ADDRESSING DIFFERENT USER GROUPS WITH ONE ATLAS: THE BIOTA EAST AFRICA ATLAS, SUBTITLED RAINFOREST CHANGE OVER TIME

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Abstract

In this paper we present the outline for a regional atlas on rainforest change over time focusing on three forest areas located in Kenya and Uganda. The atlas visualizes the results of nine years of research applying geo-spatial data within the BIOTA East Africa project. A total of 37 map themes have been identified, ranging from overview maps on e.g. orography, land cover, and forest infrastructure to thematic maps covering the topics population, forest cover change, forest fragmentation and disturbance, fauna and flora, and livelihood. When conceptualising the atlas three different user groups have been identified: local people, decision makers, and scientists. Consequently, the atlas is subdivided into three corresponding sections, each tailored to the specific needs and abilities of the user group by providing adequately prepared information.

1. Background

Atlases form a suitable medium for communicating complex and large amounts of spatial information and are generally considered a higher form of cartography (Kraak & Ormeling, 2003). While national atlases cover a brought range of fields from physical to human geography, thematic atlases usually focus on one specific topic. In this regard, several atlases on environmental change and biodiversity have emerged especially within the last two decades. At the global scale the World Atlas of Biodiversity (Groombridge & Jenkins, 2002) provides an overview of the different forms of biodiversity (terrestrial, marine, inland water), its change over time as well as human impact upon it by mainly showing thematic world maps. For Africa, comprising some of the most important biodiversity hot spots (Myers, et al., 2000), the recently published atlas titled Africa: Atlas of our Changing Environment (United Nations Environment Programme, 2008) gives information at larger scales. Besides a general overview of

Africa's geography, the atlas presents examples of regional case studies on environmental change for every country using mainly satellite maps accompanied by photographs, graphs and tables. In regard to forest cover, The Conservation Atlas of Tropical Forests. Africa (Sayer, et al., 1992) shows overview maps of forest cover and protected areas at country level including extended textual information. However, in order to better represent local patterns and processes of change, regional atlases comprising comprehensive collections of maps of larger scales are desirable. Contributions of this kind for Africa are e.g. the IMPETUS Atlas Benin (Judex & Thamm, 2008), the atlas on Biodiversity of West African Forests (Poorter, et al., 2004), and the Biodiversity Atlas of West Africa (BIOTA West Africa, in prep.).

BIOTA East Africa is an integrated research project studying tropical forest ecosystems in western Kenya and Uganda (see www.biota-africa.de). Funded by the German Federal Ministry of Education and Research (BMBF) since 2001, the project aims at recommendations towards a sustainable use and conservation of forest biodiversity. Within so far eight years of research a vast amount of geodata has been processed by subproject E02 at Karlsruhe University of Applied Sciences in order to support biodiversity research and management at the landscape scale. Collaborations with other subprojects e.g. for extrapolating biological field findings in space and time (Lung & Schaab, subm.) have further extended the geodata catalogue. Additionally, co-operations with Kenyan counterparts in a participatory forest management process (Schaab, et al., 2009), GIS courses for Kenyan project partners and long-term training of Kenyan scholars (Schaab, 2007), as well as testing of geo-spatial visualizations by local people (Schaab, 2009) have contributed to a better understanding of the various needs regarding an adequate presentation of geo-spatial data. Thus, with the project coming to an end in 2010, research results on rainforest change over time are to be integrated within one regional thematic atlas, considering the specific requests of the counterparts in Kenya and Uganda.

Atlas content should be prepared in order to meet the requirements of a specific user group (Kramers, 2007). However, when conceptualising and designing maps the target user groups and their abilities are often neglected (Häberling & Hurni, 2002). Therefore, for the anticipated atlas three main groups of users have been identified: local people, decision makers, and scientists. Murgia, et al. (2002) independently determined exactly the same three groups for their atlas on urban environment of Trujillo, Peru. While local people with generally a shorter formal education require more easy to comprehend maps, scientists expect a high level of detail and thematic depth, and decision makers should be supported in drawing conclusions from the atlas maps. Providing adequately prepared information to people of such a diverse educational background within one single atlas thus presents a challenge.

2. General aim

The general aim of the atlas project is to visualize research results in an appealing, easy-to-handle, and long-lasting format. More specifically, the landscape-level research outcomes – geodata and interpretations – are to be processed and presented according to the specific prerequisites and needs of the different anticipated target user groups. By doing so we contribute to comprehensive information means needed in environmental education and for informing policies, as well as for making the research outcomes widely visible. The focus will be on the Kakamega-Nandi forests area (western Kenya) as most geodata has been processed for this region, but also the two comparative sites of Mabira Forest and Budongo Forest (both in Uganda) are covered whenever possible

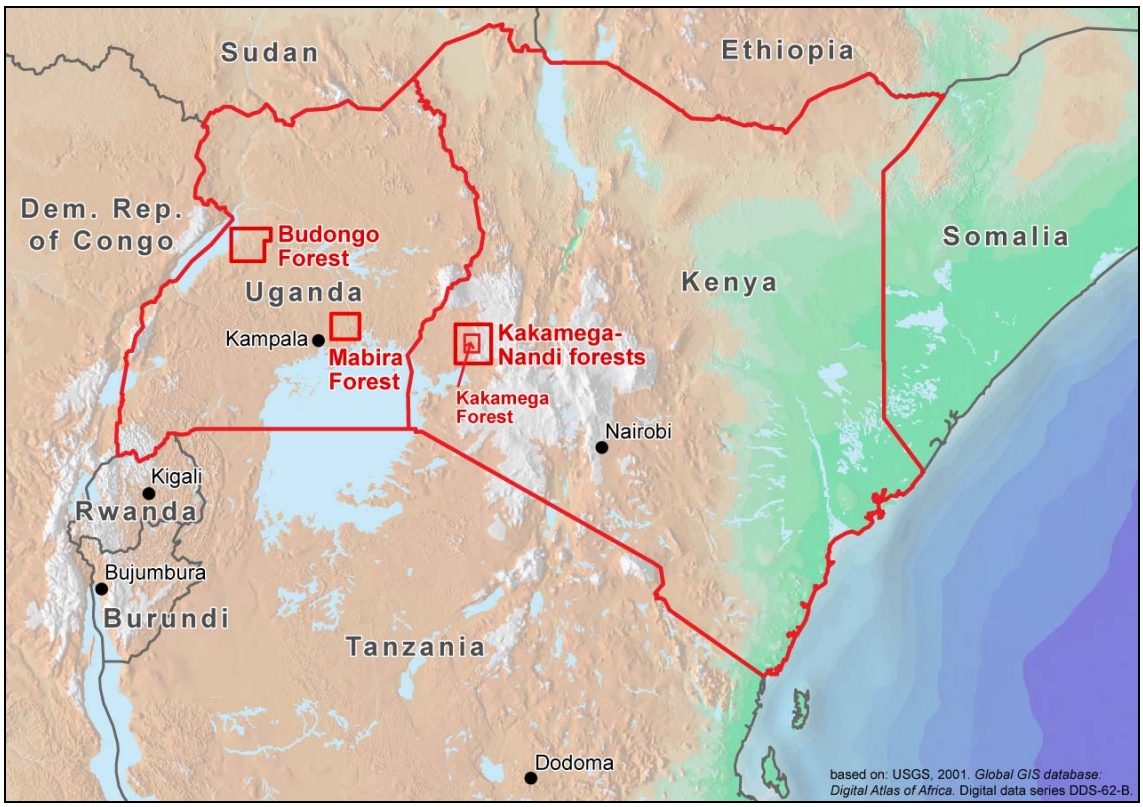

Figure 1: Spatial extents of the three focus forest regions Kakamega-Nandi forests (Kenya), Budongo Forest, and Mabira Forest (both Uganda) in Eastern Africa.

(see Figure 1 for spatial extents of maps). The decision was made for a print product and not a digital atlas accounting thus to the digital divide situation as well as to a more representative final product of BIOTA-East.

3. Conceptual planning

In the concept phase a total of 65 maps contributing to 37 map themes (see Table 1) have been identified, counting here also those of a rather similar topic but of a differing depiction due to the aim to suit three different user groups. They cover overview maps providing background, the population, forest cover change, indices, fauna and flora, and rural livelihood. While only a very few maps relate to the Eastern African context (3) or to Kenya and Uganda (1 each), most maps cover either of the three forest areas studied within BIOTA-East: Kakamega Forest, Mabira Forest (12) or Budongo Forest (13). A clear focus is set on Kakamega Forest (17), which has been in the forefront of research, however, in a rather large number of maps not just Kakamega Forest but also the Nandi Forests are covered (18) as they once formed one forest block. Quite a number of topics require map series, either to show change over time or for comparing the three forest areas.

Table 1: Map themes grouped by their content and classified regarding geographical coverage, targeted user groups, and intended illustration types.

Maps	KF	KN	MF	BF	K	U	EA	sec. 1	sec. 2	sec. 3	GTP
Overview maps											
Location of forests, location within Africa (side map)							X	X			
Orography							X	X			G
Land cover (emphasizing forest areas)					X	X		X			T
Topographic-type orientation maps of forest areas		X	X	X				X			P
Kakamega Forest Tourist Map	X							X			
Forest infrastructure	X		X	X					X		
BIOTA biodiversity observation plots	X		X	X						X	T
Thematic maps											
Population											
Population density		X	X	X				X			T
Population density, gridded		X								X	G
Population growth		X							X		G
Population, households, and poverty		X							X		T
Forest cover change											
Forest cover change		X	X	X				X			T
Forest cover mapping over time	X							X			
Land cover derived from 1) satellite imagery, 2) aerial photography, and 3) old topographic maps	X'							X			
Placename evidence		X								X	T
Land cover time series (KN/MF: 8, BF: 4 time steps)		X	X	X					X		G
Forest cover change (3 time steps, matrix legend)		X	X	X					X		T
Land cover change (cluster analysis)		X	X	X						X	T
Forest fragmentation and disturbance											
Forest fragmentation index		X	X	X					X		G
Forest fragmentation index subsets (6-8 time steps)	X'								X		P
Local disturbance index		X	X	X					X		G
Commercial disturbance index		X	X	X					X		G
Forest cover change index		X	X	X					X		G
Fauna and flora											
Biodiversity in space & time: ants (5 time steps)		X								X	GP
Forest habitat types (5 time steps)	X									X	GP
Biodiversity in space & time: bird comm. (5 time steps)	X									X	} G
Biodiversity in space & time: bird comm. (3 scenarios)	X									X	
Vegetation map	X									X	
Leaf Area Index	X			X						X	GP
Livelihood											
Climate (current and scenarios)							X			X	G
'Potential' vegetation (incl. agro-ecological zones)		X							X		
Soils		X							X		
Farmland structure & land use derived from VHR satellite imagery	X'							X			P
Farmland typology	X'								X		T
Rural livelihood: scenarios	X								X		G
Buyangu village map	X							X			GP
Participatory Forest Management zonation	X								X		P
	17	18	12	13	1	1	3				

KF: Kakamega Forest; KN: Kakamega-Nandi forests; MF: Mabira Forest; BF: Budongo Forest; K: Kenya; U: Uganda; EA: East Africa; sec.: section; G: graph/sketch; T: table; P: photo; X': subset

The BIOTA East Africa Atlas is going to start with the maps useful in education (25 pages). Here, most of the overview maps are found to give the local people (adults and school pupils) a picture of where they live and how the forests look like. They learn about the population distribution in their areas, how the forests have changed over time and the means of deriving this information from remotely sensed imagery and old maps by comparing the source material with the results. This will also be exemplified for a farmland area.

Section 2 (31 pages) is addressing people in decision making and starts with a map on infrastructure for the three forest areas, respectively. This is followed by complex maps depicting population census data and projected values. Forest cover change is shown in more detail and in various ways offering different options for information extraction. Spatially distributed indices on forest fragmentation and disturbance are included here as they can be meaningful in planning. This also relates to the maps of the topic livelihood, all referring to the Kakamega Forest area, which include visualizations of planning scenarios for the farmland as well as a forest zonation map.

The third section (23 pages) is providing maps and information particularly to scientists, starting with maps on the locations of the BIOTA biodiversity observatories in the three forests studied. Population data is shown for the Kakamega-Nandi forests area in a disaggregated manner, resulting from a modelling approach. A map revealing outcomes of a placename evidence study gives the map-reader an idea on what the forest spread might have been before the times of map-making for this area. Forest cover change as detected from satellite imagery is presented in a synoptic way for each of the three forest areas allowing for comparison. Only in this section, maps relating to fauna and flora are found, but almost exclusively for Kakamega Forest. Most of them show change of biodiversity in space and time for selected species, but a vegetation map as well as maps of green biomass distributions are included too. The section concludes with a map of potential climate change for Eastern Africa.

4. The actual making

While most geodata has been processed by means of GIS and image processing techniques in case of remote sensing data, for professional layouting and the design of graphically convincing maps and graphics, desktop publishing software will be used. Thus it is assured that the textual explanations as well as the graphs, tables or photographs accompanying every map will all follow a congruent overall layout. By not only providing just maps, we hope to make the information both understandable and more interesting for studying in detail. Because of the very different educational background of the three user groups, major efforts will be put in finding the way of a most appropriate explanation in each single case. However, the atlas users are not limited to their section. It will be tempting to also look at the many other information provided. While the style of explaining might then be ‘disturbing’, the information presented there is likely to be understood as well. This not necessarily by all decision

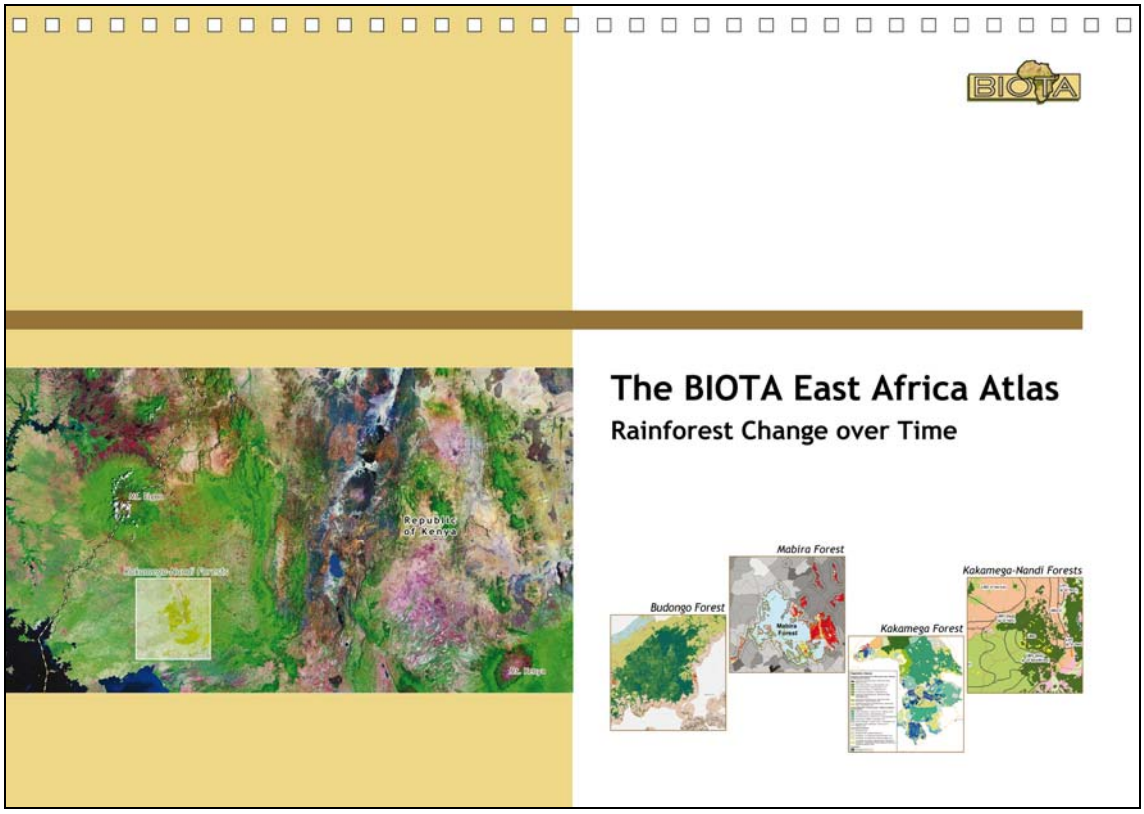

Figure 2: Layout for the front cover of the BIOTA East Africa Atlas with wireO-binding along the longer side of the A4-format.

makers and unlikely by the local people, however, after having become accustomed to maps within their sections with time an increasing number of maps might be understood also by them.

Regarding the atlas' layout (see Figure 2), we favour an A4-size atlas in landscape format. With a binding on its short side, the atlas would loose shape with use and over time. Therefore, the decision was made for a wireO-binding along the longer side of the A4-format, requiring a turning of the book by 90° clockwise for reading the maps, texts, etc. This way, included A3-format maps can be incorporated by turning in/out half of the page. The wireO-binding does not only allow to open the atlas truly flat on a table without fears of breaking the binding, but also to turn the pages in such a way that a single-side map can be hold up, a feature of value when using the atlas in front of an audience or with only little space available, e.g. on school desks.

While the different authors of the many geodatasets need to be involved for quality assurance, a single cartographer being responsible for layouting all the maps is requested (for a layout example see Figure 3). This will ensure that all maps have the same style, e.g. regarding base map features, font sizes, etc. For layouting the maps,

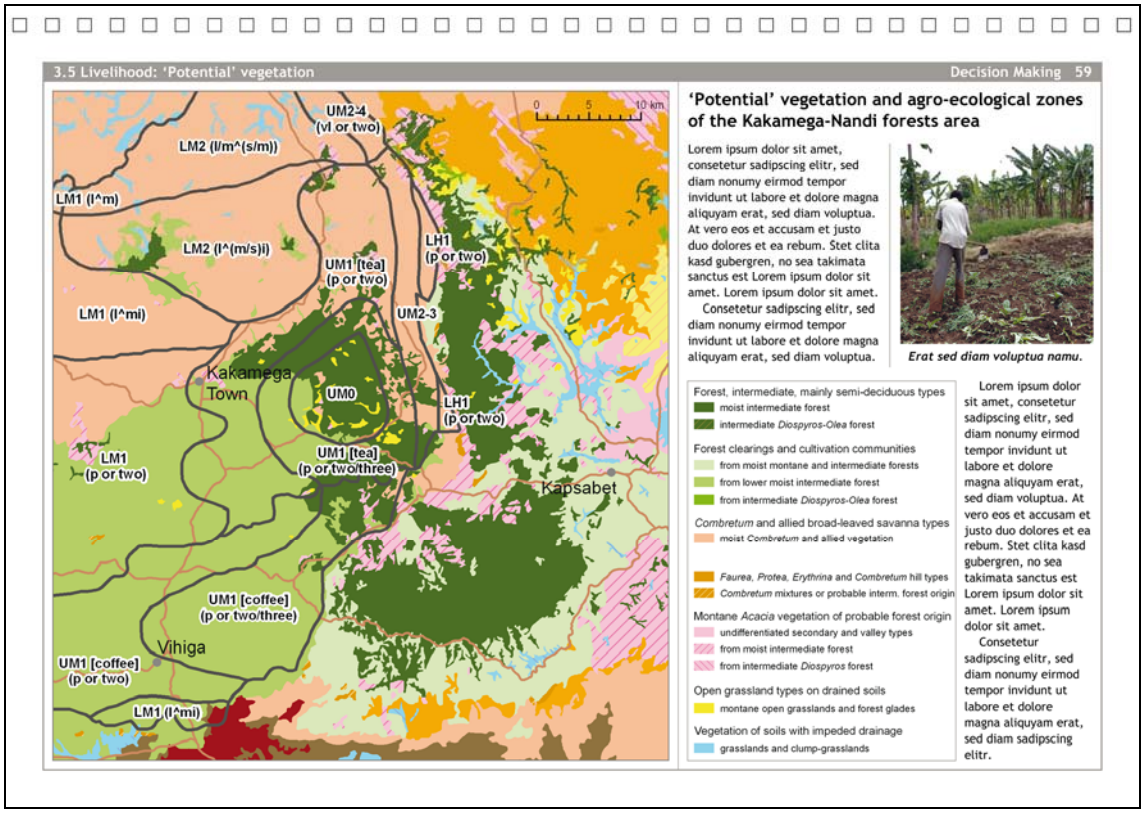

Figure 3: Layout example for an atlas page: 'Potential' vegetation and agro-ecological zones of the Kakamega-Nandi forests area.

ArcGIS in combination with Illustrator will be used, for the tables, graphics and photos Illustrator and Photoshop. For arranging the maps, texts and graphics features InDesign will be made use of. An important issue is that the textual explanations for the three different user groups need to be formulated by different people independently. Only in this way it can be ensured that they are distinct. However, an editor is required for checking all texts in combination with the other information to assure that the atlas as a whole is forming a consistent unit. An initial number of 500 copies is planned to be circulated, approximated to German BIOTA Africa membership, involved scientists and decision makers from Eastern Africa as well as likely requests from local authorities, schools etc. As the atlas presents all the main findings involving geo-spatial data processing and analysis within the interdisciplinary BIOTA East Africa project, we also expect interest by the funding agencies and other institutions or people.

5. Concluding remarks

Spatially explicit, detailed regional-scale research findings on the changing African environment should be communicated to a broader audience. For the East African areas studied, the presented regional thematic atlas on rainforest change over time will be the

first of its kind providing valuable information on the environmental transformations that have occurred within the last century. When conceptualising the atlas, the specific requirements of three target user groups have been taken into account. We optimize the usability of the atlas for each group by tailoring, within the according atlas section, both the map design and the choice of map contents with accompanying text and graphics. By addressing target groups with considerably differing backgrounds we hope (a) that the atlas will contribute to an increasing awareness of the vulnerable East African rainforest ecosystems among the local communities, (b) that it will be of use also in decision making towards a sustainable forest management and conservation, and (c) that it will help to gain a better scientific understanding of the ongoing change processes and resulting patterns.

References

BIOTA West Africa ed., in prep. *Biodiversity atlas of West Africa.* s.l: s.n.

Groombridge, B. & Jenkins, M., 2002. *World atlas of biodiversity: Earth living resources in the 21st century.* Berkeley (California): University of California Press.

Häberling, C. & Hurni, L., 2002. Mountain cartography: revival of a classic domain. *ISPRS Journal of Photogrammetry and Remote Sensing,* 57(1-2), pp.134-158.

Judex, M. & Thamm, H.-P. eds., 2008. *IMPETUS Atlas Benin. Research results 2000 – 2007.* 3rd ed. Bonn: Department of Geography, University of Bonn.

Kraak, M.-J. & Ormeling, F., 2003. *Cartography: Visualization of geospatial data.* 2nd ed. Harlow: Prentice Hall.

Kramers, R.E., 2007. The Atlas of Canada – user centred development. In: W. Cartwright M.P. Peterson & G. Gardner eds. 2007. *Multimedia cartography.* Heidelberg: Springer, pp.139-158.

Lung, T. & Schaab, G., subm. Combining long-term land-cover time series and field observations for spatially explicit predictions on changes in tropical forest biodiversity. *International Journal of Remote Sensing.*

Murgia, J. Amemiya, N. & Turkstra, J., 2002. Local spatial data infrastructure, Trujillo – Peru. In: GISDECO, *Proceedings of the 7th International Seminar on GIS in Developing Countries,* Enschede (The Netherlands), 15-18 May 2002, Available at: http://www.gisdevelopment.net/proceedings/gisdeco/sessions/s5_jose.htm [Accessed 15 June 2009].

Myers, N. Mittermeier, R.A. Mittermeier, C.G. da Fonseca, G.A.B. & Kent, J., 2000. Biodiversity hotspots for conservation priorities. *Nature,* 403(6772), pp.853-858.

Poorter, L. Bongers, F. Kouamé, F.N. & Hawthorne, W.D. eds., 2004. *Biodiversity of West African forests: An ecological atlas of woody plant species.* Wallingford: CABI Publishing.

Sayer, J.A. Harcourt, L.S. & Collins, N.M. eds., 1992. *The conservation atlas of tropical forests. Africa.* Basingstoke: Macmillan.

Schaab, 2009. Experiences from testing map visualizations in a developing country as the basis for a research framework. In: ICC, *Proceedings of the 24th International Cartographic Conference "the World's Geospatial Solutions"* [digital medium], Santiago de Chile (Chile), 15-21 November 2009.

Schaab, G., 2007. Capacity development within the BIOTA East Africa project – Promoting the use of spatial information in biodiversity research and management. In: P. Zeil & S. Kienberger eds. 2007. *Geoinformation for Development. Bridging the Divide through Partnerships.* Heidelberg: Wichmann, pp.44-49.

Schaab, G. Lübker, T. Lung, T. & Mitchell, N., 2009. Remotely sensed data for sustainable biodiversity management. The case model of Kakamega Forest in western Kenya. In: ISRSE, *Proceedings of the 33rd International Symposium on Remote Sensing of Environment "Sustaining the Millenium Development Goals"* [digital medium], Stresa (Lago Maggiore, Italy), 4-8 May 2009, ref.479.

United Nations Environment Programme ed., 2008. *Africa: Atlas of our changing environment.* Nairobi: UNEP.