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Lessons learned from censuses of the 2020 round

Combined Census of population, households and dwellings in the Republic of North Macedonia, 2021

Note by State Statistical Office of the Republic of North Macedonia*

Summary

The Census of Population, Households and Dwellings in the Republic of North Macedonia 2021 was conducted from 5 to 30 September 2021. All activities planned for the Census were successfully completed and the State Statistical Office (SSO) is satisfied with this operation, considering that we did not have a clear picture of what we would face in the field after 20 years. During the Census, the use of the new combined census method (combination of data from multiple administrative data sources with field data) was implemented. For the first time, practical and widespread use of administrative sources for census purposes, new technologies for data collection through on-line electronic channels as well as new organisation for census data acquisition, requires enormous organizational, intellectual and financial efforts, which are applied into the Census. Compared to the classic field enumeration, data processing of the combined census which took place in the Republic of North Macedonia 2021, is much more demanding and complex. The availability of administrative data can significantly improve the quality of outputs on population as administrative data could be also used to replace imputations and the most important, it could be used as a trustworthy source for solving under-coverage and over-coverage. This is a big experience for a SSO - facing many innovations in a short time in order to produce quality and comparable census data. In this paper we give an overview of the experience, summarize main points, identifying the positive and negative aspects of using the combined census method.

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NOTE: The designations employed in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

I. Introduction

1. The first combined Census of Population, Households and Dwellings in the Republic of North Macedonia in 2021 was a success story from several points of view. After 20 years, (due to the fact, that we did not conduct the 2011 Census) the Census of population, households and dwellings 2021 was not an option – it was a necessity.
2. The Census of Population, Households and Dwellings in the Republic of North Macedonia 2021 was conducted from 5 to 30 September 2021 and is successfully completed. For the first time, practical and widespread use of administrative sources for census purposes, new technologies for data collection through on-line electronic channels as well as new organisation for census data acquisition, required enormous organizational, intellectual and financial efforts, which are applied into the Census.
3. Use of the advanced combined census method has been implemented with the following main elements:
 - (a) Creation of pre-census database using data from administrative data source;
 - (b) Web self-enumeration of citizens of North Macedonia living abroad;
 - (c) Traditional door to door direct enumeration using trained census staff;
 - (d) Use of laptops with integrated application for data collection based on structure and content of questionnaires for individual enumeration units;
 - (e) On-line interaction between pre-census database, respondents and temporary census database during fieldwork.
4. The 2021 Census of Population, Households and Dwellings in the Republic of North Macedonia was as a whole conducted in compliance with international standards.
5. The total costs of the Census (7,6 million EUR of which 3 million EUR for laptops for fieldwork that are now used for educational purposes and by public administration) places North Macedonia among countries with the lowest costs per capita (4,1 EUR). Total costs include 0,5 million EUR additional expenses due to postponement of the fieldwork.
6. Less than six months were spent on data processing and final data were announced on 30 March 2022. This is a big experience for the SSO - facing many innovations in a short time in order to produce quality and comparable census data.
7. The census results are reliable, trustworthy, valid and useful for economic and social policy planning, as key objective of the Census. According to the data from the Census 2021, in the Republic of North Macedonia:
 - (a) Total resident population is 1 836 713;
 - (b) 598 632 Households;
 - (c) 839 174 Dwellings.

II. General issues for the 2021 Census

8. A combined census is a method of producing data on census units (population, households and dwellings) by statistically linking together existing administrative and statistical data sources with data from fieldwork enumeration. Prerequisites for undertaking such a project are:
 - (a) Legislation which enables the linkage of data from different sources. The Statistical Office of the Republic of North Macedonia, has in accordance with Articles 24 and 25 of the National Statistics Act the right to collect, use and link data from different administrative and other collections for statistical purposes only;

- (b) Establishment of appropriate administrative and/or statistical sources with unique identifier (e.g. PIN- Personal identification number);
- (c) Appropriate topics in the sources which cover all demands of users and legislation.

9. **Census Law** - was adopted at the end of January 2021, only two months before the primary projected start date of field enumeration in April 2021. Due to the unpredictable COVID situation, the beginning of the fieldwork had been postponed for 5 September 2021 which is the reference date of the Census. It is important to state here the Eurostat position: “The Census Law and the Methodology were recently shared with Eurostat. In most respects, they are broadly compliant with the relevant standards defined in the European Union's statistical legislation, although EU legislation is not yet binding on North Macedonia as a candidate country.”

10. **Methodology** - Another important development in transparency of census taking was the publishing (for the first time) of the complete methodological document: *Methodology for preparing, organising and conducting the Census of Population, Households and Dwellings in the Republic of North Macedonia, 2021 of 4 February 2021* which contained a description of the combined enumeration method and census technology, a list of census topics with definitions and categories (breakdowns) of each census topic and individual census questionnaires.

11. Two main international methodological documents have been respected and almost fully implemented:

- (a) *Commission Implementing Regulation (EU) 2017/543* of 22 March 2017 laying down rules for the application of Regulation (EC) No 763/2008 of the European Parliament and of the Council on population and housing censuses as regards to the technical specifications of the topics and of their breakdowns;
- (b) *Conference of European Statisticians Recommendations for the 2020 Censuses of Population and Housing*, United Nations, New York and Geneva, 2015.

12. Taking into account the country specifics, needs and also the experience from the 2011 cancelled census, the decision for online enumeration of North Macedonian citizens living abroad is an innovative solution which could be followed by other countries that face huge emigration and lack quality and updated data on citizen outflows. The data collected are important for revision of international migration data from previous decades and for other socio- demographic analyses.

13. Actual stay of at least 12 months before the reference date is the time threshold for determining usual residence in the case of international immigration. The same methodological solution is applied for respondents living abroad.

14. In general, also the definitions and classifications of census variables from EU Regulation and UNECE Recommendations are harmonised with international standards.

Table 1

Census topics/variables by census units and respective documents

Census unit	Total	EU Regulation	UNECE	National	Other
TOTAL	71	27	22	13	9
Building	6	2	3	1	
Dwelling	18	7	5	4	2
Household	6	2	1	3	
Person	41	16	13	5	7

Category “Other” includes processing variables and identifiers

15. **Pre-census database** - Creation of pre-census database (here in after PCD) and use of data in the fieldwork and later also for data processing was one of the main novelties in the 2021 Census. PCD has been set up on the basis of several administrative and statistical data sources with information from Population Register (Ministry of the Interior and Ministry of Information Society and Administration) as a primary (base) source:

- (a) AVRМ (Employment Agency)
- (b) FZOM (Health Insurance Fund)
- (c) MON (Ministry of Education and Science)
- (d) PIOM (Pension and Disability Insurance Fund)
- (e) SOC (Ministry for Labour and Social Policy)
- (f) UJP (Public Revenue Office)
- (g) Statistical surveys on graduates and enrolment in tertiary education (State Statistical Office)

16. PCD used for enumeration consisted of 2,608,921 active records, meaning live persons with registered residence in the country. Besides the key linkage variable (PIN), there are 33 variables of which 13 were used for simplification of fieldwork or they are intended to be checked during the interview. The basic demographic variables Name, Surname, Sex, Age (calculated directly from date of birth as part of PIN) and Citizenship were covered completely. The following 8 variables covering educational and economic characteristics of respondents were available:

- (a) Educational attainment (776,000)
- (b) Field of educational attainment (273,000)
- (c) School attendance – level of the educational programme (291,000)
- (d) Field of the educational programme (45,000)
- (e) Occupation (460,000)
- (f) Industry (642,000)
- (g) Source of livelihood – pension (320,000)
- (h) Source of livelihood – social transfers (307,000)

17. The most important aspect of the PCD beside simplification and rationalization of the work of the enumerator is the improved quality of data. Some data like name, surname, sex and age have been directly transferred from PCD after entering the PIN of the respondent – the enumerator just had to verify the identity of name and surname. The most important topics in the PCD from field collection perspective are data on occupation and industry which are the most demanding for answering as the definition of occupation (job) is quite complex. On the other hand, industry concerns the employer's activity and it is not directly connected to individuals which is even more demanding for respondents.

18. **Application for field data collection** - To enable the optimal application of advanced IT and telecommunications technologies for the purposes of the census the SSO establish an IT Census System, supplied by three IT contractors that provided software solutions and IT assistance for all operations within the census with direct two-way data transfer for the Census. Technical solutions for field on-line data collection that enable real-time interaction between pre-census database, respondents and storage of data into temporary census database demand intensive communication, cooperation and collaboration between companies that have been selected by the public tender. The application for field data collection consists of three modules: supervising, census cartography, and implementation of complete census methodology.

19. **Module for user administration** - This module covers organizational and supervising issues and it is hierarchically structured in terms of rights ranking from top management to state and regional instructors. The User Management System is user-friendly and allows full flexibility from an organizational point of view while the Reporting System gives real time information on the number of enumerators currently working in the field and the number of respondents enumerated during the chosen / selected period. On the basis of the Reporting System, daily information on the number of enumerated census units have been published on the SSO website.

20. **The GIS module** - allows direct geo-referencing of data by attaching the X and Y coordinates to the centroid of the building. It is easy to navigate inside the enumeration area, to select a building for enumeration and to have control of the work inside the enumeration area. Visualisation of the buildings with different colours of the centroid points depending on the status of the enumeration is another good solution for the effective work of enumerators. There could be discrepancy between the date of taking of satellite photos and the de facto situation in the field. Despite regular updates of maps (powered by ESRI) there could still be maximum delays in some places of up to three years. Beside the correction of address (street name, house number) which is the more administrative part, the most valuable functionality for the census operation is the possibility to add a new building (new centroid) with just one click. The GIS module incorporated into application for fieldwork presents innovative solution that could be considered as best practice for census fieldwork.

21. **The application for data collection** - was user-friendly and simple to handle but demanded highly skilled and trained staff. The enumerators just had to follow the logic and routing of the questions even without knowing all underlying methodological solutions and rules. Most enumerators were generally skilled to perform enumeration and they managed to use the application for data collection without difficulties.

22. Censuses are the biggest challenge that official statistical offices have to deal with. In fact, they are not only a data collection question but a logistical operation.

23. Public announcements for 506 regional instructors and 5055 enumerators for 50 Enumeration Regions were published between 20 July and 5 August. Due to the unexpected non-interest of candidates for regional instructors and enumerators (there was lack of field census staff in the 30 enumeration regions), there were three additional announcements with prolonged the opportunity to apply on the SSO website (until 12, 17 and 25 August respectively). The selection of candidates for field staff concludes with successfully passing a test.

24. The following solutions were implemented during the enumeration period to resolve the shortage of field staff:

- (a) additional engagement of new staff who passed a short one-day practical training;
- (b) delivery of a new enumeration area to already selected enumerators who have finished their basic enumeration area;
- (c) inclusion of regional instructors for fieldwork;
- (d) redistribution of enumerators in the last days of fieldwork from small municipalities to those with the highest under-coverage at that time.

25. The dates of the training sessions for different levels of hierarchical structure of field operation were organised as follows:

- (a) State instructors – at the SSO premises from 14 August to 20 August (multiple groups with different agenda regarding relation between methodology and practical work according to the knowledge and experience from the spring round);
- (b) Regional instructors – at the seats of the Regional Census Commissions from 24 August to 26 August lasting 3 days (similar as in spring round);

- (c) Enumerators – three days of training but a few days before the census reference day from 29 August to 31 August (before the new school year started on 1 September as in many municipalities the schools were the venue of the training).

26. Web self-enumeration of Macedonian citizens residing abroad, due to work or personal reasons, had been foreseen to take place in the period from 01 March to 21 April 2021 using specially designed online application. The postponement of the census did not affect the enumeration of persons living abroad and the application was available till the end of field enumeration (30 September 2021). The web application was very similar in terms of methodology to the one used for the field enumeration of persons (with the exception of some questions used to determine the usual resident status of respondents) while data on dwellings and households were not collected. Data on the latest address in North Macedonia prior to leaving the country were collected for determining the origin of emigrants. The web application was primarily intended for self-enumeration of long-term emigrated citizens but was also used for enumeration of diplomatic representatives and other officials sent abroad by government or other institutions/enterprises. Registration was possible only from outside the country, e-mail address, the PIN of respondents and their family members were pre-condition for taking part in self-enumeration. The application itself was very user-friendly, available in 8 languages – the seven languages used in North Macedonia and English.

27. Pre-enumeration for certain categories of the population (prisoners, soldiers and homeless) successfully was completed in the period from 28 August to 04 September 2021.

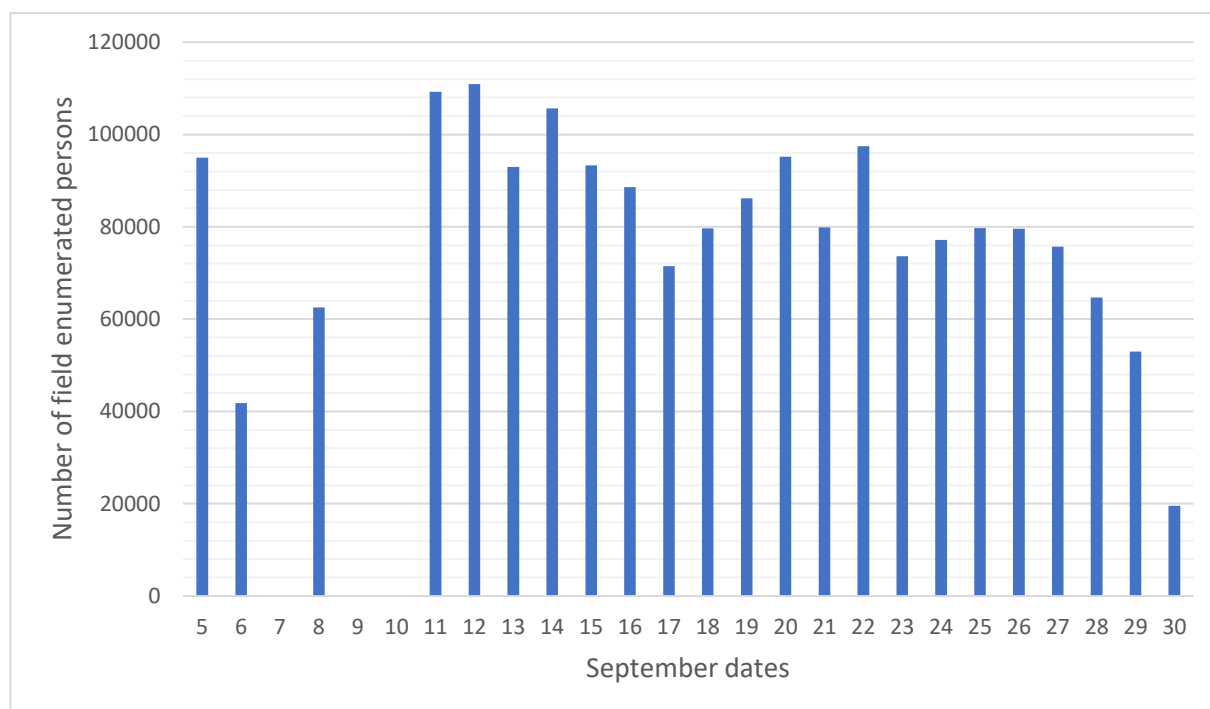
28. Field data collection started very successfully without any technical problems on Sunday, 5 September at 8:00. On the first day of the field work 95,000 persons were enumerated. SSO started to publish daily from 6 September onwards the number of enumerated persons, households and dwellings. Data were taken from the monitoring system every evening at 20:00.

29. From 6 September to 10 September, there were unrecognized and unsolved technical problems making it impossible to access the census application or limiting access for a low number of users. As a consequence, only 104,000 persons were enumerated in total during those five days.

30. After technical improvement and adaptation of the application, the most successful days were Saturday (11 September) and Sunday (12 September) with 109,000 of enumerated persons and 111,000 respectively. From 16 to 24 September the daily average number of enumerated persons was: 83,000 persons. The average size of the household was 3.23 members. The average time to enumerate most common four-members household living in an individual house or in a dwelling in multi-dwelling building was 15-20 minutes. If there had been no technical problems and interruptions in the functioning of application, despite the shortage of enumerators, the data collection process could have been concluded at least 98 per cent by 26 September.

31. On 24 September the SSO published on its website the information that citizens not enumerated yet in order not to miss anyone in the census, are allowed to go to certain locations in their municipalities and complete their civic and legal duties. About the same time, the SSO put the most efforts to replace enumerators from regions where the enumeration was almost completed to the regions with highest under-coverage based on information on the number of enumeration areas not assigned to any enumerator yet and the estimate number of centroids in those areas.

Figure I
Enumerated persons by date of field data collection



32. The SSO set up a very effective monitoring system which allowed information to be extracted on field work at any point of time by selecting starting time and current time. Two main outputs were available in a real time for the whole country: number of enumerators currently working in the field or that worked in the field during a certain period of time (Users) and the number of already enumerated persons during selected time period. Equally important is information on the number of enumerated persons by municipality.

33. **COVID Protocol** - This protocol prescribed measures and procedures which aim to minimise the risk of transmission of the disease COVID-19 for all participants in the testing phase, training phase and the phase of conducting the Census in the field. There was a special protocol for enumeration of persons who were positive for COVID-19 or isolated at home in the period of conducting the Census.

34. It was important that all census participants respect the COVID-19 Protocol, during the training process – based on four full-day personnel participation – most aspects of the Protocol were respected (such as measuring of body temperature at the entrance of the schools where most training took place, availability of hand disinfection, delivery of face masks to every census participant). COVID protocols were respected also during fieldwork with following implications:

- (a) all enumerators and other field staff wore face masks at all time during enumeration;
- (b) enumeration outside the dwelling (in multi-dwelling buildings also in the main corridor or on the balcony).

35. **Public relations and media coverage** - In general, the respondents were very well informed about the census and they welcomed enumerators. COVID protocols were respected by all enumerators. In most cases, respondents had already prepared necessary documents with PIN in advance so the enumeration went smoothly without extra waiting time. Another positive reaction from the respondent regarding the data that were available from the pre-census database on their educational attainment, occupation and industry which were not updated in several cases to the current state. Respondents understood the reasons and accepted explanations by enumerators without misunderstanding.

36. There was strong and very positive media coverage at the beginning of the field enumeration aiming to promote the necessity of the census for the country, to persuade respondents about the importance of participation in the census and to spread information of safe enumeration despite pandemic as many of enumerators were vaccinated. The enumeration in some selected households was covered by several TV stations across the country.

III. Data processing

37. Data processing followed in great manner the strategy and implementation of the Strategy for data processing, adopted at the end of November 2021. Only six months were spent for data editing.

38. The main advantages of the combined census method are the possibility to link directly collected data by field/web enumeration with data available in different administrative data sources and the possibility to overcome two basic census problematic areas on defining usual resident population: over-coverage and under-coverage.

39. Data on usual resident population stock were validated by using data on quality indicator URS_ADM which represents the probability that the record from the field / web enumeration belongs to the usual residence population. Indicator URS_ADM is calculated on the basis of six quality indicators derived from each individual database. Two main criteria were included to set up the methodology:

- (a) Hierarchy of the sources - three main quality components have been elaborated (relevance, coverage and timeliness);
- (b) Date of the last update – taking into account the census methodology to determine usual resident population (12 months);

40. The main stages of the data processing (statistical editing) were:

- (a) Completeness and uniqueness of the personal identification number (PIN) as the key variable for data linkage and removal of duplicates;
- (b) Solving multiple records - unexpectedly high number was consequence of records cancellation and automated generation of duplicate records in case of crash of application;
- (c) Determine of residency status of each record as a basic methodological solution for later derivation of preliminary population stocks;
- (d) Validation of data on preliminary usual resident population stock as one of the main advantages of the combined census method;
- (e) Solving under-coverage by imputing records from administrative target population;
- (f) Replacement of records on persons by changing basic unique identifiers (building, dwelling, household);
- (g) Household / family correction combining automated and manual editing as the most time-consuming stage due to in advance expected unsatisfactory quality of input data;
- (h) Final stage of usual resident population editing at the level of record with emphasis on missing values that were replaced from administrative data sources, 2002 Census or directly from Census 2021 at the individual level without statistical imputation.

Table 2
Census 2021 data on population, households and families

Enumerated population	Number	Share (%)	Population stock	Number	Share (%)
TOTAL	2,192,778	100	TOTAL	2,097,319	100
Field data	1,855,249	84.61	Usual resident population	1,836,713	87.57
Web data	204,804	9.34	Temporary present population	1,674	0.08
Imputed records	132,725	6.05	Population living abroad	258,932	12.35
Usual resident population	Number	Share (%)	Households / families	Figures	
TOTAL	1,836,713	100	Number of private households	598,632	
			Persons living in private households	1,833,702	
Men	911,087	49.60	Average private household size	3.06	
Women	925,626	50.40			
			Number of families	538,348	
			Persons living in families	1,634,189	
			Number of children in families	629,236	

IV. Dissemination - only final data are disseminated

41. The announcement of the final results of the Census are in batches, according to the Programme and action plan for publishing the results of the Census, adopted in November 2021. The end of 2022 is the deadline for finalizing the tabulation and dissemination of the 2021 Population and Housing Census.

42. Beside Press release, the SSO published on the same day (30 March 2022) on their website following products:

- (a) [Brochure](#)¹ with infographics and interesting facts (2 pages only)
- (b) Bi-lingual [News Release](#)² (in Macedonian and English) with 17 tables in PDF form and short basic methodological explanations (3 pages)
- (c) 17 tables in [MakStat database](#)³ (PX-Web) under folders Censuses – Population Census 2021 – First dataset

43. The first datasets were mostly dedicated to the so-called sensitive variables which represent 11 out of 17 PDF tables and 7 out of 11 PX-Web tables.

44. So far, (September 2022) five data sets have been published on the MaksStatbase PX-Web) which represent in total 83 tables under folders Censuses – Population Census 2021 on the website of the SSO.

45. By the end of the year we plan to prepare two new data sets, Census Atlas, Publication of the main features from the published tables on the MakStat database.

¹ <https://www.stat.gov.mk/InfoGraphic/2022/Broshura-en-web.pdf>

² <https://www.stat.gov.mk/pdf/2022/2.1.22.10Popis-mk-en.pdf>

³ <https://makstat.stat.gov.mk/PXWeb/pxweb/en/MakStat/?rxid=46ee0f64-2992-4b45-a2d9-cb4e5f7ec5ef>

V. Future activities

46. The main goal of the SSO and other state institutions before the next census round shall be the improvement of the quality of administrative data and the reduction of over-coverage in population register:

- (a) Raising the awareness about establishing an address register.
- (b) Establishment of population register and timely maintaining.
- (c) Raising the awareness among the ministries and agencies who have registers to regularly and timely maintain them, upgrade and update them.
- (d) Persuading citizens to update their ID's according to their usual place of residence.
- (e) Building preconditions for register-based census.