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##### Technology

### **Colombia connected with the eCenso (electronic-census)**

#### **Note by the Colombian National Statistic Department (DANE)**

##### *Summary*

Colombia just conducted (January–April 2018) its first electronic census with very good results, even compared with the international experiences: 10.2% of the population was counted through this innovative mechanism. This result is a concrete example of how the digital culture is evolving in the country, and the beginning of the transformation DANE has undertaken to conduct a modern census. The main results and lessons learned from the electronic census are presented in this paper.

## I. Introduction

1. Colombia just conducted (January–April 2018) its first electronic census with very good results, even compared with the international experiences: 10.2% of the population was counted through this innovative mechanism. This result is a concrete example of how the digital culture is evolving in the country, and the beginning of the transformation DANE has undertaken to conduct a modern census.
2. The 2018 National Housing and Population Census was conceived as a technology-intensive statistical operation throughout all the processes that support its implementation. This perspective includes the pre-census and training processes, to the development of a 4-phases operation. The first phase was the electronic census or eCensus, and the subsequent three correspond to the traditional field operation.
3. The Colombian eCensus bet on 6 key elements; it needed to:
  - (a) Be easy, usable and accessible (including all the accessibility features for persons with disabilities), without affecting the thematic objective of the questions;
  - (b) Be developed as a web application;
  - (c) Have a technological infrastructure scheme and database synchronization;
  - (d) Have a robust citizen support service, with experience in statistical operations;
  - (e) Have a broad communications strategy for the diverse audiences, messages and media; and finally;
  - (f) Be precisely coordinated with the field operation.
4. The results and lessons learned from the electronic census will be presented for each of the features mentioned above.

## II. The 2018 census

5. In Colombia, since its inception, the censuses have incorporated the technical guidelines and recommendations of international organizations, as well as technological developments that have identified the progress of this statistical operation.
6. The DANE in fulfillment of its mission objective carries out population censuses and to date, 17 population and 6 housing censuses have been developed, the most recent being the one carried out in 2005, which met the recommendations of the United Nations, of the world programme of national censuses round 2000.
7. After thirteen years, Colombia is in census mode in 2018. This large census operation is carried out in four phases.
8. The first phase lasts three months and corresponds to the electronic census. The second phase has three months of duration and as part of the same will be conducted in 481 cities where 61.59% of the population is located, the operational team required for this phase is 13,272 people. The third phase lasts two months and covers 551 municipalities with 34.39% of the population and 14,536 people. Finally, in phase four, the operation will be carried out in 90 municipalities in which 4.02% of the population of indigenous and black communities is concentrated, for this phase an operation team of 4,593 people will be required.
9. Decree 1899 of 2017 establishes the guidelines for carrying out the 2018 census in the country, which gives DANE the faculty to carry out this statistical operation in conjunction with public sector entities.

10. This document presents the key aspects of the design of the first version of the country's electronic census and presents the results and lessons learned from this process.

### **III. A technological census for 2018**

11. For the DANE, the 2018 census involved a firm commitment to the incorporation of technology in the different components and moments of the operation. Three components are highlighted: Call for the general public, Learning and selection; Collection and quality assurance and coverage.

12. In the Census Call, Learning and Selection process, we went from a physical collection of resumes to the creation of a digital platform for the registration of personnel, whose participants, in order to be elected, must pass a course that will be digital in most of the country, in b-learning mode.

13. In the collection process, an electronic census or eCensus was carried out for the first time in the country, which represented an innovation in the way in which census information is collected from households, and later the aspects related to the design of this platform and its operation will be detailed.

14. As will be seen later on, the collection of information by household self-determination implied structuring a process for the georeferencing of the location of these households, thus facilitating the process of field verification.

15. Additionally, the collection of information in the face-to-face census is carried out through mobile capture devices with GPS and with the version of the questionnaire in an APK to make the completion more agile and thus optimize the performance of census takers. Likewise, and to guarantee the security and confidentiality of each questionnaire, the information is encrypted.

16. In the process of ensuring the quality and coverage of the census, where there is a Monitoring and Control System (MCS) that is fed by the sending of text messages (SMS) from the DMCs each time a census taker located somewhere in the country completes a questionnaire (household). The system also has as input the transmission of the questionnaires (complete and incomplete) that are made every day at the end of the day.

17. This has allowed for greater control of the operation through the generation of indicators of operational progress (what is collected in the field should be promptly stored in the database) and of yields per census taker (number of questionnaires carried out per person per day).

18. Moreover, MCS has a geographical viewer for coverage control to verify operational progress in the territory.

19. In addition to the positive impacts of the incorporation of technology in terms of greater control and monitoring of each process, as well as the reduction of costs for process optimization, it is important to note that this incorporation of technologies has been made with human resources from DANE with in-house development software. This is essential for capacity building.

### **IV. Colombia's first electronic census – eCensus**

20. The eCensus was the first phase of the National Population and Housing Census 2018, which is being conducted in a digital version and is an innovation in the way census information was collected.

## A. International experience

21. The first thing we did was to study with great application the experiences of other countries that have successfully implemented electronic questionnaires for the census collection in their territory, such as Canada, South Korea, New Zealand and Australia, among others, and that have more than a decade of experience in conducting electronic censuses.

22. The reasons for tackling this type of collection strategy in statistical operations are multiple, according to the literature related to the subject: changes in the conformation of households towards single-person households, which makes it difficult to locate people to answer the census form "face to face", the wear and tear on information sources, the mobility of the population, as well as the trend towards the massification of mobile devices with the Internet and the growing generation of digital culture.

23. Likewise, according to the international experiences identified, web collection strategies allow for improving inter-census population estimates, as well as the collection of potentially usable information for the construction of censuses, based on administrative records.

24. It should be noted that in all cases, achieving considerable coverage by this means has required at least two or three electronic census applications, even in countries with an advanced digital culture tradition. In Australia, for example, in 2006 only 10% of Australians used the electronic census, in 2011 this figure reached to 35% and in 2016 nearly to 70%.

25. From the review of international experience we learned that the countries in which this strategy has been successful are characterized by:

- (a) Have good connectivity conditions;
- (b) Populations with higher levels of education and even a culture and tradition of census self-determination;
- (c) These citizens are accustomed to interacting in this way with the State, and in several cases they send their completed questionnaires by post.

## B. Digital context in Colombia

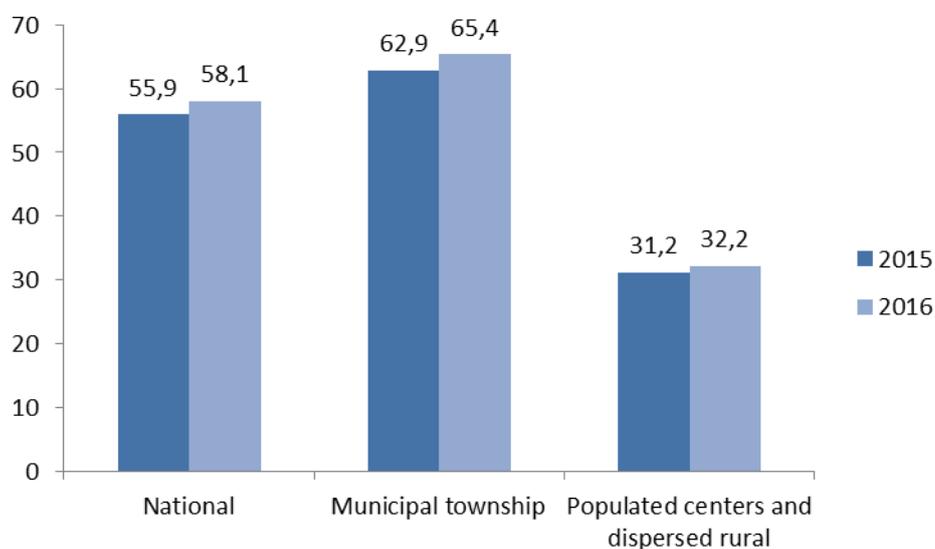
26. One of the situations that is leading countries to address the collection of information from the Census via the web is related to the increase in digital literacy, for this reason, a brief account of the conditions for the use of information and communication technologies – ICT – in households and individuals is given below, based on the sources available in the DANE.

27. The ICT household's module, which is included in the Quality of Life Survey (LCS), presents the basic indicators of ICT tenure and use in households and individuals. The target population of the survey is people aged 5 years and older. The annual sample is approximately 20,141 households. With this sample, expanded results were obtained for 13'148 households and 43'474 people, which constitute the entire country.

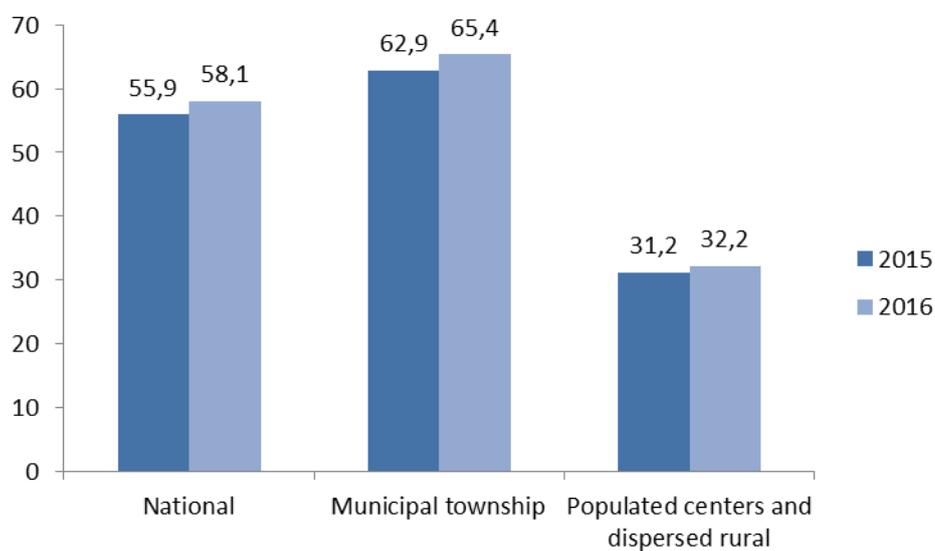
28. According to the LCS results in 2016, in Colombia 58.1% people reported use of the Internet anywhere from any device for the total national population. Likewise, of these people who said they had accessed, 70.4% did so through a cell phone.

29. This confirms that in Colombia the use and access to the Internet show that the conditions exist to initiate a strategy of this type.

Graph I  
**Percentage of people aged 5 years and over who claimed to use internet 2015–2016**  
 Source: DANE QLS 2015–QLS 2016



Graph II  
**Percentage of people aged 5 and over according to devices used to access the Internet 2015–2016, National**  
 Source: DANE QLS 2015–QLS 2016



### C. Electronic census design

30. A review of the international experience and the Colombian context highlighted the challenges of implementing such a strategy.

*Summoning citizens effectively to join the process*

31. One of the main differences between the Colombian case and the international experience is that the geostatistical frame of reference for the census is not found at the household level, which does not allow the target population of the strategy to be convened beforehand, so an open call scheme was proposed for the general population, with emphasis on specific groups such as public servants.

*Moving from a direct interview process to a self-administration process*

32. Considering that in the case of Colombia, the traditional process of collecting census information is carried out by direct interview and that implementing an electronic census implies the self-completion of the information by households, it was necessary to develop an electronic questionnaire that would facilitate this process, which would have help and definitions to facilitate the understanding of the questions, but would also be quick, intuitive and easy to use.

33. It was also determined that it was important to have a service to accompany citizens, answer their questions and thus ensure the quality of the information reported.

34. Effectively articulate the eCensus with the other phases of the census operation. Finally, carrying out the eCensus by open call implied guaranteeing the effective articulation of the eCensus and the door-to-door operation between April and June to visit again the homes electronically censused and carry out a short verification of the process.

35. With these challenges in mind, six key elements were identified for the design of the electronic collection strategy.

**1. Adequate census questionnaire to be easy, usable and accessible**

36. This is the first time that the country has proposed an electronic strategy for the collection of information from the National Population and Housing Census via the web. However, DANE already has experience in virtual collection in other statistical operations.

37. Currently, DANE carries out the process of collecting 26 statistical operations via the web, which demonstrates the expertise that the entity has for the development of applications and their maintenance, and allowed important lessons to be learned for the development of the census questionnaire. However, taking into account that the questionnaire should be completed autonomously by the general public, designing the eCensus involved the work of a multidisciplinary team in charge of adapting the questionnaire to a web version without losing sight of the objectives of the questions.

38. Taking into account the specific expertise and technical knowledge required to adapt the census questionnaire to a self-fulfilling scheme. The development of this component was carried out jointly with ViveLab, the Usability and Accessibility Laboratory of one of the most important public universities in the country.

39. Usability is a measure of the ease of use of a web application, it is important to ensure that the relationship with potential users is effective, efficient and satisfactory. The process of adapting the eCensus followed the principles of the methodologies implemented by Norman Nielsen Group, as part of which steps are established to facilitate the design, implementation and analysis of a test of tasks with users.

40. The DANE and ViveLab teams worked together to adapt the questionnaire. The DANE's role with its thematic experts focused on proposing a phrasing of the questions in accordance with the self-determination, establishing the aids and definitions required for the process and structuring the set of validations and flows that the questionnaire should have.

41. ViveLab's work focused on the review process of experts in usability and accessibility of the proposed questionnaire, as well as on testing different types of users (ethnic, people with disabilities, youth, adults, etc.) and proposing adjustments to both the design and development of the questionnaire to meet the standards required on these issues in the technical standards.

42. The development of the e-Census as a digital platform accessible to people with visual or hearing disabilities (total or partial) was carried out taking into account the Colombian Technical Standard NTC 5854, the WCAG Web Content Accessibility Guidelines of the World Wide Web Consortium W3C (1999) and the Recommendations for the Web Development of Accessible Pages for the Deaf Colombian Population INSOR (2009). In addition to this, validations were carried out with users who had some kind of disability (3 users with total blindness, 2 users with low vision and 4 deaf users) as a result, the range achieved at the end of the process is presented.

43. The eCensus tests were carried out in the laboratory, using as a tool the specialized Morae software in its three versions (Manager, Observer and Recorder) with which audio and video recordings of the work section are made, the methodology of thought was applied, in which each participant narrates the actions he or she carries out while a facilitator guides him or her through a series of tasks, thus identifying errors or successes in terms of content and interaction. The analysis of the results was carried out using the simultaneous observation methodology with experts from the laboratory and DANE personnel.

44. As a result of this process, an electronic questionnaire was available that meets the thematic criteria to be an ideal instrument for collecting information, which is also easy and quick to complete, since it has aids and definitions, as well as counting the flows and validations according to the characteristics of the people and has an accessibility bar for completion by people with visual or hearing disabilities. The accessibility bar has the features of color and letter contrast on the screen, video in sign language and the use of Jaw readers.

## **2. Be developed as an adaptive web application for mobile phones, tablets and computers**

45. Given that most people connect to the Internet from a cell phone, being responsive was a necessary attribute for the eCensus. Also all the attributes of usability, use of drop-down menus with text search to select department and municipality for example, radio buttons for multiple selection questions, have the ability to hide or show the accessibility bar, display a video with the question translated into sign language with just one click of an icon. Show help text when the cursor is moved over the text, among other features that fit the type of device was a challenge from the development and even more important the partial saving that allows to resume several times the diligence.

46. The accessibility component involved our engineers using best practices in structuring the algorithms, such as tagging all the objects on the screen so that Jaws-type readers could be used to read the questions.

47. An agile development methodology and an iterative testing scheme was the process followed in the construction of the eCensus.

## **3. Having a technological infrastructure and database synchronization**

48. The infrastructure provided for the electronic census took into account not only the storage aspects but also the high levels of attendance that were expected, especially around the time of closure. Information security was another of the most important aspects of infrastructure development.

49. Figure I shows how the eCensus works in terms of capturing and transmitting information.

Figure I  
**Process of capture and transmission in the eCensus**



**Data Center  
 DANE**

**4. Accompanying the citizen with customer service (chat, calls, mail)**

50. In order to facilitate interaction between citizens and the eCensus, it was considered necessary to have a service that could resolve the concerns and queries of citizens at the time of registration and completion of the electronic questionnaire using chat, voice and e-mail channels.

51. Two levels of care were defined:

- (a) Basic Support (Agents and Supervisors): in the first level, the agents attend to the concerns and queries presented by the users who communicate;
- (b) Specialized Support (Thematic and IT): the queries that could not be attended by the basic support are transferred to a second level, who are responsible for solving the most complex cases.

52. The infrastructure necessary for its operation considered:

- (a) Work centers;
- (b) Communications Software and Licenses;
- (c) Computer equipment;
- (d) Activation of the toll-free line 018000;
- (e) Fixed telephones and headsets.

**5. Communications Strategy for all target audiences: private, public servants**

53. Having a communications strategy that promotes and encourages web diligence is fundamental to achieving the target participation rates.

54. For the electronic census, a communications strategy was designed with a first moment of expectation and the generation of alliances with public and private entities. Subsequently and once the eCenso brand or concept is installed, the focus of the strategy would be to maintain interest in the process by expanding its reach from social networks and free press to a broader scheme in mass media (television, radio, press). From the design stage it was considered that the role of communication should also be to provide explanations and recommendations to citizens on the process, another important aspect of communication was

the possibility of timely dissemination of the results of the progress of the eCensus in the country.

## **6. Accurate articulation with the field operation, verification process**

55. As part of the design it was established that all homes would be visited as part of the sweep operation. For this purpose, the georeferencing of these homes had to be guaranteed in order to facilitate their identification in the field operation.

56. The georeferencing process required the development and integration of sophisticated standardization, normalization, semantic analysis methods and geographic algorithms to provide the results of the eCensus in a georeferenced manner at the household level, which allows data consolidation in the corresponding geographic units and greater control of coverage in the on-site operation.

57. Finally, and as a result of all the aspects mentioned above, the general outline of the eCensus is presented.

58. It is based on a call open to all resident citizens, with a special focus on public<sup>1</sup> servants in which people are invited to enter the eCensus, create an account and complete the census at home.

59. The households that complete the electronic questionnaire are georeferenced in parallel with the operation, which allows the updating of the geostatistical framework and guarantees coverage control.

60. All electronically censused households are then verified in the sweep that begins a couple of weeks after the electronic census is completed. At this time, households provide the census taker with the code that generated the questionnaire once the eCensus was completed. The census takers have the database of persons counted electronically and can consult by code or identification card of a member of the household. For identified households, it is further verified whether there was a change in the location of the dwelling. In cases where there has been a change in the location of the dwelling, the census taker may take the information in this chapter again, additionally, households may report at the time of the visit or if there has been a change in persons.<sup>2</sup>

61. In 2015 the design of the eCensus began and that same year we had an early victory when we conducted the first pilot test with public servants, for this test a prototype questionnaire was available that had a very good performance.

62. In 2016, a more far-reaching test was carried out, as it included part of the general public and the eCensus was also applied in the experimental census of Jamundi.

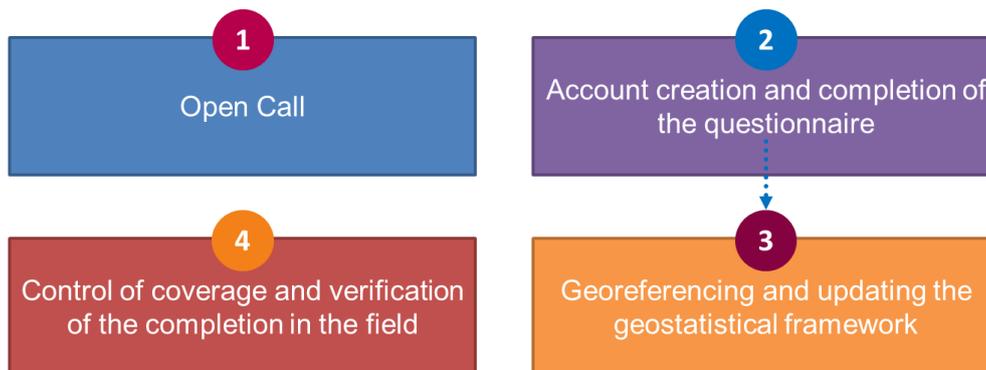
63. During 2017 and based on the results of the tests, we focused on strengthening the design of the electronic questionnaire, on the availability of the technological infrastructure and on usability and accessibility issues.

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<sup>1</sup> Decree 1899 of 2017 established the obligation to carry out the electronic census by public servants.

<sup>2</sup> Two types of novelties were defined that could appear in the household affecting their conformation: a) arrival of a new member b) departure of some member of the household.

Figure II  
General scheme of the eCensus



## V. Implementing the eCensus

64. Since December of last year, we began the work of disseminating the eCensus, leveraging for this purpose on the same information technologies, social networks, and local radio stations. The general concept is that fill the eCenso is as easy as taking a home selfie. The strategy was launched in networks with the intention that the mass media would be interested in that many messages and develop the news on their own.

65. Another important component of the communications strategy was partnerships with public and private entities to promote due diligence.

66. Since the end of 2017, significant progress has been made on security issues with the creation of a Unified Command Post made up of entities that are experts in the identification and monitoring of cybernetic risks.

67. From January 9, 2018 to April 12, the electronic census was available for completion by citizens and public servants throughout the country as part of the first phase of the census.

68. On the 9th, a press conference was held to launch this innovation to the public, the launch was a success and there was a rapid increase in the number of visitors to the site, surpassing what had been initially planned.

69. On January 10, a maximum attendance of more than 126,000 sessions was achieved. In response, the capacity of the infrastructure was increased to improve the response times of the application. In that first week, we reached 91,000 households registered electronically.

70. With the launch of the eCensus, opponents of the process began to emerge amidst the complex political and social context of the country. In the first week, fake news began to circulate about the use of census information collected through this mechanism.

71. In this context, we started the second week of the electronic census in which the fake news also cast doubt on the security of the application, negatively impacting the levels of attendance on the page and the number of households that completed the questionnaire. Due to this situation, between the second and third week, a little more than 120,000 households were added.

72. In response to the situation, the communication and media strategy was strengthened, and the Director continued to socialize in the main cities in an educational effort to explain the benefits of the process to the public and to provide them with guarantees regarding the security and use of the information.

73. In February, the scope of the communications strategy was expanded even further, which allowed alliances with public and private actors to materialize in massive electronic census days called: eCensatones, in this personal DANE scheme supported the completion of the eCensus by employees of the public and private entities allied using the infrastructure provided by the entities, the results in terms of the completion began to improve, this week there were 87,000 households and the following more than 116,000.

74. In the sixth week of the operation, two ethnic communities, the Misak people and the urban council of the Cofán people, asked DANE to accompany them so that their homes could be counted electronically.

75. In the following weeks, the communications strategy is strengthened and the messages are oriented to remember that the closing time is near. Likewise, in order to guarantee an optimal response to the eCensus in the operational closing due to the high estimated attendance, a lighter version of the electronic questionnaire was implemented and the capacity of the technological infrastructure was expanded for the first closing date. At the end of the eighth week of the operation, 196,000 homes were added.

76. In the ninth week of the operation, it was announced that the deadline for the due diligence would be extended by one month, starting from the excellent results of the process, which had materialized in the optimization of the georeferencing process, which allowed the date of the closing of the eCensus to be closer to the beginning of the on-site operation. This week, more than 200,000 homes were added.

77. The month following the extension of the deadline, a significant improvement in the performance of the eCensus was achieved, as well as an increase in the number of staff available to attend to citizens' queries and concerns. The citizen service was increased by 87.91% with the support of the technical areas of DANE to increase the capacity of response by chat, one of the most used means by citizens. With Holy Week in the middle, the communications strategy was focused these days on promoting diligence as part of the vacation by appealing to the ease of the process and the possibility of doing it comfortably from the cell phone. However, the rest period affected the level of the diligence for these days.

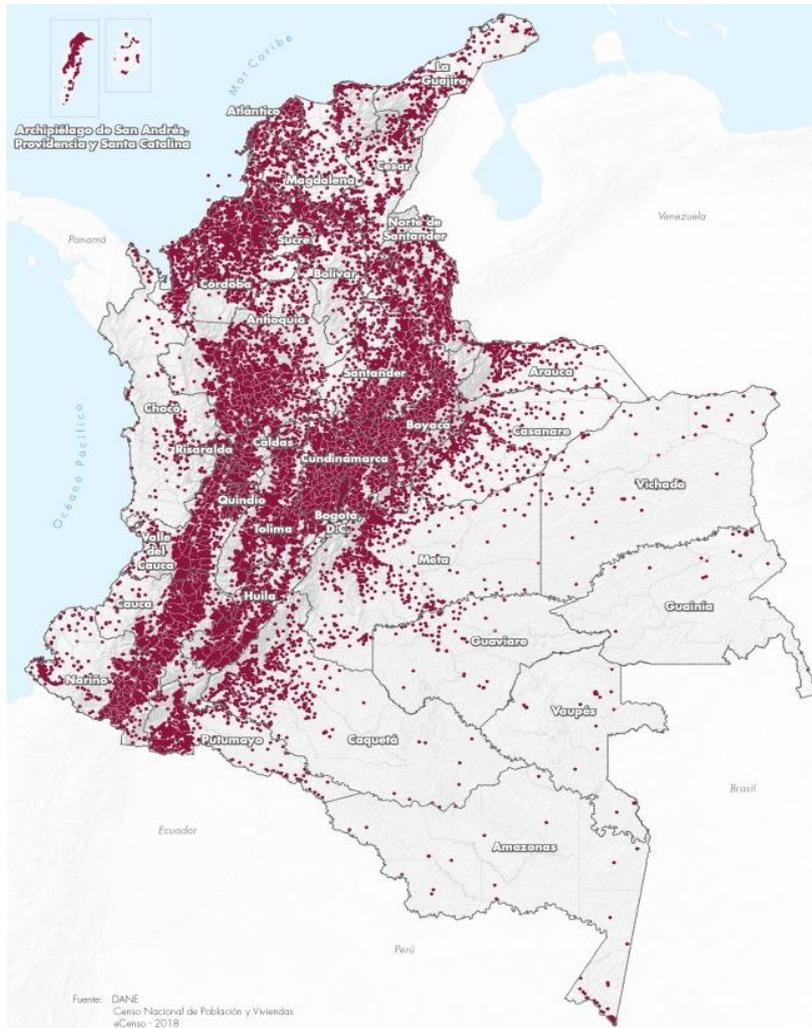
78. The eCensus was open for the creation of accounts and completion of the electronic questionnaire until midnight on 12 April. This day, as expected, all the previously observed limits of attendance and diligence were exceeded. On this day alone, more than 120,000 homes were electronically registered.

79. Below are the results delivered to the country on April 13, the day after the eCensus closed, this is clear evidence of the gains in the timeliness of the information generated from the incorporation of technological innovations.

80. The main result of this strategy is that Colombia connected to the eCensus, 5,048,492 people were registered electronically, 48.47% men and 51.53% women, representing 10.2% of the population.

81. In the 1,101 municipalities and the Island of San Andrés there are eCensed persons, and in 19 of the 20 non censoredalised areas there are eCensed persons. This can be seen in the map of points that represents the households electronically censored (Map I). There are eCensado households in the connected urban country but also in the dispersed rural one where we have reached thanks to the participation of public entities at the local level and to strategies such as the Vive Digital stations or the diffusion of the eCensus in local community radio stations.

Map I  
**Distribution of questionnaires completed through eCenso**  
 Source: Geostatistics



82. More than 50% of the eCensados are people from Bogotá and four departments.

Table 1  
**Results eCensos for main regions**  
 Source: DANE, Census and Demography

Region	Persons	Percentage of Men	Percentage of Women
Bogota	1.566.232	47,08%	52,92%
Antioquia	604.424	48,80%	52,20%
Cundinamarca	382.969	48,43%	51,57%
Valle del Cauca	381.055	47,85%	52,15%
Santander	198.755	48,67%	51,33%

83. The five capital cities with the highest proportion of eCensus in relation to the population are presented in Table 2.

Table 2

**Results eCenso in capitals***Source: DANE, Census and Demography*

Capital	Persons	Percentage of Men	Percentage of Women	Population Participation
Tunja	44.342	47,29%	52,71%	22,35%
Bogotá	1.566.232	47,09%	52,91%	19,19%
Popayán	51.467	49,03%	50,97%	18,11%
Puerto Carreño	2.936	52,79%	47,21%	17,85%
Mocoa	7.854	53,45%	46,55%	17,67%

**A. People with functional diversity (disabilities)**

84. In the eCensus, 10,510 people with visual or hearing impairment used the accessibility bar to complete the questionnaire.

**B. Two indigenous peoples bet on the eCensus**

85. These indigenous communities of the country expressed their interest in being registered only by means of the electronic form. An urban town council of the Cofán people located in the city of Cali in which 195 people were electronically censused and the Misak people of the Guambia reservation, located in the south of the Colombian Andes, where 3,269 people were electronically censused.

**VI. Conclusions and lessons**

86. Without a doubt, the Population and Housing Census of 2018 is setting milestones in our country. We are confident that this effort to provide the country with the census and properly anonymized databases will be the most important input for development public policy and allocation of resources for territorial entities over the next ten years.

87. It will help us to demonstrate to the inhabitants of the Colombian territory that the electronic census is the kindest way to communicate their needs so that decision makers can design public policies adjusted to those needs. This experience will also serve to consolidate DANE's interest in conducting modern, expeditious, inclusive, ecological and safe censuses. And this, together with the use of administrative records for statistical purposes, will undoubtedly result in more timely and quality official statistics for the benefit of all the inhabitants of Colombian territory.

88. For the next years the work will focus on expand the use of online electronic questionnaires to collect information from households.

89. The electronic census is an evidence of the great benefits that statistical offices can obtain from the incorporation of technological innovations in their processes. This not only guarantees fundamental aspects of the statistical task such as the coverage and quality of the information, but also important improvements in the timeliness of the information.