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Report of the Sub-regional Workshop on Census Cartography and Management

Lusaka, Zambia, 8-12 October 2007

Table of Contents

I. Introduction

Background and objective of the workshop:

1. The purpose of the workshop was to highlight the significant additional capabilities of GIS and other geospatial technologies in census mapping activities, including preparation of enumeration, enumeration operations, advanced analysis and dissemination of census data, and how to successfully implement and use these technologies. More specifically, the objectives of the Workshop were: (1) to present an overview of GIS fundamentals and census geography concepts, including geo-coding systems; (2) to focus on practical data collection and conversion to digital format, and on GIS-based data analysis and dissemination; (3) to show practical examples of use with appropriate software; and (4) to facilitate a dialogue among participants from countries on census mapping with GIS, sharing of experiences and practices, with a focus on institutional, organizational, financial, capacity building including implementation issues. The first day of the Workshop was dedicated to a review of the United Nations Principles and Recommendations for Population and Housing Censuses and a discussion on census management and planning.

Number and list of countries, organizations represented

2. 14 countries were represented at the workshop (Angola, Botswana, Egypt, Ethiopia, Kenya, Liberia, Mauritius, Mozambique, Namibia, Nigeria, Sierra Leone, South Africa, Tanzania and Zambia). International or regional organizations (UNECA, SADC and UNFPA) were also represented. There were 28 participants in total.

Opening session

3. Ms. Efrida Chulu, Director of the Central Statistical Office of Zambia, welcomed the participants and wished them a successful workshop and memorable stay in Zambia, a country well known for its hospitality. She explained that the workshop came at an opportune time for Zambia and in the African region as a whole when preparatory activities for the 2010 round of population and housing censuses such as census mapping are either being planned or being implemented in many African countries. In Zambia, the census mapping will include the use of a combination of GPS and satellite imagery. Fieldwork has just started and is expected to be completed in 2009. The census mapping exercise for Zambia will take about two years to complete at a total cost of US $ 7 million.

4. The single most important major product of the census mapping will be the establishment of a comprehensive frame of enumeration areas which is a pre-requisite for the conduct of a good population and housing census and forms the basis upon which all surveys (both social and economic) are conducted. Some other products of census mapping in Zambia will include a GIS database development, socio-economic databases at all geographical levels of national, provincial, district, locality, constituency, ward and enumeration area. The census mapping will also form a basis for the conducting of the next poverty mapping for Zambia. The CSO of Zambia is also linking the census maps to the needs of the electoral office

(electoral boundaries) and the fifth national development plan (local area statistics for planning).

5. Mr. Dimitri Sanga, Senior Statistician at the United Nations Economic Commission for Africa (UNECA), welcomed the participants on behalf of the Director of the African Centre for statistics (ACS), Mr. Ben Kiregyera. He explained that the UNECA has completed a repositioning exercise which culminated in August 2006 by the creation of the ACS and the design of a business plan covering the period 2007-2009. Population and housing censuses are one of the six programme elements of the statistical component of the Regional Commission's business plan.

6. He pointed out that, despite the recognition by African countries of the importance of population and housing censuses, the history of census taking in Africa has been characterized by irregularity, incompleteness, inaccuracies and subsequently a gross under-utilization of census data. In their quest to reverse the observed historical trend, African countries have undertaken a number of initiatives including the revamping of statistical activities at the UNECA with census undertaking as one of the major programme elements and the inception of the Africa Symposia on Statistical development (ASSD). The latter consists of a series of annual fora where African countries discuss issues pertaining to their statistical development on a regionally coordinated basis. Two such symposia have already taken place. The first one took place in Cape Town in 2006. One of the major outcomes of this meeting was the decision to devote the first series of Symposia to population and housing censuses in order to improve the participation of African countries in the current round. It also considered the African contribution to the revision of the Principles and recommendations on population and housing censuses (P&R). The second Symposium held in Kigali, Rwanda, in January 2007 revisited the P&R and exchange of best practices in census undertaking among African countries. The third one will take place in Accra during the first week of December 2007. These initiatives have benefited a lot from the support of the UNSD and the UNECA. This workshop is in line with these initiatives and the ongoing collaboration between the UNSD and the UNECA in various areas of statistics and statistical development and particularly in population and housing censuses.

7. Mr. Ackim Jere, Senior Policy and Programme Manager-Statistics of the SADC Secretariat, expressed the need to enhance capacity in the area of cartography and GIS, a domain that moves very fast. He mentioned a workshop organized two years ago in the region on the use of GIS, and the necessity to keep track of the implementation of GIS projects in African countries. He wished that this workshop will permit exchange of experience and best practices and encourage the participants to enhance capacities.

II. Summary of discussions

Review of United Nations Principles and Recommendations for Population and Housing Censuses

8. The UNSD presented the revised Principles and Recommendations for the 2010 round of Population and Housing Censuses, and particularly the revision process that has involved a lot of countries in the world, and the major changes from the previous version. This

9. The presentations and the following discussion stressed on the complementarities of the P&R and the addendum. The addendum is more precise than the global P&R in order to ensure better comparability among African countries. It was also noted that the definition of the place of usual residence in the world P&R rev. 2 takes into account the specificity of African countries and proposes two alternate definitions, one based on a 12 months duration, the other on six months. Even if certain countries have already undertaken their census, or the preparation of the census, it was reminded that drafts of the P&R rev.2 as well as of the addendum are available on the web for almost one year now.

10. The question of the implementation of the P&R and the addendum by the countries was raised. Some countries may decide not to implement the recommended set of core topics. It is important that the remarkable work done by African countries to produce the addendum to the P&R will not be lost. The Africa symposia, as they gather members of governments and high level policy makers, are a good place to advocate for a complete implementation of the P&R and the addendum.

11. Some countries will design their census with a short form and a long form. It was agreed that the basic tabulations recommended by the P&R should be produced through the short form at any geographical level.

Discussions on Census Management & Planning

12. The UNSD made a presentation on census management and planning, with an emphasis on quality assurance and risk management. The UNFPA presented the different phases of a census and the role of cartography team along the process, from the preparation to the dissemination.

13. The discussion emphasized on the necessity to associate very early in the census process the team in charge of cartography and the team in charge of the census, if different. If not, there is a risk that the delineation of the enumeration areas will not meet the requirements for dissemination areas. Cartography is to be considered as an integral part of the census process. The census committee must include representatives of the census cartography team and must be created at the beginning of the mapping preparation. It also reinforces the necessity to

understand the census as a programme, that is to say a set of projects, to be considered together.

14. In terms of quality assurance, participants wished to have more precise definitions of the concepts and exchange experiences on this issue. The situation in the region is heterogeneous. Some countries, like South Africa, have already an elaborated quality assurance plan and risk management document. This plan describes each risk with the estimation of the likelihood and of the impact for prioritization purposes. Other countries, less advanced in this area, would like to benefit from these experiences. It is suggested that UNSD and UNECA collect such documents and make them available on their respective websites.

15. The importance of a pilot test, as part of the quality assurance process was stressed by the participants. More generally, participants expressed the need to take into account monitoring and quality assurance at every stage of the census, including staff selection and training.

16. Budgeting all the phases is of critical importance in the preparation of the census. A credible budget plan is needed to convince the government and donors. The discussion engaged around the usual estimation of one dollar per capita. This estimation is not really proven and doesn't take into consideration technological investments. For example, Zambia will spend $ 7 million to prepare the census cartography using satellite images, but will benefit from this investment for the next censuses. There may also exist fixed costs whatever the size of the population. Participants expressed their wish to deepen the knowledge of the cost of a census, especially the rationale behind the 1$ per capita estimation, and to share information. UNSD informed the participants that it will send a short questionnaire on the cost of a census, with breakdown by major headlines. UNFPA has also information on the budget of the censuses in the region.

17. Some examples of preparation in the countries: Botswana is doing the project plan for its 2010 census. Mozambique has just undertaken the enumeration, and built a project plan to prepare the census. Kenya has planned the next census for 2009, but has not yet developed a comprehensive project plan and budget. Mauritius has prepared a calendar of activities for the 2010 census. Tanzania will start the elaboration of a project and budget plan in a few days time.

Review of EGM on Contemporary practices in census mapping and use of GIS

18. The recommendations of the expert group meeting on contemporary practices in census mapping and use of GIS held in New York in May 2007 were discussed by the participants. The handbook on geographic information systems and digital mapping is considered by the participants highly valuable, even in its first edition before revision. Participants expressed the wish to have larger dissemination of the printed version, as some countries face problems to download large documents from the web and after printing them. The French edition of the handbook is requested as soon as possible. The handbook will be translated in the six official languages of the United Nations, but translation in other languages can be undertaken by countries.

19. The handbook should reflect African specificities and the participants proposed to take part of its revision. It was suggested that UNSD send to the participants the draft version of the revision, and invite experts from Africa to the next expert group meeting in April 2008 to approve the revision. UNECA offered to coordinate the African contribution to the revision of the handbook before the expert group meeting.

20. The question of exchange of skills is critical in such a fast moving field. Participants felt that African countries should be pro-active in organizing training and knowledge transfer. The example of Namibia, which built a partnership with the Polytechnic Institute to create specific curricula in the domain of GIS and ICT, may be followed by other countries. UNECA organized a meeting in Tunis with other regional organizations to elaborate a training programme for African statisticians and reinforce training capacities in the region. The Statistical Training Programme for Africa shall be the umbrella for exchange of skills initiative.

21. Costs of the maps and software are an important issue. It is noted that often the NSO has to buy maps or images from the national mapping agencies of private providers. A way to lower prices is that countries agree on the choice of a software package in order to obtain better prices. Regional or sub-regional organizations can help to manage agreement and negotiate with vendors. SADC, for example, has a technical committee that can manage this sort of issue. Regarding mapping agencies, the best way is to advocate for the creation of a National Spatial Data Infrastructure (NSDI), to gather different stakeholders in the domain of geographical information and organize cooperation among them. For example, the mapping agency may benefit from the improvements provided by the field work undertaken for the census. It is also possible and recommended to classify the areas in terms of modifications. Slow changing areas can be covered by older and cheaper maps, whereas fast growing areas need to be updated with recent (and more expensive) maps. (South Africa)

Discussion on the situation of census mapping with GIS in the participating countries

22. The question of the delineation of the enumeration areas (EA) was debated with examples from Botswana, Ethiopia, Kenya, Liberia, Mauritius, Mozambique, Tanzania and Zambia. The size of the EA is usually between 70 to 200 households, with variants in urban and rural areas. To estimate the number of households prior to the delineation of an EA, many countries undertake a first visit to meet with local authorities and ask for the population size in each area. The size of the EA is linked to the enumeration period: the greater the EA is, the longer the data collection period will be. In some rural areas, it is necessary to reduce the size of the EA to take into account the distance to be covered by the enumerator. Nevertheless, some villages are too small and must be aggregated with other villages to be covered by one enumerator. The question is then to keep track of the identification of each village for dissemination purpose. One solution is to constitute one EA per village and to give more than one EA to an enumerator. Another solution is to code each census record (housing unit or person) with the indication of the locality. In this matter as in many others, the right way is to start from the needs of data and move backward to the preparation of the census. Another problem encountered in the region is that village boundaries are not strictly fixed.

23. The enumeration of nomadic populations was also discussed with the example of Ethiopia. The enumeration of sedentary population has started in May 2007. Nomadic populations will

be enumerated in pastoral areas in November, with the consequence of different reference date.

GIS Fundamentals/ GIS Database design

24. UNSD presented the basic GIS fundamentals and concepts, with a focus on the information cycle, the notion of projection and the difference between the two fundamental types of data representation: raster and vector. The conceptual model for the design of a geographical database and related spatial analysis were also presented. Comments were made about the necessity for the database administrator to be fully aware of the GIS concepts in order to proper organize the database for geographic information purposes.

Data Collection and Data Conversion

25. UNSD made a presentation on the concepts and methods used for data collection, from existing maps, aerial photography, satellite images, and on methods used for data conversion (scanning, digitizing) and integration. A demonstration of ArcScan, an ESRI easy-to-use set of tools for raster-to-vector conversion, was presented by GIMS, a South-African provider of ESRI products, giving a practical example of "vectorization" of scanned maps. A practical exercise provided the participants with the opportunity to delineate on-screen enumeration areas from a satellite image.

Spatial Statistics Applications & Issues and the use of Geospatial Technologies

26. Geospace International gave a presentation on the use of GIS technologies in census mapping. Traditional mapping is fieldwork intensive and requires important logistics. Paper maps are often in poor quality and cannot be processed. The modern approach uses satellites images or aerial photos as basis, requires less fieldwork and maps are available on soft copies. The modern approach has been used by South Africa (2001), Namibia (2001), Tanzania (2002) and Lesotho (2006). Currently, Zambia and Ethiopia are using it for the preparation of their next census. The Geospace representative described the process flow and the case study of Lesotho. Administrative boundaries have to be overlaid before delineation of the EAs. The demarcation process is based on a set of rules, such as the respect of the administrative boundaries, average size and some consideration of shape. Each EA can be given attributes: type (urban/rural, formal/informal…).

27. Participants made comments about the cost of satellite imagery as well as cost of fieldwork. Even if images are expensive, it is possible to share the costs with other partners, especially in the context of the National Spatial Data Infrastructure (NSDI), and the fieldwork cost is also very expensive and time consuming. A good compromise is to be found between office work and field work.

28. UNSD and ESRI presented the concepts and methods used to geo-code, through matching or direct collection. The use of Global Positioning System (GPS) was presented through a demonstration. Different kinds of devices can be used, with different levels of accuracy, and consequently of price. The main problem when using GPS is multi-path, that is to say reflection

of the signal on buildings or trees. This can make the geo-coding problematic in dense urban areas.

29. The Definiens representative presented the application of segmentation using the software developed by the company. The principle is to simulate the process of the image recognition and analysis undertaken by the human brain. The algorithm creates polygons of same features from an image, typically satellite imagery. It can be used to delineate EA, for example by identifying formal or informal settlements, of vacant areas, or even buildings or housing units.

Dissemination Issues

30. UNSD recalled the importance of census dissemination, as emphasized in the *Principles and Recommendations for Population and Housing Censuses*, and presented some of the applications of geospatial technologies for the dissemination of a census. Area selection, user-defined areas or interactive delineation of areas, for example school districts, are examples of direct applications. It is possible to determine buffer zones around a point, as a hospital, and calculate the population living within a certain distance from this point. The visualization of area of influence, or spatial smoothing modeling techniques can help to give more power to map visualization. The *Census Info* project, based on the development of new functionalities for DevInfo, was presented as a possible country customizable tool for the dissemination of the 2010 round censuses.

31. The discussion provided some other examples of use of GIS for dissemination, as the calculation of average distance, for example to a public facility. The existence of other free dissemination tools as Redatam was mentioned.

Case studies of National Experience:

32. In **Zambia**, the methods used for mapping the1980 and 1990 census were based on manual methods with prismatic compasses and drafting. For the 2000 Census, GPS technology was used to update map features but still manual plotting and drafting of maps was employed. **GIS** has not been used in pre-census cartographic activities, but the technology was widely used in the 2000 census analysis to produce Census atlas and Thematic Maps. All 2000 EAs were digitized and the administrative boundaries created (province, district, constituency and ward). GIS was used to disseminate demographic data at these levels. The 2010 Census mapping method is largely GIS-based with imagery as the base map. GPS will be used to update the locality listing and community infrastructures. The size for EA is 60 to 100 households in rural areas and 100 to 150 households in urban areas. For the 2010 Census Mapping, a Locality name boundary file will be created for dissemination of small areas statistics. The Challenges facing the Office with regards to GIS use are inadequate integrated and properly designed data warehouse and database, inadequate awareness within the organization on use of GIS in statistical agencies, lack of adequate institutional support regarding maintenance and sustainability of GIS, inadequate accurate geographic base data and Inadequate equipment and skills development and training issues. The CSO needs also funding and operational assistance. The strategy for 2010 Mapping Program is based on greater GIS data analysis and dissemination possibilities.

33. In **South Africa**, the beginning of the use of GIS was the Project Eagle in 1996, with the aim to capture enumeration areas and place names digitally. Two different consultants captured the data, using different software packages, and the challenge was after to align the EA and Place name boundaries.

34. For the census 2001, both raster and vector data were used: satellite imagery was used to detect major changes, as well as aerial photography for the demarcation of EAs in Urban areas, and videography for rapid changing informal areas. In rapid changing areas that could not be videographed, GPS units were used. The lessons learned from this experience were the importance of adequate budget and human resources, timelines and proper planning, training, and adequate and realistic levels of quality assurance.

35. The current project for the census 2011 is to collect data from SPOT 5 satellite imagery, with complete coverage of the country every 12 months. South Africa has also engaged the development of a dwelling frame, for the use of census, the Labor Force Survey and the Community Survey. Fieldworkers collect coordinates of every dwelling using GPS devices and take a photo of each housing unit. These points are overlaid on the satellite images as well as administrative boundaries. Then, enumeration areas can be demarcated, trough a specific application, by grouping dwellings on the screen. The objective is not to partition the territory but only to demarcate areas where there is population. The main challenges are to maintain up to date the dwelling frame, and to demarcate villages that have no fixed boundaries. South Africa has built a strong experience in institutionalizing technology, under the condition to involve stakeholders from the start.

36. **Namibia** used GIS to facilitate the production of base maps needed for fieldwork for its 2001 census. The country was demarcated into unique geographical areas known as enumeration areas and were captured into the database. GPS (handheld and differential) were used during fieldwork. The problems encountered during mapping and GIS establishment were due to the following factors: (i) GIS was not part of CBS structure; (ii) difficulty with boundary problems, in particular with regard to Townlands; (iii) Lack of trained personnel, in particular of training from the consultancy; (iv) Lack of existing of spatial data; (v) Lack of mapping publicity. Since 2001, CBS Namibia has cooperated with Polytechnic of Namibia to introduce B-Tech in Geo-informatics, and is currently busy setting up a Web-based GIS using open source software-Postgress. Baseline data such as administrative boundaries, infrastructure and scanned topographical maps is collected from various organizations, and integrated into a GIS warehouse. Also integrated with the field demarcation is the collection of institutions and localities. The data is stored in a database named the NamPlan. Digital aerial photographs are produced for areas without sufficient base line data, and used as backdrop to the Enumeration Area maps. Planning for 2011 census is in full swing, including how to improve census mapping publicity, and fieldwork is planned for 2008. Also a Pilot will be conducted to test mapping instruments early 2008. Other important planning activities include the use of satellite images and aerial photos, the capture of dwelling units and the demarcation of EAs in order to make it easy to control and improve dissemination at lower geographical areas.

37. Since 1969, the censuses have been held in **Kenya** every ten years. Maps assist to delineate the country into small manageable counting units or Enumeration Areas (EAs), enable the enumerators to plan their movement within the EA and identify households earmarked for call-backs especially in the urban areas, enable effective supervision, help in determining the personnel, materials and logistical requirements (budgeting) and help in presenting the results of a census. Due to rapid changes in population growth, the government continuously reviews the boundaries of the administrative units. It is therefore necessary that during the mapping for census, these changes are captured and the census geographic and coding frame updated accordingly. During the 1999 population census, the country decided to adopted GIS technology to prepare and produce maps to facilitate that year's census taking. The GIS products were also to be used to disseminate the census results. The project however was not very successful due to various factors such as: late acquisition and installation of the GIS facility, inadequate software user licenses, poor maintenance of the GIS facility, high cost of maintenance service contract; and lack of adequate personnel with appropriate skills.

38. Having drawn from the experiences of the 1999 census, Kenya has launched a project for the 2009 census mapping with the support of the development partners (USAID, DFID, UNFPA). The project was presented to the government and approved in July 2006 for implementation. Arrangements have been made to offer sufficient training to the personnel in the cartographic team. GIS has also been upgraded and a maintenance and service contract signed. But due to delays in the disbursement of funds and to other logistical issues such as the lack of vehicles the work is already lagging behind by 4 months. The field mapping exercise is supposed to be completed by April 2009 and map verification and call backs by June 2009.Regarding the workflow, prior to the delineation of the EAs, the mapping teams accompanied by the village elders/chairmen visit every structure within the village or the residential estate to establish the resident households and then create EAs based on an average size of 100 households. Where boundaries do not follow well defined features e.g. rivers, roads, tracks or footpaths, GPS is used to capture the boundaries which will later be transferred to the base maps or incorporated into the digitized shape files. An important issue in Kenya is the existence of huge urban slums which require very large scale maps if they have to be adequately mapped. To address this problem, census mapping for the 2009 census is making use of satellite images, aerial photographs and GPS.

39. The participant from **Sierra Leone** made a presentation on the extensive use of GPS to delineate enumeration areas (It took them 18 months to collect and integrate point data and produce 9671digital EAs). He indicated that there were no digital base maps and available maps were outdated. Therefore, maps had to be updated by visiting localities and GPS coordinates of administrative boundaries and social institutions were captured. At the same time, household counts of local areas were carried out and based on this information demarcation of enumeration areas was conducted. The EA database will be used for the National sampling frame, delimitation of electoral wards, reproduction of constituency maps, reproduction of administrative maps as well as for spatial distribution of health and education facilities.

Census Management & Planning for the use of Geographic Information Systems

40. The presentation of **Mauritius** described the country experience in the cartographic activities and the setting up of a geographic information system. The main objectives of the cartographic work were to partition the national territory into enumeration areas to ensure the exhaustiveness of the census, build up a geographic information system for the household and population surveys and censuses, and disseminate census data through maps. Current census mapping activities include digitizing boundaries of all administrative boundaries, boundaries of all EAs (of lower spatial level), as well as land features such as roads, rivers, street names etc. EA maps are currently being digitized in AutoCAD and are expected to be completed by end of 2008. Future developments of the GIS would include its use in national surveys and censuses (sample design, workload, allocation, spatial analysis etc..); its adoption with the web as part of the dissemination strategy through integration of interactive maps; its use for the enhancement of the quality and the presentation of the EA maps and thematic maps; and its use to relate socio demographic and economic characteristics to the housing and living conditions of the population by merging records of the Housing and Population Census enabling a more comprehensive analysis of the census data.

41. The presentation of **Ethiopia** described the country experience in cartographic activities which were carried out in traditional way. However, for the third round Population & housing Census, which took places in 2007, the cartographic approach shifted to the use of GPS technology and digitizing. The main objectives of the census cartography work were to: determine the need of manpower that will participate in the census; to distribute equal workload among enumerators; to ensure the completeness of coverage; to determine the amount of materials & logistic needs for the census; to establish statistical frames for sample surveys; and to produce thematic maps for spatial analysis. Regarding the results of census cartographic work, the fieldwork in the sedentary areas had finished in March 2007 (82,799 enumeration area maps, 16562 supervision area maps & 615 “Wereda” maps were prepared for the implementation of the census), but in the pastoralist areas, the census will be conducted at the beginning of next December 2007, where preparatory activities are carried out to use satellite image. Manpower shortage both in cartography, digitizing and GIS teams was stated.

42. The participant from **Liberia** made a presentation on the status of census mapping activities for the 2008 Census. In his presentation, he indicated that the last census was conducted in 1984 and currently, there are no digitized maps and some of the available maps are outdated. Due to the lack of paved roads, the field work is focusing on the delineation of enumeration areas in urban areas. Maps had to be updated by visiting localities and entered into a computer as well as on a field form including GPS coordinates of administrative boundaries and of social institutions. Field work is currently carried out in order to conduct census in March 2008. The objectives of census mapping are to: (i) provide maps for census enumeration; (ii) construct an updated master sampling frame; (iii) develop a geo-referenced spatial database on statutory boundaries, EAs, localities and social amenities; (iv) provide a basis for GIS analysis and dissemination of the census results; and (v) develop capacity in Census mapping/GIS. The expected outputs are as follows: production of maps for census enumeration ; an updated master sampling frame; a geo-referenced spatial database on statutory boundaries, EAs, localities and social amenities; GIS analytical reports on various thematic topics; and an enhanced capacity in census mapping/GIS.

43. UNECA presented the role and activities of its Geo-information system section. The presentation highlighted the paramount interest of spatial data for evidence-based decision making. Issues in sustainable development and achieving the Millennium Development Goals require that all data sets be integrated. Producers are multiple, and there is a need to build National Spatial Data Infrastructures to gather data as well as skills and organize data in a way they can be used by many stakeholders. The AFREF Project aims at creating a common geodetic framework for Africa, a unified geodetic reference frame for Africa to be the fundamental basis for the national and regional three-dimensional reference networks fully consistent and homogeneous with International Reference Frame, and a network of Continuous Operation GNSS Reference Stations (CORS) spread all over Africa. Countries are encouraged to build their data based on this National geodetic network.

Commercial suppliers' presentations

44. Kelly & Kelly (ESRI provider in Zambia), GIMS (ESRI provider in South Africa), Geospatial International (South Africa), Optron (Trimble provider in South Africa), Definiens (Germany) presented their approach and practical solutions to census mapping issues.

III. Recommendations & Conclusions

45. The participants welcomed the addendum to the Principles and Recommendations for Population and Housing Censuses for Africa and urged the UNECA to finalize and publish the final version as soon as possible. They strongly recommended active advocacy for the complete implementation of the P&R and the addendum in the next censuses in Africa. The Africa Symposium for Statistical Development in Accra, 3-6 December 2007, as it gathers high level decision makers, should be an appropriate forum for such advocacy.

46. Participants stressed the importance of census undertaking, and particularly the mapping activities, using project management methods: planning, quality assurance and risk management. The participants requested UNSD to elaborate precise definitions and concepts on that matter, and to organize in collaboration with UNECA exchange of experiences, by collecting country documents and make them available on their respective websites.

47. The meeting emphasized the need to formulate, well in advance, a detailed and credible activities and budget plan for the census, giving breakdown by phases, in order to advocate in favor of the census and to sensitize the government and donors to provide funds. In this regard, participants recommended for enhancement of the knowledge pertaining to census costs, and urged UNSD and UNFPA to collect and disseminate information on census costs by major activities.

48. The meeting recommended to consider cartography as an integral part of the census project and to associate as early as possible the team of cartographers with the census team. In particular, the geographical domain levels on which dissemination is required shall be taken into account for the delineation of the enumeration areas. A possible way is to include representatives from the census

cartography team in the census committee and to create the committee from the beginning of the mapping preparation.

49. The meeting discussed and reviewed different approaches and national experiences in census cartography and emphasized the fact that there is no universal solution that fits for all, meaning that each country should adopt an approach based on its needs and available resources. It recognized however that NSOs that can commit resources and efforts to develop census geography gain to adopt a long-term investment and a continuous process, allowing to develop census geographic databases, statistical GIS databases, spatial analysis and tools for dissemination of census geographic products, and going beyond the production of enumeration area maps for census enumeration and thematic maps for census publications.

50. The meeting called upon the UNECA and the UNSD to coordinate the African contribution to the revision of the Handbook on Geographic Information Systems and Digital Mapping. This would ensure that the Handbook takes into account African context and realities. In this regard, the UNSD shall send a copy of the draft version of the revision and invite African experts to participate in the next expert group meeting in April 2008 for the approval of the revised draft. They also requested the UNSD to ensure a larger dissemination of hard copies of the current and subsequent versions of the handbook.

51. The meeting discussed at length the best ways to improve skills and acquire expertise in the use of geospatial technologies for census geography. It recognized that a well-trained staff is a key factor for the success of GIS-based census mapping projects and proposed the exchange of skills and best practices between countries as an efficient means to acquire knowledge and expertise. The meeting also stressed the fact that some resistance to acquire new methods may be encountered and therefore, it was proposed to set up mechanisms to manage the change ("change management") through communication in a way that can shift from resistance to acceptance.

52. The meeting resolved that the update of skills of NSOs staff is of paramount importance especially when the latter adopts new technology. UNECA and UNSD were therefore called upon to put in place mechanisms aimed at updating the skills of NSO staff in the framework of the Statistical Training Programme for Africa. In addition, there is need to update the curricula of African Statistical Training Centers so as to be in line with new and emerging issues.

53. The meeting emphasized the need to develop acquisition mechanisms in order to reduce the significant costs of satellite imagery, aerial photography, GPS and hand-held devices as well as GIS hardware and software. For example, a regional or sub-regional regrouping of data acquisition and maintenance may constitute a market power and convince geospatial technologies providers to reduce their initial costs. At the national level, the Workshop encouraged the active participation of the NSO, in partnership with other national authorities, in the development of a national geographical information capacity, including the National Spatial Data Infrastructure (NSDI).

54. The meeting called upon African countries to use the GIS technology in the analysis and dissemination of statistical information in order to fully inform policy decision making, formulation, and track progress made towards reaching development agendas including the MDGs. The UNSD, UNECA and UNFPA are urged to continue to develop tools, software applications, handbooks, and organize seminars/workshops in this regard.

VI. Evaluation

55. The evaluations received for the workshop were exceedingly positive. The feedback from the participants was extensive and outlined the interest and enthusiasm of the participants. Although the large number of responses detailed many useful elements of the workshop, the most useful elements according to the participants was the sharing of country experiences and the practical exercises on the use of GIS for census mapping. The participants expressed the need for more time for a thorough execution of the practical exercises. They also suggested that the duration of the workshop be longer and that more time be allocated to both the practical exercises and country presentations due to their technical nature. Overall, while the participants were appreciative of the content of the workshop, they suggested that it be longer to effectively harness the wealth of information contained in the presentations, discussions, and exercises provided.

V. Annexes

Annex I. Agenda of the Workshop
Annex II. List of participants

Annex I: Agenda of the Workshop

Monday October 8, 2007

1. Opening

8.30 – 9.00 Registration

Administrative Matters

9.00 – 10.00 Opening Remarks

- UNSD

- CSO Zambia

- ECA

- SADC

2. Review of United Nations *Principles and Recommendations for Population and Housing Censuses and a Discussion on* Census Management & Planning

Objective: To present revisions of the United Nations Principles and Recommendations for Population and Housing Censuses followed by a presentation on international recommendations on quality assurance & national issues for census management and planning.

10:30 – 12:30 **Review of United Nations *Principles and Recommendations for Population and Housing Censuses***

(Handbook Discussion) Presentation of revised international standards for conducting population and housing censuses.

- **Presentation by UNSD on P&R**
- **Presentation by ECA of the Addendum to the Principles and Recommendations for Population and Housing Censuses for Africa**
- **General discussion**

10:30 – 12:00 **Census Management & Planning**

International recommendations on quality assurance, national issues and gender issues.

- **Presentation by UNSD**
- **General discussion**

12:30 – 14.00 ***Lunch Break***

14:00 – 16:30 **Census Management & Planning**

International recommendations on quality assurance, national issues and gender issues.

- **Presentation by UNSD**
- **General discussion**

<u>Tuesday October 9, 2007</u>

3. Review of EGM on Contemporary Practices in Census Mapping and Use of GIS and present GIS Fundamentals, Database design, Data Collection, and Data Conversion

<u>Objective</u>: Briefly introduce EGM conclusions, recommendations and related country issues as well as to introduce the necessary concept and design issues with concern to geographic information systems.

8:30 – 10:00 **Review of EGM on Contemporary Practices in Census Mapping and Use of GIS**

To review and assess recommendations made in the EGM and discuss the situation of census mapping with GIS in participating countries as well as associated issues and difficulties (based on the results from the Questionnaire).

- **Presentation by UNSD on the EGM Recommendations**
- **General discussion**

10:30 – 12:30 **Invite discussion on the situation of Census Mapping with GIS in the participating countries**

Continue discussion the situation of census mapping with GIS in participating countries as well as associated issues and difficulties.

- **Presentation by UNSD on GIS Questionnaire**
- **Brief report by participating countries on their Census Cartography**
- **General discussion**

12:30 – 14:00 ***Lunch Break***

14:00 – 15:00 **Introduce GIS Fundamentals/ GIS Database design**

Present GIS concepts, definitions, and characteristics, geographic databases modelling, and data structure (Vector vs. Raster); Pre-requisites to and instructions on how to build a GIS project.

- **Presentation by UNSD on GIS Concepts**
- **General discussion**

15:30 – 17:00 **Data Collection and Data Conversion**

Discuss different data collection methods such as GPS, Imagery acquisition, and local knowledge as well as data conversion such as scanning or digitizing; introduce a GIS platform and conduct a digitizing exercise such as EA creation and splitting.

- **Presentations by UNSD on Data Conversion/Integration**
- **Exercise 1 on Heads-up Digitizing**
- **General discussion**

Wednesday October 10, 2007

4. Demonstrations of Spatial Statistics Applications/Technologies and Issues

Objective: To present and discuss applications and issues with new approaches in census geography, including the use of Geographical Information Systems in census mapping, data collection and dissemination and to demonstrate some of the capabilities of the various platforms.

8:30 – 10:00 **Spatial Statistics Applications & Issues and the use of Geospatial Technologies**

EA design: different factors/considerations; Practical examples of delineating EAs; Advantages and constraints of these technologies with regard to the production of EA maps.

- **Presentation by GeoSpace Int. on How to delineate EAs using satellite imagery**
- **Exercises 2 and 3 on the use of these technologies for EA mapping**
- **General Discussion**

10:30 – 12:30 **Demonstration of Spatial Statistics Applications**

Practical examples of Geocoding from direct collection using GPS, geocoding features in a GIS, and integrating data; Advantages and constraints of these technologies with regard to Geocoding.

- **Presentation by UNSD on Geocoding and GPS**
- **Exercise 4 on GPS Data Integration**
- **Demo by ESRI Provider on Field Data Collection Utilizing ArcPad**
- **General Discussion**

12:30 – 14:00 ***Lunch Break***

14:00 – 15:00 **Demonstration of Spatial Statistics Applications (cont.) and Dissemination Issues**

Practical examples of segmentation using object oriented technology, basic spatial analysis such as buffer, nearest neighbor, advanced spatial analysis such as spatial autocorrelation and probability thresholds. Dissemination Issues introduced.

- **Presentations by UNSD on GIS Platforms/OpenSource Technologies**
- **Presentation by DEFINIENS on Segmentation**
- **General discussion**

15:30 – 17:00 **Dissemination Issues (cont.)**

Discussion on the issues involving authoring maps and data, metadata requirements, technology issues

- **Presentations by UNSD on the importance of Dissemination/Freeware DevInfo**
- **Exercise 5 on Dissemination**
- **General discussion**

Thursday October 11, 2007

5. National Experience Case Study Presentations and Institutional and Organizational Issues associated with Census Management and Planning for the use of GIS

Objective: Explore approaches to census mapping with GIS through case studies presented by countries and discuss Institutional and Organizational Issues associated with census management and planning for the use of Geographic Information Analysis and Systems

8:30 – 10:00 **Case studies of National Experiences:**

- **Presentation 1 (Zambia)**
- **Presentation 2 (South Africa)**
- **General discussion**

10:30 – 12:30 **Case studies of National Experiences (cont.)**

Presentation of national experiences on the use of contemporary practices in census mapping using GIS, GPS, Remote Sensing, etc.

- **Presentation 3 (Namibia)**
- **Presentation 4 (Kenya)**
- **Presentation 5 (Sierra Leone)**
- **General discussion**

12:30 – 14:00 ***Lunch Break***

14:00 – 15:00 **Census Management & Planning for the use of Geographic Information Systems**

Discussion on the Institutional and Organizational Issues related to commercial and non-commercial technologies and purpose and responsibilities in the selection of geospatial statistics technologies.

- **Presentation by UNSD on How to structure, design and evaluate capacity for the use of GIS for Census activities**
- **Presentation by ECA on How GIS can be used in Census Mapping in the context of integrating Statistical data into the National Information Infrastructure for Development**
- **General discussion**

15:30 – 17:00 **Census Management & Planning for the use of Geographic Information Systems (cont.)**

- **Country presentations: Mauritius, Ethiopia, Liberia**
- **General discussion**

<u>Friday October 12, 2007</u>

8:30 – 10:00 **Commercial suppliers' demonstrations**

Presentation by corporate (commercial) providers of GIS/Remote sensing solutions for censuses (ESRI, Geospace International, etc.).

- **Presentations by ESRI, GEOSAPCE, DEFINIENS**
- **Presentations will be followed by Q&A sessions**

6. Final Report, Recommendations & Conclusions

10:30 – 13:00 **Review and adopt report, conclusions and recommendations**

Annex II: List of participants

No.	Country Name	Contact Person/Address
1.	Angola	Mr. Francisco João Domingos Geographer / Technician of GIS Instituto Nacional de Estatistica Rua Ho-Chi-Min Cx.P. 1215 Luanda, Angola
2.	Botswana	Mr. Royal Kumbulani Chalashika Senior Statistician Central Statistics Office P/Bag 0024 Gaborone, Botswana
3.	Egypt	Mrs. Nahla Sedik Mohamed Saleh Central Agency for Public Mobilisation and Statistics (CAPMAS) P. O. Box 2086 Nasr City, Cairo, Egypt
4.	Ethiopia	Mr. Abate Sidelel Wolde Cartographer (Expert) Central Statistical Agency P. O. Box 1143 Addis Ababa, Ethiopia
5.	Kenya	Mr. Joseph Nyangaya Ndubi Kenya National Bureau of Statistics P.O. Box 30266-00100 Nairobi, Kenya
6.	Liberia	Mr. Augustine Fayiah Census Project Coordinator/ Director for Surveys and Censuses Liberia Institute of Statistics and Geo-Information Services Tubman Boulevard, Sinkor P. O. Box 629, Monrovia, Liberia
7.	Liberia	Mr. Thomas L. Davis Director Liberia Institute for Statistics and Geo-Information Services
8.	Liberia	Ms. Juanita Y. Dunna Assistand Director GIS Liberia Institute of Statistics and Geo-Information Services
9.	Mauritius	Mr. Yousouf Mahmood Buxsoo Central Statistics Office – Senior Statistical Officer/Head of Cartography Unit Lic Centre 1, John Kennedy Street Port Louis, Mauritius
10.	Mozambique	Mr. Antonio Adriano Team Leader of census mapping unit in NSI

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11.	Namibia	Mr. Ottilie Mwaalele Mwazi Chief Statistician Central Bureau of Statistics National Planning Commission Private Bag 13356 Windhoek, Namibia
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13.	Nigeria	Mr. Nweze George C. Director, Statistics National Bureau of Statistics (NBS) Plot 762, Independence Avenue Central Business District, P.M.B. 127 Abuja, Nigeria
14.	Sierra Leone	Mr. Andrew Johnny Director Census' & GIS c/o Statistics Sierra Leone A. J. Momoh Street Tower Hill, PMB 595 Freetown, Sierra Leone
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16.	South Africa	Mr. Lucky Ngwenya Manager – Census Strategy Integration Statistics South Africa Private Bag X44 Pretoria 0001, South Africa
17.	Tanzania	Mr. Vincent Chacha Mugaya Head of Geo-Information Section National Bureau of Statistics P.O. Box 796 Dar es Salaam, Tanzania
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19.	Zambia	Iven Sikanyiti Geographic Information Officer Central Statistical Office

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20.	Zambia	Mr. Edward Kasali Senior Cartographer Central Statistical Office P O Box 31908 Lusaka, Zambia
	Internacional/Regional Agencies	
21.	ECA	Mr. Dimitri Sanga ECA P.O.Box 3113 Addis Ababa, Ethiopia
22.	ECA	Andre Nonguierma ECA P.O.Box 3005 Addis Ababa, Ethiopia
23.	UNFPA	Mr. Samson Lamlenn Programme Adviser on P + D UNFPA, Africa Division New York
24.	UNFPA Liberia	Mr. Isaac Mwangangi Census Cartography/GIS Adviser UNFPA Country Office Monorovia, Liberia
25.	SADC	Mr. Ackim Jere Senior Policy and Programme Manager-Statistics SADIC Secretariat P/Bag 0095 Gaborone, Botswana
	Private Companies	
26.	GIMS/ESRI	Mr. Pieter van Jaarsveld Mobile GIS Specialist GIMS (PTY) Ltd ESRI Southern Africa Distributor P O Box 652 Halfway House, 1685 South Africa
27.	Kelly & Kelly	Kenna Kelly GIS Mapping and Analysis ESRI business partner Postnet No 336, Private Bag E891 Lusaka, Zambia
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