fast and online access to reports which show the evolution of each step of data collection, informing the manager, about the necessity of intervention in the service area under his/her responsibility;
- provide the technical coordinators, throughout the collection period, with the indicators generated by the use of collection evaluation parameters which allow fast intervention, in case distortions are detected; and
- provide preliminary results for dissemination, as soon as collection is finished.

For the monitoring of data collection, of the validation of coverage and of the electronic sending of preliminary results of the 2007 Censuses, IBGE used a computerized system similar to the one used in the 2000 Census, SIGC. However, in the operation of 2007, due to difficulties for data extraction out of the database which received the information from the 82.5 thousand PDAs, SICG could not pro-

vide updated reports during all the collection period. This difficulty jeopardized the monitoring of the operation by several management levels, and, as a consequence, it made it difficult to make decisions and the application of corrective measures in due time. The need of an effective control system was partially fulfilled by the Emergency System of Collection Monitoring, as described below:

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Figure 36 - SIGC screen.

With this new system, the head of the collection station, or another person in charge of it, should provide information about the units and households visited, overall number of persons interviewed, agricultural holdings, census tracks being surveyed, census tracks in which the activities had not begun, census tracks with interrupted activities and census tracks already surveyed directly through the Internet (http://censos2007.ibge.gov.br/coleta/admin), on a site accessed through the use of a password.


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Figure 37 - Screen of the Emergency System of Collection Monitoring.

The loading of the system could also be done via PDA or by telephone (0800 721 8181), since the latter was equipped with a resource called Audible Answer Unit - URA.

The data were updated every two days and, near the end of the collection, the system was usually loaded every day, which allowed the monitoring and management of the collection by municipality, by sub-area, by state and all over Brazil.

Within the collection period, the system was expanded, generating new search options. It was possible to observe, for example, if the number of persons interviewed in a municipality exceeded – and to what extent – the estimates for such data. The system also made it possible to check the consistency of data of municipalities in which collection had been finished.

Data capture and transmission systems

These systems allow IBGE personnel to detect inconsistent data at the moment of their input in the system, preventing, this way, the return to the place of interview in order to validate incorrect information. The system also allows the transmission of information from the PDA directly to the IBGE database, without the need of the stages of data digitizing or scanning, which were necessary previously.

IBGE equipped 530 agencies which are permanently distributed over the Brazilian main municipalities and about 574 customer service units with computers and broadband internet access. Computerized Collecting Stations were created and, in these places, enumerators were able to connect their PDAs to microcomputers, us-

ing local wireless communication device – Bluetooth, more specifically – in order to transmit data from the PDAs to census computers located in Rio de Janeiro.

Taking into consideration the communication resources existing in all the Brazilian areas, the following communication system was chosen for these stations: about 400 of them used ADSL technology (a name given to public telephony commuted) and 700 stations had communication technology by satellite, when there weren't land means of transportation, especially in the North Region of the Country.

The connections were made with IBGE Networks, using the Internet, through an exclusive software for transmission of cryptographic data (Virtual Private Network - VPN), which guarantees the security of information transmitted through the Internet. The PDA used to do the transmission, was connected to a microcomputer through the Microsoft Active Sync. Software.

In these areas, in case there were communication problems through the VPN, the PDAs data were copied to the computer and could, alternatively, be sent by CDROM, FTP or electronic mail to the central computer located in IBGE networks, in Rio de Janeiro.

The remaining collecting stations (about 4,400) did not have a personal computer; therefore, communication with the central base was done by a fixed telephone line, through the use of a modem with Bluetooth technology, to communicate with the PDA. Initially, a connection between the PDA and the modem to be used in that station was established. In the beginning of the transmissions, the PDA software dialed to a fixed telephone line, which was bought from a national operating company with local taxes charged in the place of destination of the call, and, after the synchronization of the PDA and one of the computers in the census, Rio de Janeiro, the data were sent. In this case, the data were turned into cryptographic information in a private network and not through the Internet, as it was in the case of Computerized Collection Stations.

During the data collection period, the enumerators periodically transferred the data obtained to the central equipment in IBGE. At the end of the collection, it was sent to the corresponding supervisor, who: scanned the data collected with an audit software; finished the work in the census track; generated the return action to the field, or the conclusion of the collection in the census track; and sent the data to the central computer in IBGE, completing, this way, the collection process.

The transmission of data was done through remote connection close to the collecting area, which assured the integrity, security and quality of data transmission and its proper storage in the central computer of IBGE. Transmission controls were aimed at guarantee the data of the enumerator (who was responsible for the transmission) were kept with security in the central computer.

The partial or final data sent to the central computer of IBGE were always subject to a central plan of correction (data consistency or quantitative management plan), of

which reports were transmitted to handheld computers (PDAs) of enumerators, in a way as to allow the individual control of field operations by their own executors.

Therefore, besides scanning data with a local correction program, the PDA application software was also prepared to receive information about the quality of data transmitted and stored in the central computer.

Data tabulation system

IBGE has developed a new integrated system for data tabulation of its surveys, which involves the use of two other already existing systems: Retrieval of data by microcomputer - REDATAM and IBGE System for Automatic Recovery - SIDRA.

REDATAM is a system developed by the Latin American and Caribbean Demographic Center - CELADE, an organization of the United Nations system based on the Economic Commission for Latin America - CEPAL. The system aims at storing a big volume of data, for example, microdata of a demographic census, in a microcomputer.

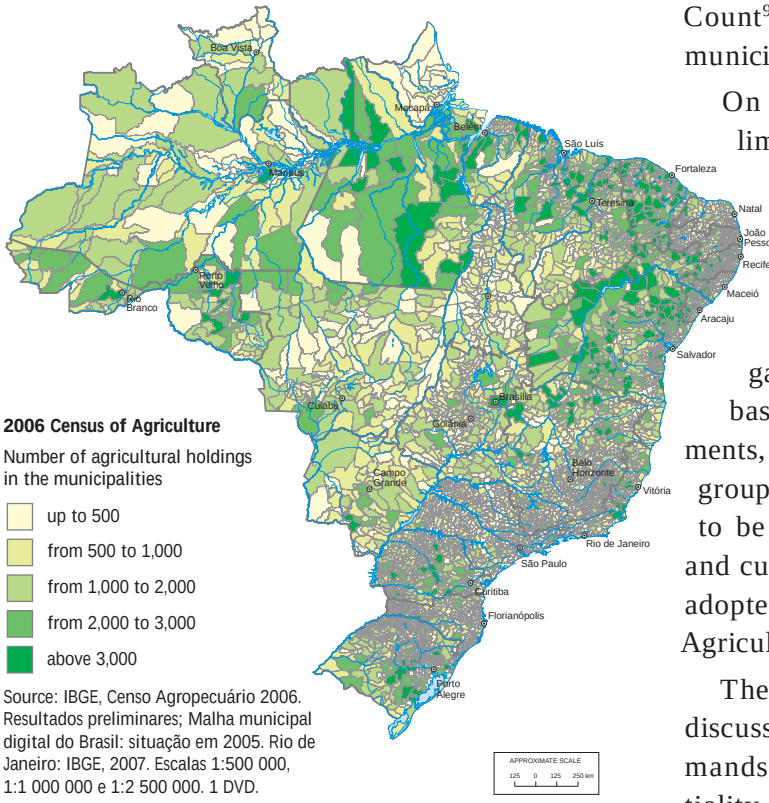
SIDRA is a system developed by IBGE in order to make available to the public information from the Aggregated Database surveys.

The new tabulator consists of loading REDATAM with microdata from the survey. Afterwards, a tabulation procedure is executed in REDATAM creating aggregated information that were loaded into SIDRA. From this moment on, it is possible to prepare tables for different types of media: printed publications, CD ROMs, Internet, etc. The advantage of this system is the unification of all the tabulation procedures in a single system, which guarantees the consistency of information tabulated in several different means of communication. The system was used to release results of the National Household Sample Survey - PNAD 2006, of the 2006 Civil Register Survey, of the final results of the 2007 Population Count, and of the preliminary results of the 2006 Census of Agriculture.

Release of results

On August 31, 2007, the first population results for all the municipalities surveyed were made available to society and widely disseminated on the IBGE website and on the media. After the collection review in some municipalities, on October 5th, there was a second release with the population of 5,435 municipalities surveyed and of the 129 municipalities which were not subject to the Count operation, but had their population figures estimated by IBGE (METODOLOGIA..., 2007). On November 14, IBGE sent to the Brazilian Court of Audit (TCU) a list with the final results, either counted or estimated, for all the municipalities.

The release of the Population Count final results occurred on December 21st, 2007 (CONTAGEM..., 2007a). According to the Count, the overall population of the Country was 183,987,291 persons, being 108,765,037 from the Population

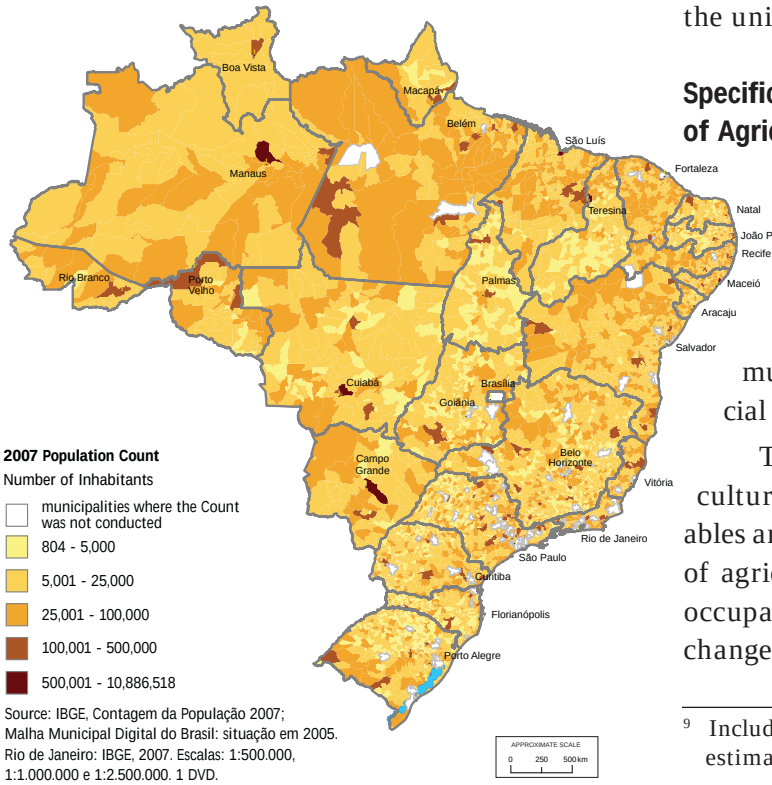


2006 Census of Agriculture

Number of agricultural holdings in the municipalities

- up to 500
- from 500 to 1,000
- from 1,000 to 2,000
- from 2,000 to 3,000
- above 3,000

Source: IBGE, Censo Agropecuário 2006. Resultados preliminares; Malha municipal digital do Brasil: situação em 2005. Rio de Janeiro: IBGE, 2007. Escalas 1:500 000, 1:1 000 000 e 1:2 500 000. 1 DVD.



2007 Population Count

Number of Inhabitants

- municipalities where the Count was not conducted
- 804 - 5,000
- 5,001 - 25,000
- 25,001 - 100,000
- 100,001 - 500,000
- 500,001 - 10,886,518

Source: IBGE, Contagem da População 2007; Malha Municipal Digital do Brasil: situação em 2005. Rio de Janeiro: IBGE, 2007. Escalas: 1:500.000, 1:1.000.000 e 1:2.500.000. 1 DVD.

Count[9] and 75,222,254 estimated for the 129 municipalities which were not counted.

On the same day, December 21st, the preliminary results of the 2006 Census of Agriculture (CENSO..., 2007b) were released; the final results will be available in the second semester of 2008. The final results of the 2006 Census of Agriculture will be aggregated in different ways: by hydrographic basins, biomes, Indian lands, rural settlements, environmental reserves. These different groups will allow the analyses of census data to be done according to geographic, social and cultural variables, besides the commonly adopted economic approach of information in Agricultural Censuses.

The release of CNEFE data is still under discussion, but the fulfillment of specific demands is expected, considering the confidentiality of information, especially due to the existence of georeferenced information for the units visited in the rural area.

Specificities in the release of the 2006 Census of Agriculture

The Census of Agriculture constitutes a landmark in the definition and standardization of agricultural surveys. It is a unique source of information, since it provides data at municipal level which can undergo special tabulation, based on census tracks.

The release of the 2006 Census of Agriculture data will reveal a group of new variables and indicators concerning the dynamics of agricultural activity in terms of territory occupation in the Country. It will reveal the changes generated by the process of econom-

[9] Including 788,713 persons, referring to population estimates for 259,850 closed households.

ic restructuring, of governmental politics for land distribution, of production levels reached due to the implementation of modern technologies, of harvest control and seasonal influences and of production of environmental indicators.

Besides, information about agricultural activities obtained from Indian population groups, rural settlements, preservation units and hydrographic basins will be combined with those related to education, health establishments and households of the 2007 Population Count.

Structural data may be organized by specific territory structures created to fulfill the demand for information for the formulation of local and regional policies for rural development. Moreover, they will allow the monitoring of agricultural practices in the inner part of areas submitted to specific control, such as environmental conservation units and Indian land.

The data collected in the Census will also be used for the correction of estimates and review of IBGE continuous agricultural surveys: Municipal Agriculture Production - PAM, Production of Vegetative Extraction and Silviculture - PEVS; Municipal Livestock Survey - PPM and Systematic Survey of Agricultural Production - LSPA.

In previous editions, Census of Agriculture results were released as volumes published for each one of the Brazilian states and for the Federal District. The analysis of the data followed a standard form, and took into consideration the specificities of each state: characteristics of agricultural holders and establishments, land use, number of animals and production.

For the release of the 2006 Census of Agriculture results, the objective is to systematize information by legally defined units – countries, major regions, states, municipalities, nature and environmental conservation units, Indian territory, etc – and by rural settlements, hydrographic basins, by topic or group of topics, as follows:

- Agricultural holder characteristics;
- Technicality and technology;
- Land use;
- Diversification of agricultural activity;
- Potential for stocks in agricultural production;
- Occupation and plurality of activities in agriculture and Livestock;
- Use of irrigation in agriculture;
- Workers' health and agricultural practices;
- Environmental health and Brazilian agriculture: agricultural practices, land use and preservation and use of water;
- Livestock characteristics;
- Subsidies for agriculture;

- Aspects of household agriculture in Brazil;
- Special dissemination areas; conservation units and environmental conservation, rural settlements, Indian territory, biomes, hydrographic basins; and
- Special tabulations: done in order to fulfill specific demands, considering institutional policies about information dissemination in effect.

A multidisciplinary staff to conduct the analyses of information tabulated by topic will be created. This group will be formed by technicians from IBGE and from other organizations which develop agriculture-related activities (research institutes, universities, foundations, governmental agencies.

In order to fulfill this demand, the results of the 2006 Census of Agriculture will be grouped into the following procedures:

- publications presenting the main tables for Brazil, its Major Regions and states; and
- digital media (CD ROM), containing tables for the several existing administrative levels and census track territory analyses.

These products will be developed after the conclusion of data treatment and the analysis of the crossing of variables of interest, without any damage to comparisons with time series, when compared to previous editions of Agricultural Censuses.

Impacts of the 2007 Censuses on the brazilian statistical and geographic information systems

Integration of cartographic information with the address list

With the implementation of the National Address List for Statistical Purposes - CNEFE, in coming operations, enumerators will receive the data about the census track in which they are working in two different ways: through the traditional map, with the identification of its limits and its internal organization and through a previous list of all the addresses included in it. Locations represented in the map will be found in the list and those included in the list will be identified in the map.

This requirement of integration constitutes a challenge to be faced in the following years. Coming from different productive processes, carried out by independent teams, address lists and maps of census tracks will evolve to an integrated environment in which the updates and corrections of one will necessarily reflect on the other one. One of the keys to attaining this level of integration will be the use of a common technological platform: the Geographic Information System - GIS. While allowing the storage and the combined processing of graphic and alphanumeric information, the structure of GIS will lead to the expected integration.

However, several obstacles still prevent the introduction of this technology, such as:

- The unification of software and hardware platforms used in the projects;
- The formation of an integrated and decentralized work environment, which will include the use of mobile equipment - PDA;
- The existence of only one database;
- The evolution of the present stage of urban mapping to a GIS environment; and
- The training of central and local teams for the use of the new environment, since, presently, only a small number of the Institute's professionals are qualified to handle graphic information.

The implementation of these activities will demand the construction of pilot-projects in order to identify the critical points of this project. Finally, it is worth observing that due to the dimensions of this work and the short period until the next census operation, it would be unreal to imagine the total National Territory available in this integrated environment. Nevertheless, an initial version, covering part of the most dynamic areas of the Country may and shall be implanted at this moment, due to the risk of seriously endangering the operational and technological development of the Institution if this is not done.

Integration of the urban and rural territorial bases

Currently, cadastral mapping does not follow cartographic norms and specifications, creating obstacles to the integration of the Urban and Rural Territorial Bases. This occurs due to lack of definition of the register maps regarding the geodetic reference system and the adopted cartographic projection, and also due to problems with the geometry of bases. Due to this fact, in the operation of pre-collection of the 2007 Censuses, coordinates of four identifiable points in each map of the urban census track underwent GPS observation, in order to promote the diagnosis and the correction of the corresponding cadastral map through adjustments by translation, rotation and scale. Besides this, the National Commission of Cartography (COMISSÃO NACIONAL DE CARTOGRAFIA, 2007), a department related to the Ministry of Planning, Budget and Management which assists the Minister in the supervision of the National Cartographic System and coordinates the performance of the National Cartographic Policy, formed a Specialized Committee in order to elaborate norms and specifications for cadastral mapping that shall be followed by the diverse producers in the Country. This will cause the urban bases used in the Census 2010 to fulfill requirements of quality and standardization.

Address list in household surveys systems

The continuous updating of the address lists of the selected census tracks in the samples of inter-censuses household surveys is a fundamental activity for their

success. Therefore, a significant number of technicians and financial resources are directed all the years to listing activities.

However, since there was not an integrated project, such as the CNEFE, each household survey conducted its own updating operation with isolated procedures and its own methodology. With the implementation of the CNEFE, it will be possible to concentrate, in only one area, the diverse activities of address updating in order to generate gains in productivity and scale.

This form of work will guarantee, in first place, the total coverage of the census tracks of interest of the surveys besides functioning in areas which can become outdated more easily. This way, each survey will receive from the CNEFE the addresses of interest, conduct its collection and report back to the list eventual changes identified in field work. The activities of address updating will therefore be planned, budgeted and performed in a unified way and will be developed according to a timetable compatible with the household surveys.

The continuous updating of the CNEFE is one of the elements that will facilitate the implementation of a new modality of execution of Demographic Censuses, as is being studied in IBGE, in the project named Alternative Modalities Studies for Demographic Censuses, which considers the collection distributed by the territory in a defined period of time, instead of the traditional operation. It will also be useful for a new Integrated System of Household Sample Surveys, currently being planned in IBGE.

Area and list frames for an agricultural sample surveys system

The 2006 Census of Agriculture will give society a wide set of information for the constitution of systems of reference and of statistical infra-structure which will be necessary for the implementation of sample surveys of agricultural holdings. It will also provide the construction of complete and updated list and area frames.

Combining the information from the address list (CNEFE) and the 2006 Agricultural Census provides IBGE an Agricultural Holding and Farmers List, which will allow it to conduct efficient sample surveys of agricultural holdings.

The Agricultural Holding and Farmers List Frame derived from the 2006 Census of Agriculture will be the first automated listincluding all agricultural producers in the country, with identities and characteristics of each holding. With this frame, it will be possible to identify and distinguish all the agriculture farmers and holdings, facilitating the contact with the persons in charge of the producing units considering the statistical investigation. Besides this, these frames will provide sufficient data for the definition of samples which will be able to be used in future surveys about the census track.

In addition to other information on the list, GPS coordinates of the agricultural holdings is also recorded. This position data, besides providing an additional ad-

dress component, is important to guide field work, and can be employed in the eventual design of an area frame.

The flexibility and efficiency of statistical sampling from a list frame is well known. However, a continuously updated list is necessary to ensure ongoing quality of the sample results. Because of this, maintaining and updating the list is of paramount importance, and resources must be permanently allocated to this vital activity. Hence, the use of external sources, such as cooperatives, official agencies, and other institutions which have information about agricultural holdings and farmers, is one way to keep the lists current. To successfully manage this effort, IBGE will need to forge ahead into new partnerships with other institutions, and assume new tasks in its lead role in the national statistics system.

The ideal list updating is the one obtained in a sweeping operation, that is, it occurs when all the agricultural holdings are visited, which is only possible when a census is conducted. As a consequence, the list updating shall use other methods to guarantee a complete and updated list. This way, the use of external sources, such as institutions and entities which produce information about agricultural holding and farmers, will become a fundamental and feasible alternative. In this sense, the task of frame updating will involve different institutions working in the coordination and sharing of updating efforts.

The set of enumerations area forms a area frame which, through an exhaustive and mutually excluding way, covers all the universe of identifiable events in the territory. Therefore, it is admitted that the group of census tracks with agricultural activity, together with aggregated information about the agricultural structure obtained in the Census, constitutes an adequate frame available for the selection of area samples to be used in the research of agriculture in the intercensus period.

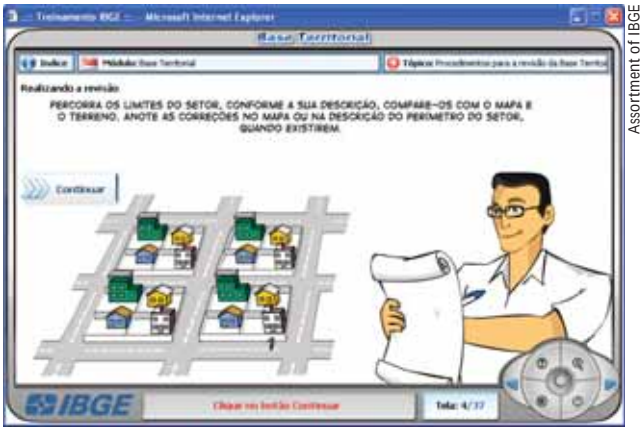
In this sense, through the 2007 Censuses, an Census Track Frame with Agricultural Information will also be obtained. It will be structured with the incorporation of adjustments of the descriptions and delimitations of the census track grid of the 2007 Censuses.

The statistical infrastructure represented by the development of both a comprehensive list frame and exhaustive, well stratified area frame opens several possibilities for the Brazilian agricultural and statistical surveys. Currently, ongoing programs to provide statistics on Brazilian agricultural are based primarily on indirect investigations collecting subjective data. Information is obtained from agricultural specialists and people with knowledge of existing conditions within one or more municipalities. In general, collecting precise information on individual holdings is not done in the survey programs. The conditions established through the results of the census operation allow the implementation of a national system of agricultural surveys, based on probabilistic samples of agricultural holdings, and may include list samples surveys as well as area samples surveys.

The configuration of this system will serve a program of regular surveys and also provide support for the execution of special surveys. The development of a system of continuous agricultural surveys by probabilistic sample for the Country, which can guarantee more accuracy, reliability and control of statistical precision is a strong demand, having been expected for many decades. It is also important that the statistical infrastructure associated to the system be able to face challenges – new demands, eventualities and changes - when the options of public policies depend on fast and precise answers to result in government actions.

Information and communication technologies applied to training

The establishment of distance training (EaD) inaugurated in the Institution a significant period in terms of personnel development. While reaching all the Federative Units, it showed the possibilities of integration, based on a common platform. It represented the first access and opportunity of qualification for an important number of servants, who were as well benefited with the access to the institutional electronic mail.



Assortment of IBGE

Figure 38 - Distance training: Territorial Base.

Besides the immediate results, the EaD project for the 2007 Censuses contributed to create favorable conditions for the dissemination of learning processes through electronic communication, which will allow IBGE to increase the opportunities of organizational learning, using the models of network learning. The entirety of this experience will be utilized in the program of institutional training as well as in qualification activities related to the surveys.

Impacts on the structure and activities of IBGE

As a result of the necessity to adapt the structure of collection to the new technology, all IBGE's network comprising 530 agencies and 27 State Units has broadband Internet access now.

The acquisition of PDAs for the 2007 Censuses directly influenced the working routine of all IBGE. The National Household Sample Survey - PNAD 2007 is the first continuous survey to use the experience acquired in the Census, by introducing electronic collection. All the other continuous surveys will be adapted in due course, until the conduction of the 2010 Demographic Census, which shall be the major questionnaire using electronic collection to be carried out by IBGE.

Currently, a pilot-project of updating the territorial base is in progress; it is aimed at the transferring of the alphanumerical and digital bases to a totally graphic envi-

ronment. The objective of this process is to use the potential of the present technology and supply the 2010 Census with a completely digital and interactive base.

Besides, the PDA is also being used in some administrative applications as, for example, a system of registry of temporarily-hired personnel, the data processing register of entrance of vehicles and an inventory of patrimonial goods, with the register of all mobile goods existing in the diverse areas of the Institution.

Once the PDAs have GPS, it is also possible to use them in several applications directed to cartography, such as: field checking, register of demarcating points, positioning of geographic limits, etc.

When technicians visit rural areas, or when they cross the territory of the Country, the availability of a PDA with GPS and maps represents the possibility of assisted driving, which makes it easier for drivers to know their exact location, in case there is no other form of orientation.

It is also worth mentioning that the use of the PDA equipment contributed to digital inclusion in IBGE as well as in the Country, since approximately 80 thousand PDAs were used by IBGE servants, as well as by enumerators temporarily-hired. The training activities of PDA use, in the categories attending course and in distance learning, also contributed to the dissemination of this technology. Besides this, the interview carried out with the PDA allowed several citizens to have contact with this type of equipment for the first time. This is a relevant fact, considering that only 16.9% of the permanent private households of the Country were equipped with microcomputers connected to the Internet in 2006 (PESQUISA..., 2007).

Final remarks

The great technological innovation implemented in the operation of the 2007 Censuses, was, undoubtedly, the utilization of hand-held computers PDAs – in the field work, before and during the data collection in households and agricultural establishments. It is also undeniable that this type of modification significantly affected the organization of the processes involved in the gigantic operation of the 2007 Censuses.

Besides, the construction of the National Address List for Statistical Purposes - CNEFE and its integration with cartographic information and with the elaborated territorial base which give support to collection and supervision operations and lead to the generation of new digital products, represented a strong effect on the activities of the Brazilian statistical and geographic information systems, mainly, in the system of household surveys, which is currently under revision, and in the system of agricultural surveys by probabilistic sampling, which is currently on the planning stage.

Despite the concern with the effect of these changes on the working processes with the introduction of PDAs, it is now possible to affirm that this innovation was a success.

The difficulties faced due to the very limited turnaround time and to operational problems did not prevent the 2007 Censuses from representing a great leap in tech-

nology and quality for an operation of this magnitude. Many problems were found in the stages of data collection and supervision of the enumerators' work, since there was a need for quick adaptation to the new work processes which the use of the PDA and of GPS required.

Among other lessons, four are worth mentioning:

- The necessity of strong investment in the planning stage, during which the equipment to be used is defined, the forms of communication and data transmission, and the software solution to be implanted, are basic factors for the success of the operation;
- The necessity of strong investment in the planning stage, during which basic factors for the success of the operation are defined: the equipment to be used, the forms of communication and data transmission and the software solution to be implanted;
- The necessity of carrying on dress rehearsals censuses in order to validate all the stages and anticipate alternative solutions. In the case of the 2007 Censuses, this work was not done as a consequence of the established turnaround period;
- The necessity to reinforce the training for the use of PDAs and associated systems, which should be including all the involved persons in the operation; and
- The urgent necessity of increasing the number of IBGE workers in order to prepare the Institution for the 2010 Demographic Census and the continuous censuses in the coming decade.

Considering the technological advances and the new available inputs, the experience obtained by IBGE with the 2007 Censuses is extremely important for the adequate planning of the 2010 Demographic Census, for the structuring of the Project of Alternative Modalities for Demographic Censuses, and for the current household surveys, as it is the case of the use of PDAs in the National Household Sample Survey - PNAD.

In summary, the lessons learned and the experience and the technological and methodological innovations introduced in the 2007 Censuses constitute a landmark in IBGE history and will exert significant influence on the institute's future activities, through:

- the experience obtained from the large scale process of Distance Learning of the IBGE personnel and the attendance of a course in which the PDA and other multimedia resources were used
- the obtaining of coordinates of rural area establishments, which will allow a better quality of field operations in the future, including in sample surveys;
- the increase of the analytical possibilities of information, provided by georeferencing and by the combination of information of geographic base associated to address, as well as the unlimited possibilities of the graphic base in construction; and
- mainly, the rewarded audacity in the digital inclusion of approximately 100 thousand Brazilians in a work of this magnitude.

Assortment of IBGE

Figure 39 - Banner of the advertisement campaign of the 2007 Censuses.

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Annexes

Annex 1 – Municipalities with over 170 thousand inhabitants covered by the 2007 Population Count

Federative Unit	Municipalities with over 170,000 inhabitants covered by the 2007 Population Count (1)	
	Number	Names
Brazil	**21**	
North Region	**6**	
Rondônia	1	Porto Velho
Acre	1	Rio Branco
Amazonas	1	Manaus
Roraima	1	Boa Vista
Amapá	1	Macapá
Tocantins	1	Palmas
Northeast Region	**11**	
Maranhão	2	Imperatriz São Luís
Piauí	1	Teresina
Rio Grande do Norte	2	Mossoró Natal
Paraíba	2	Campina Grande João Pessoa
Alagoas	2	Arapiraca Maceió
Sergipe	2	Aracaju Nossa Senhora do Socorro
Central West Region	**4**	
Mato Grosso do Sul	2	Campo Grande Dourados
Mato Grosso	2	Cuiabá Várzea Grande

(1) Municipal population estimates - 2005.

Annex 2 – Municipalities with over 170 thousand inhabitants not covered by the 2007 Population Count, by Federative Unit

(continues)

Federative Unit	Municipalities not covered by the 2007 Population Count (1)	
	Number	Names
Brazil	**129**	
North Region		
Pará	4	Ananindeua
		Belém
		Marabá
		Santarém
Northeast Region		
Ceará	5	Caucaia
		Fortaleza
		Juazeiro do Norte
		Maracanau
		Sobral
Pernambuco	6	Caruaru
		Jaboatão dos Guararapes
		Olinda
		Paulista
		Petrolina
		Recife
Bahia	7	Camaçari
		Feira de Santana
		Ilhéus
		Itabuna
		Juazeiro
		Salvador
		Vitória da Conquista
Southeast Region		
Minas Gerais	13	Belo Horizonte
		Betim
		Contagem
		Divinópolis
		Governador Valadares
		Ipatinga
		Juiz de Fora
		Montes Claros
		Ribeirão das Neves
		Santa Luiza
		Sete Lagoas
		Uberaba
		Uberlândia
Espírito Santo	5	Cachoeiro do Itapemirim
		Cariacica
		Serra
		Vila Velha
		Vitória
Rio de Janeiro	15	Barra Mansa
		Belford Roxo
		Campos dos Goytacazes
		Duque de Caxias
		Itaboraí
		Magé
		Mesquita
		Niterói
		Nova Friburgo
		Nova Iguaçu
		Petrópolis
		Rio de Janeiro
		São Gonçalo
		São João de Meriti
		Volta Redonda
São Paulo	44	Americana
		Araçatuba
		Araraquara
		Barueri
		Bauru
		Campinas
		Carapicuíba
		Cotia
		Diadema
		Embu
		Ferraz de Vasconcelos
		Franca
		Guarujá
		Guarulhos
		Hortolândia
		Indaiatuba
		Itapevi
		Itaquaquecetuba
		Jacareí
		Jundiaí
		Limeira
		Marilia
		Mauá
		Moji das Cruzes
		Osasco
		Piracicaba
		Praia Grande
		Presidente Prudente
		Ribeirão Preto
		Rio Claro
		Santa Bárbara D'oeste
		Santo André
		Santos
		São Bernardo do Campo
		São Carlos
		São José do Rio Preto
		São José dos Campos
		São Paulo
		São Vicente
		Sorocaba
		Sumaré
		Suzano
		Taboão da Serra
		Taubaté

Annex 2 – Municipalities with over 170 thousand inhabitants not covered by the 2007 Population Count, by Federative Unit

(concluded)

Federative Unit	Municipalities not covered by the 2007 Population Count (1)		Federative Unit	Municipalities not covered by the 2007 Population Count (1)	
	Number	Names		Number	Names
South Region					Caxias do Sul
Paraná	8	Cascavel			Gravataí
		Colombo			Novo Hamburgo
		Curitiba			Passo Fundo
		Foz do Iguaçu			Pelotas
		Londrina			Porto Alegre
		Maringá			Rio Grande
		Ponta Grossa			Santa Maria
		São José dos Pinhais			São Leopoldo
Santa Catarina	5	Blumenau			Viamão
		Criciúma	**Central West Region**		
		Florianópolis	Goiás	4	Anápolis
		Joinville			Aparecida de Goiânia
		São José			Goiânia
Rio Grande do Sul	12	Alvorada			Luziana
		Canoas	Distrito Federal	1	-

(1) Municipal population estimates 2005.

Annex 3 – Items and Variables of the 2006 Census of Agriculture Questionnaire

1) Identification and location of the agricultural establishment

- Federative Unit, Municipality, District, Sub-District, Census Track, Questionnaire;
- Geographic Region, Mesoregion, Microregion, Metropolitan Area;
- Status and type of census track (urban/rural and special/non-special);
- If the collection of information will be held in another Municipality (decentralized collection);
- If it originates from family settlement projects; and
- If it has a telephone line and electronic mail (e-mail).

2) Identification and characteristics of the agricultural holder

- If they belong to cooperatives and professional associations;
- Legal condition of the agricultural holder: individual, condominium, cooperative, corporation, etc.;
- Management of work: the agricultural holder, third party, administrator and community;
- Locality of residence of the manager: in the establishment, in the Municipality, in another Municipality; address;
- Sex and age;
- Place of birth and nationality of agricultural holder; and
- Level of schooling of the manager and how long this person has been in charge of the work in the agricultural holder.

3) Characteristics of the establishment

- If it is registered with the National Directory of Legal Entities (CNPJ);
- If it uses electricity (in the residence or agricultural holder);
- Access to electricity: bought, ceded, generated, and from what source (solar, wind, hydraulic and other);
- If there are consumer goods (including computers with Internet access);
- If it uses traction force (animal or mechanic) and from what origin (own, community, ceded, etc.);
- If it has technical guidance and from what origin (government, own, cooperatives, etc.);
- If it uses agricultural practices (terraces, slash and burn, planting in contour line, fallow, crop rotation, etc.) and which one were applied in 2006;

- If it uses application of limestone or other soil pH correctives;
- If it applies manure in crops or pastures, and what products are used;
- If it applies pesticides for controlling plagues and diseases, and what equipment/vehicles are used ;
- The destination of empty casks and packages from pesticides;
- If and what type of equipment is used for individual protection - EPI in pesticide application;
- The number of persons intoxicated by pesticides;
- If and what alternatives methods are used to control plagues and diseases; and
- If it uses organic agriculture, and if it is certified by an accredited entity.

4) Area of the agricultural holding in the reference date

- If the agricultural holding has an area;
- Total area and what unit of measurement is used in the agricultural holding - hectare, *alqueire, tarefa, braça*, etc. (Brazilian land measures) (There are different values of *alqueires, braças* and *tarefas* in the Brazilian states. For example, 1 *alqueire paulista* is 24,200 m², 1 *alqueire fluminense* is *27,225* m², *alqueire geométrico* is 48,400 m²*;* 1 *braça de campo* is 14,250 m²; 1 *tarefa* is 237 m², 3,025 m², or 3,630 m².)
- The composition of the areas (owned, rented, occupied, in partnership and ceded); and
- The form of obtainment of land - bought from a private owner or by rural credit, inherited, prescription and land reform.

4.1) Distribution of lands of the agricultural holding

- What are the respective areas of crops, forages, floriculture, pastures, woods and forests, tanks, lakes and dams, constructions and improvements, useless and damaged land.

4.2) Value of investments in land, permanent crops, planted woods, pastures and real estate

- The total value of incorporation, in 2006, of new areas to the agricultural holding.

4.3) Total value of land, permanent crops, planted woods and real estate

- The value of these areas, on 12.31.2006, according to the evaluation of the agricultural holder.

4.4) Utilization of the land of the agricultural holding

- What system of soil preparation is used (conventional cultivation, minimum tillage, direct sowing, none);

- Existence of fountains, rivers, lakes, dams, wells and cisterns;
- If irrigation is applied, the irrigated area, the method applied and the origin of the water used.

5) Storage units in the agricultural holding

- Quantity and capacity – forage silos, deposit silos, silos for grain and other products, cooling milk tanks.

6) Implements, machines and vehicles

- Number and characteristics of tractors, ploughs, rails, strimmers, seed drills, combine harvesters, pulverizers, manure spreaders, reapers, traction vehicles (animal and mechanic), vessels and aircrafts;
- The total value of investments in the acquisition of implements (new and used), in 2006; and
- The total value, on 12.31.2006, of agriculture implements, machines and vehicles of the agricultural holding.

7) Employed persons in the agricultural holding

7.1) Relatives of the agricultural holder or administrator

- Persons (men, women and children) who helped them, in 2006, in the activities of the agricultural holding, by working days;
- Wages paid (in money or products) to these persons;
- How many of these persons were employed in the agricultural holding on 12.31.2006, by sex and age group; total number of persons who received wages, knew how to read and write, had professional qualification and lived in the agricultural holding;
- How many had economic activities (agricultural or not) outside the agricultural holding.

7.2) Non-relatives of the agricultural holder or administrator

- Total employed persons (permanent, temporary or partners) and other (men, women and children) working in agricultural holding activities, in 2006, by working days;
- Paid wages (in money or products) received by these persons;
- Total employed persons and non-paid persons related to them who were working in the agricultural holding on 12.31.2006, by sex and age group; total persons who earned salaries, had professional qualification and lived in the agricultural holding; and

- Temporary employees: how many were hired by the agricultural holder; how many by intermediaries; the daily wages paid, total expenses with hiring and the tasks they were hired to perform.

8) Livestock and poultry

- Existence of animals in 2006 (large, medium, small size);
- If the activity is integrated to industry and expenses paid by the integrator;
- If there was manure treatment and what method was used; and
- If there was control of diseases/parasites and pasture rotation.

8.1) Cattle

- Born, put down, bought and slaughtered in the agricultural holding in 2006;
- Production of milk: milked cows and occurrence of mechanic milking;
- Total milk produced (crude, pasteurized and processed), average unit price (produced and sold);
- Total number/distribution by age group and value of cattle on 12.31.2006;
- Quantity (by age group) and value of cattle sold in 2006;
- Main purpose of livestock (slaughter, milk or work);
- If there were animals tracked or confined; and
- Occurrence of additional feeding, pastures outside the agricultural holding, artificial insemination, embryo transfer, buying and selling of semen.

8.2) Buffaloes

- Quantitative, value and composition of herd on 12.31.2006;
- Value of buying and selling of semen or embryos in 2006;
- Quantity (by age group) and value of buffaloes sold in 2006; and
- Production of milk: milked female buffaloes, total produced milk and average unit price, and total milk sold in 2006.

8.3) Horses

- Total number and value of animals on 12.31.2006, total born and put down in the agricultural holding, total value of purchased and sold in 2006; and
- Value of purchase and sale of semen in 2006.

8.4) Asses and Mules

- Total number and value of animals on 12.31.2006, total born and put down in the agricultural holding, total value of animals purchased, sold and slaughtered in 2006.

8.5) Hogs and pigs

- Total number and value of animals on 12.31.2006, total born and put down in the agricultural holding, total value of purchased, sold and slaughtered in 2006; and
- Occurrence of artificial insemination, value of purchase and sale of semen/ embryos in 2006.

8.6) Goats

- Total number and value of animals on 12.31.2006; total born and put down in the agricultural holding, total value of goats purchased, sold and slaughtered in 2006;
- Value of purchase and sale of semen and embryos; and
- Production of milk: milked goats, total milk produced, average unit price and total milk sold in 2006.

8.7) Sheep

- Total number and value of animals on 12.31.2006; total born and put down in the agricultural holding, total value of sheep purchased, sold and slaughtered in 2006;
- Value of purchase and sale of semen / embryos; and
- Production of wool: fleeced sheep, quantity of wool produced and average unit price of kilo, and total wool sold in 2006.

8.8) Hens, roosters, pullets and chicks

- Total number and value of animals on 12.31.2006;
- Main purpose of livestock; and
- Animals and eggs bought and sold in 2006 (eggs sold for consumption and incubation);
- Total born, put down and slaughtered in agricultural holding.

8.9) Other poultry

- Species, total and value of species; quantity and value of purchase and sale; production and sale of eggs.

8.10) Rabbits

- Total number and value of animals on 12.31.2006; total and value of purchased, sold and slaughtered in 2006.

8.11) Apiculture

- Production of honey, wax and sub-products in 2006; total hives on 12.31.2006; expenditure with swarm of bees in 2006.

8.12) Aquaculture

- Environment of breeding (salt, sweet, brackish water);
- Species and value of production of fish, shrimps, oysters and mussels in 2006.

8.13) Frog culture

- Total and value of production of meat and sub-products of frogs in 2006.

8.14) Sericulture

- Total cocoons and average unit price, in kilograms, of sold silkworm cocoons, in 2006.

9) Vegetal Production

- Survey of all products of vegetal origin, total trees of silviculture and permanent crop produced in the agricultural holding in 2006;
- Main destination of production (consumption or sale);
- Quantity produced and sold; average unit price of sold products;
- Total planted area (permanent crop) on 12.31.2006; harvested/cut area (total figures of silviculture and crops) in 2006;
- Existing units (total figures of silviculture and products of permanent crop) on 12.31.2006;
- Units cut/ harvested (total figures of silviculture and products of permanent crop) in 2006;
- Units planted in 2006 among total figures of silviculture (more than 500 units) and products of the permanent crop (more than 50 units)[10] in 2006;
- Utilization of irrigation (horticulture and products of the permanent and temporary crop) and fertilization in 2006;
- If production is integrated to industry (tobacco or other type) and what expenses are paid by the integrator;
- Total number of planted forest trees existing in the agricultural holding on 12.31.2006;
- Production obtained from extraction of planted or forest species (firewood, latex, etc.) in 2006;
- Production obtained from extraction of non-planted forest species (firewood, açai, yerba mate, carnauba, latex, etc.) in 2006;
- Production obtained from horticulture and floriculture: total produced, traded and consumed in 2006;

[10] For up to 50 units, it is registered if there was production only for consumption and, if there was sale, besides the value of production, the value of sale and the destiny consumption/sale.

- Type of seed used (temporary crop): certified, transgenic, common;
- If combine harvesters were used;
- Types of planting (simple, associated, interspersed and mixed); and
- Main month for planting (temporary) and for harvesting (permanent and temporary).

10) Rural Agriculture industry

- For products of animal and vegetal origin transformed or processed in the agricultural holding: quantity of raw material by origin, processing installations, quantity produced and sold, average unit price and destiny of production.

11) Fuels and lubricants

- Quantity consumed and average price of the product used in the agricultural holding.

12) Financing or loans

- Purpose (investment, costing, trade and maintenance);
- Cause of not obtaining (no personal guarantee, bureaucracy, does not know, etc.); and
- Origin (banks, cooperatives, governmental programs, etc.) and value of financing.

13) Debts and liabilities

- Value of debts and to whom they must be paid.

14) Other expenses

- Total value of expenses with renting, production storage, acquisition of raw material, transportation, sacks and packaging, buying of seeds and rations, banking interests, taxes and fees, etc.

15) Other revenues

- Total value of revenues with sale of animals, humus, manure, rural tourism, mineral extraction, service rendering, workmanship, sale of fish, transportation, sacks and packaging, buying of seeds and rations, etc.

16) Authentication

- The register of the person providing information (agricultural holder, administrator, relative, overseer, employee, other).

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