2 case studies = GMES SAFER activations:

- Sa’ada Governorate – Yemen
- Beled Weyne, Hiraan province – Somalia

GISAT, Prague - Czech Republic  [www.gisat.cz](http://www.gisat.cz)
- active in emergency response services domain
- active in land cover and agriculture monitoring
- partner in ESA GSE RESPOND, FP7 SAFER, GIO ERS
Since early 2004, the militant rebels Al-Houthi are in armed conflict with the Yemeni army and government-backed tribal fighters in Yemen’s governorate Sa’ada. Up to now, **six rounds of armed conflicts took place whereas the 6th and latest one lasted from August 2009 until February 2010.**

In April 2008, the United Nations High Commissioner for Refugees estimated that the conflict had created **77,000** internally displaced persons (IDPs) in Sa'dah Governorate.
DG ECHO/UNOCHA requested SAFER for up-to-date information on state of play of the cultivated land and agriculture recovery after the 6th war in Yemen in the Sa'ada Governorate, comparing to „normal“ (ceasefire) situation.

Helping to assess the impact of the war on livelihood, identify state of agriculture recovery and plan contingency for humanitarian community.
Case Study - Sa’ada Governorate - Yemen

Approach

Multi-temporal set of archived and recent satellite imagery - SPOT4 (2006 acquisition) and RapidEye (2010 acquisition) - was utilized to analyze the coverage of agriculture land and cultivation activities (sowing coverage).

GISAT carried out object-based image classification supported by image interpretation to extract agriculture land and distinguish its management status.

Area of interest consisted of 13 of 15 Sa’ada district (~7000km2), covering more than 95% of district’s arable land.
Case Study - Sa’ada Governorate - Yemen

EO data acquired

MODIS NDVI

01.03.2010
21.06.2010
08.09.2010
Case Study - Sa’ada Governorate - Yemen

Products provided - Maps / GIS data

Extent of managed agriculture land

Scale 1:200 000
Case Study - Sa’ada Governorate - Yemen

Products provided - Maps / GIS data

Changes in managed agriculture land 2006 - 2010/11

Scale 1:40 000
Series of 15 maps
Products provided – Analytical Report

Comprehensive technical report summarizing facts identified using EO data and providing analytical assessment of agriculture status and change both on governorate and district level

Support of adoption of the product by the user

Demonstration of the EO-based data analysis capability

Statistics at governorate and district level provide in-depth insight into agriculture status and change.
Case Study - Sa’ada Governorate - Yemen

Analytical Report - Themes

- Share of agriculture land per total districts’ area
- Distribution of agriculture land with respect to the orography – slope & altitude
- Dynamics and evolution of agriculture land management
- Increase and decrease of managed land categorized per districts and per predefined altitude / slope classes
- Intensity of managed land increase, decrease and intensity of its share per agriculture land
Case Study - Sa’ada Governorate - Yemen

Analytical Report - Examples

Agriculture change assessment was carried out by comparison of imagery from 2006 (situation in normal year without fighting) and 2008/2010; situation after the "w" war. Change of agriculture land and change of managed / cultivated agriculture land were identified for western part of Sa’ada governorate.

Fig. 4.2: Area of interest (AOI) overview

As mentioned in chapter 2, the area of interest (AOI) for analysis is located in the Sa’ada governorate in northern Yemen. Based on preliminary agriculture analysis, the area of interest was focused on 13 of Sa’ada districts, covering more than 95% of district’s available land and, at the same time, suffering the most from armed conflict during last years. Analysis is based on Earth observation (EO) information derived from data for 2008/2010 and 2006 year. While actual status situation (2008/2010) is provided for all districts, agriculture change analysis (2006/2010/2011) is provided for districts covered with multi-temporal EO data only. Summary table below gives overview with respect to agriculture land share in each district in observed years. In total, only about 30% of the area (641,512m2 out of 6068,405m2) was identified as agriculture land. As seen in table below, the general tendency between 2006 and 2008/2010 shows decrease of managed agriculture land and increase of fallow land share (with few exceptions) all over the AOI.

Fig. 4.3: Agriculture land area share per altitude

|----------|----------------|---------------------------------|---------------------------------|---------------------------------|----------------|---------------------------------|---------------------------------|---------------------------------|----------------|---------------------------------|---------------------------------|---------------------------------|}
| Ad Dhalea | 22.9% | 21.4% | 19.7% | 22.1% | 21.4% | 19.7% | 19.7% | 22.1% | - | - | - | - |
| Al-Safa | 35.6% | 33.5% | 32.2% | 34.8% | 30.4% | 29.5% | 29.5% | 34.8% | - | - | - | - |
| Baha | 16.0% | 18.9% | 18.7% | 17.8% | 15.9% | 18.0% | 18.0% | 17.8% | - | - | - | - |
| Al-Hadram | 53.9% | 56.5% | 57.8% | 53.5% | 52.3% | 54.6% | 54.6% | 53.5% | - | - | - | - |
| Al-Hada | 6.9% | 7.3% | 8.0% | 6.6% | 6.7% | 7.6% | 7.6% | 6.6% | - | - | - | - |
| Al-Maklad | 5.3% | 5.9% | 6.8% | 5.3% | 5.0% | 5.8% | 5.8% | 5.3% | - | - | - | - |
| Al-Mukh | 29.8% | 31.3% | 32.4% | 29.3% | 30.0% | 31.3% | 31.3% | 29.3% | - | - | - | - |
| Al-Mahd | 11.8% | 12.9% | 13.9% | 11.2% | 11.2% | 12.9% | 12.9% | 11.2% | - | - | - | - |
| Al-Hudaydah | 7.5% | 7.0% | 7.0% | 7.5% | 7.0% | 7.0% | 7.0% | 7.5% | - | - | - | - |
| Al-Mahd | 12.2% | 12.5% | 12.4% | 12.3% | 12.3% | 12.4% | 12.4% | 12.3% | - | - | - | - |
| Al-Muhaydah | 16.4% | 16.6% | 16.6% | 16.4% | 16.6% | 16.6% | 16.6% | 16.4% | - | - | - | - |
| Al-Mahd | 6.9% | 6.7% | 6.7% | 6.9% | 7.0% | 6.7% | 6.7% | 6.9% | - | - | - | - |
| Al-Mahd | 6.9% | 6.7% | 6.7% | 6.9% | 7.0% | 6.7% | 6.7% | 6.9% | - | - | - | - |

Fig. 4.4: Agriculture land area share per slope

4.1 Overview for the Sa’ada governorate - agriculture land status

Fig. 4.5: Agriculture change assessment (2006/2010/2011) for all districts in Sa’ada governorate.
Case Study - Sa’ada Governorate - Yemen

Analytical Report - Examples

Table 4.7: Agriculture land uses, managed agriculture land area and fallow land share and total agriculture land area in 2015-16.

General tendency of decline of cultivated area or agricultural land is also demonstrated in figure 4.3 providing detailed comparison of managed agriculture land increase/decrease balance in particular districts during period 2000 - 2010/11. Overall distribution of managed agriculture land increase/decrease (figures 4.8-4.12) roughly follows the overall agricultural land share according altitude and slope, nevertheless slight tendency can be observed of higher managed agriculture land increase in low altitude areas. Finally, figure 4.14-4.18 show increase, decrease and overall change dynamic (total turnover) of managed agriculture land per district in percent of total agriculture land area in particular district.
“On my block for some time now I have had that I wanted to congratulate on the work you have done on the Yemen case. The credit is obviously directed to you as the SPs responsible for adapting to the user’s requirements and producing good quality work”

Mrs. Soleil Beaulieu
Disaster Response Unit
DG Humanitarian Aid and Civil Protection (ECHO)
Case Study - Beled Weyne - Somalia

AGRICULTURE CHANGE ASSESSMENT
[2009 – 2011]
Beled Weyne, Hiraan province - Somalia

User: UN WFP
Service Provider: GISAT
SAFER Activation ID: SFR20120216_3
Situation

According to UNHCR reports in early 2012 the tension in Hiraan region continues to rise due to guerilla warfare carried out by Al Shabaab targeting the Ethiopian military. Increased insecurity consequently resulted in protection violations by armed forces including arbitrary arrests and restrictions on movement of civilian population.

Main source of population livelihood is agriculture which is highly dependent on amount and distribution of seasonal precipitations during *Gu* and *Deyr* rain seasons.
UN World Food Programme (WFP) requested SAFER for up-to-date information (2011) on state of play of the cultivated land in the Beled Weyne district, comparing to former state in 2009 and 2010.

Large scale maps, GIS layers and analysis of croplands to assist in estimating the current agriculture production in the district, and houses and huts to further enhance estimation of the population density in the district were requested.
Approach

- Multitemporal set of archived and recent satellite imagery - GeoEye (2009 and 2011 acquisition) and QuickBird (2010 acquisition) to analyze the coverage and development of agriculture land (trend croplands coverage, extension/reduction of cropland area, transitions i.e. to shrubs or built-up).

- Multitemporal MODIS NDVI composites to support estimation of crops vigor during harvesting periods subsequent to each year Gu and Deyr rain seasons.

- GISAT carried out object-based image classification supported by image interpretation to extract agriculture land and dwellings.

Area of interest covers the Beled Weyne city and its rural vicinity as defined by the WFP.
Case Study - Beled Weyne - Somalia

trends in croplands coverage

Dry Crops

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>4000</td>
</tr>
<tr>
<td>2010</td>
<td>4300</td>
</tr>
<tr>
<td>2011</td>
<td>4400</td>
</tr>
</tbody>
</table>

Fruit Trees (Orchards)

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>70</td>
</tr>
<tr>
<td>2010</td>
<td>80</td>
</tr>
<tr>
<td>2011</td>
<td>85</td>
</tr>
</tbody>
</table>

Dry Cropland consumption structure

- 2009-2010: 60% decrease, 40% increase
- 2010-2011: 90% decrease, 10% increase

Dry Crops: formation - consumption [ha]

- 2009-2010: 300,000 ha decrease
- 2010-2011: 0 ha variation

extension/reduction of cropland area
Case Study - Beled Weyne - Somalia

assessment of vegetation development 2009

Harvesting season Gu, 2009 (June - August)

Harvesting season Deyr, 2009 (October - January)

Legend

- Main Road
- River
- Cropland Extent
- Built-Up, Settlement

Mean of NDVI maximums from MODIS 16-day composites

- < 0.2
- 0.35
- 0.55

gisat

Safer
Case Study - Beled Weyne - Somalia

assessment of vegetation development 2010

Harvesting season Gu, 2010 (June - August)

Harvesting season Deyr, 2010 (October - January)

Legend
- Main Road
- River
- Cropland Extent
- Built-Up, Settlement

Mean of NDVI maximums from MODIS 16-day composites
< 0.2 0.35 0.55

Safer
Case Study - Beled Weyne - Somalia

assessment of vegetation development 2011

Harvesting season Gu, 2011 (June - August)

Harvesting season Deyr, 2011 (October - January)

Mean of NDVI maximums from MODIS 16-day composites

- Main Road
- River
- Cropland Extent
- Built-Up, Settlement

< 0.2  0.35  0.55
Case Study - Beled Weyne - Somalia

Legend
Beled Weyene: Dwellings Density 2009
(Dwellings Number per sqkm)
- 1 - 1000
- 1001 - 2000
- 2001 - 3000
- 3001 - 5000
- 5001 <

assessment of population density
Conclusions

EO data are effective tool to monitor agriculture status and development worldwide
provide effective combination of MR, HR and VHR
up-to-date and archive data available
results to be delivered in user friendly form of maps, tabular statistics, analytical report or even online exploration tool (see example on eoworld.gisat.cz)
EO data can support not only information on food supply potential but also on food demand potential
Thank you.
For additional information please contact

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