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History of Mapping in Tanzania

1- Early Maps and Exploration Mapping
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   c-Early Mapping Equipment

2- Colonial and Post-Colonial Mapping
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3- Current Mapping with GIS and Remote Sensing
   a-GIS Mapping
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ABSTRACT:

The history of mapping in Tanzania can be divided into three main periods.

The first is the time when small scale maps were made because of navigators who established the shapes of African coasts and explorers who drew the main rivers, relief and types of vegetation.

Then Tanzania was influenced by two European cultures through its colonization first by Germany and then by England. First, there were German maps made by the Department of Surveying and Agriculture from 1890 to 1914. When the British took over the mandate for that territory after World War I, they also used the "old" German maps until very recently and then they made other topographic maps. In 1961, the Surveys and Mapping Division was created.

Today, there are still the topographic maps from the Surveys and Mapping Division but there are also the maps and the 3D Terrain Modelling made with GIS and remote sensing. It has been quite a signficant evolution because maps are made more easily.

KEY WORDS:

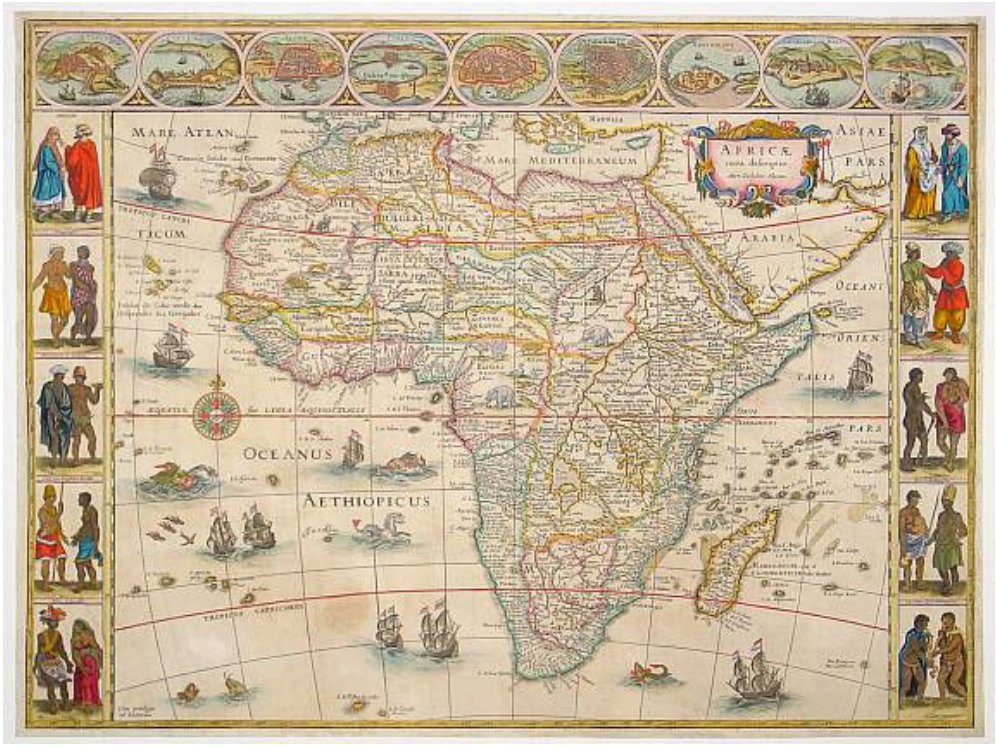
Tanzania, Tanganyika, Triangulation network, Map, Scale

1-Early Maps and Exploration Mapping

a- Early Maps of Africa

Oldest Map of Africa(1389)- Created in China on Silk (17 m^2)

Map of Africa – 1555



Map of Africa- 1645

Map of Africa- 1788

b- Exploration Mapping of Africa

Africa has remained resistant to exploration and mapping for a long time. Even if the coasts of the continent became well known through the writings and maps of ocean voyagers, the African interior remained largely inaccessible to exploration and surveys. Up to the early 18th century, maps of the continent were filled with topographical details and place names even if the accuracy of this data was vague. The early maps were also filled with pictures showing myths and legends about African civilization.

In the 19th century, there was a purging of the maps with the elimination of false details. These maps were suddenly full of spaces of emptiness. Consequently, Africa became an interesting place for mapmakers, it was an invitation to exploration, surveying and mapping.

The maps of Africa were progressively filled by British geographical institutions such as the Royal Geographical Society.

c- Early Mapping Equipment

The mapping equipment at this time was mainly composed of compasses, sextants, thermometers and aneroid barometers.

Barometer

Prismatic Compass

Chronometer

Sextant

Explorers could take compass bearings, they knew altitude above the sea level thanks to aneroid barometers. They measured the latitude of their stations from the meridian altitude of a star taken with the sextant, and of the compass variation by azimuth. Occasionally there was a fixing of certain crucial stations, at intervals of 60 miles from lunar observations, they also could measure the distances of the sun from certain stars to determine the longitude.

2- Colonial and Post-Colonial Mapping

a- German Mapping of Tanzania (1890/1918)

Tanzania traces its early surveying and mapping during the German colonial administration in **1893**. The department of Surveying and agriculture leads by Dr. Franz Stuhlman encouraged the collection of topographic information in order to map Tanzania. The first mainland surveyed were those in which European farmers, mainly German, lived : Pangani, Usambara, Tanga-Mombo, Kilimanjaro, Meru, Kilosa and Morogoro. The scale of first maps was **1: 300,000**.

In 1914, **36 multi-colored map sheets** covered the whole territory of Tanganyika, including the present Rwanda and Burundi. The information that was contained in them was mainly relief, location of various tribal settlements, the ten principal exploration and communication routes and hydrological features. The names of the places shown in these maps were not the same as those found in the later maps published by the British. Tribal names were used to describe the location of some places.

German 1:300,000 scale map

British 1:300,000 scale map

We see that the second map is a copy of the first one by the British (the toponym words are exactly at the same places). The British used German 1:300,000 scale maps a long time before having their own.

The first atlas of Tanganyika was made by Dr. Dietrich Fulleborn and published in 1906. However this atlas was mainly made of series of photographs that showed various landscapes and the people who occupied them. The only map which was included in the atlas was at the scale of 1:1,000,000 and covered the South of the territory.

The surveys that led to the publication of these maps were based on the isolated triangulation networks mainly established for boundary surveys.

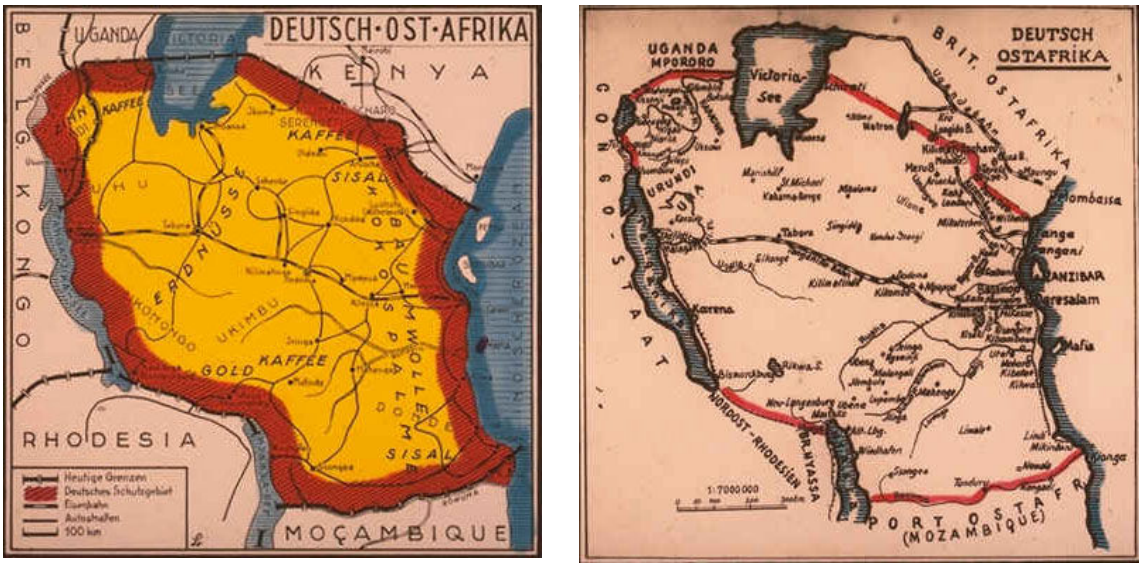
The first triangulation network with a local astronomical origin (near Lushoto) was established between 1894 and 1911 and covered the Usambara Mountains. This was extended later to the North and covered the areas of Pare, Moshi and Arusha mainly to demarcate the Anglo-German boundary between Kenya and Tanganyika.

The second triangulation was established in 1898, with a local latitude origin. This triangulation covered the Mbeya and Rukwa areas and was later used to demarcate the boundary between Tanganyika and Nyasaland.

The third triangulation was observed between 1902 and 1906. For this, the geodetic longitude of Zanzibar which was used as the origin, was transferred across the Zanzibar Channel to connect to the Usambara mountains triangulation.

The fourth network was established in 1907, with a local astronomical origin, in the south-western corner of the country (Mbamba Bay). This was used to demarcate the boundary between Mozambique and Tanganyika.

The only triangulation network which was not used to demarcate a boundary was that which was established between 1912 and 1914 in the Morogoro area. This network was purely for cadastral purposes because Europeans needed this survey for their plantations. However, the German surveyors did not finish demarcating all the boundaries of Tanganyika. The work was completed later by the British who adopted some of the German field observations and extended these as required.



German maps- 1890- 1:7,000,000

b- British Mapping of Tanzania (1919/1961)

Triangulation Networks

The British administration took over from the German administration after the First World War and formed the Surveying Department under the Ministry of Lands and Mines in **1920**. The Department considered that it was necessary to unify and coordinate all the surveys of the German administration which were very sporadic and unrelated to one another.

In 1905 the British launched the initiative to measure very long lines to determine the shape and size of the Earth. They decided to establish a **triangulation network along the Arc of the 30th Meridian: from North Cape in Norway to the Cape of Good Hope in South-Africa**. A considerable amount of work had already been done in southern Rhodesia (now Zimbabwe), and in Uganda. However, there was a break in this Arc in the German colonial territories: Tanganyika, Burundi and Rwanda. Consequently, it was logical for the British to continue with this network and connect the existing isolated triangulation networks. In **1931**, Major M. Hotine continued the triangulation work along the Arc by leading a field survey party in the western part of the country from Kate to Kigoma.

Later, in 1944, the Colonial Surveys and Geophysical Committee put forward the argument that a geodetic survey is essentially a matter that must be planned for a whole geographic region. In 1946, when the **Directorate of Colonial Surveys** came into being, this policy was adopted and they integrated the different triangulations as they existed.

Although Uganda and Kenya already had a considerable amount of triangulation networks, these were of variable qualities. In Tanganyika, other triangulation networks observed between 1931 and 1938 had not been computed, leaving the three East African countries disconnected. In 1950, it was decided to connect all these networks .Therefore, in1953, a new triangulation network chain (960 km in length) was observed by the **Directorate of Overseas Surveys (DOS)**. It began from the existing triangulation near Morogoro to the Tanganyika-Mozambique border joining up with the Portuguese triangulation. Then, it turned along Lake Nyasa to join up with the main Tanganyika network. It was completed in 1954.

The Arc and its attached networks of triangulation constituted a foundation for the mapping of the whole East and Central Africa.

This framework now constitutes the basis of accurate control surveys for geodetic and topographic mapping activities in Tanzania.

Levelling

The primary levelling network was designed in **1960**. The routes chosen for this network followed the railway lines. 53 fundamental benchmarks were determined, these were named after the towns in which they were built. In 1961, the first lines from Arusha to Tanga were calculated. By 1964 the levelling was more or less complete.

Aerial Surveys

The first aerial surveys were carried out in Tanganyika territory in **1931** by the Air Section that depended on the Directorate of Surveys and Aviation. Topographic maps at

1:50,000 were produced from these aerial surveys. It is not known how many sheets were published thanks to these surveys but the areas of Lindi, Mtwara and Tunduru were covered. Aerial surveys continued to be carried out during the 30's and in 1939 more photographs were taken in the area of mounts Kilimanjaro and Meru with the first stereoscopic measurements.

Topographic Mapping

After the Second World War, the DOS carried out mapping operations at the **1:50,000** scale using aerial photographs taken between 1946 and 1958 by the Royal Air Force and the Directorate of Military Surveys (DMS). The priority was given to the areas where agriculture was widely developed such as south of Lake Victoria, the south-western part of the country and the north-east coastal area.

By **1961,** when **Tanganyika gained independence**, DOS had already published map at the 1:50,000 scale covering 1/3 of the country. At the same time, 70% of the territory was covered by aerial photographs.

After independence most of the mapping at the 1:50,000 scale was produced thanks to foreign aid programs.

The DOS of the UK carried out much of the original topographic map coverage in the period of the 50's and 60's and continued into the 70's. During the 80's the DOS carried out an updating campaign covering 94 map sheets from Arusha to the south of Dar Es Salaam (to the Rufiji delta).

A great contribution was made by Canada which carried out a program of topographic mapping mostly in the southern part of the country: Mtwara(1979), Mbeya(1985) and Kagera(1987) and Songea(1991) near the Lake Victoria. This was organized by the Canadian National Mapping Organization.

The Japanese government still helps Tanzania, too. They produce maps of parts of the north west of Tanzania. This is essentially a re-mapping project.

A large project funded by the Norwegian International Development Agency to produce township maps for nine towns was launched in 1995. For this project, GPS-controlled aerial photographs were taken at the 1:12,500 scale while the maps were compiled by photogrammetry at the 1:2,500 scale.

In all these foreign projects the ground operations were carried out by the Division of Surveys and Mapping.

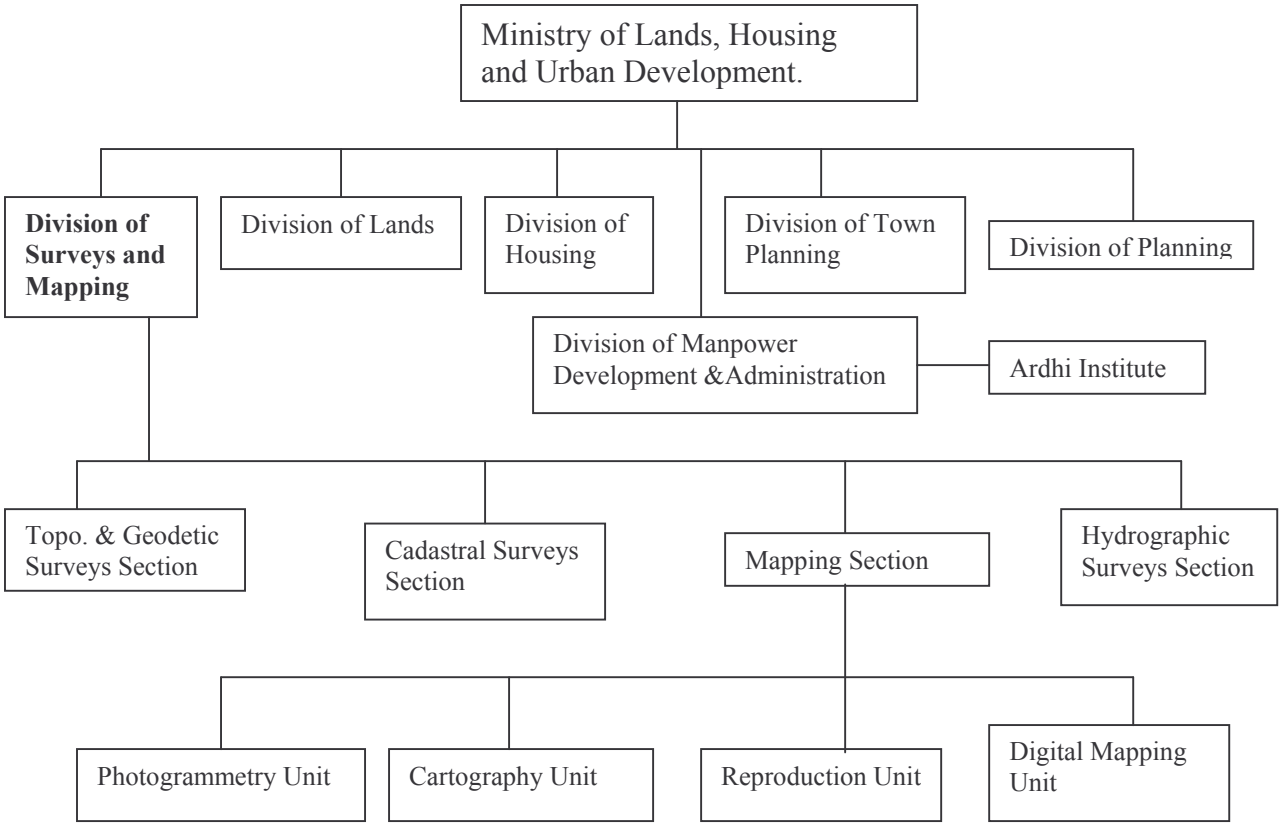
c- The Division of Surveys and Mapping

Surveys and Mapping is one of the six Divisions within the Ministry of Lands, Housing and Urban Development.

The Division of Surveys and Mapping (DMS) is an establishment of the Tanzanian government responsible for all topographic mapping in the country. It was created in 1961, when Tanzania became independent. It has four components as shown in the organigramme of the organization.

The Mapping Section is the only Tanzanian institution responsible for topographic mapping.

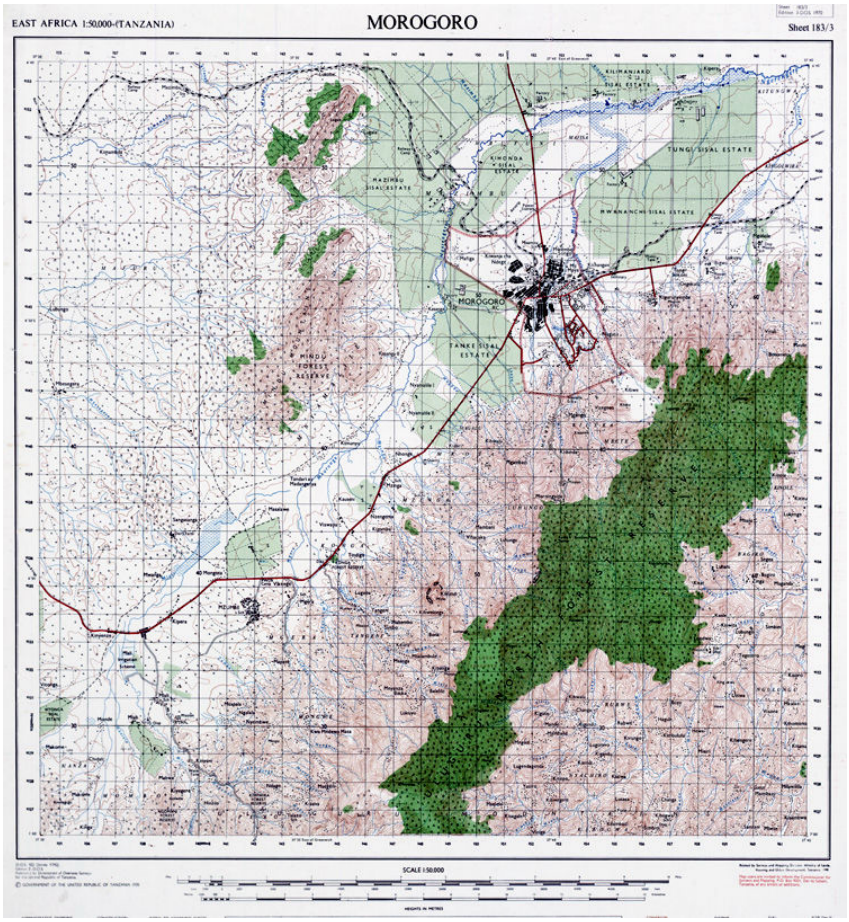
Organization of the DSM Within the Ministry of Lands, Housing and Urban Development:



Existing Maps of Tanzania

1:50,000

This is the **basic mapping scale** covering the whole country of Tanzania. They were based on the **Universal Mercator projection**. They were compiled by photogrammetric methods and ground control. All recent maps are published in 5 colors (red, blue, green, brown and black) and show lots of details. Relief is represented by contours which are at intervals of 20 meters (earlier sheets had a contour interval of 50 feet). The whole territory is covered by **1294 sheets**. The equivalent base maps of the islands of Zanzibar and Pemba are at the 1:63,360 scale and two sheets cover each island. These maps are the basis for all maps derived at other scales.

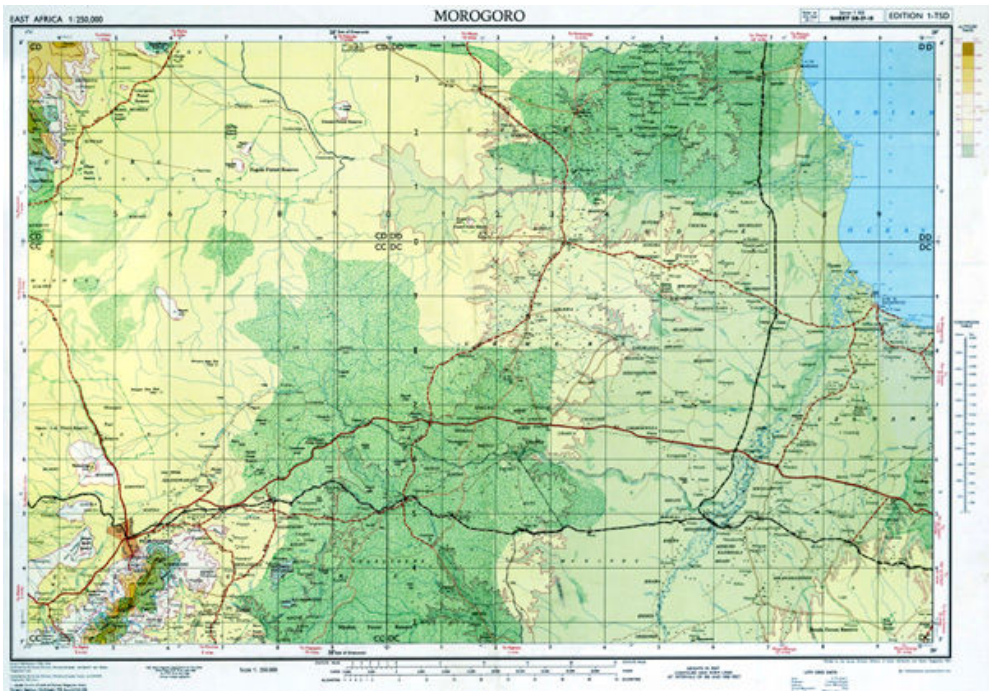


Morogoro 1:50,000 scale map sheet.

1:250,000

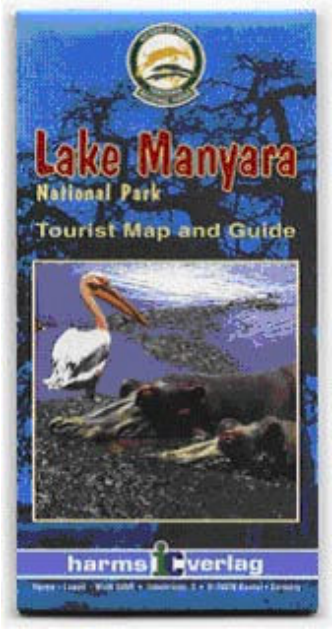
These maps were compiled from the 1:50,000 scale sheets after **1953** when the DOS decided to make them at the same time as the 1:50,000 scale maps. The whole territory is covered by **65 sheets**. These are hypsometric maps (layered with altitude tints).

Morogoro 1:250,000 scale map sheet.



1:100;000 1:500,000

These scales are used to map **Districts and Regions** for administrative purposes. These are essentially planimetric maps showing each administrative District (or Region) on a single sheet at scales which vary from 1:100,000 to 1:500,000 depending on the size of the District (or Region). Other information put on these maps are roads, settlements, administrative boundaries, forest reserves and large farms.
There are also **tourist** maps at the same scales.



Lake Manyara National Park (Tourist Map) 1:100,000

1:1,000,000

These topographic maps form part of the so-called International Map of the World on the 1:1,000,000 scale. Six sheets cover the whole country of Tanzania and there is on this maps a representation of the relief.

1:2,000,000

This is the largest scale map which shows the whole country on one sheet. The first edition of the map was published in 1965 by the DOS. It shows relief by contours and hypsometric tints, roads, railways, towns and other urban centres, regional and district boundaries. This is the base map for the Atlases that have been derived from it.

1:3,000,000

This is the typical scale used in the National Atlas of Tanzania. Several atlases have been made. The first one was published in 1906 by the German administration(Deutsch-Ost-Africa (ix)Atlas), followed in 1942, 1948 and 1956 by National Atlases of Tanganyika and in 1967 and 1976 by the National Atlases of Tanzania.

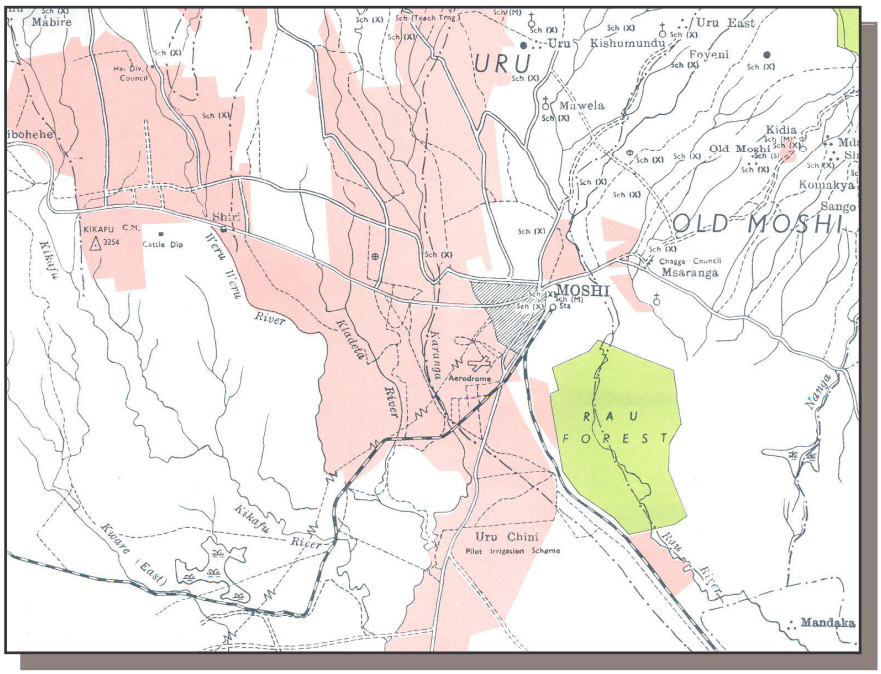
Township Maps (Large Scale Maps)

Each township is covered by a series of basic maps at the scale of 1:2,500 or in the case of Dar es Salaam 1:5,000. The larger urban areas are in addition covered by smaller scale maps: 1:5000, 1:10,000, 1:20,000 (and 1:25,000 for Dar es Salaam).

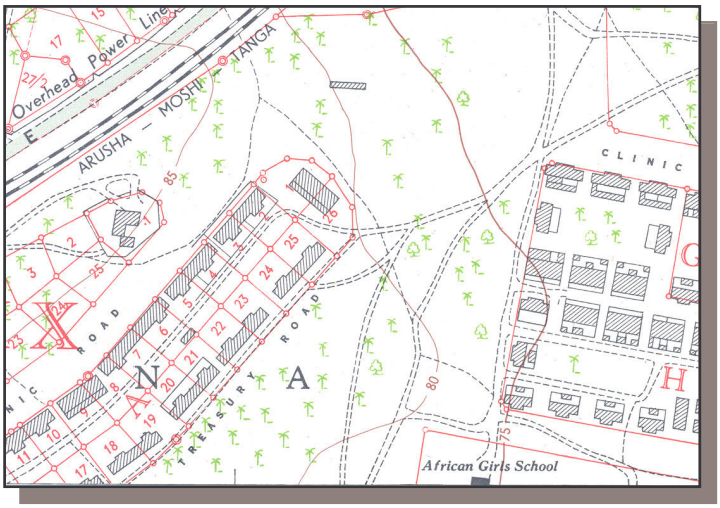
Dar Es Salaam 1:5,000 scale map

Cadastral and Village Mapping

The cadastral survey is the surveying activity which is best known by Tanzanian people. It concerns the determination of property boundaries. They are used in the registration of the individual pieces of land.
In the village surveys, the boundaries of villages and the properties within them are determined.



Cadastral Map



Village Map

3-Current Mapping with GIS and Remote Sensing

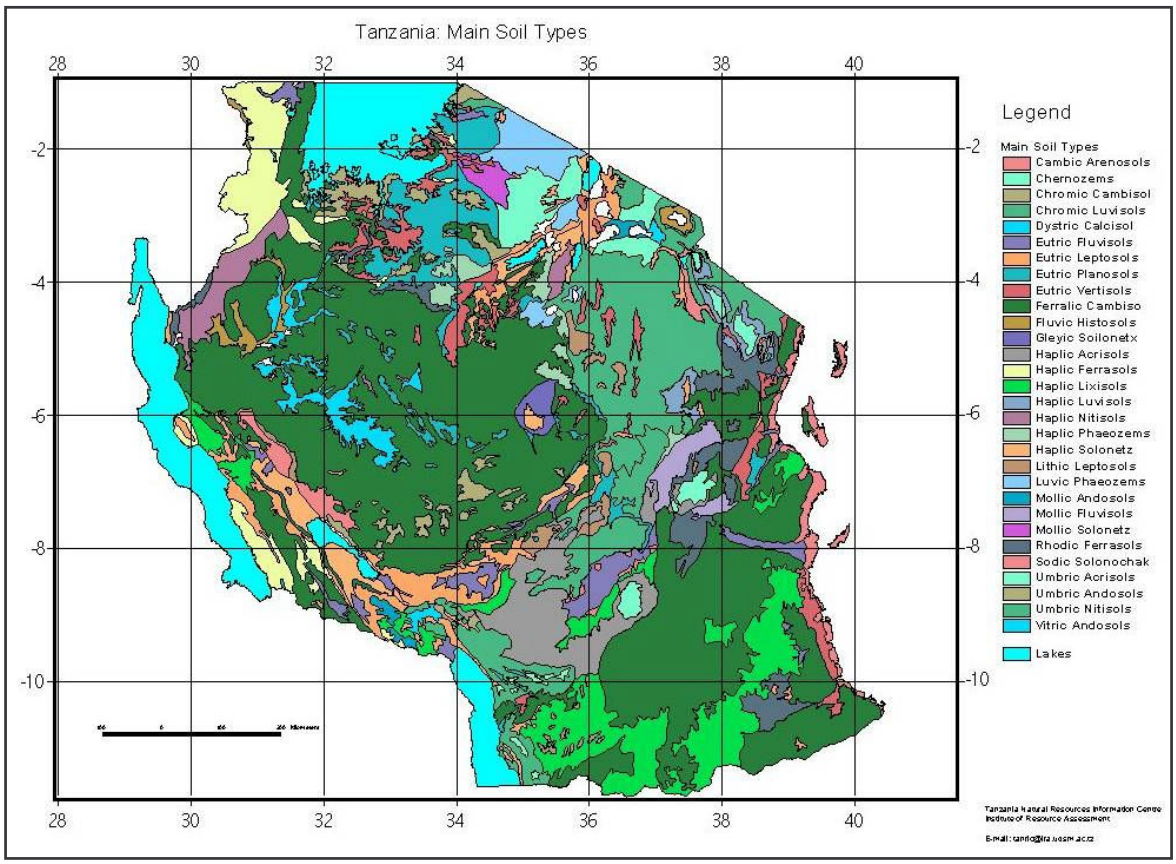
In Tanzania there are lots of fields in which GIS are used:

- Environmental Management
- Urban and Rural Planning
- Wildlife Management
- Monitoring Desertification, Study of Farming Systems

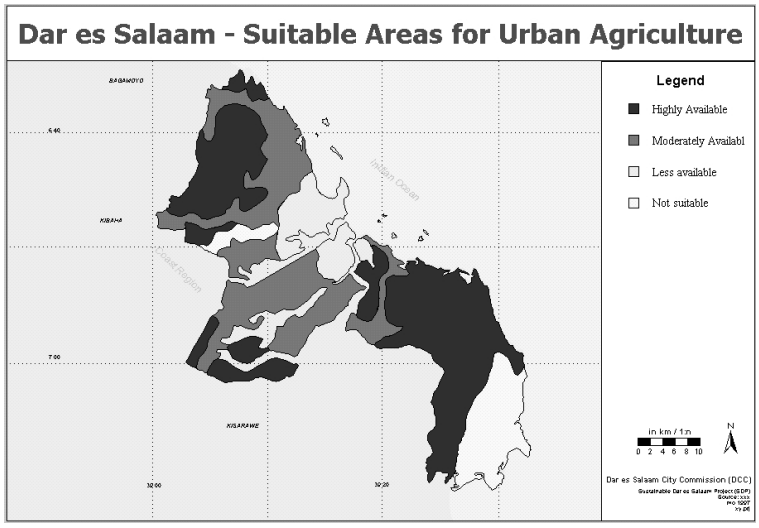
- Infrastructural Development
- River Basin Studies, Utilities, Transmission Line Surveys
- Zanzibar Fisheries Institute
- Health Services
- Department of Meteorology
- The Mineral Centre in Dodoma
- Tanzania Petroleum
- Cartographic Applications

GIS is used to make thematic maps very easily; thus, it is applied to lots of fields.

Examples:



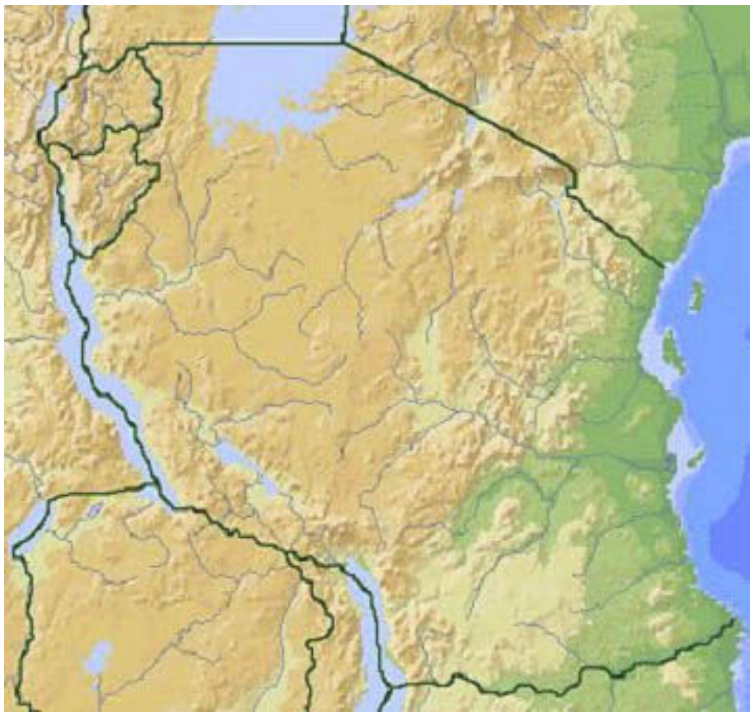
Produced by TANRIC
(Tanzania Natural Resources Information Centre)University of Dar es Salaam



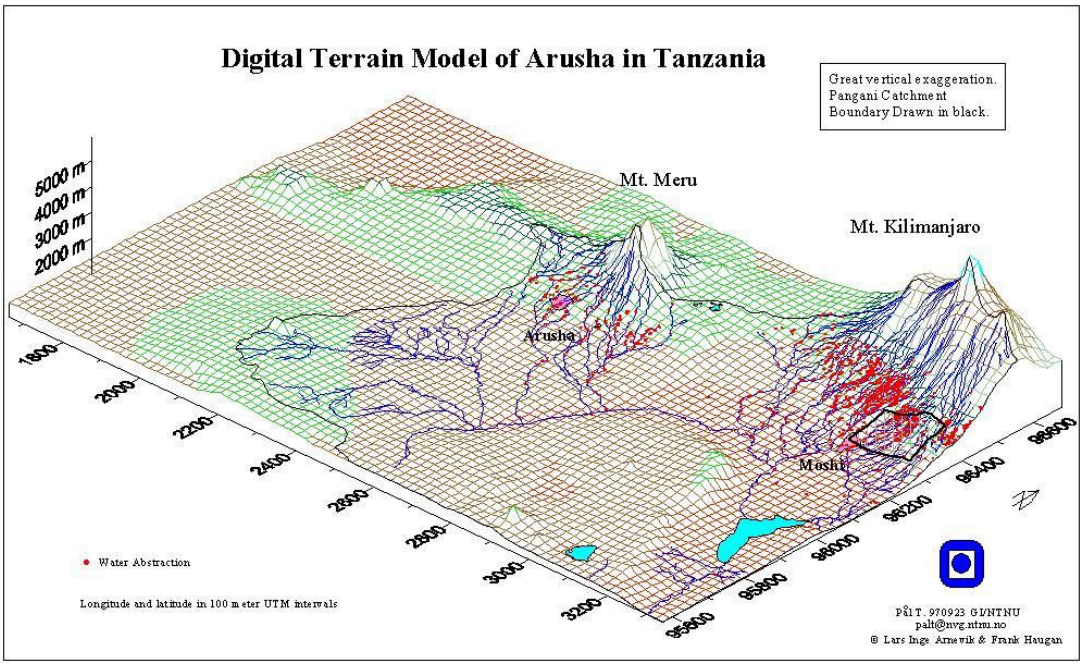
Project of Development in Dar es Salaam

3D Digital Elevation Models

Digital Elevation Models of Tanzania have been produced from satellite images as GPS measurements.



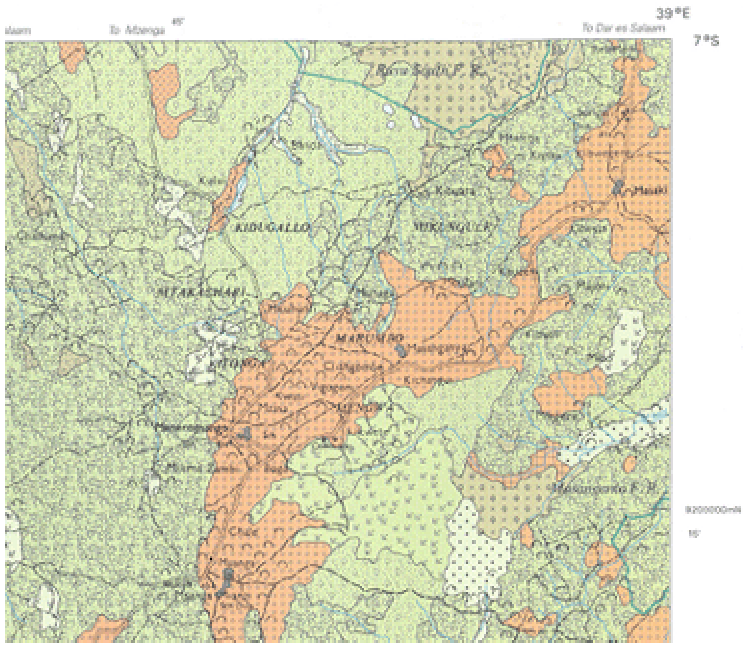
Tanzania DTM



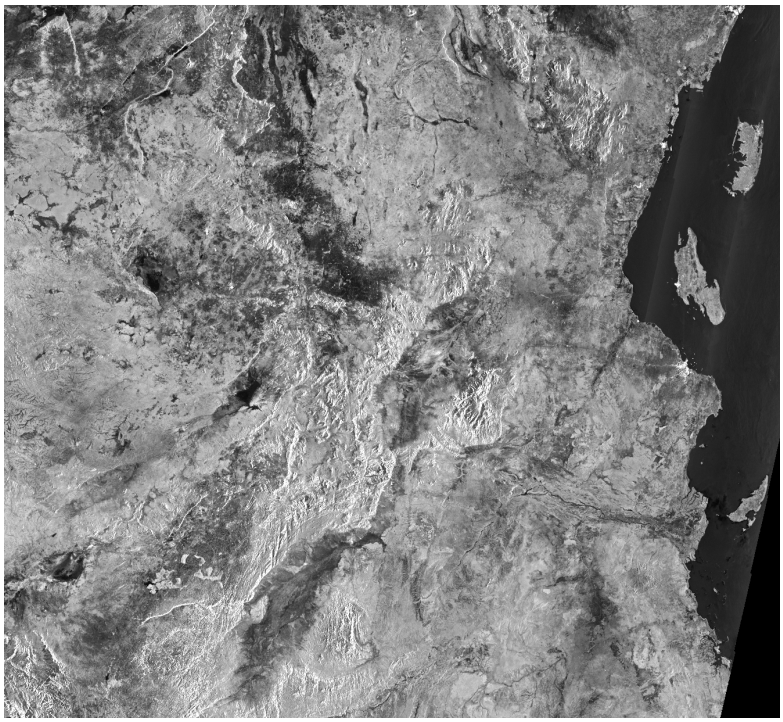
Digital Elevation Model Around Arusha

Satellite Image Mapping

By means of satellite images, thematic maps can be made quickly and easily in comparison with classical maps which need a huge ground work. Moreover, developing countries can produce maps from satellite images in a less expensive way.



Satellite Image Mapping



Satellite Image taken over the east of Tanzania

MAIN SOURCES USED

Liwa, E.J., October 1994: "*Satellite Map Revision In Tanzania"*, Departement Of Geography and Topographic Science, University of Glasgow.

And several documents and maps from:

Mr. Michael SHAND:
Glasgow
Senior Cartographer at the Department of Geography and Topographic Science in the University of Glasgow. He wrote the Digital National Atlas of Tanzania
e-mail: mshand@geog.gla.ac.uk