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Synthesis of available information for the preparation of national adaptation programmes of action

Technical paper

Summary

This technical paper prepared by the Least Developed Countries Expert Group (LEG) provides guidance on synthesis of available information in the preparation of national adaptation programmes of action (NAPAs). It responds to a need identified by least developed country Parties during regional workshops on NAPA preparation held by the LEG in 2003. The paper covers the nature of information to be sought as well as ways to access sources of this information. Collating existing information can facilitate rapid assessment of vulnerability and adaptation and inform the NAPA preparation process.

CONTENTS

I. Introduction

1. The synthesis of past studies and other available information is a necessary step in the development of national adaptation programmes of action (NAPAs). Although some vulnerability assessments may exist, they may not give the required level of detail to enable urgent and immediate adaptation actions to be specified. It is also unlikely that many existing assessments would have developed or applied a clear adaptation framework in the context of major development goals to ensure mainstreaming of adaptation into national development. Main development thrusts are likely to be those articulated in poverty reduction strategy papers (PRSPs) or other similar documents. Part of the synthesis activity should be devoted to identifying appropriate links to development. The ideas presented here by the Least Developed Countries Expert Group (LEG) are meant to guide a national team towards assembling data and information to support the NAPA process, which would then be used for identifying adaptation needs, including through a rapid participatory assessment of vulnerability and adaptation.

2. A NAPA is intended to be a brief document prepared using a streamlined approach that recognizes the limitations of least developed countries (LDCs) in terms of availability of data and capacity to conduct comprehensive assessments. However, there is usually sufficient information within a country to determine what warrants urgent and immediate adaptation measures and what is required to enhance coping ability or adaptive capacity in the short term. Longer-term needs for adaptation should be considered outside the NAPA process and can be identified through a more comprehensive assessment process. It is thus assumed that a participatory process of assessment among stakeholders will result in a list of adaptation activities. These activities should then be ranked according to their urgency.

3. The first step in the NAPA process is the establishment of a NAPA team which in accordance with paragraph 8 (b) of the NAPA preparation guidelines (annexed to decision 28/CP.7) assembles a multidisciplinary team responsible for the synthesis of available information. The multidisciplinary team is mandated in paragraph 8 (b) (i) of the NAPA guidelines "to synthesize available information on adverse effects of climate change and coping strategies, which would be collated and reviewed, including the national strategies for sustainable development, the Programme of Action for the Least Developed Countries, the United Nations development assistance frameworks, and poverty reduction strategy papers, if available in the countries".

4. The outcome of this synthesis feeds into the section of the NAPA that deals with the adaptation framework (see paragraphs 10–12 of the NAPA guidelines), which should "provide an overview of climate variability and observed and projected climate change and associated actual and potential adverse effects of climate change. This overview will be based on existing and ongoing studies and research, and/or empirical and historical information as well as traditional knowledge". The same section of the NAPA will also describe the framework's "relationship to the country's development goals ... to make the framework consistent with socio-economic and development needs. In addition, it would also describe the goals, objectives and strategies of the NAPA, taking into account other plans and multilateral environmental agreements".

5. A useful way to organize spatial data and information about a country is through the use of geographic information systems (GIS). Many basic data layers already exist that show administrative boundaries; physical features such as roads, rivers, lakes and dams, and slope; and thematic features such as land cover, land use, population, and average climatic conditions. Software for manipulating GIS data is relatively inexpensive, and free versions of such software exist that can easily be utilized by NAPA teams to manage information. Some of the analyses can be carried out in a computer spreadsheet application, such as Microsoft Excel, and the results displayed using GIS. Capacity for GIS exists in many LDCs. Lists of readily available software, data sources and analysis packages suitable for application in the context of NAPA development are given in annexes I and II.

II. Development framework

6. Development plans and policies should be examined in an effort to link adaptation planning with national development priorities and programmes. This includes examining legislative frameworks and development plans as well as documents describing long-term strategies, such as Vision 2020, documents to gain an overview of the most important development goals for the short and medium term. The multidisciplinary team could rely on previous development assessments, including PRSPs and their interim versions, national strategies for sustainable development and country profiles prepared in 2002 for the World Summit on Sustainable Development, and national action plans developed for the Third United Nations Conference on the Least Developed Countries (held in Brussels, Belgium, in May 2001), available from the secretariat of the United Nations Conference on Trade and Development <http://www.unctad.org>. Other important sources of information include specific sectoral development plans, such as for water, agriculture, forestry, energy, health and population, and disaster management and preparedness policies. Once the plans and policies have been examined, a short overview should be written, which could include goals; expected time frame; relationship between various development goals; and external factors, e.g. changing subsidies and quotas for major export crops such as sugar and tobacco, in relation to overall national economic growth development plans.

7. In many cases there are existing development projects with implementation models useful for NAPA development. These include small grants programmes, including micro-finance schemes that enable communities to access funds for local development. It is unlikely that many of these programmes would address climate change concerns explicitly; however, existing implementation infrastructures may form a useful model for delivering NAPA projects and activities at the community level, and should be taken into consideration in the description of a country's development framework.

8. The team should consult the general national environmental action plan (NEAP) to learn which environmental issues are targeted and how, at what levels, and in what time frame. NEAPs also give an overview of existing environmental priorities (e.g. the preservation of natural resources). In addition, specific legislation (e.g. the national wetland policy in Uganda) can be of value.

III. Vulnerability framework

9. The Intergovernmental Panel on Climate Change (IPCC) Third Assessment Report (TAR, 2001) presents a common approach towards assessing vulnerability, which was further expanded in *The NAPA Primer*.[1] At the core is a conceptualization of a coupled human–economic–environment–climate system at the national level, represented by the development framework (described above). In some cases, mathematical models have been constructed that take into account these linkages to study such problems as poverty and impacts of various interventions. No such mathematical models are necessary for the NAPA process, but a conceptual understanding of how the different spheres (human, social, economic, and environmental) interrelate is important in quantifying vulnerability. In cases where such modeling assessments exist, the results can be used to guide interventions to target key determinants of poverty and vulnerability. In general, vulnerability is a function of exposure (to climatic hazards and associated risks), impact potential or sensitivity of the system to climate change, and adaptive capacity or resilience of the system.

10. In accordance with decision 28/CP.7, it is important to rely on previous assessments as much as possible, or on data and information that may be available in regions with similar vulnerabilities. Reports by the IPCC are important sources of reliable, general information regarding potential effects of climate change, such as expected trends in extremes, but their conclusions are often too broad to apply in a specific LDC setting.

[1] By Paul Desanker, 2004. Available at <http://www.napaprimer.org>.

11. Although the NAPA process does not entail a comprehensive assessment of vulnerability, it is important to conceptualize vulnerability explicitly, in order to guide the synthesis of available information, and to enable meaningful comparison of the circumstances of different management units (communities, districts, etc.) for the purpose of identifying intervention targets. By using available information it should be possible to assess vulnerability and identify areas or communities of high vulnerability to climate change, which would then be subject to further assessment of possible interventions or adaptations.

IV. Review of past assessments including action plans under various multilateral environmental agreements

12. After analysing the broad development and vulnerability frameworks, the country's multidisciplinary team should study previous climate change and vulnerability assessments to develop an overview of existing and future climate hazards that could undermine achievement of development goals. As a first step, the NAPA team should consult the country's initial national communication to the UNFCCC[2] if one has been completed.

13. The vulnerability assessment in the national communication is normally based on scenarios derived from general circulation models, which project future changes in temperature and precipitation. These predictions are used in modelling possible positive and/or negative impacts of climate change for various sectors and areas, such as agriculture, water resources or coastal zones. Based on projected impacts, many LDCs have already proposed a number of adaptation options. For example, Ethiopia plans to improve its management practices and techniques, for example by adjusting planting dates, seeding rates, and fertilizer application rates within its agriculture sector, and Burkina Faso plans to better manage water resources through river basin management agencies. Such plans could constitute an initial input into the pool of potential activities and projects to be considered during the consultative process of the NAPA, as long as there is adequate detail about the rationale for such actions and details on how these activities would be implemented.

14. Besides national communications, a number of regional vulnerability assessments exist, which have been carried out by sector or in an integrated manner, and which may provide information to guide the selection of vulnerabilities (e.g. the Assessments of Impacts and Adaptations to Climate Change project[3]). In some cases, these assessments cover non-LDCs. For example, a number of assessments have been carried out for the small island developing States (e.g. Pacific Island Climate Change Assistance Programme) to analyse patterns and trends in natural disasters, and these provide a useful source of information for NAPAs.

15. Past assessments, including in national communications and disaster preparedness plans, would have identified major climatic hazards and, in some cases, estimated the risks posed by each. This information is a useful basis for evaluating climate change hazards. In many cases, this information can be readily mapped with GIS. Expert consultation can also produce a GIS data layer showing areas exposed to particular threats. It is likely that flooding, droughts and major storms will be the most important hazards, but there can be localized issues, such as landslides, siltation, etc., and, in some cases, more than one hazard will be present, such as both flooding and drought risks.

16. In addition to specific climate change assessments, a number of national and regional vulnerability studies have been conducted on food security, droughts and floods. As they are concerned with current vulnerabilities they are more suited for the NAPA process. For example, the Famine Early Warning Systems network <http://www.fews.net/> conducts periodic assessments of the food situation in

[2] Available at <http://unfccc.int/national_reports/non-annex_i_natcom/items/2979.php>.
[3] <http://www.aiaccproject.org/aiacc.html>.

relation to seasonal circumstances and publishes newsletters, maps and data.[4] Similar assessments can be found at the United Nations World Food Programme web site <http://www.wfp.org>.

17. In cases where vulnerability assessments are unavailable or only relate to long-term developments, recent trends in climate parameters, such as temperature and rainfall distribution, are probably useful indicators of potential trends over the short to medium term. Usually, such data can be obtained from meteorological stations. In cases where climatic records are unavailable, there are global datasets that provide monthly summaries over a half-degree grid of the land surface, available through the IPCC Data Distribution Centre <http://www.ipcc.ch>, based on the monthly climate data from the University of East Anglia, United Kingdom of Great Britain and Northern Ireland. An Internet-based graphic tool draws a profile of these data for land-based locations.

18. Other important sources of information include action plans developed under multilateral environmental agreements, such as national action plans and regional and subregional action plans under the United Nations Convention to Combat Desertification,[5] which outline the practical steps and measures to be taken to combat desertification and mitigate the effects of drought in specific ecosystems, and national biodiversity strategies and action plans under the Convention on Biological Diversity,[6] which outline the steps to implement the Convention.

19. Case studies from particular regions and for specific situations are useful in elaborating how communities are affected by climate change, how they respond to these effects, and what are their major needs. It is well established that vulnerability is context-specific, in terms of geographic location and socio-economic situation of the exposed populations.

20. If a number of projects have already been implemented, the team could provide an overview of the costs and benefits of specific activities for possible use during ranking later in the NAPA process. Sometimes, economic analyses exist that have compared different development options to address major problems, such as food security or water shortage. These are useful in informing the process of selecting cost-effective solutions. It is important to note that because data on costs and benefits are likely to be scarce, NAPA preparation need not include explicit consideration of costs and benefits where such data do not exist. Instead, other ranking methods can be used, including multi-criteria analysis.

21. Finally, after all relevant information has been synthesized, it is worthwhile to give a brief description of how these findings relate to national development plans. For example, how do climate hazards, such as droughts, hinder achievement of certain goals, such as agricultural self-reliance. In addition, the team could elaborate on how achievement of development goals could contribute to a country's resilience. For example, Cambodia's national communication concludes that "the impact of climate change on rice production in Cambodia would not be substantial if the Government could meet the agriculture development plan".

V. Trends in climate parameters and indices

A. Past climate

22. Many communities will have observed that climate is changing. However, development of specific adaptations will require some elaboration of the direction and extent of climate change. Climate data are collected at the national level, and various summaries are available from several international sources. Although the density of weather stations (and hydrological monitoring stations) is low and needs to be increased in LDCs, it has been possible to construct general trends in past climate using the

[4] Additional sources of information and data are provided in annex I.
[5] Available at <www.unccd.int>.
[6] Available at <www.biodiv.org/world/reports.aspx?type=nbsap>.

few weather stations that exist, or based on global climate databases, such as the Climate Research Unit (CRU)-Hulme dataset.[7] The IPCC Data Distribution Centre also provides an online tool for plotting the CRU data for given locations. Software for analysing station data is available, and includes such packages as RClimDex, which can be downloaded free from <http://cccma.seos.uvic.ca/ETCCDMI/software.html>.

23. There is also an archive of various satellite measurements (rainfall, vegetation cover and greening, etc.) that spans more than 20 years in some cases, providing an observed record of climatic conditions that can be useful in national-level assessment and planning. Regional early warning systems exist for many developing regions, and these are a useful source of data and information for active planning. For Southern Africa, the Southern African Development Community's Regional Remote Sensing Unit in Harare, Zimbabwe, provides seasonal summaries of weather conditions and provides predictions to guide agricultural activities.

24. Identification of critical thresholds for particular applications should be an important outcome of the analysis of past climatic trends. For example, particular crops require a certain minimum moisture content (a function of temperature and rainfall inputs), while applications such as hydropower generation require certain minimum water levels. Identification of these thresholds is useful in planning interventions or changes in management, and this information should be readily available from people in the various sectors within the country. Knowledge of the properties and trends of the growing season – beginning, quality, length and end – is essential in designing adaptation measures for the agriculture sector. In parts of Southern Africa, for example, farmers are able to point out with certainty how the beginning of the growing season has shifted by three to four weeks, which can be confirmed by specific data.

B. Future climate

25. As climate continues to change, the challenge for planners is to design activities and programmes that are applicable both to current climatic conditions and possible future climate change scenarios. The IPCC predicts that the frequency and intensity of extreme climatic events are likely to increase, and the IPCC TAR projects a 2–6º C increase in temperature over the next 100 years (however, larger changes are possible locally and regionally). If scientific studies of future climatic trends exist, these should be included in the synthesis of available information.

VI. Regional dimensions of vulnerability

26. In some cases, there will be regional factors to consider during the NAPA preparation process. For example, climatic hazards that evolve in regions that include shared river basins spanning several countries, or in regions where food is traded amongst several countries, could affect a given country or community but in fact originate from outside the country or community.

27. Flood assessments, for instance, often point to sources of contributing factors of vulnerability that operate at regional, multi national levels. In the case of Mozambique, for example, heavy rains in several areas of the Zambezi River Basin in 2000 and 2001 led to excessive run-off into the Zambezi River and subsequently to severe flooding in the lower Zambezi region in Mozambique. Dams and man-made lakes can also contribute to flood dangers when flood gates are opened to avoid catastrophic dam failures, often with little or no warning for rural communities in downstream flood plains.

[7] Available from the Climatic Research Unit of the University of East Anglia <http://www.cru.uea.ac.uk>.

VII. Local coping strategies

28. For the climatic hazards identified above, it would be helpful to document coping strategies at the community level, as well as other higher level responses, including some assessment of effectiveness. In many cases, there will be effective local coping strategies, some of them based on indigenous technologies and traditional knowledge, that may have been in use for generations. These "adaptations" will be useful in designing new activities, especially in areas where new hazards evolve. For example, experiences in regions or areas that are subject to chronic floods might provide solutions for areas that are becoming flood-prone due to climate change.

29. In the case of flooding, there is a wealth of experience and good practices from countries in Southern Asia where communities have adapted their housing and way of life to floods. In contrast, areas in Southern Africa that are now beginning to experience repeated and severe flooding, do not have housing and farming techniques designed to withstand flooding. The opportunity exists for a lateral transfer of experiences and technologies. Building elevated houses, a common practice in South-East Asia, might work in other regions facing increased flood risk.

30. In arid and semi-arid regions, many techniques for harvesting and managing water have been mastered. Whether such experiences will indeed contribute to better adaptation will eventually depend on specific socio-economic and cultural factors. Communities must be in a position to incorporate new experiences into their livelihoods. As practical experience with adaptation is gained, it will be useful to document inputs and outputs (costs and benefits), including lessons learned in adopting solutions from other areas.

31. The NAPA team could acquire such information through non-governmental organizations (NGOs), from regional and local plans and policies or from international databases, including the World Bank's indigenous knowledge database <http://www4.worldbank.org/afr/ikdb/search.cfm> and the United Nations Educational, Scientific and Cultural Organization's MOST database <http://www.unesco.org/most/bpikreg.htm>. The UNFCCC secretariat has also developed a database on indigenous and community-based coping strategies relevant to adaptation to climate change <http://www.unfccc.int/ldc> to support the work programme of the LEG, and to build on the outcome of the UNFCCC workshop on local coping strategies (New Delhi, November 2003).

32. The documentation of these local coping strategies could also be enhanced through local consultations at the community or project level, including:

(a) Interviews in communities at risk from droughts and floods to collect people's views and experiences from past events (coping strategies, danger thresholds and ideas about what could be done to avoid future hazards)

(b) Consultations to prepare profiles of major installations that are especially vulnerable to climatic events, such as hydroelectric power stations, major dams, water sources for major urban areas, major industries in drought- or flood-prone areas

(c) Characterization of the country's population into groups whose needs could be addressed jointly, e.g. urban residents (they share water and energy sources), rural subsistence farmers, commercial farmers, industrialists, etc. It would be especially useful to identify the most vulnerable groups

(d) Development of profiles of population groups that have been involved in establishing current programmes and strategies used to address climate variability and disasters

(e) Assessment of the status of community-level warning systems for extreme weather (e.g. radar installations)

(f) Case studies of local responses to the impacts of the El Niño Southern Oscillation.

VIII. Presentation of synthesis results

33. Collecting stakeholders' inputs relating to decisions about adaptation solutions and priorities is an important step in the NAPA process. It requires effective communication of information to non-expert audiences to facilitate discussions. The use of maps and other visual representations can greatly enhance this process. Use of GIS to create maps showing administrative units, distribution of population, infrastructure, land use, river systems, temperature and precipitation distribution, etc., is proposed, in order to assist in identifying the most vulnerable regions and communities. Most LDCs have some capability for using GIS, and numerous resources are available from public online databases, so use of GIS outputs in NAPA preparation is relatively easy.

34. Useful reference and data resources include:

(a) Down to Earth: Geographical Information for Sustainable Development in Africa (2002), Board on Earth Sciences and Resources, National Academy Press, 2002[8]

(b) Basic country-level data (administrative and basin boundaries, land cover, population, etc.) as well as satellite images for 1990 and 2000 based on Landsat 5 and 7 data[9]

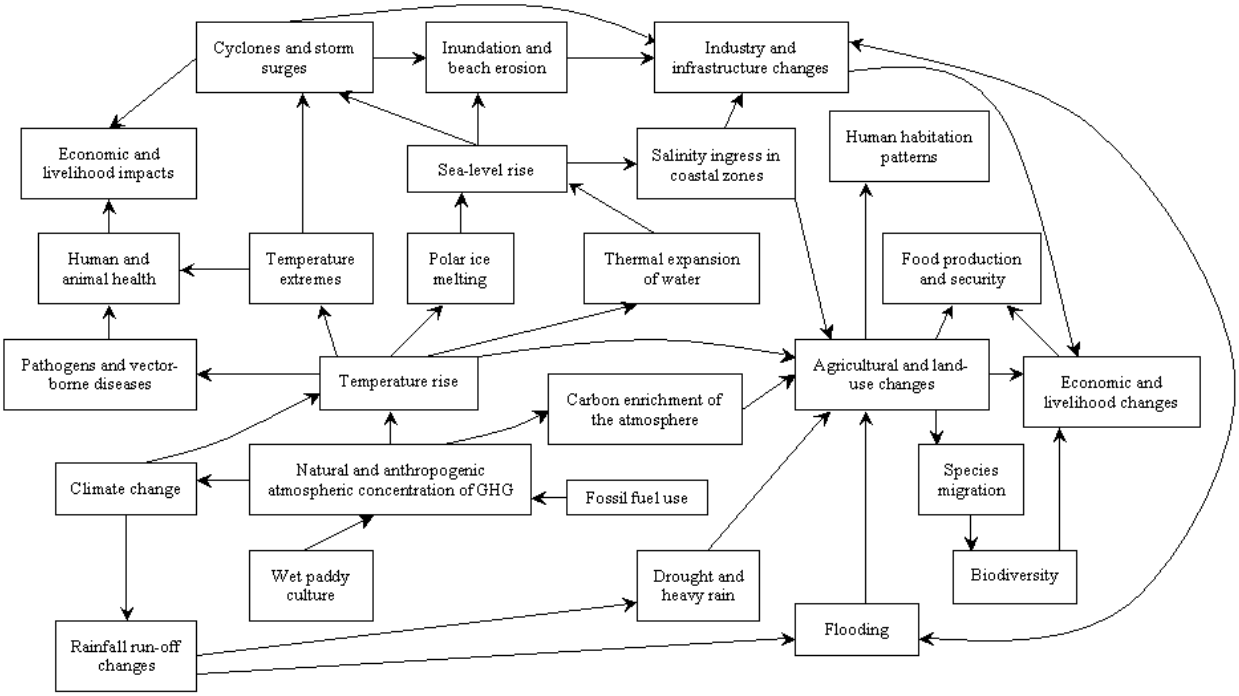
(c) The AWhere software package includes data bundles for many African countries, and includes tools for easy spatial characterization of weather and related analyses for agricultural planning and other uses. A bundle of data was assembled for Samoa and Malawi and used during the LEG regional workshops on NAPA preparation.[10]

35. It is important to design the synthesis of available information in such a way that it informs the later steps in the NAPA process effectively. Results are best presented in the form of data sheets (spreadsheets), graphs, figures and maps rather than exclusively in descriptive reports. The main purpose of this information is to inform the identification of possible adaptation activities, be they policy reform activities or concrete actions in specific regions or sectors. Each proposed activity should include information about how it relates to past adverse impacts, trends in climatic hazards, and coping strategies of communities in similar situations in other regions.

36. In addition, a diagram summarizing major symptoms of climate change and how these would affect critical sectors and systems of the country under study could be useful in guiding the NAPA assessment. This could be constructed through a participatory process to identify which drivers of change and sectors are important. For example, the Bangladesh NAPA team members developed a flow diagram that presents a useful overview of vulnerability for their country (see figure below).

[8] Available at <http://www.nap.edu/books/0309084784/html>.
[9] See <http://www.napaprimer.org> for links to online sources.
[10] Available at <http://www.napaprimer.org>.

Overview of Bangladesh's vulnerability to climate change



Source: Adapted from a diagram prepared by the Bangladesh NAPA team, available at <http://www.sdnpbd.org/sdi/issues/climate_change/napa/workshop/bd_valnerability_napa_action.pdf>.

37. At the end of the synthesis exercise, the team should have an overview of the development framework, existing and future climate hazards as well as different approaches to deal with vulnerabilities. Finally, the synthesis of information should not be seen as an end but rather as a means to inform the NAPA process and to develop concrete adaptation activities.

38. Having completed the synthesis exercise and a presentation of its results, the NAPA team can now proceed to the next step in the NAPA process, i.e. conduct a participatory vulnerability assessment and consult with stakeholders, including local communities, on potential adaptation activities.

Annex I

Selected data sources for geographic information systems and remote sensing analysis

Data source	Description	Contact or availability
Miombo CD-ROM. START Secretariat, LUCC/DIS, and the Miombo Network	Data includes the 1-km digital elevation model for Africa, elevation and ocean depths, 1-km Africa drainage basins and systems, administrative boundaries, climatic data (1977–1995), tropical Africa biomass (1980), CO_2 emissions, White's 1983 vegetation map of Africa (1:5 million scale), land cover maps (the IGBP, USGS and UMD 1-km land cover maps), global vegetation. African population for 1960, 1970, 1980 and 1990, and World Bank socio-economic data are also included. The CD-ROM includes a spatial data viewer.	More information available at <http://www.miombo.org>
Miombo Landsat TM/ETM$^+$	Landsat Thematic or Enhanced Thematic Mapper (TM/ETM$^+$) data for selected countries covering the *miombo* region of Central and Southern Africa are available to members and collaborators. Data cover mid-1980s and the 1990s.	More information available at <http://www.miombo.org>
Global Land Cover Facility (GLCF), University of Maryland	The GLCF develops and distributes remotely sensed satellite data and products relating to land cover from the local to global scales. This is a great site to download the latest Landsat, MODIS and other remotely sensed data and products. The 90-m digital elevation data from the Shuttle Radar Topography Mission are also available for download for free.	<http://glcf.umiacs.umd.edu/index.shtml>
Tropical Rain Forest Information Center (TRFIC), Michigan State University	TRFIC provides Landsat and other high resolution satellite remote sensing data as well as digital deforestation maps and databases to a range of users through web-based geographic information systems (GIS).	<http://www.globalchange.msu.edu/trfic> <http://www.landsat.org>
ALCOM Water Resource Database. The Aquaculture for Local Communities Development Programme, Harare, Zimbabwe	A comprehensive FAO supported data source on surface-water resources for Southern Africa. Data include water bodies, watersheds, rivers, aquatic species distribution, wetlands, capital cities and administrative boundaries, and other specialized databases on fish and fisheries. The map scale is 1:15,900,000. A GIS viewer is included.	Data is downloadable at <http://www.zamnet.zm/zamnet/alcom/wrd.htm> E-mail: ALCOM@harare.iafrica.com

IPCC Climate Change and Related Scenarios for Impacts Assessment CD-ROM. The IPCC Data Distribution Centre	Data include mean monthly results from five global climate model climate change experiments; monthly-observed global climate data (1961–1990) gridded at 0.5 degrees, various country-based social economic environmental indicators for the 1990s, atmospheric CO_2 concentrations for 1957–1997, greenhouse gas emissions and non-climate information from two climate change scenarios (IS92 and SRES98). A visualization tool is included.	Data is downloadable: <http://ipcc-ddc.cru.uea.ac.uk/>. The CD-ROM can be ordered free of charge, by e-mail: ipcc.ddc@uea.ac.uk
SADC RRSP CD-ROM. FAO/SADC Regional Remote Sensing Project (RRSP)	CD-ROM contains decadal normalized difference vegetation index (NDVI) data for 1984–1990, 1993, 1994, 1996–1997, decadal rainfall estimates (1996–1998), FAO and SADC spatial climatic data, ALCOM hydrology layers, agricultural and population statistics (1:1,100,000 scale). Land cover, soils, topography, transportation and administrative boundary maps are included, as well as the WinDisp GIS/RS software.	Contact by e-mail: rrsp@fanr-sadc.org.zw
START/Miombo Regional Climate CD-ROM	The CD-ROM contains temperature and rainfall data for Botswana, Malawi, Mozambique, Namibia, Tanzania, Zambia and Zimbabwe, as well as some Landsat TM data. The CD-ROM is the output of a workshop held in Zambia in April 1999.	Available at <http://www.miombo.org/climatecd>
The IGBP Data and Information System global land cover product, IGBP-DISCover Dataset	Continental-level land cover database developed from 1-km monthly NOAA-AVHRR NDVI composites covering the period 1992–1993. The dataset has 17 land cover classes, but the classification has not been verified with ground data yet and should be used with caution, especially at national level.	Available at <http://edcwww.cr.usgs.gov/landdaac/gll/glcc.html>
AWhere Almanac Characterization Tool, (AWhere ACT), Mudsprings Geographers	AWhere ACT is a GIS software application (built on Arcview software) that contains a set of biophysical and socio-economic data for many countries, and the tools to explore and query these data to provide information for decision-making for agriculture and natural resources management. It includes spatial climate data, soils, population density, elevation, land cover, agricultural census and production information. These data are combined with ancillary data, such as roads, rivers, towns, political units, watersheds, water bodies, towns and cities in the GIS application. The software allows queries to be conducted including complex combinations of several input maps. It is also possible to manage weather data, and standard analyses can be carried out with ease.	More information available at <http://www.mudsrpings.com>
FAO Forest Resources Assessment Data. FAO, Rome, Italy	Includes land cover and change analysis on a country-by-country basis, ecological zones and ecofloristic zones.	Data is downloadable at <http://www.fao.org/forestry/fo/fra/index.jsp>

Degradation data, GLASOD - UNEP GRID.	Global dataset on environmental degradation.	<http://www.grid.unep.ch/index.html>
Solar radiation, NASA Langley DAAC, United States of America	Solar radiation data.	Available at <http://eosweb.larc.nasa.gov/sse/>
Digital Soil Map of the World and Derived Soil Properties CD-ROM FAO/UNESCO, Rome, Italy.	This is based on the FAO/UNESCO soil map at 1:5,000,000 scale, or in 5 x 5 arc-minute grid cells. It is available in Arc/Info export, Erdas, and Idrisi formats.	More information available at <http://www.fao.org/ag/agl/agll/dsmw.stm>. To purchase contact local FAO offices or e-mail: Publications-sales@fao.org
GIS data clearing houses	Provide links to sources of geographic data.	GIS Data Depot: <http://gisdatadepot.com>, Global Change Master Directory: <http://gcmd.nasa.gov/>, The Geography Network: <http://www.geographynetwork.com/>

Note: ALCOM=Aquaculture for Local Communities Development Programme; DAAC=Distributed Active Archive Center; FAO=Food and Agriculture Organization of the United Nations; GIS=Geographic Information Systems; GLASOD=Global Assessment of Human-induced Soil Degradation; GRID=Global Resource Information Database; IGBP=International Geosphere–Biospehere Programme; IPCC=Intergovernmental Panel on Climate Change; LUCC/DIS =Land Use and Cover Change/Data Information Systems programmes of the IGBP; MODIS=Moderate-resolution Imaging Spectroradiometer; NASA=National Aeronautics and Space Administration; NOAA–AVHRR,=National Oceanic and Atmospheric Administration–Advanced Very High Resolution Radiometer; RRSP=Regional Remote Sensing Project; SADC,=Southern African Development Community; START=System for Analysis, Research and Training; UMD=University of Maryland; UNEP=United Nations Environment Programme; UNESCO=United Nations Educational, Scientific and Cultural Organization; USGS=United States Geological Survey.

Annex II

A selected list of commercial geographic information systems and remote sensing software

Software name[a]	Software producers	Raster/vector capabilities	Comments
Arc/Info	Environmental Systems Research Institute (ESRI), Redlands, California, United States of America <http://www.esri.com>	Vector and raster	Industrial standard and most widely used geographic information systems (GIS) software. Originally command based. Latest versions are marketed under ArcGIS.
ArcView	ESRI, Redlands, California, United States of America <http://www.esri.com>	Vector with raster capability as add-ons	A popular and commonly used GIS software, simplified and inexpensive version of Arc/Info. Newer versions being released under ArcGIS.
ArcGIS	ESRI, Redlands, California, United States of America <http://www.esri.com>	Vector and raster, expandable with extensions	New spatial database model and reorganization of ArcView and Arc/Info into suites of software applications arranged into three integrated functions: ArcMap, ArcCatalog, and Editor. Desktop versions of ArcGIS include ArcView 8x, 9x and Arc/Info 8x, 9x.
ERDAS Imagine Professional	ERDAS (subsidiary of Leica Geosystems), Atlanta, Georgia, United States of America <http://www.erdas.com>	Raster, with vector capabilities	Industrial standard remote sensing software. Includes radar analysis and graphical modelling. Imagine Advantage is intermediate level version that excludes 3D, radar and other radiometric functions. Imagine Essentials is a low-cost mapping and visualization tool. Both versions are expandable to the Professional version.
Idrisi32 for Windows	Clark University, Worcester, Massachusetts, United States of America <http://www.clarklabs.org/>	Raster with limited vector capabilities	Inexpensive, easy -to-learn, GIS and image processing system, with good documentation and training materials, advanced research applications such as decision support, uncertainty management and geostatistics. Widely distributed and commonly used in Africa.
CartaLinx	Clark University, Worcester, Massachusetts, United States of America <http://www.clarklabs.org/>	Vector	Inexpensive, spatial data building tool with standard vector GIS analytical and mapping tools.
ENVI	Research Systems, Inc., RSI (a subsidiary of Eastman Kodak Company). <http://www.rsinc.com/index.asp>	Vector and raster	Advanced and powerful remote sensing software; leader in hyperspectral analysis; can use virtually any type of data; interactive data language allows programming and expansion of ENVI's features to meet specific applications, and easily integrates GIS/RS with modelling.

[a] This is only a small sampling; many more packages exist from different regions.

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