

## INTRODUCTION

Environment and natural resources can play a role in the onset, duration, and termination of conflicts. Conflicts are not caused by environmental factors only. However, they can play a key role in the dynamics of conflicts. This role is complex and has an impact only in combination with other socio-economic factors. Generally speaking, it is often the lack of vital goods (such as food, but also access to land, work or housing) or the availability of valuable goods (such as diamonds, gold, etc.) coupled with poor economic conditions and weak constraints (state, foreign countries, etc.) that could contribute to (violent) conflicts. Earth observation (EO) data could help to measure both environmental and certain

socio economic factors. In this brochure, the service concept and products for the activation on the two Kivu provinces, eastern Democratic Republic of Congo (DRC), are provided.

### The information is derived from:

1. Multi-temporal analysis of EO data aiming at identifying possible hot spots of change, which are potentially important for a crisis within a country,
2. Through a situation monitoring using information about conflictive events, population, socio-economic data where available and other relevant datasets.

### INSIDE THIS ISSUE:

- > CONCEPT OF THE SERVICES
- > PRODUCT EXAMPLES
- > REQUESTING THE SERVICE.

## MULTI-TEMPORAL ANALYSIS OF LAND USE IN EASTERN DRC

### LINKING LAND USE CHANGES WITH CONFLICT INFORMATION

The Democratic Republic of Congo (DRC) is still suffering the impacts of extended, intensely violent conflict. The wars of 1996 and 1998 were characterised by a series of complex, shifting alliances between foreign and indigenous armed groups, national government, and foreign governments. Despite recent combined military operations by Uganda, Rwanda and the DRC, supported by United Nations forces, rebel violence continues in the north and east of the country.

Insecurity in eastern DRC is heightened by its peripheral location and relative inaccessibility given the state of all transport and communication infrastructure. Most known deposits of strategic mineral resources are found in the East and South of the country and in Eastern DRC, control over areas with mineral deposits has changed hands several times

between different armed movements and FARDC units (UN 2009). While natural resources are only one possible source of conflict, attention has been paid to the role of governance of resources as a tool to address conflict over allocation and management of resources.



### POINTS OF INTEREST:

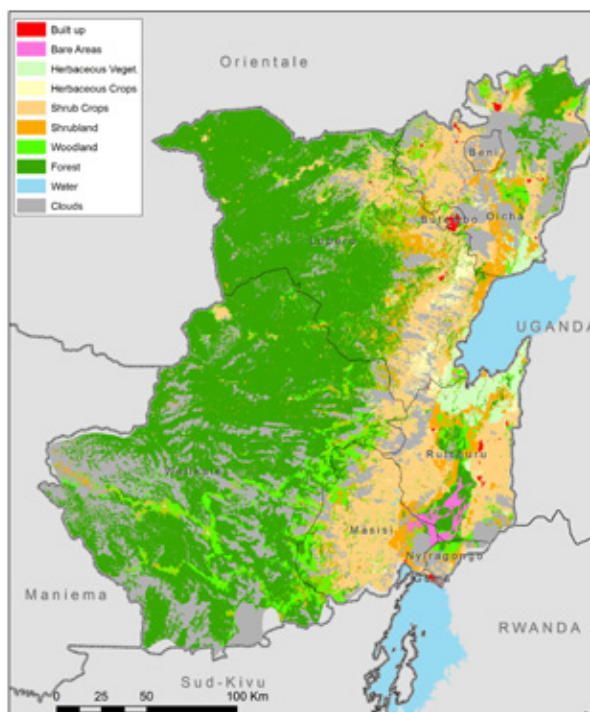
- > GEO-SPATIAL INFORMATION IN THE FIELD OF NATURAL RESOURCES AND CONFLICTS
- > ANALYSIS OF THE EVOLUTION OF CONFLICTS AND THE LINK TO NATURAL RESOURCES
- > SITUATION MONITORING
- > CONFLICT DATA AGGREGATED AT SUB-NATIONAL LEVEL
- > MULTI-TEMPORAL ANALYSIS OF LAND USE IN EASTERN DRC
- > LINKING LAND USE CHANGES WITH CONFLICT INFORMATION

# EXPLOITATION OF NATURAL RESOURCES SERVICE CHAIN (CRISIS INDICATORS)

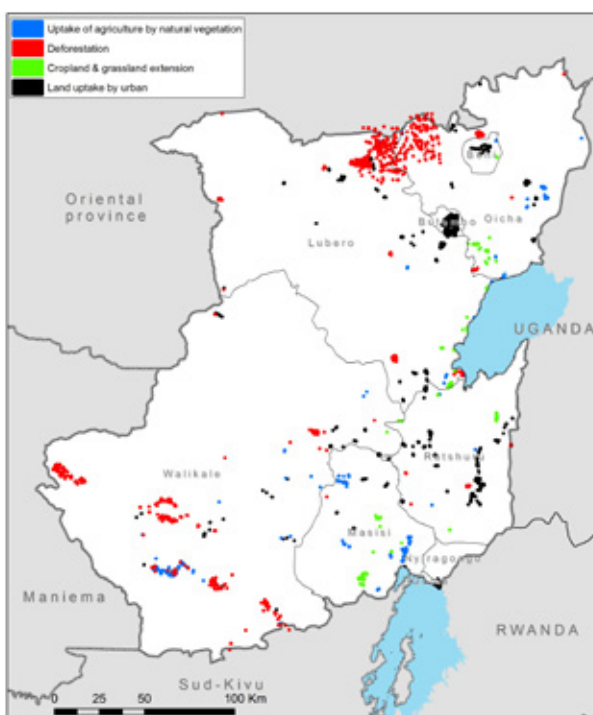
## LAND USE / LAND COVER

EO satellite images allow for the investigation of where and how resources are exploited in remote and insecure areas (right). The total surface of primary land resources (fresh water, agriculture, forest, mining areas) is compared to economic data on primary industry production and conflict-related information. Doing such analysis for the region of interest over a multi-year series is expected to yield important indications on unreported production, inputs to environmental degradation indicators and the key processes that lead to depletion of the natural resources (e.g. input to illegal activity assessment).

*Land cover map 2010*



## GEO-SPATIAL INFORMATION ABOUT LOSS OF NATURAL RESOURCES



Transition zones with natural resource decrease are detected annually from existing reference maps and land use/land cover mapping from EO data (left). This important change rates indicator assesses the pressure levels on diminishing land and water resources, potential causes for rural migration and efficacy of environmental governance. Geo-spatial information and reports about changes in land cover and/or land use indicate potential areas of depletion of natural resources and environmental degradation related to conflict.

*Land cover change map  
(aggregated classes) 2008-2010*

*EO based change detection allows synoptic analysis of large areas for the identification of change hot-spots for further analysis.*

# ANALYSING NON-EO DATASETS

The factors leading to or sustaining conflict are very complex and cannot be explained using only EO based geo-spatial

information. Consequently, considerable effort has been directed towards collecting and analysing non-EO datasets.

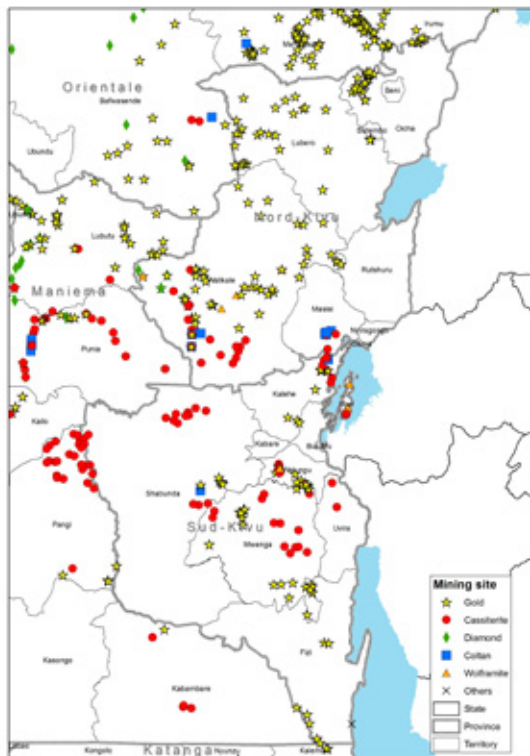
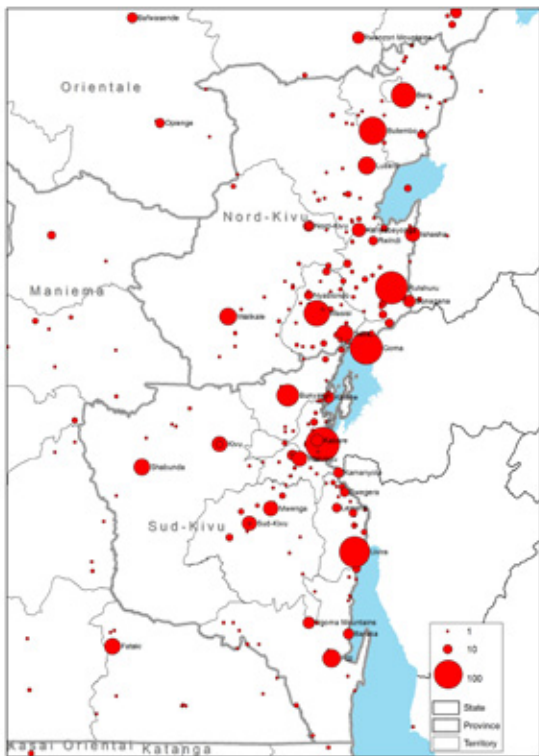
## CONFLICT EVENTS

Local conflict information databases are analysed to understand the timeline and actors involved in the conflict. In the DRC many actors are involved and conflicts occur mainly in the Eastern part of the country (see pie-chart).

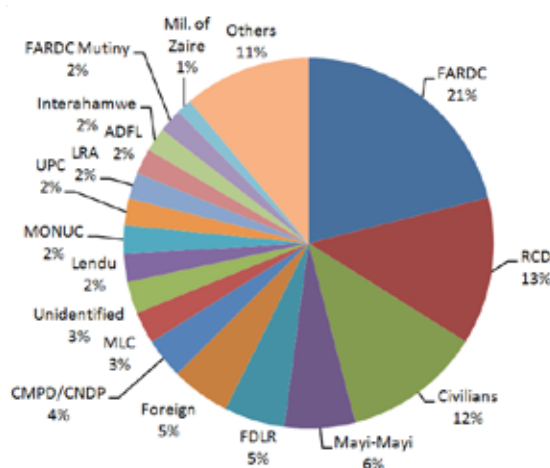
## MINING SITES

The International Peace Information Service (IPIS) collects information on the location of mines, the presence of armed groups at mining pits and a number of other variables. This information is important as the region's relative mineral wealth contributes towards the

financing of armed groups. By combining geo-spatial information about the depletion of natural resources, with conflict and other socio-economic information it is possible to identify future conflict potential.



*The combination of geospatial information with conflict and socio-economic data allows for the identification of hot spots of activities relevant for the understanding of a conflict.*



Left: Reported clashes in the Kivus, 1997-2010 (Source: Raleigh et al. 2010)

Right: Mining sites in the Kivus, 2009 (Source: IPIS)

Armed groups involved in the DRC conflict, 1997-2010 (Source: Raleigh et al. 2010)

# EXPLOITATION OF NATURAL RESOURCES SERVICE CHAIN (CRISIS INDICATORS)



MORE INFORMATION AT  
[WWW.GMES-GMOAIC.EU](http://WWW.GMES-GMOAIC.EU)

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*This service is coordinated by the Joint Research Centre with the efforts of other partners inside the G-MOSAIC project : Adelphi Research, GISAT, and Swisspeace.*

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*As a coordinator of the Crisis Indicator services the JRC organizes the production of the above mentioned products and ensures the quality of the product and the suitability to the user needs.*

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