Costs of land degradation in Eastern Africa

Oliver K. Kirui and Alisher Mirzabaev

Center for Development Research, University of Bonn, Germany.

okirui@uni-bonn.de / almir@uni-bonn.de

Introduction

Land degradation is a serious impediment to improving rural livelihoods in the Eastern Africa region.

Majority of the very poor, who heavily depend on natural resources, live on degraded lands. Land degradation, thus, poses a challenge to efforts to eradicate extreme poverty and enhance food security.

The objective of this paper are threefold; (i) To identify land degradation patterns in Eastern Africa due to biomass productivity decline and due to Land Use Cover Change (LUCC). (ii) To estimate the costs of land degradation, and (iii) to compare the costs of action verses inaction against land degradation.

We use a comprehensive definition of land degradation following the Millennium Ecosystem Assessment (MEA, 2005) to assess the patterns and extent of land degradation and the Total Economic Value (TEV) approach in estimating the costs of land degradation.

Materials and methods

Causes of land degradation are divided into proximate and underlying, which interact with each other to result in different levels of land degradation (Figure 1). The level of land degradation determines its outcomes on the provision of ecosystem services and the benefits humans derive from those services. Actors can then take action to control the causes, levels, or effects of land degradation.

Empirical Strategy

The cost of land degradation due to LUCC is given by:

\[ C_{LUCC} = \sum (\Delta a_1 + p_1 - \Delta a_2 + p_2) \]  

(1)

where: \( C_{LUCC} \) = cost of land degradation due to LUCC; \( \Delta a_1 \) = land area of biome 1 (being replaced by biome 2); \( p_1 \) and \( p_2 \) = TEV per unit area of biome 1 & 2 respectively.

Cost of taking action against land degradation:

\[ CT_{Act} = \frac{L}{p_1} \left[ f_1 + \sum f_i (x_i + p_2 x_i) \right] \]  

(2)

The cost of inaction will be the sum of annual losses due to land degradation, given by:

\[ CI_{act} = \sum f_i x_i \]  

(3)

Acknowledgements

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Results

Results show that land degradation covers about 51%, 41%, 23% and 22% of the terrestrial areas in Tanzania, Malawi, Ethiopia and Kenya, respectively.

Land degradation ‘hotspots’ in the region are: central, southern and eastern Ethiopia, western and southern Kenya, northern and central Tanzania and northern and southern parts of Malawi.

Table 1: Change in land area of terrestrial biomes between 2001-2009 (Ha and %)

<table>
<thead>
<tr>
<th>Country</th>
<th>Forest</th>
<th>Coipeland</th>
<th>Grassland</th>
<th>Woodland</th>
<th>Shrub-land</th>
<th>Bare-land</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethiopia</td>
<td>-141,289</td>
<td>378,381</td>
<td>313,198</td>
<td>-25,153</td>
<td>696,517</td>
<td></td>
</tr>
<tr>
<td>Kenya</td>
<td>-371,322</td>
<td>907,706</td>
<td>361,319</td>
<td>125,804</td>
<td>-609,477</td>
<td>-667,904</td>
</tr>
<tr>
<td>Malawi</td>
<td>305,997</td>
<td>-5,274</td>
<td>104,206</td>
<td>-959,33</td>
<td>-650,21</td>
<td>-634</td>
</tr>
<tr>
<td>Tanzania</td>
<td>-684,551</td>
<td>-1,734,47</td>
<td>559,128</td>
<td>-291,069</td>
<td>-382,400</td>
<td>239,28</td>
</tr>
</tbody>
</table>

Source: Author's compilation based on MODIS data.

Table 2: Terrestrial ecosystem value & cost of land degradation due to LUCC

<table>
<thead>
<tr>
<th>Country</th>
<th>GDP</th>
<th>TEV</th>
<th>Cost of land degradation (2001-2009)</th>
<th>Annual costs of land degradation</th>
<th>Cost of LD as % of GDP</th>
<th>Cost of LD as % of TEV</th>
<th>Annual costs of land degradation US$ billion</th>
<th>%</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethiopia</td>
<td>19,346</td>
<td>206,41</td>
<td>34,825</td>
<td>4,353</td>
<td>22.3</td>
<td>16.9</td>
<td>38.49</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kenya</td>
<td>27,236</td>
<td>127,74</td>
<td>10,645</td>
<td>1,331</td>
<td>4.9</td>
<td>3.8</td>
<td>22.88</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malawi</td>
<td>3,647</td>
<td>24,98</td>
<td>1,980</td>
<td>0,248</td>
<td>6.8</td>
<td>7.9</td>
<td>21.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tanzania</td>
<td>16,825</td>
<td>223,10</td>
<td>18,474</td>
<td>2,369</td>
<td>13</td>
<td>8.3</td>
<td>24.53</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: TEV and Land Degradation –Author’s compilation; GDP – World Bank data

Table 3: Cost of action & inaction against LUCC-related land degradation (2007 US$ billion)

<table>
<thead>
<tr>
<th>Country</th>
<th>Cost of Action</th>
<th>Cost of Inaction</th>
<th>Cost of Action as % of Inaction</th>
<th>Cost of Inaction</th>
<th>Cost of Action as % of Inaction</th>
<th>Opportunity cost of action</th>
<th>Opportunity cost of action</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethiopia</td>
<td>53,900</td>
<td>168,674</td>
<td>52.6</td>
<td>34,026</td>
<td>22.8</td>
<td>53.2</td>
<td>45.2</td>
<td>53,215</td>
</tr>
<tr>
<td>Kenya</td>
<td>41,027</td>
<td>153,366</td>
<td>52.6</td>
<td>14,607</td>
<td>24.3</td>
<td>17.7</td>
<td>17.47</td>
<td>39,983</td>
</tr>
<tr>
<td>Malawi</td>
<td>4,044</td>
<td>11,828</td>
<td>53.1</td>
<td>4,051</td>
<td>26.0</td>
<td>4,191</td>
<td>103.5</td>
<td>4,191</td>
</tr>
<tr>
<td>Tanzania</td>
<td>56,423</td>
<td>102,603</td>
<td>55.5</td>
<td>26,380</td>
<td>25.8</td>
<td>56,091</td>
<td>99.6</td>
<td>56,091</td>
</tr>
</tbody>
</table>

Total: 112,150 338,09 33.2 112,39 457,64 24.6 111,26 98.9

Source: Author's compilation based on MODIS data.

Conclusions

Losses due to land degradation are enormous. The costs of land degradation due to LUCC between 2001-2009 period based on TEV framework amount to:

- Representing about 5%, 7%, 14% and 23% of GDP in Kenya, Malawi, Tanzania and Ethiopia respectively

It is worthwhile to take action against land degradation. The TEV computation shows that the costs of action are lower as compared to costs of inaction against land degradation in all the countries both in a 6-year and a 30-year cycle.

- The costs of inaction against land degradation (30 years) were: US$17 billion in Malawi, US$75 billion in Kenya, US$138 billion in Tanzania and US$228 billion in Ethiopia.
- Representing about 9%, 14%, 27% and 39% of GDP in Kenya, Malawi, Tanzania and Ethiopia respectively
- The costs of action against land degradation (30 years) were: US$4 billion in Malawi, US$18 billion in Kenya, US$36 billion in Tanzania and US$54 billion in Ethiopia.
- Representing about 2%, 4%, 7% and 9% of GDP in Kenya, Malawi, Tanzania and Ethiopia respectively

This implies that for each dollar spent to control/prevent land degradation, it returns about $ 4.3, $4.8, $4.2 and $3.8 in Malawi, Kenya, Ethiopia and Tanzania respectively.

Literature cited


Figure 1. Conceptual Framework

Source: Nkonya et al., 2011.