Food and Agriculture Organization of the United Nations

Good practice fact sheet
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REMOTE SENSING:
MONITORING THE CASH FOR WORK PROGRAMME

Objective

The objective of this good practice fact sheet is to provide guidance on using remote sensing technology in a developing country environment, in particular to verify infrastructure rehabilitation. The document explores how the technology can be used to monitor improvements made as part of a Cash for Work programme, providing accountability to donors. It also highlights the benefits to local communities, through increased employment opportunities and restoration of critical productive assets that can help them to enhance their livelihoods.

Geographical coverage

This methodology has been applied to all the areas of Somalia, including Somaliland and Puntland.

Introduction

The Somalia Water and Land Information Management (SWALIM) project – winner of the e-category prize in the 2016 World Summit on the Information Society (WSIS) awards – uses Information and Communication Technologies (ICTs) to manage land and water resources in the extremely challenging environment of Somalia. It has been implemented as a continuum of activities designed to empower selected Somali institutions to achieve self-sufficiency in generating and managing information about the country's natural resources.

The use of remote sensing and image analysis is a key part of FAO-managed SWALIM's data gathering activities. Remote sensing refers to the acquisition of information without coming into physical contact with the object or area being studied. In this specific context, remote sensing is used as one of a number of innovative systems to monitor activities undertaken as part of the Cash for Work programme (CFW). These various systems and methods complement each other and provide a comprehensive risk management framework that ensures compliance with standards and guidelines for project implementation.

The high level of security risk present in Somalia created major challenges for controlling work carried out by NGOs and local beneficiaries to rehabilitate degraded productive infrastructures in remote areas of the country. Donors sought accountability and verification that the work was being completed according to set standards. Given the significant investment made and, in some cases, the considerable security constraints hindering the planning and executing of assessment missions in the field, it was decided to use a combination of tools to triangulate information received from the implementing partners. Remote sensing is one of the technologies being harnessed to monitor and verify work carried out by Cash for Work beneficiaries.

What is Remote Sensing?

Remote sensing is the ability to capture and analyse information about an object or phenomenon from a distance, without making physical contact. It is used in a wide range of fields, including geography and most Earth Science disciplines (for example, hydrology, ecology, oceanography, glaciology or geology). It also has military, intelligence, commercial, economic, planning, and humanitarian applications. The term generally refers to the use of aerial sensor technologies to detect and classify objects on Earth (both on the surface, and in the atmosphere and oceans) by means of propagated signals, such as electromagnetic radiation.

In Somalia, SWALIM developed a remote monitoring system using remotely sensed data to observe large swathes of territory on a regular basis, much of it inaccessible due to insecurity. This enables payments to be made for work done by communities, without expensive – and often dangerous – on-site assessments. In Somalia, remote sensing is proving a powerful and economical methodology, compared with complex, costly and sometimes perilous field surveys.

Methodological approach

Cash for Work (CFW) activities are monitored by a triangulation of information using various methods, including multi-temporal Very High Resolution (VHR) satellite imagery to capture the 'before and after' status of infrastructure sites for verification purposes. Managed by the Remote Sensing Unit within the SWALIM project, VHR satellite imagery is currently used for all areas of Somalia.

The rehabilitation of water catchments is one of the major infrastructure works monitored in the CFW framework. Different features are considered during the image analysis, such as the size and shape of the watershed, evidence of soil movement, new vehicle tracks and vegetation removal. Other rehabilitated infrastructures include canals, soil bunds, broken river banks and feeder roads. Their assessment is performed by comparing VHR satellite images taken before the start of the work (Date 1) and images acquired after the end of the work (Date 2).

The VHR images used for the monitoring are either provided free-of-charge by the US Department of State through the Digital Globe Enhanced View Web Hosting account, or procured/purchased from a provider of commercial satellite images.

The provision of training and capacity development on the use of remote sensing are critical components of SWALIM, making the programme a participatory initiative that will one day be owned and managed by the people it serves.

The Cash for Work (CFW) programme was designed to engage vulnerable households affected by extreme levels of food insecurity in activities of productive infrastructure rehabilitation (dams, canals, etc.). The households targeted are composed of at least 30% women. This initiative helps the most vulnerable sectors of the population to gain immediate cash relief, so as to address food needs during the lean season and in times of other shocks, while rehabilitating key assets that improve productivity and resilience. In addition, work opportunities provided by CFW ensure that vulnerable people remain in their communities, thereby avoiding more displacement and keeping social ties intact. Monitoring supplied by remote sensing enables the programme to provide evidence of existing degraded infrastructure and the need for rehabilitation, as well as proof of completed work once it has been carried out. This in turn allows final payments to be disbursed to the NGOs and local beneficiaries. Payments are also linked to Global Positioning System (GPS)-tagged photographs showing the progress of works and results are verified by telephone surveys from a dedicated call centre. Individual workers are also identified through a system of biometric registries and verification in the field, ensuring that the workers who did the work are the ones who get paid.

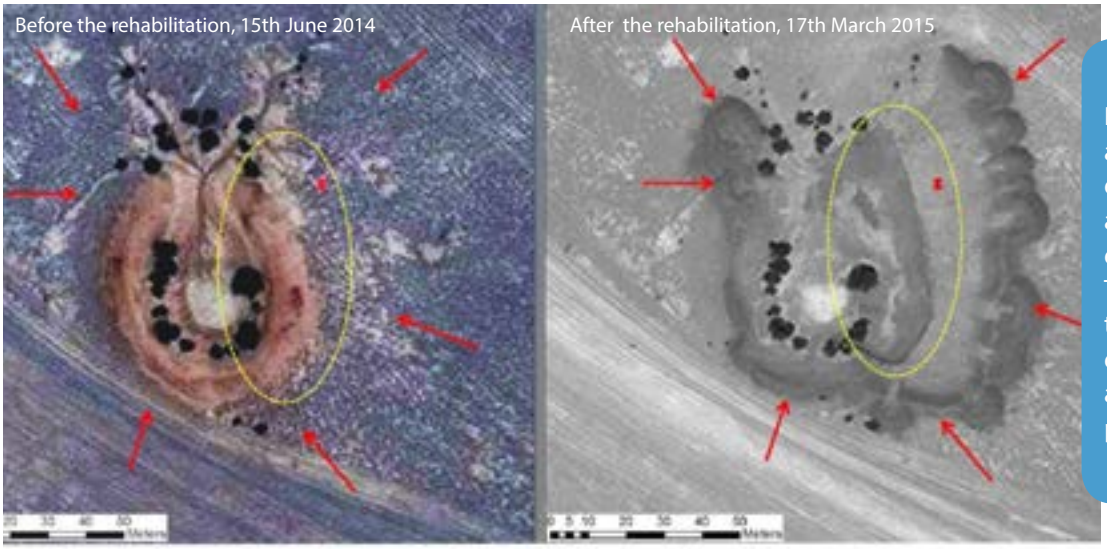
Cash for Work in action?

The households targeted by the Cash for Work programme are in areas classified as either in a 'humanitarian emergency' or 'humanitarian catastrophe', according to the Integrated Food Security Phase Classification system (IPC 3 and IPC 4).

Households are directly selected by the communities, in close consultation with local authorities, and contracted through the facilitation of NGO's partners. In order to ensure that the partner NGOs do not need to handle cash to pay beneficiaries, the Cash for Work programme in Somalia uses the traditional system of Hawala money vendors, who make payments on presentation of an FAO serialized payment voucher. The partner NGO gives a signed copy of the list of beneficiaries to the money vendor, against which the payee's name and voucher are checked when payment is made.

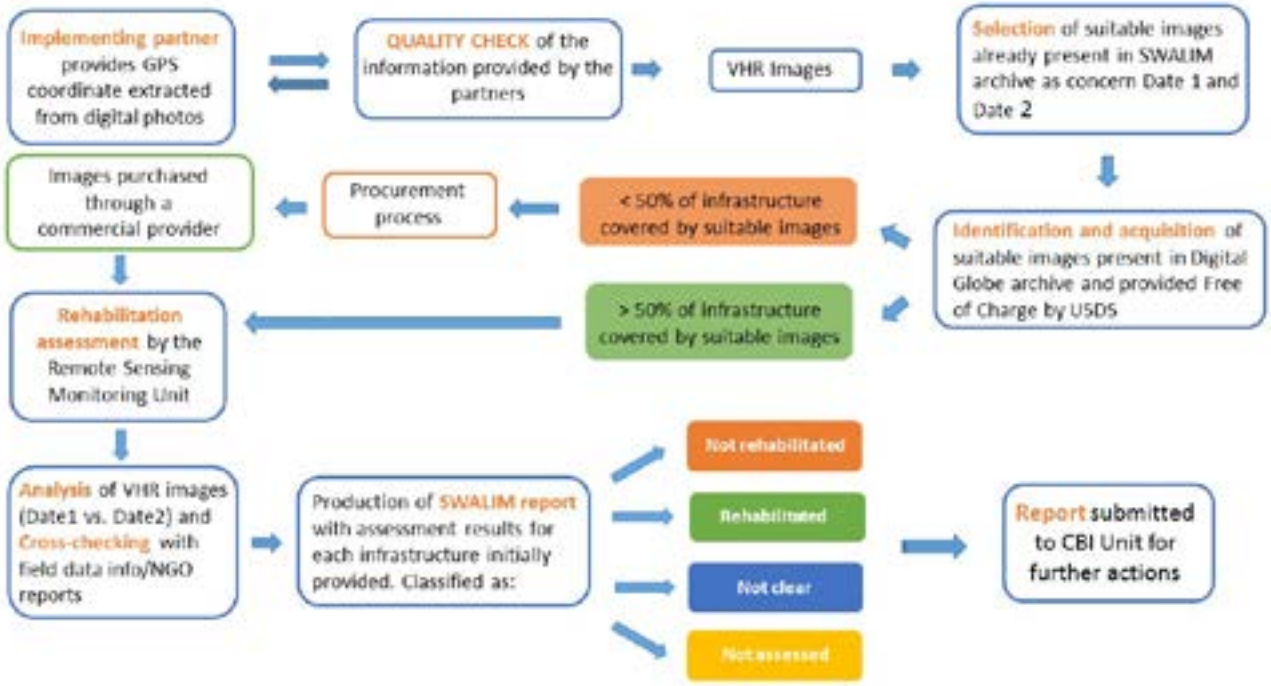
The programme has continuously improved security measures within the transaction flow and is now registering and checking beneficiaries through digitalized fingerprints (biometrics). It has also introduced photographs on vouchers, in addition to the cross-referenced serial number, in order to facilitate verification of beneficiaries in some districts where biometric data cannot be collected due to security reasons.

The monitoring system is based on the triangulation of information obtained from different sources: remote sensing, the FAO Somalia Call Centre – which conducts beneficiary surveys by phone – field missions, NGO reports, comparison of GPS-tagged photographs and external monitors' reports (third party monitors). The main purpose is to support the verification of proper field execution of project activities, including rehabilitation works, payments to beneficiaries and training. To evaluate impact, FAO uses a combination of tools, including the findings of training evaluation assessments and post distribution assessments. Remote sensing, including used of VHR satellite images, provides clear verification of work carried out at a given site. It specifically answers the question: Did any rehabilitation process (i.e. excavations, vegetation removal, infrastructures enlargement, etc.) take place or not?



Remark: The image analysis shows clearly evidence of soil heaping around the catchments embarkment (red arrows). The images also show that the catchment has been excavated on one side and enlarged in its eastern portion (outlined in yellow)

How does the monitoring procedure work in detail?



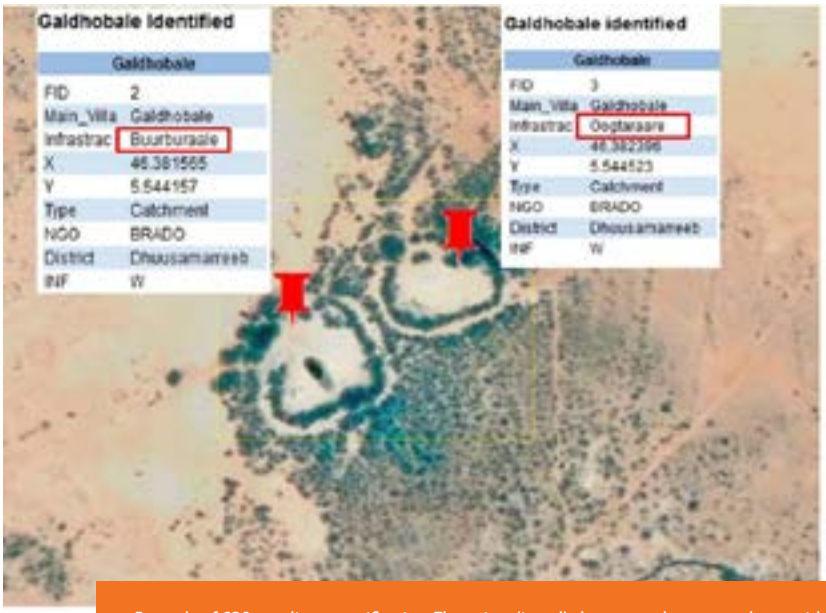
1. **Letter of Agreement:** The monitoring procedure on infrastructures rehabilitation starts with the inclusion of compliance and risk management requirements, including remote sensing, in the Letter of Agreement (LoA) between FAO and the service provider, usually a NGO.

2. **GPS photographs:** Among the requirements agreed in the LoA, the NGO undertakes to provide GPS-tagged photographs taken before, during and after the rehabilitation work, to give proof of job completion. In addition to showing the progress of works, these photographs provide the GPS coordinates required for confirmation of the infrastructure via remote sensing.

The GPS coordinates of the infrastructures to be rehabilitated can be provided by the NGO **in different formats,** such as:

- .gpx format (it is a common GPS device format)
- .xls tabular data format
- .jpg geo-tagged photographs format

The geo-tagged field photograph format is the most commonly used, since it provides both the geographical location and an overview of the area from the perspective of the ground.



Example of GPS coordinates verification. The points (in red) show a good correspondence with water catchments to be rehabilitated

3. **Satellite images:** The RS monitoring unit transforms the coordinates in GIS format, in order to plot the intervention sites on geo-referenced satellite images.

4. A first screening of the quality of the data provided by NGOs is performed by importing points in Google Earth software or displaying them on the available VHR satellite images from SWALIM's archive. Considering the infrastructure to be monitored, the screening compares its geographical location with captured coordinates. If there is no correspondence, the NGO is contacted to clarify and/or amend the information provided.

5. **Exact date:** The NGO should also provide precise start/end dates of the work implementation and give prompt communication in the event that it is postponed.

6. The acquisition date and technical specifications of the images needed are critical for a correct assessment during the infrastructure monitoring phase.

7. **Verification:** This consists of finding evidence that the intended rehabilitation work actually occurred through the visual analysis of suitable VHR satellite images.

8. **Report:** The full results of the analysis are given in a report, which contains a map with the location/status of the infrastructure, a summary table of the results and evidence based on the VHR image analysis, with additional remarks explaining the findings if necessary.

The remote monitoring process, from the GPS coordinates to the rehabilitation assessment, is explained in the workflow diagram at page 4.

The Remote Sensing softwares and VHR images

- The main software packages used in this phase are ESRI's ARCGIS, Google Earth, OkMAp (for .gpx-type data extraction) and BR's EXIFextracter (to extract the geographic coordinates from the GPS-tagged photos).
- GIS software (including ArcGIS, Qgis, ERDAs and Mad-cat) is generally commercial and licenses are purchased by SWALIM.
- The biometrics verification software was developed and is owned by FAO Somalia.
- The commercial VHR satellite images used are mainly World View 1/2/3, GeoEye, IKONOS, Quick Bird or any other commercial satellite images with a Ground Spatial Distance (GSD) < 1m, possibly having multispectral bands. The cloud cover of the VHR images should not exceed 10%. World View 1 (only panchromatic band) should be considered as a last resort, if no multispectral VHR images are available.

Validation

The Validation of Cash for Work activities is carried out through triangulation of information collected by the Call Centre, field monitors, a toll-free hotline and reports from the implementing NGOs.

The Call Centre, based in Nairobi and staffed by Somali speakers, conducts telephone surveys of village or town council members, elders and beneficiaries. An initial survey ensures that the beneficiaries identified in the selection process meet the criteria of CFW projects. A second stage focuses on the work performed, (i.e. number of days), and verifies that payments/benefits are received.

The Hotline allows beneficiaries to make complaints, request assistance and provide other important feedback to FAO.

The information collected through the Call Center and the Hotline is also used to make adjustments or improvements in project implementation and provides lessons for future interventions. The entire procedure is part of the FAO Accountability to Affected Population protocol.

Impact

The target of the Remote Sensing Unit is to monitor 50% of infrastructure rehabilitations implemented by each NGO. The percentage may be higher if images are readily available. The remote monitoring system used in Cash for Work enables the programme to verify the completion of works and offers donors assurance, to encourage their ongoing support. As a result, FAO can continue to provide men and women with immediate cash relief, while at the same time improving the assets of communities, allowing members to avoid displacement and be more resilient in the long term.

Records show that the Cash for Work programme met its primary expected outcome: beneficiaries used the CFW payments to purchase food. It has been calculated that there was an increase in the proportion of households spending above average amounts after they received the last CFW payment, compared with before the intervention. Aside from food, households spent more on school fees, transport, clothing and fishing equipment. Moreover, analysis shows that most of this expenditure is made within the community, contributing to the improvement of livelihoods in the group as a whole.

One of the major FAO Emergencies interventions implemented in Somalia, the Cash for Work programme made a significant contribution to ending the country's last severe famine in February 2012. According to a report by the FAO-managed Food Security and Nutrition Analysis Unit (FSNAU) and USAID's Famine Early Warning System Network (FEWSNET), the number of people in need of emergency humanitarian assistance in Somalia between August 2011 and February 2012 declined from 4 million to 2.34 million, the equivalent of 31% of the population.

The CFW programme incorporated women in the water catchment committees that managed the sites (44%). Women were also involved in training in water infrastructure management.

Success factors

- In order to use the remote monitoring methodology outlined here, the executing agency must have in place a remote sensing unit capable of obtaining accurate geographical coordinates of the locations in question, as well as expert analysis of remotely sensed images covering these areas.
- The satellite image acquisition date and the technical specifications of the images are critical factors for a correct assessment during the infrastructure monitoring phase.

Constraints

The use of remote sensing to monitor infrastructure rehabilitation works can be impacted by the following constraints:

- **Satellite image quality:** the analyses cannot be accurately conducted if the satellite image is marred by cloud cover or atmospheric haze.
- **The typology/ extent of the intervention**: not all types of infrastructure intervention can be detected by remote sensing. For example, if the intended intervention is to deepen a water catchment bed, without any enlargement or shape changing, high resolution images may not be sufficient to verify the full and correct implementation of the work.
- **Judgement on the intrinsic quality** of rehabilitation intervention cannot be based solely on remote sensing data. Only field visits can give a definitive evaluation.

Sustainability

In order to strengthen local communities and institutions, the SWALIM project is also involved in providing capacity development and logistical support to SWALIM liaison offices, Somali line ministry data centres and NGO/partner agencies. Over the years, SWALIM has conducted a series of courses on GPS, GPS cameras and devices, Google Earth, basic and advanced GIS, remote sensing and other topics.

SWALIM has also contributed to capacity development by assisting in policy formulation and providing equipment and resources. The ultimate aim is to hand over all project activities to the Somali partners. The SWALIM project, now in Phase V, is due to close at the end of February 2017. However, as the handover process is continuous and has been part of project plan for many years, it is likely that a Phase VI will be developed to carry the work forward.

Replicability and Scaling Up

In order to replicate and scale up remote sensing for monitoring Cash for Work activities, the following actions will be necessary:

- Capacity development for local/regional and/or national institutions to manage and maintain high quality Remote Sensing Analysis units, able to cope with the geographical and topical areas to be covered.
- Acquiring adequate remote sensing and GIS related software and hardware. Using open source software would reduce costs.
- Obtaining cost-effective contracts (or subscriptions or agreements) with providers and/or through donors of appropriate satellite images.

Scaling up remote sensing to monitor Cash for Work activities in another country, such as South Sudan, would require increasing human and capital investment by approximately 100%. Similarly, increasing the scope of monitoring to cover the migration of herd animals in one region of Somalia (Puntland), would entail doubling costs, due to higher frequency requirements. Any scaling up would involve increased management and administration costs for the Cash for Work programme.

Stakeholders and partners

Beneficiary The direct beneficiaries of the Cash for Work programme are people engaged in infrastructure rehabilitation, generally in remote areas of Somalia, who are paid for their work. Communities where the infrastructure is located also benefit indirectly, through their use of the developed/rehabilitated infrastructure.

Programme beneficiaries are selected by the Village Relief Committees (VRC), made up of representatives of the different clans and sub-clans. Led by the village elder, these determine how the resources are shared within their communities.

This project is an example of collaboration between several different teams

SWALIM The Remote Sensing Unit that provides before and after verification of the infrastructure work is part of the Somalia Water and Land Information Management project (SWALIM). SWALIM is technically managed by FAO in Somalia and funded by the European Union (EU), the United Nations Children's Fund (UNICEF) and the Common Humanitarian Fund (CHF). SWALIM serves Somali government institutions, NGOs, development agencies and UN bodies engaged in assisting Somali communities whose lives and livelihoods depend directly on water and land resources.

Cash Based Interventions group is at the centre of the FAO Cash for Work programme in Somalia and manages the overall process.

- **FAO Somalia Finance Unit** manages the payment to beneficiaries, including contracts with money vendors and other matters related to finance.
- **FAO Somalia Information Management Unit** provides information systems development and support to all facets of the project, in particular the biometrics registration and verification systems.
- **FAO Information and Communication Technologies Unit** provides support for infrastructures and communication aspects,both in Nairobi and in the field.
- **The Compliance & Risk Management Unit** manages the Call Centre and the Hotline Service monitors the entire process to ensure compliance with international norms and correct implementation

Conclusion

The use of remote sensing, in combination with other tools and systems, to monitor and verify rehabilitation works on infrastructure has proved to be a key element in reducing costs and security risks, thereby allowing the Cash for Work programme to be implemented in a timely and efficient manner in Somalia.

The efficient and cost-effective implementation of Cash for Work helps to improve the resilience and livelihoods of vulnerable people, enabling households to absorb shocks while protecting the productive and non-productive assets of the community.

Beyond the Cash for Work initiative, remote sensing ensures a more secure and rapid means of verification for many other FAO programmes

References and resources

Related websites

- FAO SWALIM - www.faoswalim.org
- Somalia famine ends, but situation still dire - www.fao.org/news/story/en/item/122091/icode
- The Food Security and Nutrition Analysis Unit - Somalia - www.fsnau.org/
- Global implications of Somalia 2011 form famine prevention, mitigation and response - www.ipcinfo.org/fileadmin/user_upload/ipcinfo/docs/Global_Implications_Somalia2011.pdf

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