A Review of Land Degradation Assessment & Monitoring Methods

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On behalf of Taimi S. Kapalanga

Layout

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Introduction

Land degradation (LD):

- LD is a complex term (NRC, 1994).

- Immediate causes:
  - Inappropriate land use
    - Degradation of soil, water & vegetation cover
    - Loss of both soil and vegetative biological diversity
    - Loss of ecosystem structure and function

(Snel and Bot, 2003)
Introduction cont...

- 20% of cultivated areas, 30% of forests and 10% of grasslands undergoing degradation (Bai et al., 2008).

- Land degradation is associated with poverty and drought.

- Estimated: 2.6 billion people are affected in more than 100 countries (Adams and Eswaran, 2000).

Picture: LADA website photo gallery, June 2005
Introduction cont....

- **LD is a HOT TOPIC**

- **Global development and environmental issue highlighted in:**
  - UNCCD,
  - COD,
  - Kyoto protocol on global climate change and
  - MDG

*(UNCCD, 1992; UNEP, 2007).*

*Picture: from internet*
Introduction cont........

Why LD assessment and monitoring?
- To improve understanding of causes, impacts, degree and acquaintances with climate, soil, water, land cover and socio-economic factors.

Picture: LADA website.
Introduction cont.

Why assessment and monitoring?

- A primary goal in decision support systems for reversing degradation

Restoration project, Namibia

Picture courtesy, CIFOR
Different methods have been developed and used to assess and monitor land degradation.

Biodiversity monitoring, Namibia

Picture: Henschel, 2008
Aim of the study

- Explore and Review existing land degradation assessment and monitoring methods or approaches used at global, national, local & farm.
  - Have a broad understanding
  - Recommend suitable methods for Namibia’s environment
  - Contribute to a database for LD assessment and methods
Methodology

- Desktop study
  - Published and unpublished materials
    - Library
    - Internet
    - Personal communication with specialists
Main questions for the study

- What systems were assessed?
- What process/factors were assessed?
- What approaches were used?
- What units / values?
- What level?
- Where?
Outcomes of the study

- 65 papers were reviewed.
- These focused on:
  - Soil degradation and erosion assessment
  - Land, water and vegetation assessment
  - Rangelands & croplands Assessment
  - Dry and wet lands
  - Others
<table>
<thead>
<tr>
<th>e.g. Systems</th>
<th>e.g. Processes/Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soils</td>
<td>Fertility decline</td>
</tr>
<tr>
<td>Rivers and other catchments</td>
<td>Soil erosion</td>
</tr>
<tr>
<td>Forests</td>
<td>Land use and Cover</td>
</tr>
<tr>
<td>Rangelands &amp; croplands</td>
<td>Rangelands health</td>
</tr>
<tr>
<td>Drylands</td>
<td>Crop yield</td>
</tr>
<tr>
<td></td>
<td>Climatic factors</td>
</tr>
<tr>
<td></td>
<td>Biodiversity loss</td>
</tr>
</tbody>
</table>

Outcomes of the study
Six extensively used methods for Land Degradation assessments

- Expert opinion
- Land user’s opinion
- Modelling
- Field observations, monitoring and measurements
- Productivity change estimates
- Remote sensing and GIS
## Summary of some reviewed papers

<table>
<thead>
<tr>
<th>Initiatives</th>
<th>Methods</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>RALA Classification methods</td>
<td>Experts opinion, remote sensing, GIS, field observation</td>
<td>National (Iceland)</td>
</tr>
<tr>
<td>NZLRI erosion classification</td>
<td>Experts opinion, Remote sensing, GIS, field assessment</td>
<td>National, local (New Zealand)</td>
</tr>
<tr>
<td>Classification of the state of erosion</td>
<td>Experts protocol, field observation</td>
<td>local/farm (Chile)</td>
</tr>
<tr>
<td>BIOTA</td>
<td>Expert &amp; land users opinion</td>
<td>Regional, National, local, remote sensing, GIS, field assessment</td>
</tr>
</tbody>
</table>

Outcomes of the study
### Summary of some reviewed approaches cont..

<table>
<thead>
<tr>
<th>Initiatives</th>
<th>Methods</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>REMOTE SENSING (MSI, NDVI, FID54, SAVI)</td>
<td></td>
<td>All levels (most countries)</td>
</tr>
<tr>
<td>Attributes, indicators and Classification approach</td>
<td>Expert &amp; land users opinion, remote sensing, GIS, field assessment</td>
<td>Local/Farm (USA, Australia, Mexico)</td>
</tr>
<tr>
<td>VS-FAST methodology</td>
<td>Land users opinion, field assessment, field and laboratory assessment</td>
<td>Local/Farm (China)</td>
</tr>
</tbody>
</table>

*Outcomes of the study*
## Summary of reviewed papers cont...

<table>
<thead>
<tr>
<th>Initiatives</th>
<th>Methods</th>
<th>level</th>
</tr>
</thead>
<tbody>
<tr>
<td>LFA approach</td>
<td>Expert &amp; land users opinion, GIS, field assessment, monitoring</td>
<td>National, Local/Farm</td>
</tr>
<tr>
<td>LLM approach</td>
<td>Land users opinion, field assessment, measuring</td>
<td>National, Local/Farm</td>
</tr>
<tr>
<td>Grazing Gradient Method (GGM)</td>
<td>Expert &amp; land users opinion, remote sensing, GIS, field monitoring</td>
<td>Local/Farm</td>
</tr>
<tr>
<td>Participatory Degradation Appraisal (PDA)</td>
<td>Farm-level field criteria, field monitoring</td>
<td>Local/Farm (Kalahari)</td>
</tr>
</tbody>
</table>

### Outcomes of the study
Land degradation assessment & monitoring in Namibia

- National Monitoring System
  - Indicators:
    - Population pressure
    - Livestock pressure
    - Rainfall variability
    - Soil erosion hazards

(Klintenberg and Seely, 2004)

Outcomes of the study
Land degradation assessment & monitoring in Namibia cont.

- Remote Sensing and GIS
- Degradation Gradient Method
- Canonical Correspondence Analysis (CCA)
- Local Level monitoring
- Landscape Function Analysis (LFA)
- others

Outcomes of the study
There are several approaches for assessing and monitoring land degradation worldwide.

NO single best method for assessing land degradation.

The first distinctions to be made: land use, type and scale
Methods or techniques need to be critically selected

- taking into account: suitability, applicability and adaptability level to local conditions

Integration of Local knowledge with scientific knowledge is very important.
Conclusion cont...

- The use of statistical methods, ordination, and modelling approaches provide good results.

- Stories of failures in using different assessment approaches & methods are very few.

Does that mean everything works?
Assessment and Monitoring of Land Degradation is crucial to improve understanding and assist in decision-making Processes.
Recommendations for Namibia

- Improve the national monitoring system indicators. E.g. use example of indicators developed by other countries.

- LLM approaches should be introduced to all communities.
Recommendations for Namibia cont...

- More participatory approaches that involve all land stakeholders.

- New methods could be tried on the more sensitive satellites that are being developed, in the hope of finding better interpretation.
  - Remote Sensing and GIS tools should be used more
Specialists should equip themselves with assessment and monitoring skills and

- Encourage involvement & leadership of local people

Review full version of this paper.
Acknowledgements

- The Agricultural University of Iceland and Soil Conservation Service of Iceland.
- Dr. Patrick Klintenberg, DRFN.
- Mr. Ibo Zimmermann, Polytechnic of Namibia.
- Gobabeb Training and Research Centre.
- Everyone who helped.

Thank you all for your support!!
Thank you

for

taking assessment and monitoring of any environmental issue seriously, before and after taking action to reverse problem.

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