

CENSUS CARTOGRAPHY: THE KENYAN EXPERIENCE
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By

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Abstract

Introduction: Kenya has been taking census every ten years since 1948 the last one was taken in 1999. The information collected includes: Demographic, education, Labour, Housing and Sanitation. The administrative hierarchy, which ranges from provinces, Districts, Divisions, Locations, Sub-location and Villages, is used to divide the country into Enumeration Areas (EAs).

All the units are coded and given unique identifiers for purposes of data processing from the province to the smallest unit, the EA. In the office the maps are drafted, at the sub location level. A sub location may have several EAs depending on its population. The maps are then printed and dispatched to the districts for verification. During the intercensal period the cartographers embark on production of thematic maps, the main product being the Population Atlas. The Atlas together with other census publications is disseminated at Provincial level.

Constrains faced include: -

- Long delays in processing funds meant to facilitate Geographic Mapping activities.
- Lack of adequate personnel with the appropriate skills.

The Bureau is in the process of introducing the use of remote sensing and GPS technique in census mapping especially in urban slum areas.

INTRODUCTION

This paper looks at census mapping activities in Kenya since independence. It begins with a brief overview of the 1969, 1979 and 1989 census-mapping activities and then focuses mainly on the 1999 census mapping in Kenya. Kenya conducts censuses every ten years following the United Nation recommendations. The first census was done in 1948 under the colonial government and was followed by one in 1962, just before Kenya's independence. The last four censuses conducted in 1969, 1979, 1989 and 1999 respectively were undertaken after independence

Importance of Maps in Conducting a Census:

- 1) Maps assist/facilitate the delineation of the country into manageable units referred to as Enumeration Area (EAs)
- 2) The EA maps facilitate easy identification of the areas assigned to enumerators during enumeration.
- 3) If properly used maps ensure that errors of duplication/omission are avoided
- 4) Workload, and hence other related census resource requirements can be determined using the maps.
- 5) They are used for budgeting in the counting requirements.
- 6) Specifically, maps will also help the census enumerator to: -
 - Determine the precise boundaries of his/her assigned area and at the same time plan the best route of travel in order to cover area of assignment systematically and efficiently,

- Mark the location of structures with households earmarked for callbacks

Maps make it easier to present, analyze and disseminate census results (post-enumeration). Cartographic presentation of census results provides a powerful means for visualizing the results of a census. This supports the identification of local patterns of important demographic and social indicators. Maps are thus an integral part of policy analysis in the public and private sectors¹. Mapping of the entire country is therefore an essential requirement to precede the census.

It is important in the process of planning for the census-mapping program to assess the requirements of personnel that is

needed to ensure that the stipulated outputs are achieved within the prescribed time period. Therefore the period just before the mapping activities begin is usually devoted to recruitment and training of the census mapping cartographic staff. For the years 1979, 1989 and 1999 the personnel requirement for the census mapping activities increased to a maximum of 50³, 263⁴ and 300⁵ respectively.

CENSUS MAPPING ACTIVITIES

1969-1989 Censuses

The first census undertaken in post Kenya independent was carried out in 1969. Its mapping activities were carried out by the Survey Department in the Ministry of Lands and Settlement in collaboration with the Department of Geography of University of Nairobi, Kenya. The maps, which were used for the 1969 census, were not satisfactory, since very little field work was undertaken. The enumerators used topographic maps-cuttings as EA map. Most of these were cuttings lacking in detail as the scale of 1:50,000 was too small for some of the high population density areas².

The second post-independence census was carried out in 1979. Attempts were made to improve on what was done in 1969 census. Hence in September 1976, a Cartographic Unit was set up in the Central Bureau of Statistics (CBS) Ministry of Finance and planning to prepare maps for this Population Census. Initially this unit had two professional officers and nine clerks. Later on the number of clerical staff was increased to fifty at the peak of census preparation work. The clerks were not trained in any basic cartography; they received on the job training. The Central Bureau of Statistics began preparing maps for the 1979 census with no prior experience of mapping on this scale. However this was a starting point for future census mapping activities in CBS. Due to logistical problems mainly related to lack of time and transport EAs were delineated in the office with few field trips undertaken to verify problematic EAs. There was also an attempt to use satellite imageries for the Arid and Semi Arid areas of the country. However, this effort was fruitless as there was no adequate time for this undertaking.

The third post independence census held in 1989 benefited from lessons learnt from the 1979 census. During this census, measures were put into place to further improve on the mapping exercise. The preparation of the 1989 census base maps was started in January 1986 and completed in December of the same year. First, the maps available in the Cartographic Section were evaluated to determine their suitability. The base maps included the 1979 census maps, the Survey of Kenya topographic maps, and national maps showing District boundaries, communication network, location of important places and population density. All the maps available in the Cartography Section were examined and listed down. Those found to be useful for the census work were selected for reference and use.

In preparation for the 1989 census mapping work, the cartographic officers were both trained locally and abroad before the census mapping work started. Two senior officers of the section were trained at Glasgow University. Four officers from the middle cadre were trained at the Institute for Aerial Survey and Earth Sciences in The Netherlands and at Kenya Polytechnic. Ten clerical officers were trained at the Department of Survey of Kenya. The rest of the officers with no formal training were trained on the job by qualified staff. In addition the entire census mapping staff participated in various cartographic seminars, which were organized to prepare them for their participation. There was an elaborate attempt to have all sub-locations visited and EAs delineated in the field. The concept of using the village as the smallest unit was mooted and used for the first time during this census. The second concept, which was also introduced, was that of structure counting and listing in the urban areas, and the result of the count was used to delineate EAs in these areas. This concept proved to be useful especially in the unplanned /slum areas of towns.

Master transparencies of all the maps were geographically classified and indexed. Although the 1979 census maps were fairly elaborate showing boundaries down to the sub-location level, they did not meet a

major part of the 1989 census mapping requirement that is involvement of the assistant chief in the mapping exercise. The survey of Kenya topographical maps with a scale of 1:50,000 and 1:250,000 which covered the densely and sparsely populated areas respectively were found to be lacking in detail as far as physical features were concerned, as most of them were drawn in the 1960's. The 1:50,000 and 1:250,000 survey of Kenya topographical maps were used for the densely populated areas and sparsely populated areas respectively as base maps. In the densely populated areas, these maps were supplemented with the 1979 census EA maps. The 1979 census maps were extensively used since they were large-scale maps. They provided enough space for collecting as much details as was required. For the areas with dense population, the maps were further enlarged to suitable scales for fieldwork. Below are sample EA maps for 1979 and 1989 respectively.

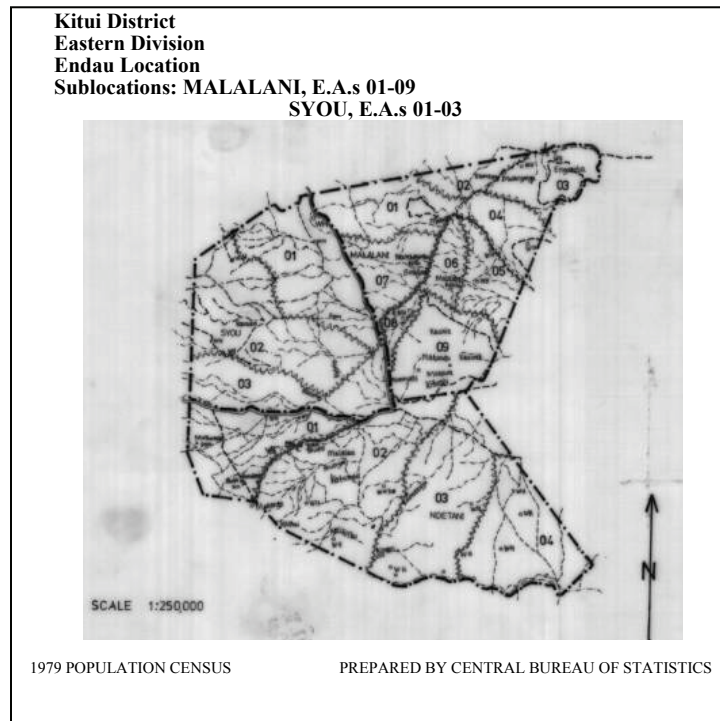


Figure 1: 1979 Syou Sub-location EA Map

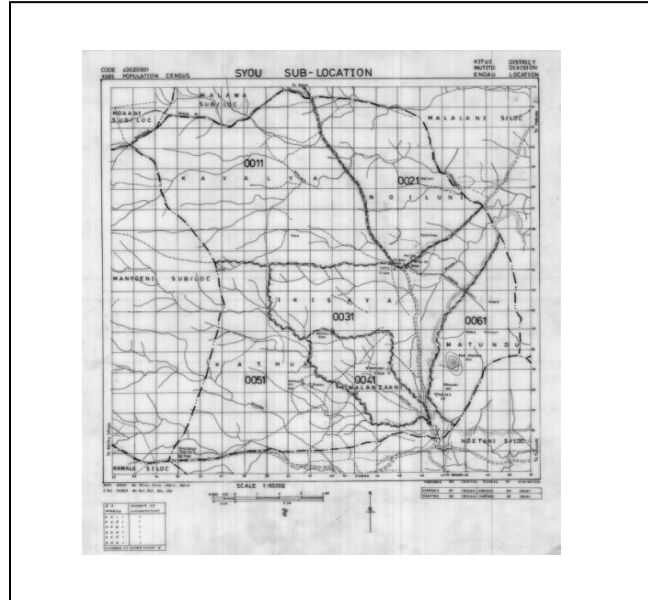


Figure 2: 1989 Syou Sub-location EA Map

1999 Census

The last census held in Kenya was in 1999. Training needs for the 1999 census changed slightly due to changes in cartographic technology. There was therefore need to train officers in the Cartography Section in computer-assisted cartography particularly Geographic Information System (GIS) at Regional Center for Mapping, Surveying and Remote Sensing (RCMRD) in Kenya.

The 1999 Geographic Frame

The geographic frame is a thorough and exhaustive inventory of all the administrative units in the country. In planning for the population census geographical work, an important decision to make is about the areas for which data is to be collected and reported. The Geographic Frame, which includes, provinces, districts, divisions, locations and sub-locations was recommended for use in the 1999 census (see Table 1 below).

The first step in preparation of the Geographic Frame is to list down all the administrative areas starting from the Province down to the Sub-locations. This is important before taking other aspects of planning the census geographic work. The information is useful in determining the type and quantities of maps to be prepared, especially during the pre-enumeration phase. For each census, the previous census is used as a bench-mark (reference point) with respect to administrative units. Updating is then carried out through field mapping and additional information from Office of the President. Changes in the administrative units especially below the province, are usually numerous in the intercensal periods as shown on the table 1 below.

		Number of Administrative Units			
Administrative Units	Administrator	1969 ²	1979 ³	1989 ⁴	1999 ⁵
Kenya	President	1	1	1	1
Province	Provincial Commissioner	8	8	8	8
Districts	District Commissioner	41	41	41	69
Divisions	District Officer	154	184	260	497
Locations	Chief	567	618	1,099	2,427
Sub-Locations	Assistant Chief	2410	3,111	3,553	6,612
Enumeration Areas		20,000	25,000	36,979	61,921

Table: 1 Changes in the number of Administrative units between the last four Censuses

Additional administrative areas are created as a result of rapid population growth. The cartographic unit therefore, planned to obtain information concerning the boundary changes for all the administrative areas for the census through fieldwork. The information was obtained from provincial administration (Provincial Commissioner, District Commissioner, Divisional Officer, Chiefs and Assistant Chiefs). The Chiefs and Assistant Chiefs (in-charge of location and sub location) respectively are very resourceful. They are able to show the teams the boundaries and names of the sub location and villages, number of households per village, and names of homesteads along imaginary boundaries.

PREPARATION OF BASE MAPS AND MAPPING INSTRUMENTS

Procurement of Equipment and Other Supplies

An assessment of the equipment and materials needed to successfully undertake the mapping and data capture exercise is carried out before each census. These usually include expendable (Drafting film, tracing paper, Topographic sheets, Ammonia printing paper, drawing equipment, and non-expendable materials (Computers, vehicles, plotters, photocopiers, topographic maps and software)

Field Work

The cartographic work needed to be done more extensively and in a more elaborate manner than the previous censuses. The field mapping work required the mapping staff to cover the entire geographical area of the country. The task needed people who are qualified with the necessary skills, properly trained, and dedicated to their work and who can be relied upon. Training of field mapping staff and other officers involved in census mapping work was necessary, and hence seminars are organized. All the District Statistical officers (DSO's) and senior members of Central Bureau of Statistics who are involved in the census work are trained. Several workshops are held for DSO's to review progress of work and also to introduce them to the techniques being used so that they can monitor the mapping work in their respective districts. The mapping officers are organized in teams of four members. Each team comprised of a team leader and three mapping assistants. The team leader is the overall in charge of the team and he/she is professionally more qualified than the mapping assistants' and is senior officers from cartography section.

The administrative officials e.g. the District Commissioner's, District Officers, Chiefs and Assistant chiefs in each district are sensitized and kept informed about the census field mapping. It is the responsibility of the team leader to contact these officials and solicit for their support. It was also necessary to make them understand what was involved in the mapping exercise. Each assistant Chief with the assistance of his village Elders has to take the mapping team round his/her sub location boundaries so that they can be plotted on the maps correctly.

Before proceeding to the Sub-location, the mapping staff holds a meeting with all the assistant Chiefs at the District officer's office to brief them about their role in the census field mapping. At the meeting the Assistant Chiefs together with their Village Elders are asked to identify and familiarize themselves with the sub-locations and village boundaries, resolve all the boundary conflicts with the adjacent sub-location and complete the listing of households.

Each mapping team is assigned a number of districts to carry out field mapping work. The time required to complete the fieldwork in each district is estimated on the basis of the total number of the sub-locations. The mapping teams are asked to adhere to the mapping timetable as much as possible. The procedure of putting more teams to work in one District in a sweeping manner had been tested earlier but was not suitable because it was difficult to edit field work e.g. check if there were overlaps between adjacent sub-locations mapped by different teams.

DELINEATION OF ENUMERATION AREAS

In terms of mapping EA's there are three distinct categories according to population density in Kenya, each requiring different treatment. These are: agricultural areas of more or less dense rural settlement, semi-arid and arid areas with sparse population distribution and urban areas with very high population density. In drawing maps for the census, administrative structures (see Table 1) are used from the province to the smallest unit (sub location) these are divided into Enumeration areas (EAs). It is intended that EA's should be roughly of equal size and with easily identifiable boundaries. The size specified being 100 households (hh) or 500 persons. It is anticipated that this size will differ between different geographical areas. For example, in the Arid and Semi-arid areas, the size is expected to be lower and the geographical area larger while in the densely populated areas it is expected to be higher and the geographical area smaller. The most important principal guiding the delineation of EA's is that, under no circumstances should an EA cut a cross any existing sub-location boundary. Each census EA area is assigned to a village(s) and each village is assigned to a sub-location. An example of 1999 census EA map is given in figure 3 below.

While delineating EA's, the mapping staff make sure that, as far as possible, the boundaries of EA's are made following identifiable or visible features whenever possible such as roads, footpaths, fences, streams, rivers e.t.c. Where imaginary boundaries have to be used, this is done with reference to prominent features for example, churches, schools, and plotting homes of people along the imaginary EA boundary. In practice, during 1989 and 1999 population census, it was not possible to delineate enumeration areas of the prescribed size of 100 hh's all the time due to various factors e.g. alignment of physical features for defining EA boundaries is lacking, the geographical terrain in some areas are flat and featureless, information regarding population estimates are received late from some of the assistant Chiefs. However, the 1999 census mapping staff were instructed to keep the population size variation within acceptable ranges of 50 to 150 hh's. In cases where it is difficult to delineate EAs of prescribed size, composite EAs are allowed and arrangements are made to assign more enumerators to such EAs.

Maps are required for each district showing administrative areas. Maps are also required for the sub locations showing EA boundaries. Different scales are used depending on the population density of the area being drawn as indicated below:

- Rural: 1: 10,000, 1:20,000,
- Arid and Semi Arid: 1:50,00, 1:100,000, 1:250,000
- Urban: 1: 1,000, 1:2,500 1:5,000

- District maps: 1:100,000 and 1:200,000

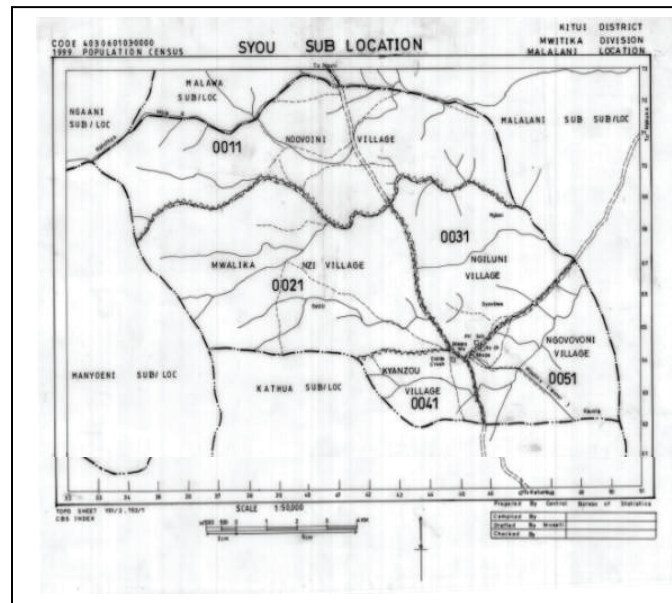


Figure 3: 1999 Syou Sub-location EA Map

URBAN MAPPING

Currently, base maps for most of the urban areas are acquired from the 1989 census but a complete inventory is obtained from the municipalities, town and urban councils and from other private agencies. In the situation where suitable maps are not available, the mapping staff are encouraged to make sketches, especially for slums (informal settlements).

The City of Nairobi, Mombasa, all Municipalities, District Headquarters, all towns and trading centers with a population of 2000 persons or more are designated as urban areas. The field procedures used in the urban areas include updating of base maps, listing of structures and quick counting of hh's to derive population estimates and accordingly delineate the EAs on the urban base maps. All the structures are plotted on the base maps. Each structure is assigned a number, which, is written on the structure as well as on the base map. This is meant to facilitate quick identification of the structures in the EAs on the ground as well as on the EA map at the time of census. This exercise of listing the structure and obtaining hh's estimates was done for the first time in the history of census taking in the country in 1989. The delineation of the EAs was carried out on the base maps on the basis of the estimated number of households. Each EA was to contain approximately 100 households like in the rural areas.

The boundaries of some municipalities, towns and urban councils as defined by Ministry of Local Government generally encompass one or more sub-location in their entirety. Thus, these urban and town councils often include areas, which are not urban in nature. Therefore, while delineating these urban areas into EAs, the limit of the actual urban area is identified and the EAs curved out within the same. The EAs are coded differently for identification purposes so as to facilitate reporting of the data for the "core urban" (2), "peri urban" (3) and "rural" (1). These codes appear at the end of the EA number e.g. 0012 for core urban or 0051 for pure rural (see figure 3).

In updating the base maps and delineating EAs in the urban areas, each sub-location is divided into blocks using major features like roads, streets, rivers, railway lines, etc. In the major urban areas each block is made up of one or part of a housing estate. Great care is taken to make sure those areas of different economic status e.g. slums are not put together with other planned housing estates. While numbering the structures, the mapping assistants are required to take note of the purposes for which the structure is used. This is achieved by interviewing people living or using the structure. The importance of doing this is to ensure that it is possible to know how many of them are used for dwelling purposes out of all the structures listed in a place. The total numbers of dwelling units in the various structures in a block are taken to be

equivalent to the total number of households in that block. This information is used to delineate EAs of approximately 100 households within each block. Urban maps are checked against adjacent rural maps to ensure that there are no gaps or overlaps.

ARID AND SEMI-ARID AREAS

Field mapping in the arid and semi-arid districts is usually completed within one month in August the year before the census. It is assumed that these people would return to this same settlement in August the following year where they can be enumerated. In the nomadic areas the size of the EA is mainly determined in terms of the distances and walking time without laying much emphasis on the population size. In such an area, an EA contains one or several settlements depending on the distances between them. Enumeration area boundaries are fixed arbitrarily to encompass the settlement(s) already forming the EA(s). The most important element is the location of the settlement but not the EA boundary. There are two types of EAs delineated in these areas, namely EAs covering permanent settlements and those covering temporary settlements. The locations for permanent and temporary settlements are shown on the base maps using different symbols. Large urban centers in these areas are treated like any other urban centers.

NATIONAL PARKS, FORESTS AND OTHER SPECIAL EAs

During mapping for the census, the National Parks and Forest areas are treated and coded at the level of sub-location or location or divisions depending on their sizes. The mapping staff obtains information concerning the people and location of the settlements. Collective households such as Hospitals, Hostels, Prisons, Army camps etc. are treated as special EAs. If population of any collective households is less than the prescribed EA size, it is put together with other neighbouring population for the purpose of EA delineation. However, some households of classified nature like the army, police and prisons camps are left to form separate EAs.

SPECIFICATIONS

Specifications are set before commencing field-mapping work. Different mapping teams are assigned different parts of the country, and there is need to ensure comparability and a common interpretation approach. This calls for comprehensive specifications on color, line gauge, point size, text and text size and symbols. To be complete the specifications are accompanied by “a lay out”, which explains the positioning of items, which do not appear as part of the map detail, e.g. title, foot notes, marginal information, legend and also specify their form and appearance.

Symbols for representing administrative, village and EA boundaries, place names and EA numbers during the census field mapping are chosen very carefully. While choosing the symbols, care is taken to avoid over crowding the base maps. It is important to make sure that while updating the base maps other topographical features are not covered. Therefore transparent colors are used to annotate the maps. This technique provides clarity without blocking other background features.

NUMBERING OF EAs

The EAs in each sub-location are systematically numbered e.g. 001, 002, 003, 004 etc making sure that consecutive numbers are placed next to each other. They are numbered starting at the northwest or north east and moving in a clockwise direction (see figure 3). Numbering the EAs is done immediately after completing their delineation in each sub-location.

VARIATION IN EA SIZES

Variation in EA sizes is however expected because of the following reasons: in some areas, EAs are delineated without hh estimates; in some cases it proves too difficult for the field mapping staff to

subdivide some villages to obtain the required EAs due to lack of convenient features on the ground; and in the congested areas in some urban centers, it is difficult to show very small EAs (area wise) on the base maps. Table 3 below shows the variation of during 1979, 1989 and 1999 population censuses.

Household Range	1979 ³	1989 ⁴	1999 ⁵
Less than 51	7%	15%	14.86%
51 to 150	42%	66%	71.48%
151 to 250	25%	15%	10.62%
251 to 500	20%	4%	2.63%
501 to 700	4%	0%	0.26%
More than 700	2%	0%	0.15%

Table: 3 Variation in EA sizes

GEOGRAPHIC CODING

Geo-coding is the process of assigning each administrative unit, and EA a unique identifier (unique I.D). This covers the entire administrative hierarchy from Province to the Sub-Location and the “data collection unit EA”. The Kenya National Bureau of Statistics is responsible for allocating area codes and compiling a file containing names of administrative areas, towns, trading centers and EAs. The file is used to control the enumeration and to order data for tabulation. It is important that the file be complete and checked before the enumeration because it is the base on which data is aggregated. In 1979 census this was not achieved and there were a number of errors and omissions. However in 1989 and 1999 this process was achieved and each area had a unique identifying code starting from the province down to the EA. This task is best executed in the field after the field-mapping officers have compiled an exhaustive list of all the administrative units at each level and within each level. Each province in Kenya is given a unique code; each district in each province is also given a unique code; every division in each district is given a unique code; every location in each Division is given a unique code; every Sub-location in each Location is given a unique code and every EA in each Sub-location is also given a unique code. Coding for province and district is done prior to going to the field, assigning each province, district, division, location, sub location a number while EAs are assigned a number in the field as shown Table 4 below.

The complete code number for an EA has 13 digits. The flow of the code for province, district, division, location, sub location and EA in terms of the number of digits is as shown in Table 4. The last digit (13th) is either a 1, denoting rural or a 2, indicating it’s an urban EA or a 3, representing a peri-urban area. The code for province up to the sub location is located on the top left side of each map, while the EA code is located at the center of each EA on the map.

Administrative Unit	No of Digits
Province	1
District	2
Division	2
Location	2
Sub location	2
EA	4
Total	13

Sample code for one EA

Administrative Unit	Code
Central	2
Kiambu	01
Limuru	01
Ngecha	01
Kabuku	01
EA	0011
Full sub-location code	201010101
Full EA code	2010101010011

Table 4: Coding System³

COMPILATION, DRAUGHTING, PRINTING AND DISPATCH OF EA MAPS

In 1999 all the EA maps were drawn on plastic film and reproduced on a diazo printer in sufficient numbers to allow for one copy per enumerator, one copy per supervisor, and a complete set for the District Census Officer. The step used in preparation of these maps was as follows:

- The base maps are enlarged to appropriate scale as shown in table 2 using a photocopier. The various enlarged sheets are then joined together to form a mosaic of a sub-location.
- This is followed by tracing of the joined sheets and drafting of the same in ink, following the prescribed specification for EA maps.
- The editing team then edits the drafted maps before being submitted to the printing team.
- Enough copies of each sub-location map are then printed and packed ready for dispatch to the various districts either for verification or for use for the actual enumeration.

It was considered important that District Census officers should have their maps in ample time to be able to examine them in order that errors inherent in the method of working might be discovered and corrected before enumeration.

GROUND VERIFICATION

This is the process of checking the maps on the ground by the sub-chiefs and CBS field staff. It is an important exercise meant to ascertain the suitability of the maps for the intended purpose. This activity was not achieved in 1979 and 1999 census. However, 1989 census maps were printed early and sent to the field for verification and corrections then were made where necessary.

AREA MEASUREMENTS

This is a requirement so that population density can be calculated for each administrative unit. Several methods have been used in the past three censuses namely: the dot method for the 1979, optical pantograph for 1989 and lastly the sub locations for 1999 were all digitized and areas derived automatically.

CONSTRAINTS

The following were the main constraints encountered during the execution of the 1999 population census mapping: -

- Digital Mapping GIS:
It was initially the preferred method of preparing EA maps. However, with time, it became quite clear that the cartographic section was not prepared for implementing a GIS system. The mistaken notion that computers will from the word go make the production of maps easy, without a proper database landed the section in trouble. Considerable time was spent struggling to produce enough EA maps but the pace was painfully low. A hasty decision had to be made to supplement the digital production with manual methods of EA production. This had its cost implication in terms of time and money.
- Late Disbursement Of Funds From Funding Agencies:
This was a major draw back, which seriously impacted on field mapping, and the net effect was enormous (chain effect)
- Coordination And Communication:
Between Headquarters and Field teams and amongst the field teams themselves became a big problem, which hindered quick progress of mapping work.

LESSONS LEARNED:

For GIS to be an effective tool in census mapping there is need first to:

- Train the concerned personnel well to garner confidence in the various elements of computer assisted cartography with emphasis on GIS.
- Expose them widely through workshops and study tours on the various fields of computer-assisted cartography.
- Take stock of, and digitize all relevant available data so that when it comes to the time for census mapping, the main **task** will be updating what is already in place. Otherwise, the initial phase of converting data (electronic conversion) may appear to overshadow the benefit of computer mapping due to the “heavy” work load involved, hence the need to tackle this stage when there is ample time (preferably way before census mapping activities begin)
- Mapping activities being the first activity preceding the census should have funds allocated early and **accessible** without undue procedural delays.
- The necessity and usefulness of an efficient communication system cannot be overemphasized to day, more so in an exercise of this magnitude and importance.
- Finally, and most important, careful stock taking of the successes and failures of past censuses, followed by a thorough analysis of the **short-comings** and their **causes** and remedial measures required in future should be undertaken. All this should be documented, and shared among all stakeholders. This will reveal the constraints which do recur from one census to the other, identify new ones and form a reliable base for reference in formulating solution oriented measures

FUTURE DEVELOPMENTS

The preparatory work for the 2009 census started with a pilot mapping census in one district to test all the mapping instruments. This has been followed by revision of the instruments before the actual field mapping started in full swing. The Kenya National Bureau of statistics intends to make sure that all the maps are produced digitally before the enumeration.

USE OF GEOGRAPHIC INFORMATION SYSTEM

The 2009 census will be the second to be undertaken using computer assisted cartography (CAC). The UNFPA provided support for the establishment of a GIS facility which was commissioned in 1998 and envisaged to culminate into a fully fledged Kenya Census Geographic Information System. However the implementation of the project experienced a number of setbacks that led to a slow pace in the process of preparing the enumeration area maps. As a result of the slackened pace, maps for 26 districts were prepared using the GIS whereas the rest of the districts (43) were prepared using the conventional cartography.

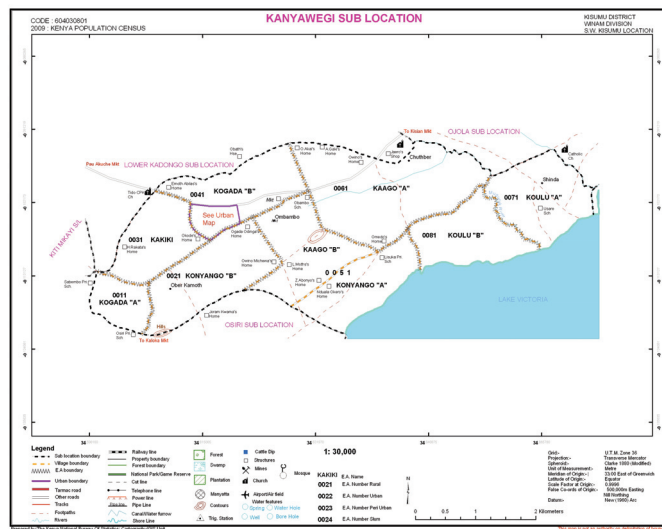


Figure 4: 1999 census Sub location EA map done using GIS

CONSTRAINTS

- Late acquisition and installation of the GIS facility.
- Lack of adequate skilled staff in Computer assisted cartography
- Inadequate software user licences
- Poor maintenance of the GIS facility
- Servicing of equipment was not adequate
- Upgrading of software was tied to maintenance service contract
- The cost of maintenance service contract was and still is very high. If not on this contract you can not get any upgrade on the new software release

USE OF SATELLITE IMAGES IN MAPPING FOR THE 2009 POPULATION CENSUS

One of the biggest challenges facing census mapping in the heavily settled and un-planned areas in Kenya is lack of suitable base maps in terms of *scale* and *currency*. The heavily settled areas which are mainly in urban areas are associated with slums where the settlements patterns are very dynamic with rapid changes taking place. Current and very large scale maps are therefore compulsory to enable proper mapping and the creation of suitable Enumeration Areas. Unfortunately, those responsible are not able to provide such maps when required. Such challenges are quite serious in countries such as Kenya where about 60% of the urban populations live in these heavily settled areas (Slums). There is hardly any town in Kenya which does not have slum settlements and this underlines the seriousness of the problem. The above mentioned challenges are quite serious in Kenya where a high percentage of the population lives in the slum areas. In the censuses of 1989 and 1999, an attempt was made to solve this problem by relying on the preparation of sketches. But after the censuses, the sketches could not be relied on during the design of NASSEP programs and in the conversion of the EA maps into digital formats especially after the 1999 census.

During the cartographic mapping for the 2009 Census, satellite images and aerial photographs are being used so as to address this problem. These products were used in Kisumu during the pilot mapping and they have also been used during the phase one mapping covering a larger part of Nyanza province and which was concluded recently. The products have proved to be very useful. They have enabled the preparation of excellent maps of the covered towns. Indeed they offer a complete solution to the problem cited above because the products are very current and therefore enabling the mapping of every part of any urban area and at any desired map scale. The maps produced are of very high quality and accurate and therefore they will ensure a complete and accurate coverage of the census. Further, because of their high quality and accuracy, they will enable a better sampling frame to be put in place since the urban population can be demarcated precisely from the rural population. This was not possible in the last census as it later led into a gross under quotation of the urban population.

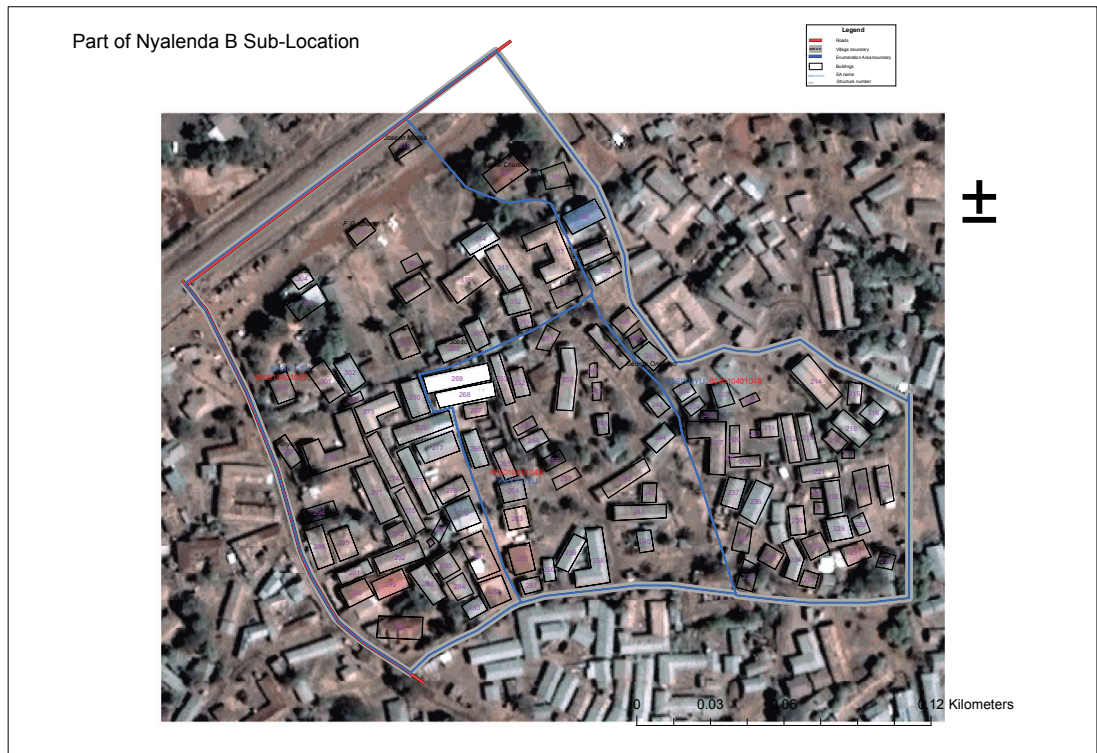


Figure 5: *Sample of Satellite Image being used for 2009 population and housing census*

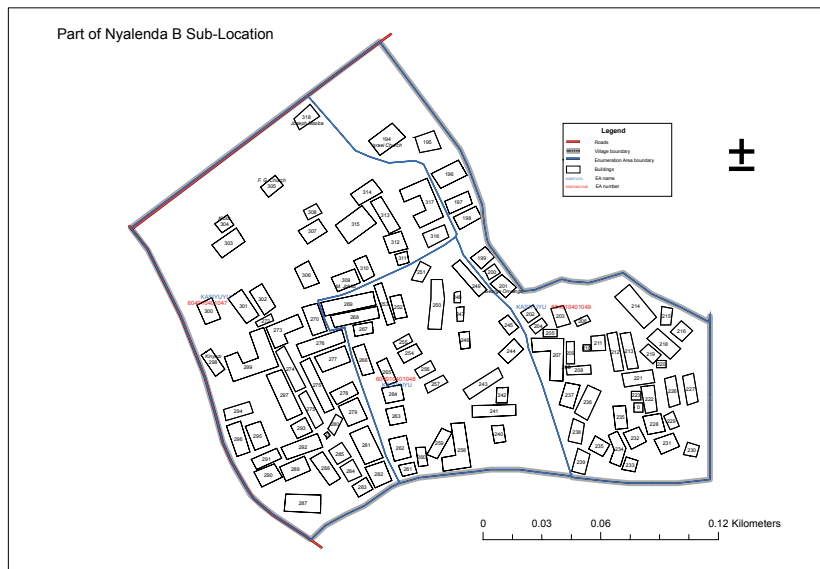


Figure 6: *Sample of Shape file produced from Image and field work*

Constraints

- The cost of the images and shape files is too high
- The satellite images are usually not current hence not giving the true picture on the ground
- The time taken to access the images and to create shape file from them is also too long

USE OF GEOGRAPHICAL POSITIONING SYSTEM

Geographical positioning is also being used to pick coordinates of educational, health, and other important facilities. In addition GPSs are being used to mark imaginary boundaries by picking all the structures along EA boundaries. It is hoped that the above three methods will greatly improve the quality of maps for the forth coming census.

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