HUMANITARIAN AID

BELGIAN EARTH OBSERVATION

Projects financed by the Belgian research programme for Earth observation Telsat 4 (1996-2000)

Introduction

Natural disasters can lead to enormous economic losses, and also frequently cost large numbers of human lives. In some cases, adequate assistance can save many people and ensure swift reconstruction of the area. In other cases, the situation for a part of the population is so hopeless that flight is the only solution.

War, oppression based on political or religious differences and famine also force people to flee. Currently, more than 80 million people are living in a foreign country, and an estimated 2 million people emigrate annually on a permanent basis (FAO). The number of refugees world-wide are estimated at between 11.5 million (UNHRC) and 20 million people (FAO). A large number of these refugees find themselves in nearby countries in refugee camps.

Satellite images can contribute to more effective assistance; they offer virtually immediate information allowing one to quickly estimate the scope of a natural disaster and take the right measures to limit the consequences as far as possible.

Satellite images can help in the various phases of establishing refugee camps (assessing the supporting capacity of the environment, setting up the camps).

Recent research has also demonstrated the potential utility of satellite images for identifying antipersonnel minefields.

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HUMANITARIAN INTERVENTIONS

Three types of organisation help displaced people, namely the United Nations' High Commission for Refugees (UNHCR), bilateral agencies, and non-governmental organisations (NGOs). The UNHCR (or HCR) is responsible for the legal protection of refugees, mobilisation and coordination of aid, and the refugees' repatriation once the situation is safe again.

The bilateral agencies usually provide material assistance (often food). The NGOs help refugee populations meet their basic food, health, and other such needs, but they also provide longer-term educational, psychological, agricultural, environmental, and other types of support. The organisations' responsibilities and means of action thus differ. However, the humanitarian aid organisations present in the field are usually brought to co-ordinate their actions under the UNHCR's supervision.

Aerial photograph of Hagadera camp

DIFFERENT NEEDS

To identify the usefulness of remote sensing in this context, it is first necessary to identify the spatial information needs, which differ in line with the course of events.

Emergency phase

During the emergency phase priority is given to ensuring the people's safety and satisfying their basic needs for food, water, and shelter. At this stage, spatial information is required to organise the relief work. Such information must be obtained as quickly as possible.

When the refugee flows are predictable and the humanitarian aid organisations have had the time and means to react, camps are set up and planned before the populations arrive. In this case, the camps are well organised.

Photograph of rectangular Bantu hut in Hagadera camp

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In contrast, when events get the jump on people the refugee populations plunk down wherever they can as soon as they are out of danger, and the areas that they chose may not necessarily be suitable for harbouring such concentrations of people.

In this case, and when safety conditions allow it, one of the humanitarian aid organisations' first tasks will be to identify a better place for hosting the populations and to set up one or more camps on that site.

Site selection is one of the UNHCR's responsibilities and is negotiated with the local authorities, which tend to provide marginal lands for this purpose. As a rule, 1:200,000 or 1:100,000 topographic maps exist, but they are often old and hard to get (time-consuming administrative procedures). They are usually replaced by smaller-scale road maps. The data that they provide are very fragmentary and incomplete and often old and out of date. There are few more detailed topographic or thematic maps (smaller scaled than 1:50,000) for developing countries. Site selection is thus done in the field and based on interviewing the local population.

Spatial information is also very useful for estimating the number of refugees or displaced people. This figure is of crucial importance, for it is the multiplicative factor that enables aid organisations to quantify the food, water, equipment, and other needs. There are various ways to estimate the number of people quickly. Two of them – one based on estimating the camp's surface area, the other on counting shelters - could be used more easily if spatial information existed.

Consolidation phase

The emergency phase ends when the refugees have water, food, and shelter. That is when the consolidation phase starts.

A detailed map of the camp, drawn to a large scale (1:1,000-1:5,000), can then be used to re-organise the camp and locate the facilities and infrastructure (wells, latrines, dumps, cemeteries, food distribution points, storage areas, etc.). Such a map is sometimes drawn up from enlargements of (1:25,000 to 1:50,000-scale) aerial photographs or topographic maps. However, as both snapshots and maps tend to be rare, the detailed maps are primarily the result of fastidious field surveying work.

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This phase also involves keeping track of changes in the population. If a refugee headcount not yet has been taken (such censuses are sometimes impossible, for reasons of security or emergency), the number of ID cards that have been handed out can be used to estimate the number of people. However, this figure is often overestimated. Several indirect methods can be used to check the validity of this estimate (number of under-fives receiving medical care, water consumption, etc.). Aerial snapshots are a source of additional estimates. When the estimates diverge too much, a census becomes indispensable.

Chronic phase

When the situation drags on, the camp becomes permanent. Spatial information then becomes necessary to monitor the camp, the population's distribution, and the environment. This is because the camp's infrastructure and facilities will change.

New activities, such as market gardens and farming, spring up, and the population's distribution inside the camp changes. The detailed map of the camp should be updated periodically. Keeping track of the refugee population remains a must.

Tensions between locals and refugees can also arise fairly quickly, and for many reasons. One reason is the increased competition for limited renewable resources. Because of the huge concentrations of people on marginal land, environmental degradation (deforestation, overgrazing, erosion, etc.) is often seen close to the camp. The closer one is to the camp, the worse such degradation is, but huge areas can also be affected. Unsafe conditions can make it difficult, even impossible, to work the land. Any technique that allows one to characterise environmental degradation will lighten the work in the field. Such monitoring can then be used to keep track of environmental rehabilitation programmes.

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Methodology and Results

As the right map scales are greater than 1:200,000, only high-resolution satellite remote sensing (SPOT and LANDSAT TM data) can provide the necessary information in this context. Very-high-spatial-resolution satellite remote sensing (IKONOS data) opens up new mapping prospects for humanitarian aid for refugees by making maps at scales close to 1:10,000 possible.

Emergency phase: Emergency relief work calls for rapid reactions

At the start of an intervention, high-resolution satellite remote sensing can serve as a basis for rapid mapping of the regional geographic context (major plant formations, main land use categories, etc.) of the sites where displaced populations cluster and the location of the main topographical features (towns and large villages, roads and tracks, rivers, lakes and streams, etc.).

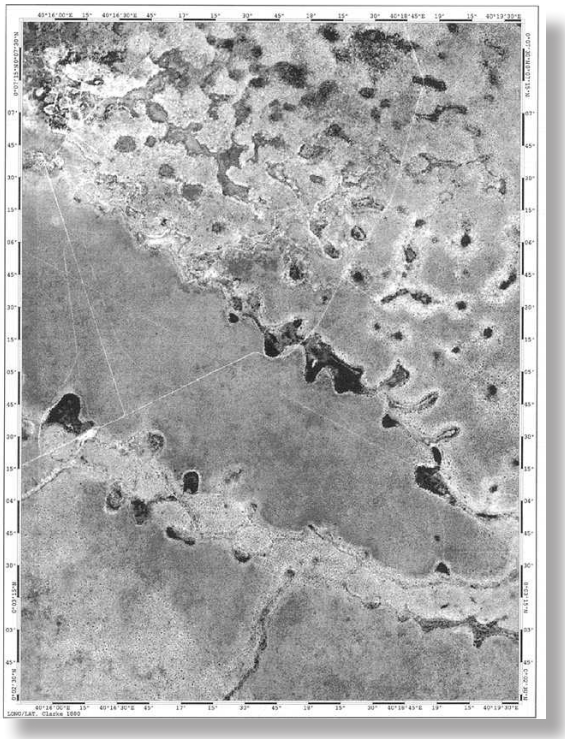
Today's high-spatial-resolution sensors (SPOT and LANDSAT TM) can provide relevant spatial information as long as the images are recorded, for the information production deadlines are incompatible with the difficult-to-foresee duration of satellite data acquisition programming. The systematic acquisition of data by Earth-observing satellites is limited by two parameters, namely, the cloud cover, which varies according to the region's climate, and the existence of a receiving station.

The metadatabases are checked to see if such images are available. Now, there currently does not exist any complete, standardised metadatabase accessible through a network that can answer the question 'Do high-resolution satellite images exist for a given region?' in a single search. You thus have to consult the different distributors' catalogues.

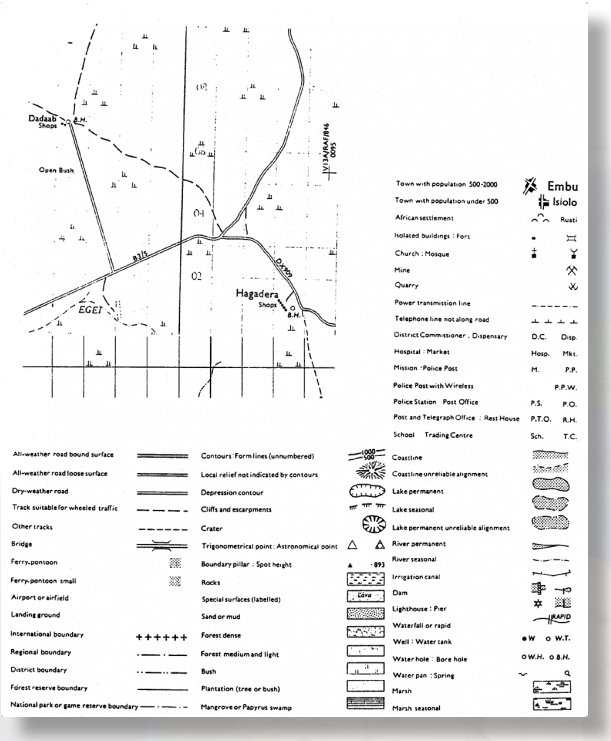
Very few cloudless images exist for this part of Kenya (which is not covered by a receiving station). The only satellite images that do exist are two SPOT images taken in 1990 and a Landsat TM image from 1986. The panchromatic SPOT images were acquired in digital format. The Landsat image was too old.

After undergoing some processing (geometric correction and contrast enhancement), the panchromatic SPOT images were used to mark out the network of tracks and locate the villages, ponds, and streams. Printouts on a 1:100,000 to 1:25,000-scale were produced, since at smaller scales the data are no longer pertinent. Such satellite image maps provide precious spatial information for starting up emergency relief work.

Methodology and Results



Satellite image map derived from panchromatic SPOT image of Dadaab region (Kenya), (detail of a mosaic of scenes 145/350 and 146/350 from 12/01/1990) © CNES, distribution Spot Image



Example of available rudimentary topographical map (detail of a 1 : 100 000 scale map

Comparing the information supplied by this type of geospatial map with the features on the 1:100,000-scale topographic maps is a quick way to see what remote sensing adds. Only a few topographic features are indicated on the topographic maps, whereas trails, tracks, streams, ponds, and many other features are visible in the satellite images. However, the satellite image is a crude document that must be interpreted by an experienced analyst or, failing this, backed up by a field survey. What is more, small point-like features, such as antennae and wells, and the toponymy are not visible on satellite images.

The consolidation phase

Once the emergency phase is past, these satellite data can also be very useful for situating the camps in their environments and drawing a situation map, that is, a map of the modified network of tracks, camp locations and structures, locations of the non-governmental and international organisations' facilities, locations of ponds and water holes, mapping of plant formations, etc. That is why the SPOT satellite has been programmed to acquire simultaneously recorded panchromatic and multispectral images of the same area. These panchromatic SPOT data have undergone digital processing, i.e., geometric correction, IHS-RGB fusion, computer-aided photo-interpretation, and satellite image maps generated at different scales.

Methodology and Results

The 1:25,000 satellite image map of Hagadera Camp shows the camp's arrangement in blocks and sections, underscored by hedges of thornbushes. The planted fields are visible, as are the ponds.

The camp is divided into two parts, one on either side of a wadi, not far from a tributary of the stream. The two parts of the camp are surrounded by a halo of bare ground.

To the west, structures marked by the alternation of inorganic surfaces and vegetation reveal the presence of the market and humanitarian aid organisations' facilities (hospital, offices, warehouses, hangars, etc.).

Transects can be seen cutting through the vegetation north-west and south-west of the camp. These lines mark the blocks and sections that were foreseen for additional refugees.

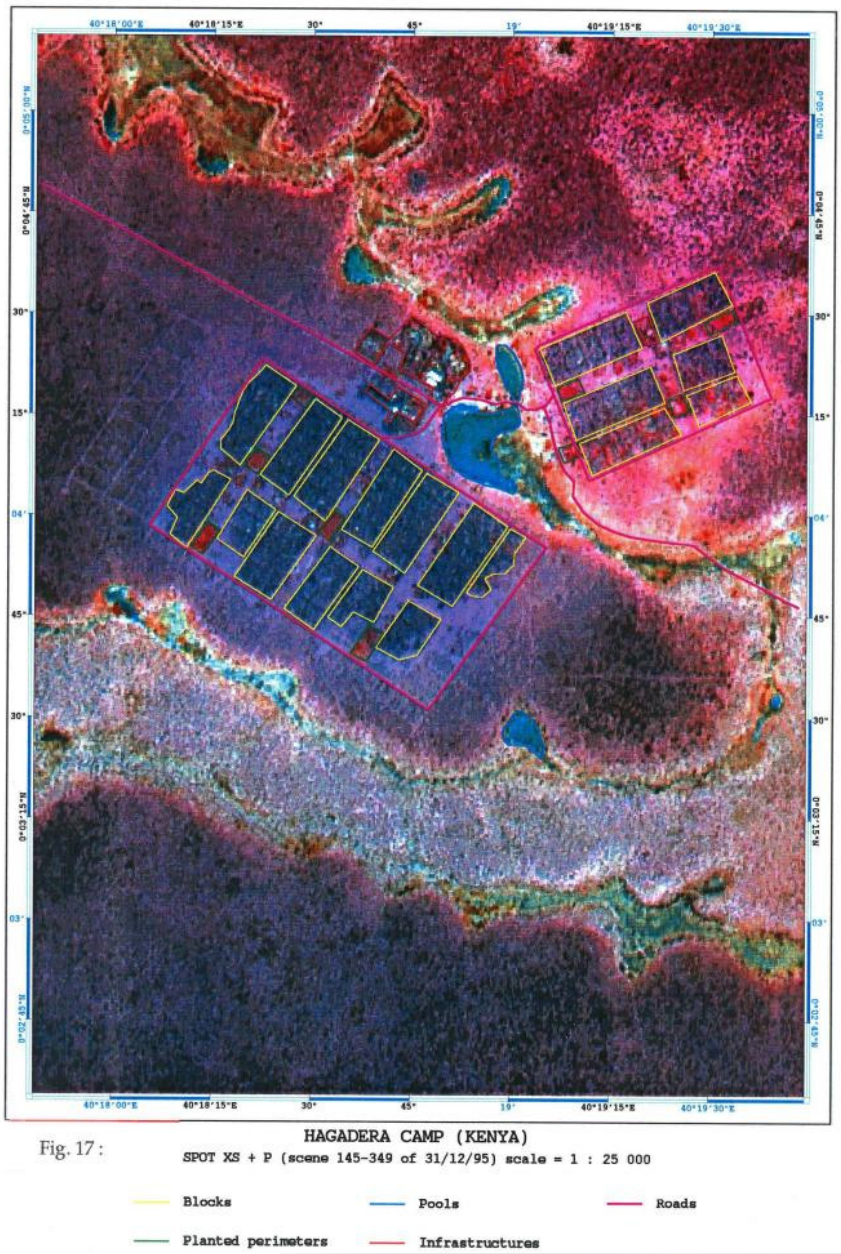


Fig. 17 :

Satellite image map of Hagadera camp (Kenya),
Spot XS+P (scene 145-139, 3/12/95)

We can also discern the line of the track linking Hagadera Camp to Dadaab, the town located 10-km away. The dominant colours in the areas next to the camp are linked to differences in the type of land (colour and moisture content). A more detailed interpretation of the site would call for more fastidious field work.

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Methodology and Results

After a quick field check, visual interpretation allows one to produce a site map to the scale of up to 1:25,000. This is not detailed enough for running the camp's operations, but provides a sufficiently good overview and can serve as the foundation for more detailed mapping based on aerial snapshots or surveying on the ground.

Chronic phase

Satellite data can also be used to monitor the camps' impacts on the environment, which is often marginal and fragile. In Dadaab, for example, these refugee populations are degrading production factors that are vital for the local population, that is, the pastures and waterholes. In other geographic contexts nature reserves are sometimes endangered (see the case of Virunga National Park, near Goma, in the Democratic Republic of the Congo).

Indeed, the gathering of wood around the camps for various uses (cooking, building kraals, and building shelters) creates an aureole of damage to the surrounding vegetation that is characterised by a gradient of damage that decreases with increasing distance from the camp (up to 40 km in some cases). The concentration of livestock is undoubtedly the cause of overgrazing of some pastures and trampling of the ground around certain waterholes.

In the case of permanent refugee camps, comparing satellite data acquired on different dates enables one to monitor the regional environment and organise its management more effectively.

The lower you fly, the better the view, but the greater the risk

For scales smaller than 1:20,000, satellite remote sensing is now giving way to airborne remote sensing. Aerial photographs are very useful for mapping camps, estimating population sizes, and monitoring the environment.

Very few aerial photographs exist in the developing countries, and when they do exist, they are usually out of date. Carrying out a photogrammetric flight is a cumbersome and costly operation. That is why the company I-Mage Consult has developed a streamlined technique based on the use of a camera linked to a global positioning system (GPS) and a portable computer. The GPS and computer trigger the camera and situate the photographs according to geographic coordinates. The camera is attached to a small light passenger plane (high wings and removable door).

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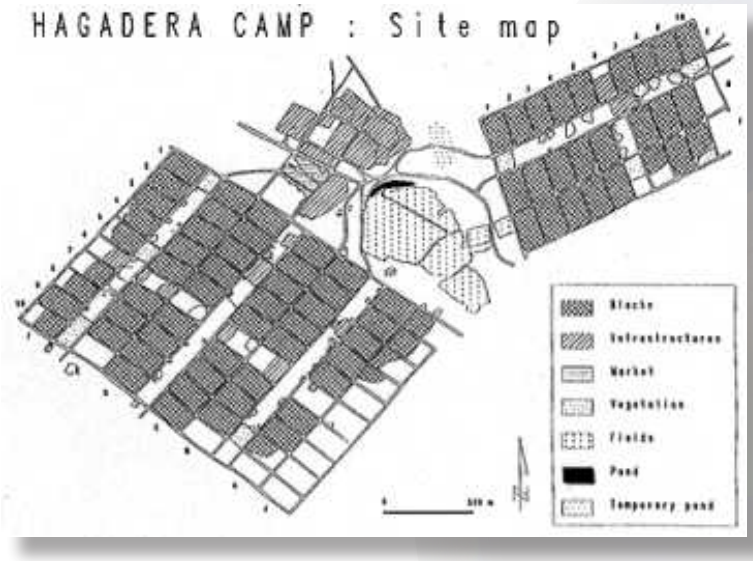
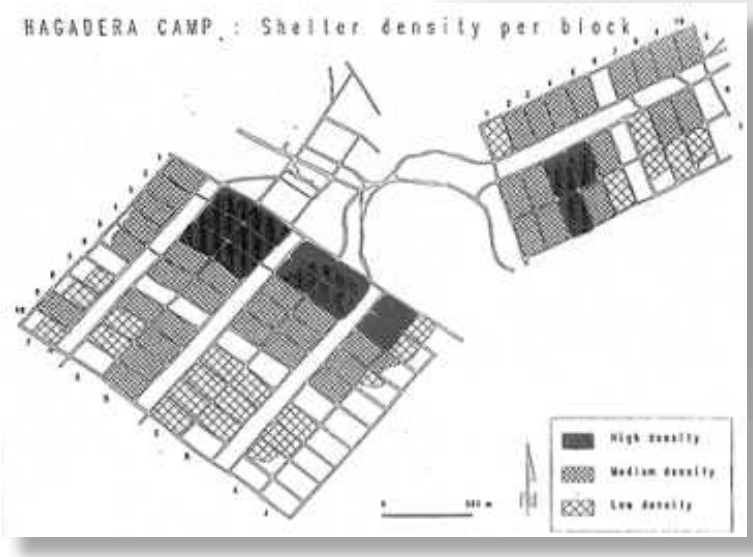
Methodology and Results

These images show the results of a low fly-by (at 500 m) to take vertical aerial snapshots of Hagadera Camp. These aerial photographs were printed out on paper to a scale of 1:2,200. It is easy to see the camp's organisation in sections and blocks separated by trails edged with thornbush fences. Inside the blocks the refugees have built their huts, kitchens, and latrines according to their traditions, i.e., rectangular huts for the Bantus and low round huts for the Somalis. The families group together and sometimes isolate themselves within the privacy of a thornbush kraal. The dwellings are very easy to spot, for they are usually roofed with the white canvas or blue plastic that the UNHCR hands out. With a little training one can distinguish the dwellings from the kitchens and latrines.



Map of Hagadera camp (key : block, infrastructures, markets, vegetation, fields, waterhole, temporary pool)



Map of hut density per block in Hagadera camp

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Methodology and Results

These aerial photographs make it possible to map the camp in detail and count the huts. The number of huts may then be multiplied by the mean family size (a figure yielded by fieldwork). It is also possible to estimate the hut density per block and thus get an estimate of the population's breakdown, which fluctuates over time and space. As a rule, when the refugees are first settled in a camp, some 120 families (about 600 people) are set up in each 100 x 200m block. However, as the months go by families move about, move out of the more dangerous marginal areas, move closer to the market and hospital, join relatives, etc.

These aerial snapshots may also be used to back up an environmental assessment of the camps. The pictures are taken according to a predetermined sampling scheme in order to cover the entire area to assess. It is possible to recognise vegetation and land characteristics in each picture. Such snapshots can also serve as a back-up for interpreting satellite images and thus replace ground surveys when the latter are too dangerous.

This technique is very flexible and clearly less dependent on atmospheric conditions than satellite remote sensing is. However, it is severely hampered by unsafe conditions. Unauthorised fly-bys may be possible under certain conditions, provided that people's safety is not jeopardised. However, even at Dadaab, where the situation is relatively stable, the Kenyan authorities did not take kindly to the flight, which was made possible only with the help and intervention of the UNHCR.

Conclusion

Remote sensing is an important tool in the various stages of refugee relief efforts.
In the emergency phase, when a crisis erupts and people flee from danger, airborne remote sensing can help to select a camp site and to estimate the number of refugees.
During the consolidation phase, remote sensing by satellite serves to map the camp, which is quite useful to organise logistics. Quite often, camps remain in place for years. Remote sensing then is useful to monitor the evolution of the camp, update site maps, and monitor the camp's impact on the environment in view of its rehabilitation.

So the different remote sensing techniques are major supporting tools. The competence acquired in this project is a valuable addition to the means available for humanitarian help efforts.

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Team

Coordinator

Eléonore Wolff
Institut de Gestion de l'Environnement et d'Aménagement du Territoire
Université Libre de Bruxelles (ULB)
Campus du Solbosch
av. Antoine Depage, 13
B-1050 Bruxelles

www: igeat.ulb.ac.be
Tel : +32 (0)2 / 650.50.76
Fax : +32 (02) / 650.50.92
e-mail: ewolff@ulb.ac.be

Partner

Michel Lambotte (I-MAGE Consult)

e-mail: i-mage@i-mage.be

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Info

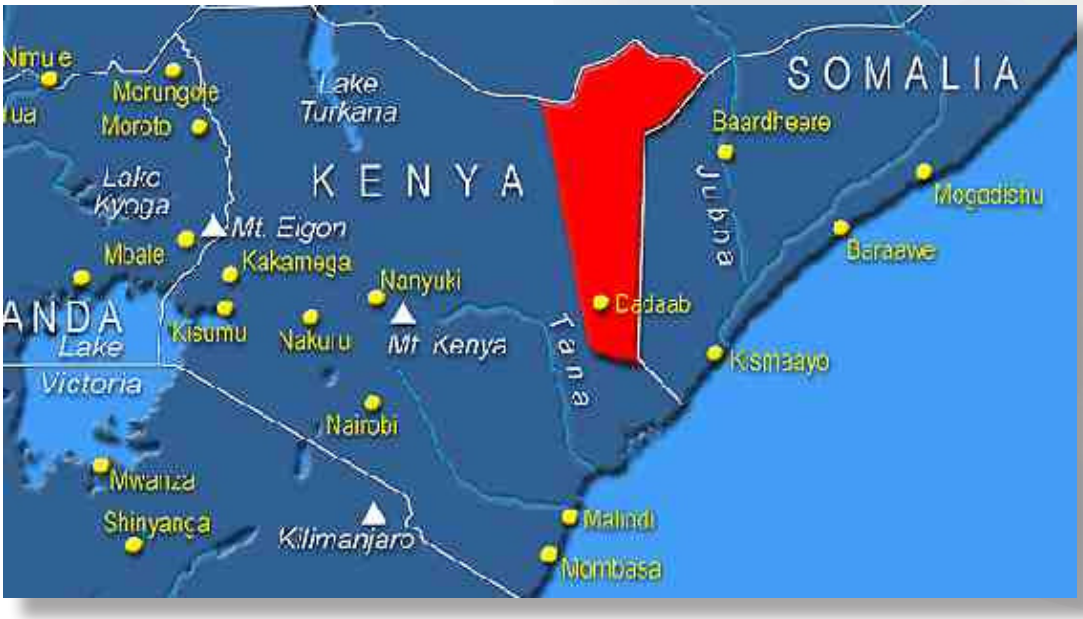
Abstract

The news is constantly showing us pictures of refugees. These mass population movements can be caused by conflicts, political repression, famine, and natural disasters. The people flee as long as they are in danger, then stop as soon as they feel safe, forming camps that may or may not be planned, depending on how fast the crisis develops;

Effective large-scale humanitarian aid requires a good inventory of the theatre of operations. This aid is often dispensed in remote areas for which large- and middle-scale maps are non-existent or obsolete. Emergency mapping then becomes necessary. Such mapping is based on recent satellite images, to which one adds knowledge of the terrain resulting from either field surveys, if possible, or data culled from an inventory of various documents.

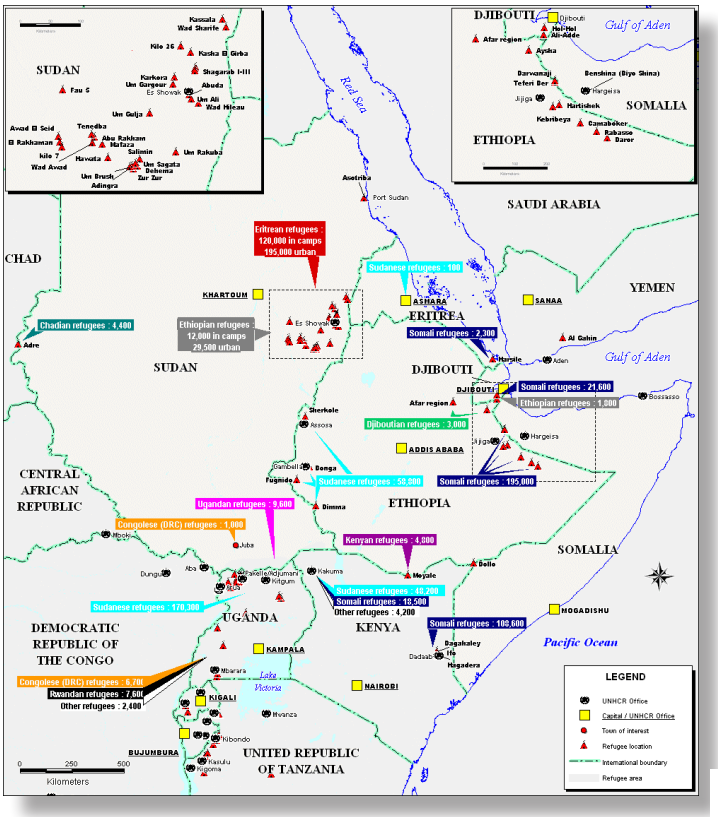
Remote sensing is also suitable for ad hoc operations. So, studies and methods have been developed to use satellite imagery to look for appropriate sites for setting up refugee camps. Other studies show the usefulness of remote sensing for monitoring the refugee camps' impacts on the local environment over the longer term. With the help of aerial photography or high-resolution imagery, large-scale remote sensing can also provide back-up for camp management and the detection of risk area.
The various remote sensing techniques are important logistic support tools. The expertise developed in this field contributes to a whole set of means that Belgium makes available for humanitarian aid purposes.

Observation area

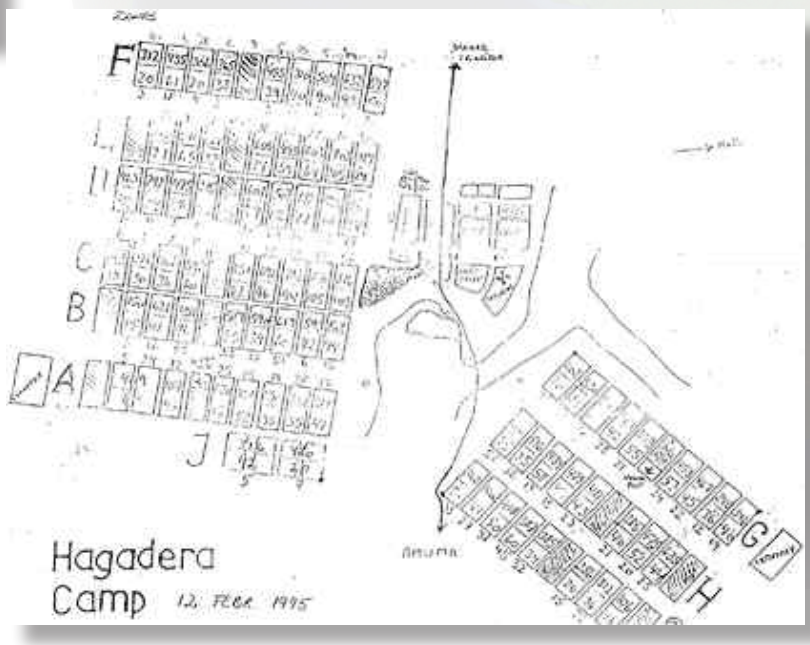


Info

The site of this study is Hagadera Camp, located near Dadaab, in Eastern Kenya, some 100 kilometres from the Somali border.
A regional map, put together from UNCHR documents, shows the sites of the refugee camps in the Horn of East Africa.



Localisation of refugee camps in the Horn of East Africa, situation in april 1999, source UNHCR



UNHCR hand-drawn map of Hagadera camp (situation on 12/2/1995)

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Info

The climate in this region is semi-arid. The vegetation is characterised by shrubs with a few sparse trees. The local populations make their livings primarily off livestock. Banditry has risen sharply over the past ten years in this border area, which the Kenyan authorities seldom patrol. As a result, the pastoral populations have fallen back to the smaller towns and people travel in convoys under the army's protection.

Hagadera Camp was set up by the United Nations' High Commission for Refugees (UNHCR) in 1992. It is 'home' to some 39,000 Somali refugees and covers a 3-square-kilometre area that is divided up into sections, each of which is in turn divided into 100 x 200m blocks. The camp is located on a vast plain near a source of water. This detailed map was compiled from field readings and drawn by hand.

Various non-governmental organisations provide health care, distribute aid, protect and help restore the environment, provide schooling, etc. The UNHCR is in charge of coordination, security, and planning.

Satellite imagery

SPOT P
SPOT XS
LANDSAT TM
(IKONOS)

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