


Integrating Multispectral Satellite Imagery for Monitoring Land Use and Land Cover Changes in Gatumba Mining Landscape, Rwanda

Presented by:

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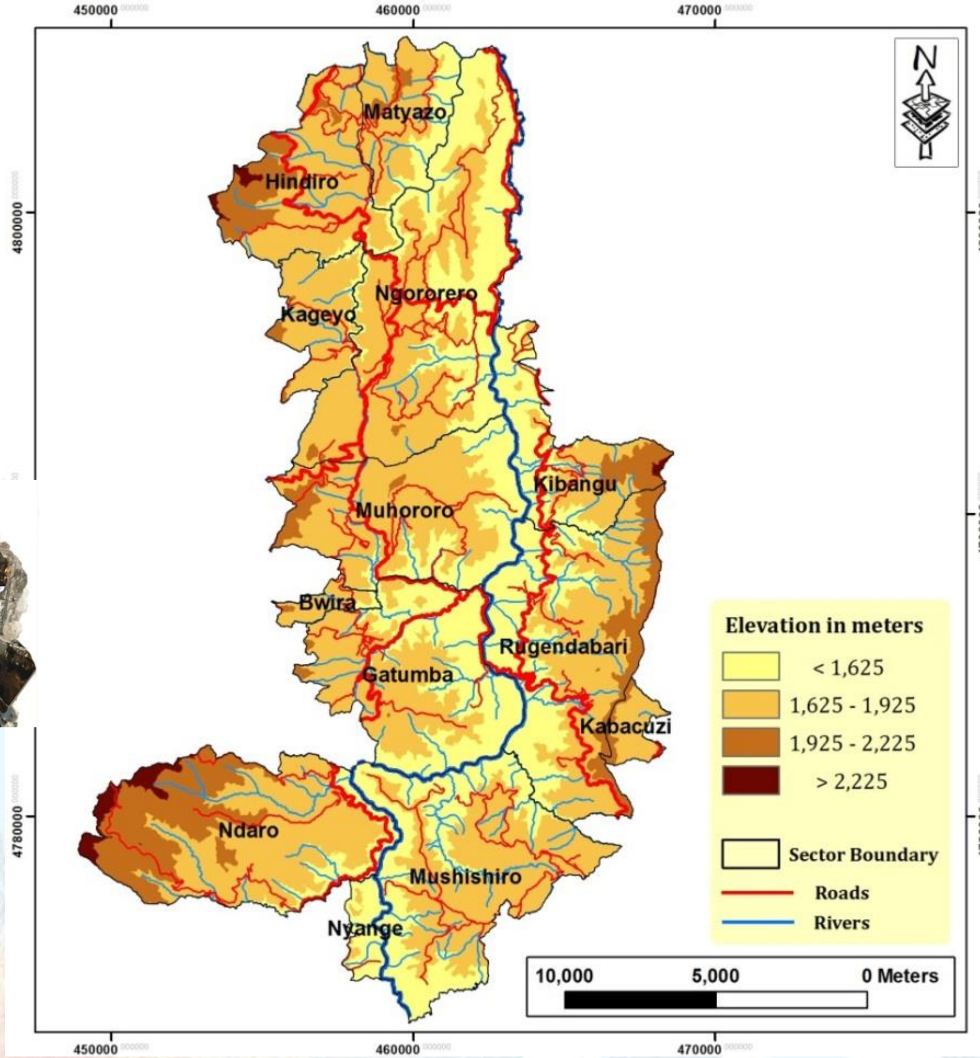
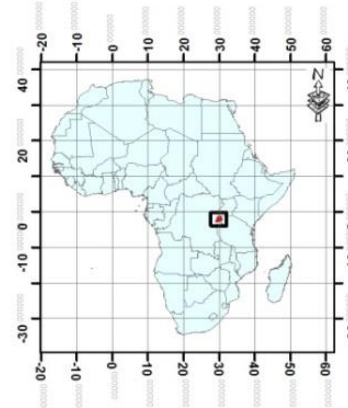
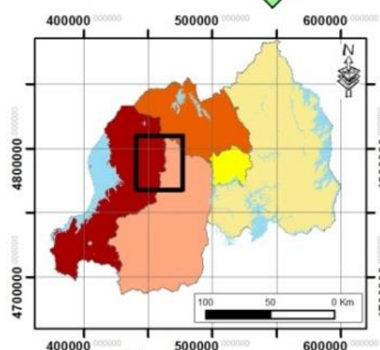
Study area

Location of the study area.
It covers 31,243 Hectares







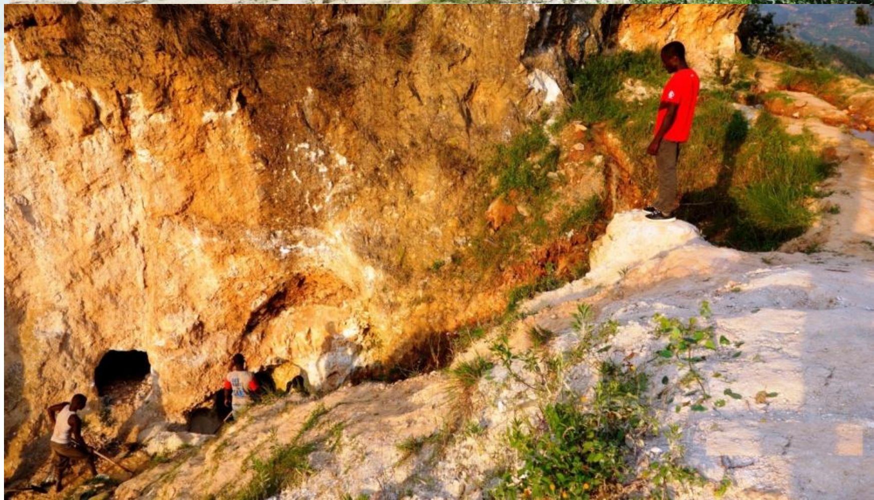
- Area characterised by extensive **opencast mining .**
- Gatumba region is rich in mineral resources such as **coltan, cassiterite, wolfram** and **gemstones.**

1. Background and Research problem

- Mining activities in Gatumba region are still inadequately developed and the surrounding environment suffers from artisanal and small scale mining practices.

- Lack of proper environmental protection regulations.

- Soil erosion, barren waste rock dumps, and polluted rivers.



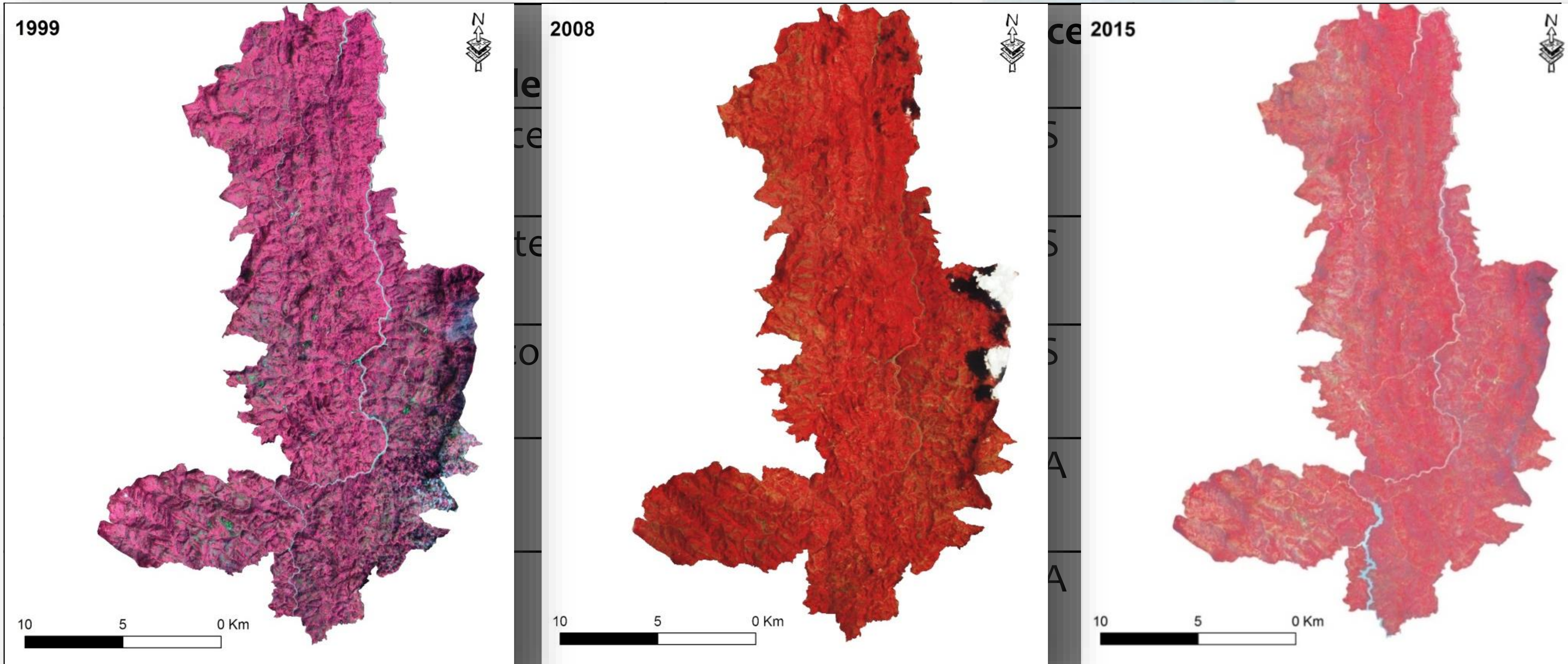
2. Research Objectives

The main objective of this study was to analyse the spatio-temporal pattern of land use/land cover changes by determining the main driving forces behind Gatumba landscape deterioration over the period of 1999 to 2015 using multi-temporal Landsat data and to assess the associated environmental impact using qualitative instruments.

The specific research objectives are:

- To analyze the spatial temporal land use/ land cover change induced by mining activities in Gatumba region from 1999 until 2015,
- To determine the driving forces of mining activities and associated land use/ land cover changes in Gatumba region during the period of 1999 until 2015,
- To evaluate environmental impacts of mining activities in Gatumba region.

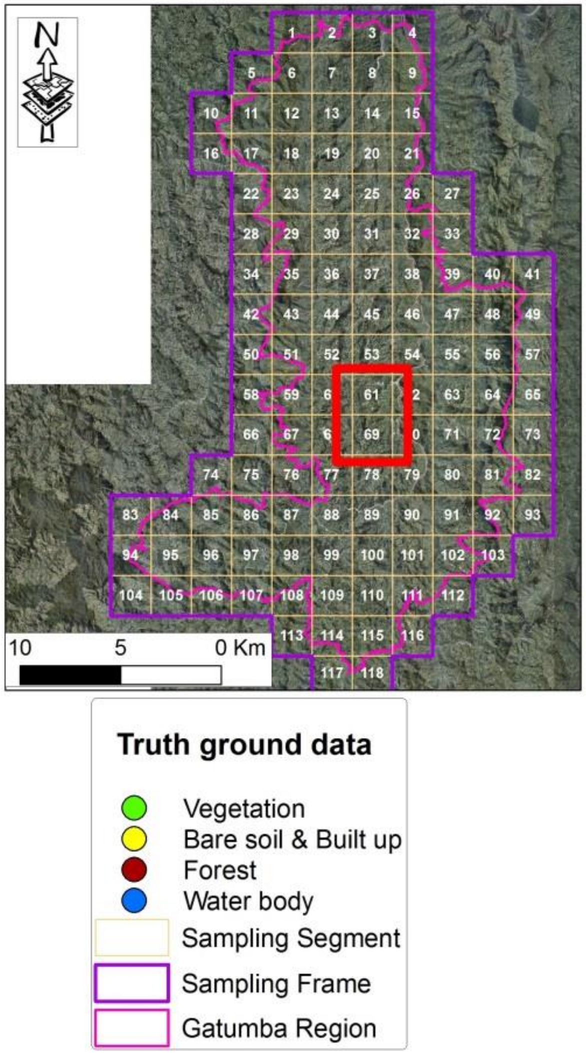
3. Data collected: Remote sensing data

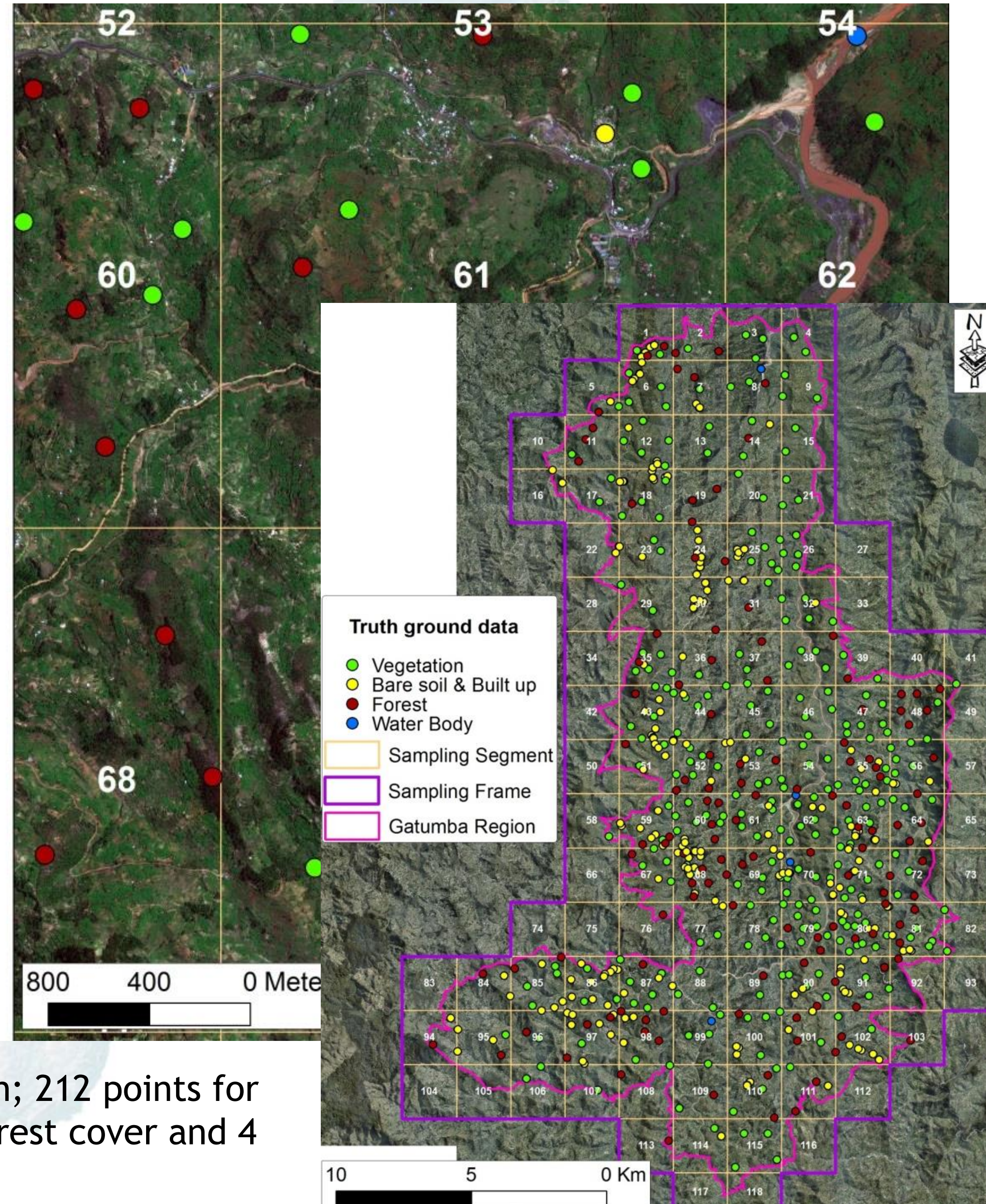


False color composite 432: Landsat TM (1999), Landsat ETM+ (2008) and Landsat OLI (2015) images of Gatumba region.

Topographic map	1988	1/50,000	RNRA	Gather mines information
Mineral map	1982	1/250,000	RNRA	

3. Data collected: truth ground data and training samples





631 ground truth data: 282 points for vegetation; 212 points for bare soil and built up; 133 points for the forest cover and 4 points represented water bodies.

. Methodology

Dataset / Inputs

- Landsat 7 ETM+ (1999),
- Landsat 5 TM (2008),
- Landsat 8 OLI/TIRS (2015)

Gatumba region Multispectral Image 1999, 2008, 2015

Classified map with 4 land use/ cover classes 1999, 2008, 2015

Classified map 1999, 2008, 2015 with 5 land use/cover classes

Processing Methods

A) Layer Stacking,
B) Pan-sharpening,
C) Subset

Supervised classification: Pixel based approach by Maximum Likelihood algorithm

Training data

Verification data (A)

A) Accuracy assessment: Overall accuracy & Kappa statistics,
B) Post image classification.

Vectorized Mining areas for 1999, 2008 & 2015 (B)

Change detection: Time spans matrix

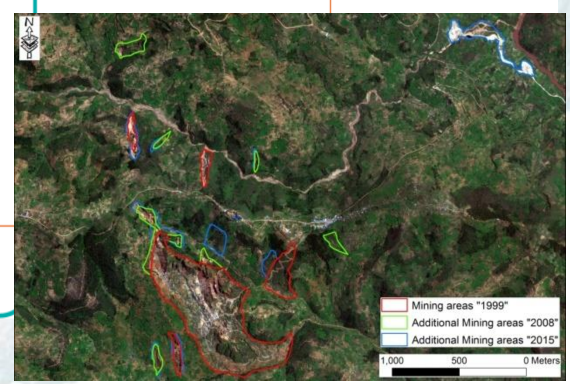
Output / Results

Gatumba region Multispectral Image 2008, 1999, 2015

Classified map (2008, 1999, 2015) with 4 land use/cover classes

Classified map (2008, 1999, 2015) with 5 land use/cover classes

Change magnitude counted for 1999 – 2008, 2008 – 2015, and the overall 1999 – 2015

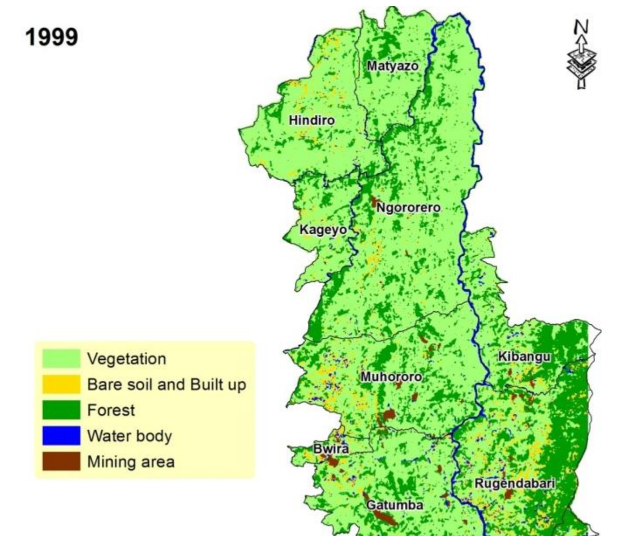


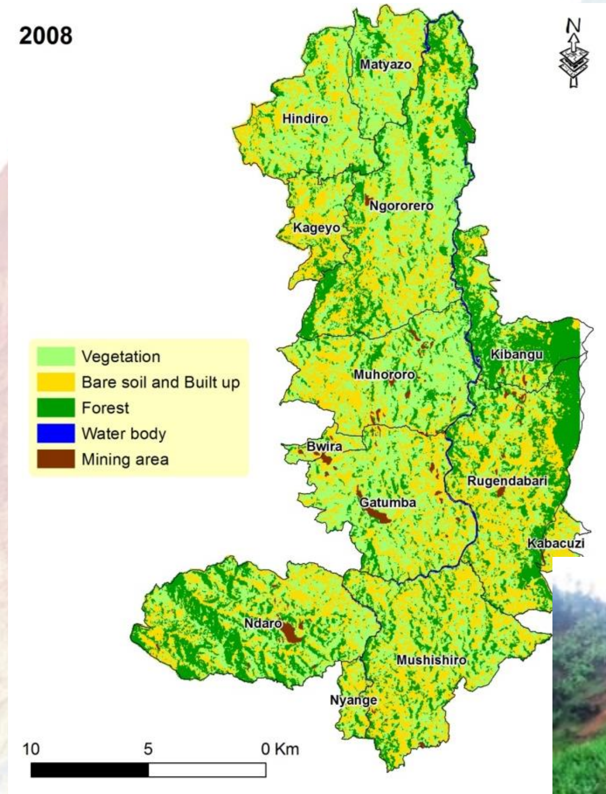
3. Data collected: Questionnaire administration

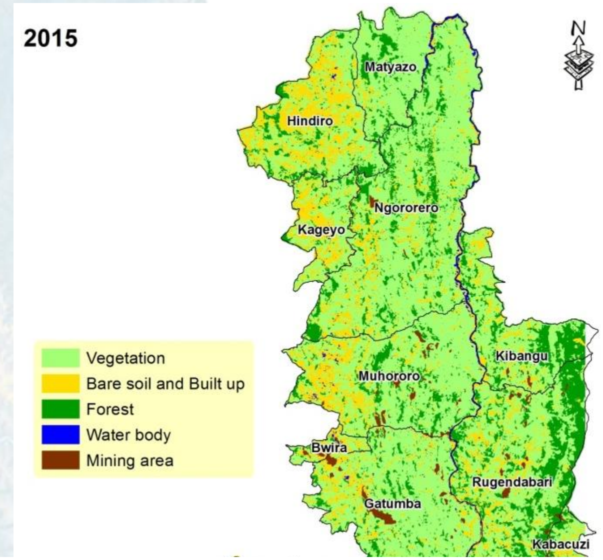
- The field observation and questionnaire survey helped to investigate the driving forces of mining activities and the associated environmental impacts.

- Key informants interview facilitated by a Questionnaire:
  - → Local leaders at the level of Sector and severally Cell,
  - → Elderly people in the area,
  - → Working/actual miners,
  - → High level managers and miners who used to work in Gatumba region before 2015.

4. Results (1): Trends and pattern of land use/cover in Gatumba

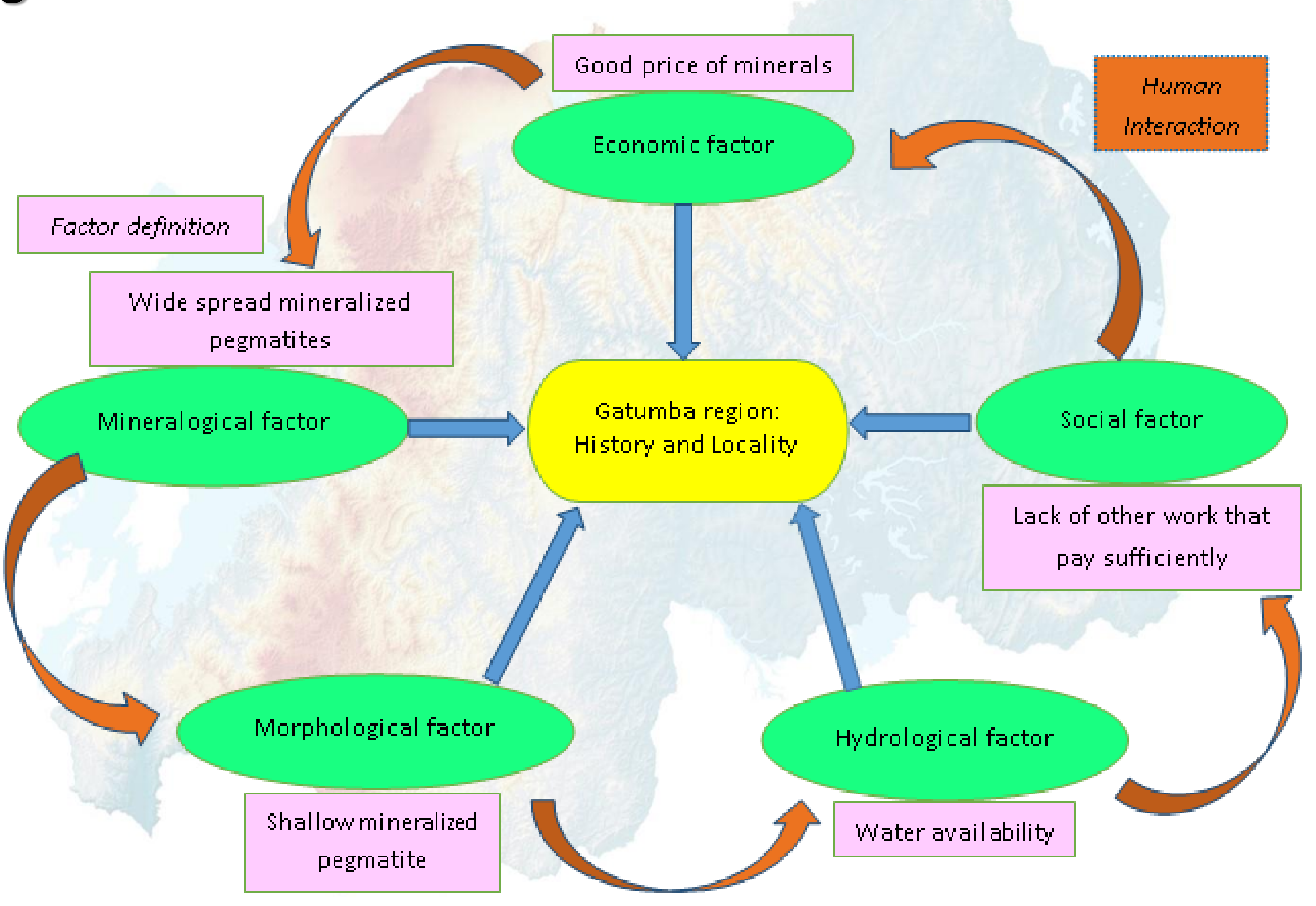




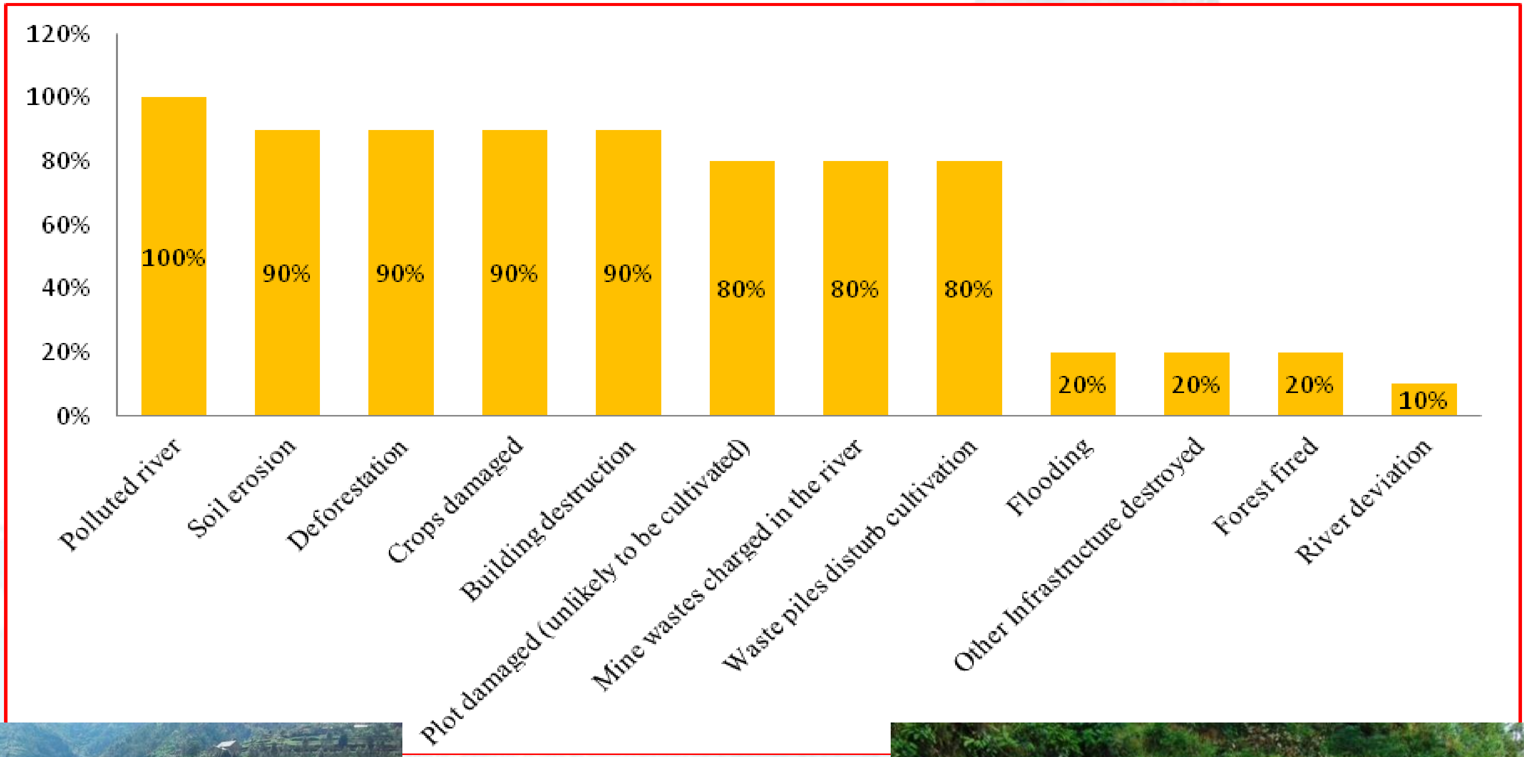


%	2015 Area in Km²	%
0.91	5.55	1.7
0.92	3.36	1.0
9.35	60.67	19.
26.33	50.84	16.
62.49	195.82	61.
100%	**316.24**	**100**

4. Results (2): Driving forces of mining activities in Gatumba region



4. Results (3): Environmental impacts of mining activities at Gatumba



4. Results (4): Implications of future mining activities on environment at Gatumba mining landscape

- Already the current environment is damaged primary due to mining activities,
- If no proper and serious measures taken and by which will be monitored to be implemented, the nature will turn in chaotic,
- Rivers will continue to be deviated, polluted more to cause diseases, inundations and soil erosion,
- The magnitude of deforestation will increase to induce crops damages and soil erosion accompanied by landslides.

5. Conclusion

- The study highlighted explore the use of hybrid remote sensing based classification methods strengths to monitor mining landscape degradation.

- Results revealed the main driving factors of mining activities, in turn, will form the basis of policy options/ decisions for mining sector.

- The study results also can be taken as validation tool for locating mining sites and environmental protection and policies formulation.

Thanks for your attention!