

Operational Guidance for Climate Risk Management through Sustainable Land Management

Inception Report

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Background

The Africa Region of the World Bank is leading analytical work entitled "Managing Land in a Changing Climate: An Operational Perspective for Sub-Saharan Africa". This work aims to support decision-making processes within sub-Saharan Africa (SSA) countries, regional institutions and the World Bank, within the context of the TerrAfrica partnership, about (i) the risks posed by climate variability and change in relation to land resource dependent livelihoods in SSA, (ii) the impact of land use practices on carbon stocks and greenhouse gas emissions, and (iii) to provide practical guidance and tools about sustainable land management (SLM) approaches and practices that are best suited to meet development objectives while also addressing climate change adaptation and mitigation concerns.

This analytical work is divided into three main pillars which can be summarized as follows: (i) under Pillar One, climate change and variability as well as land management data will be collected and presented in one integrated information system at a regional level with some specific sub-regional focuses; (ii) under Pillar Two, case studies will provide context specific and operational recommendations; and (iii) under Pillar Three, the information and knowledge collected and generated will be presented in a format designed for broad dissemination. The case studies will draw upon the information generated under Pillar One, combined with specific information collected in selected case study sites to draw practical, context-specific lessons and recommendations for SLM approaches and practices to improve adaptation to and mitigation of climate variability and change.

This inception note describes the objectives, scope, target audience, outputs, methodology and work plan for the case studies conducted under Pillar Two.

Objectives

The overall objective of the case studies is to generate practical, context specific recommendations of sustainable land management approaches and practices which are suited to improve food security and economic prospects while reducing climate related risks and greenhouse gas emissions. The case studies are expected to answer the following questions:

- What types, modalities and conditions of SLM investments are the most relevant in terms of adaptation to current variability and future climate change?
- What context specific actions can improve the contribution of SLM investments to adaptation and mitigation, considering improved information, institutions, and policy, program and regulatory instruments?
- What are the best synergies between water and land resource management to generate mitigation and adaptation benefits?

In addition to the case studies, a joint TerrAfrica paper on climate change and land management will be prepared that explains the conceptual linkages between climate change and land management, and which will serve as the theoretical basis for the case studies.

Scope

The case studies will focus on assessing the nature of climate variability and change in selected case study sites in two sub-regions of SSA during a recent historical period (within the past 25 years); community and household responses to climate variability and change, including especially changes in land use and land management; and implications of these responses for household food security, livelihoods and poverty reduction, carbon sequestration, and other outcomes of climate change adaptation and mitigation. The time period for the case studies may vary across sub-regions, depending on the nature of climate variability and change within the past 25 years. For example, if there has been a change in the climate trend during this period in a sub-region (e.g., decreasing rainfall in the 1980s and increasing rainfall subsequently), we will select the most recent period in which a consistent trend has been observed. Within sub-regions, different case study sites will be selected representing different climate conditions and trends (to the extent possible), as well as comparison sites in which climate variability and trends are similar but in which there are differences in land management responses and differences in other factors conditioning these responses, such as different policy environments and differences in access to markets, services or SLM programs. The purpose of this approach is to enable investigation of how such factors affect responses to climate variability and change and the implications for SLM and livelihoods. The approach to selecting the case study sites and the factors that will be investigated are discussed in detail in the methodology section.

Case study sites will be selected in two sub-regions of SSA. These will be selected to represent areas of high climate variability and different major agro-ecological zones, farming systems and vulnerability to climate change. The proposed sub-regions include semi-arid and sub-humid zones of West and East Africa (Table 1). The West African Sudano-Sahelian region and East Africa are priority regions for studying climate change and SLM linkages because they are characterized by high levels of current climate variability and severe levels of land degradation. The risks of climate change differ between these regions. East Africa is strongly influenced by the El Niño Southern Oscillation (ENSO), and most Global Circulation Models (GCMs) predict that the climate in this region will become wetter, with increased risks of erosion and flooding. By contrast, the Sudano-Sahelian climate of West Africa is less predictable both inter-annually and in the long term (Traoré et al., 2007), with some models predicting a wetter climate and some predicting a drier climate. In general, a more variable climate and a decreased growing period for crops (due to increased temperature) are expected. Investigating options for adapting to and mitigating climate change in these different climate environments of West and East Africa will therefore provide an interesting contrast, and will be representative of a wide range of contexts in SSA.

Outputs

The outputs of the project will include

- (i) a TerrAfrica paper on climate change and SLM, which will serve as the conceptual framework for the case studies as well as informing the broader development community about linkages between these issues and making the case for SLM as an essential component of actions to mitigate and adapt to climate change in SSA;
- (ii) a full synthesis report on the case studies, including an executive summary, objectives, methodology, findings and recommendations of the case studies and a comprehensive bibliography;
- (iii) a short report highlighting the objectives, main findings and recommendations of the case studies;
- (iv) individual reports on the case studies in each selected sub-region (one report for East Africa and one for West Africa);
- (v) a CD-ROM including the detailed results of the case studies, including data collected in a GIS format with a user-friendly demonstration;
- (vi) two policy briefs (one for each sub-region) summarizing the main findings and recommendations of the case studies; and
- (vii) communication materials to be disseminated to wider audiences through the media, such as photos and press releases.

These outputs, along with the target audience, content, and dissemination plans are summarized in Table 2.

Target Audience

The target audience for this project includes government policy makers in SSA and development partners involved in promoting SLM in SSA – including the World Bank and other members of the TerrAfrica partnership – and the broader development community concerned about climate change and SLM issues. The aim is to generate context specific knowledge and operational recommendations to improve the effectiveness of policies and investments related to SLM in responding to climate variability and change. As indicated in Table 2, somewhat different audiences are envisioned for different outputs. For example, the specific case study reports will be targeted to officials of the World Bank, local policy makers, and other stakeholders interested in addressing climate change and land management problems in particular countries; while the TerrAfrica paper on climate change and SLM and the policy briefs and media materials will be targeted to the broader research and development community and the broader public concerned about climate change and natural resource management issues more generally.

Methodology

Given the objective of the case studies, it is essential that the case studies selected represent important contexts in SSA in which climate change and variability are having or are expected to have substantial

impacts in the future, where people are vulnerable to the impacts of climate change, and include variations in land management approaches, so that the impacts of such factors on key outcomes can be assessed. Since the aim is not only to assess which land management practices are best suited to adapt to and cope with current climate conditions and to maintain and enhance carbon sequestration while serving food security and development objectives, but also to understand what knowledge, processes and institutional support are needed to promote SLM in the face of climate variability and change, it is important to include variations in knowledge and institutional contexts within the case studies as well as variations in climatic vulnerability contexts. The methodology proposed for site selection takes these considerations into account.

The methodology used for the case studies seeks to assure the construct, internal and external validity of the findings (Cook and Campbell 1979). This means that we need to use indicators of the causal factors we are assessing (climate change and vulnerability, land management policies, institutions, programs and practices), responses (land management practices) and outcomes (environment and development objectives, carbon sequestration) that adequately reflect the underlying concepts they are intended to represent (construct validity). We seek to assure to the extent possible that the factors being assessed are indeed the causes of observed changes in the outcomes; ruling out plausible alternative explanations for correlations between these factors and outcomes (internal validity). We also want to be able to extrapolate our findings beyond specific study sites and households as far as can be confidently done (external validity). We will of course be limited in our ability to assess causal relationships, since this is not an experimental study and will only partially be able to rule out confounding factors and alternative explanations using quasi-experimental design principles and a combination of quantitative and qualitative data collection and analysis methods (discussed further below). Nevertheless, it is important to address these concerns to the extent feasible using the methods discussed, even though these will not provide a perfect solution.

Other objectives of the methodology include being cost effective, building on past and current research and data collection efforts, and including sub-regions and countries that are of high relevance to ongoing or planned activities of the World Bank and that provide opportunities for uptake of concrete guidance to development activities that will result from the studies.

Considering these objectives, we propose the following approach to site selection, information sources and data collection methods, and methods of analysis.

Site Selection

Within the West African and East African sub-regions, countries and sites will be selected to represent important agro-ecological zones and farming systems, prevalent land management practices, policy and institutional environments, and the nature and extent of exposure and vulnerability to climate change found in the broader sub-region. We propose to conduct trans-boundary case studies in southern Niger and northern Nigeria (representing semi-arid Sudano-Sahelian West Africa) and western Kenya and eastern Uganda (representing sub-humid areas in the Lake Victoria basin and highlands of East Africa). By studying sites that are in close proximity on each side of these national boundaries, we can

investigate the effects of different policy and institutional environments on land management responses to climate variability and change. In addition to trans-boundary sites, we also will include case study sites in the Sudanian sub-humid zone of Nigeria and in the semi-arid zones of Kenya and Uganda, ensuring representation of semi-arid and sub-humid climate zones in both West and East Africa. Since exposure to climate change varies between West and East Africa (with precipitation more likely to increase in East Africa), comparisons between similar agro-climatic zones in these two regions may yield important insights about how people respond to different forms of climate change in otherwise similar agro-climatic zones and farming systems.

Within these sub-regions, particular sites and communities will be selected to represent variations in the factors being studied (agro-climatic zones, climate variability and change, land management policies and institutions, and access to markets, infrastructure and land management programs) and in land management responses, to allow comparison of outcomes for sites and communities having differences in these factors and responses. The sites will be political and administrative units at a level where key local policy and management decisions related to land use and management are made according to decentralization policies; i.e., districts in Kenya and Uganda; local government areas (LGAs) in Nigeria; and communes in Niger. Information will be collected for selected sites as a whole, and within each site, a few villages will be selected for more intensive study. In the countries and sub-regions proposed, the case studies will build upon data collected in prior surveys conducted by IFPRI, ICRISAT, ICRAF and other organizations; and secondary data collection efforts led by IFPRI and others in these countries.

Table 3 indicates the site selection approach. In West Africa, four sites (two communes in Niger and two LGAs in Nigeria) are to be selected in the trans-boundary region of the two countries, representing semi-arid agro-pastoral cereal-livestock systems in the Sudano-Sahelian region. One pair of sites will be selected to represent areas having poor access to markets and infrastructure. One of these sites could be selected in southern Zinder or Diffa region in Niger and a nearby one in northern Jigawa, Yobe or Borno state in Nigeria. The second pair of sites will be in the same agro-climatic zone, but will represent areas with relatively favorable access to markets and infrastructure, where greater cash crop production (mainly oilseeds) is found. These sites could be selected in southern Maradi region in Niger and northern Katsina state in Nigeria.

The selection of specific sites in these locations will be based on analysis of secondary data on changes in climate (indicated by monthly rainfall) and vegetative cover (indicated by the normalized difference vegetation index (NDVI)), other relevant secondary data, and on consultations with knowledgeable stakeholders in the sub-region. Using data on monthly rainfall since the early 1980s, available at half-degree or one degree resolution, we will analyze the variation and trends of rainfall in each pixel to identify trends and break points in rainfall trends within particular sub-regions (e.g., agro-climatic zones) of the two countries. If a common timing of changes in trends can be identified within a particular zone (e.g., rainfall trended downward until the early 1990s and then upward afterward throughout the semi-arid zone of the two countries), this will be used to select the starting date in the trend analysis (e.g., at the turning point in the early 1990s). If no common turning points in trends are found, the analysis used for the site selection will be based on climate trends and variability for the entire period since the early 1980s. The analysis will characterize rainfall levels, trends and variability within each pixel using four

indicators: the mean and coefficient of variation of annual rainfall, and the annual time trend coefficient of rainfall and standard error of that trend based on a regression trend analysis (controlling for seasonality in rainfall). To the extent possible, simple overlays of these indicators using the GIS will be used to identify zones of similar rainfall levels, trends and variability (if necessary, cluster analysis can be used to classify similar zones).

A similar type of analysis will be used to identify zones of similar levels, trends and variability of vegetation cover, based on NDVI data. Then, overlaying these NDVI trend zones with the climate trend zones, areas may be identified having similar climate levels, variability and trends but different trends and variability in vegetation cover. To the extent such contrasting cases are found, it would be valuable to select case study sites representing these contrasts and investigate in the case studies the reasons for different land management responses to similar climate exposures. For example, it appears that there has been more “re-greening” of the Sudano-Sahelian zone in some areas of southern Niger than on the Nigerian side of the Niger-Nigeria border (Herrmann, et al. 2005). This secondary data analysis may identify contrasting sites where this appears to be the case, despite similar climate variability and change. If so, investigation of the reasons for such contrasting responses through case studies could be very fruitful.

Even if such interesting contrasts cannot be identified based on the secondary data analysis, this analysis will be useful to identify the representativeness of different potential sites, as an aid in selecting sites that are broadly representative of conditions in the sub-region (external validity). After completion of the secondary analysis, consultations with knowledgeable stakeholders in these countries (e.g., researchers and development practitioners) will be conducted to obtain their feedback and suggestions on priority sites to select, considering such factors as policy and institutional impacts on land management responses and the presence or absence of SLM programs. Review of other available data, such as GIS information already assembled by IFPRI, ICRISAT and ICRAF (Table 4), and the data being assembled in the climate portal under Pillar One of this project, will also be used to assess the suitability and representativity of particular sites.

Two additional sites will be selected in central Nigeria, representing areas with relatively favorable vs. poor market access in cereal and root crops systems in the sub-humid moist savannah zone. These sites could be selected in Niger, Kaduna, Bauchi, Plateau, Gombe, or southern Borno state. If possible, these case study sites will be selected to coincide with at least one of the states and sites where another new World Bank-supported analytical project is conducting cost-benefit analysis of SLM approaches and a review of public expenditures related to SLM in Nigeria (and Mali), enabling synergies between these two projects to be exploited.

Within each site, four villages will be selected for the study, representing differences in SLM program involvement and in access to infrastructure and services.¹ Comparing responses and outcomes over

¹ For Niger, selection of villages can be based on a village level database assembled by ICRISAT for the World Bank/TerrAfrica project “Assessing impact of sustainable land rehabilitation programs on poverty and sustainable land management in Niger” (Pender and Ndjunga 2008).

time of villages having similar agro-climatic, market and program environments between the two countries can provide insights into the impacts of different national policy and institutional environments on adaptation responses to climate change and variability. Comparing villages from the same country having different market environments but similar agro-ecologies and access to programs can provide insights into the impacts of different market environments. And comparisons of villages with different program environments from the same sites having similar agro-ecological, policy, institutional and market environments can provide insights into the impacts of programs of different types. Given this approach, we envision conducting case studies in 6 sites and 24 villages in West Africa.

Using a similar approach, we will also select 6 sites and 24 villages in Kenya and Uganda. We will select trans-boundary sites (districts) for comparison near the Kenya – Uganda border in the Lake Victoria region and in the highlands of western Kenya and eastern Uganda. This will enable comparison of sites having similar agro-ecological and market environments, but different policy and institutional environments, as in West Africa. In addition, we will select sites in semi-arid areas of both countries, which are further from the border (e.g., central Kenya and northern Uganda), to increase the representativeness of sites in this region. One pair of districts will be selected in the trans-boundary region near Lake Victoria (e.g., Busia district in Kenya and Tororo or Busia district in Uganda). These represent mid-altitude areas with sub-humid to humid climate, good access to markets and roads, and where perennial crops are dominant. A second pair of districts will be selected in the highlands (e.g., Bungoma or Kakamega district in Kenya and Kapchorwa, Sironko or Mbale district in Uganda). These represent highland areas with sub-humid to humid climate, varying access to markets and roads, and predominant farming systems including maize, perennial crops and livestock. One additional site will be selected in semi-arid lowland or midland agropastoral areas of each country (e.g., Laikipia, Machakos or Kitui district in Kenya; Soroti, Lira, Apac or Gulu district in Uganda).

Of particular importance for the site selection will be the availability of climate and weather information at higher resolution for the recent past that can be used in the case studies to assess actual climate variability and change and compare that to rural people's perceptions of it. As shown in Map 1, there are many weather stations in southern Niger providing daily weather data since 1975 or before; these locations can be used to help guide the selection of case study sites. Unfortunately, the coverage of daily weather stations in Nigeria is much less dense, but there are stations in suitable areas near the Niger border (e.g., in northern Katsina and Yobe states) and in central Nigeria (e.g., in Kaduna state). However, other meteorological data with less than daily temporal resolution can also be used in the case studies, and these locations are more numerous in Nigeria. Further investigation of the locations and data available from other weather stations will be used in the site selection.

We will also consider the availability of existing primary survey data in the site selection. In West Africa, the proposed case studies can draw upon large community and household surveys recently completed by IFPRI and its partners and baseline surveys that are planned within the next 12 months in Niger and Nigeria. In Nigeria, a survey of 48 Fadama Community Associations and more than 3,700 households in 12 states was conducted in early 2007 in *fadama* (low lying floodplain) areas, including both communities and households participating in the Fadama II project and comparable non-participants. In Niger, a survey of 139 communities and more than 1200 households was conducted in five regions in

early 2007, including communities and households participating in SLM projects and comparable non-participants. In addition, baseline surveys will be conducted for the next phase of the CAP in Niger (CAP-2) and the Fadama project (Fadama III) in Nigeria that can provide useful information for the case studies.

As in West Africa, the case studies can build upon a large amount of research led by IFPRI, ICRAF and others in Kenya and Uganda. IFPRI has assembled a large amount of secondary and primary data in a GIS database for the entire ASARECA region, and has used/is using these to identify development domains, assess agricultural technology options, and recently to assess impacts of climate change and model adaptation and mitigation options. In Uganda, IFPRI and its partners have conducted community and household surveys focusing on SLM issues in 273 communities with more than 1,400 households since 1999, with most of this in the Lake Victoria Basin region. We also have access to and have used several years of the Uganda National Household Survey data, which contains relevant information on more than 500 rural communities and more than 9,000 households (in 2002/03). ICRAF has also partnered on studies of about 1,000 households each in Kenya and Uganda, with a significant share in the greater Lake Victoria Basin. In western Kenya, in addition to several household level data sets, ICRAF has also analyzed land use and tree cover patterns at the meso scale, and has conducted detailed vegetation and soil assessments. A recent PhD student at ICRAF studied perceptions of climate change and variability among different stakeholder groups in western Kenya as well as their responses. Finally, ICRAF has conducted numerous agroforestry trials in western Kenya, including an assessment of carbon sequestration for some land uses.

The availability of these large surveys, as well as the secondary data collected and assembled in a GIS for these countries, will increase the cost effectiveness of the case studies by building upon prior data collection efforts. It will also help to assure the external validity of the case study findings, since particular case study sites can be selected from the larger number of sites in these surveys, and the survey data used to show how representative the selected case study sites and communities are in terms of biophysical and socioeconomic characteristics. We will not restrict the selected sites to only be where previous surveys have been conducted, though other factors equal, sites and villages for which we have relevant prior survey data will be preferred.

Information Sources and Data Collection

The information used in the case studies will be collected from a variety of sources and at different scales, and will include both qualitative and quantitative information. Examples of the types of information to be collected and the sources of information are summarized in Table 5. We will seek information on the nature and perceptions of climate change and variability in the study sites, the vulnerability of people to climate change and variability, adaptive or other types of responses to climate change and variability (emphasizing, but not limited to changes in land use and management), factors affecting these responses in addition to climate change and variability, and impacts of the responses on agricultural production, economic development, poverty, vulnerability, local natural resource and environmental conditions, and carbon sequestration.

Relevant information will be collected from secondary sources where available, such as weather station data, remote sensing information on land use and land cover change, population and agricultural censuses, available community and household survey data, and documents and data from national and local governments and development and natural resource management programs. Primary information will be collected through stakeholder consultations at the national and site level; focus group discussions, key informant interviews, and group surveys at the village level; observations by natural scientists at the village level (e.g., to assess changes in natural vegetation building on remote sensing information and to estimate carbon sequestration); and discussions and surveys at the household level.

Given that the concepts being studied are complex and multi-dimensional (e.g., vulnerability, adaptation, economic development, poverty, local environmental conditions), multiple indicators of these concepts will be used to reflect their multi-dimensional nature (construct validity). For example, adaptation to climate change can include many possible responses, such as diversification of livelihood strategies (e.g., shifts in types of crops or livestock produced, shifts to rural non-farm activities, migration), changes in cropping practices (e.g., changes in planting date or planting densities, crop varieties, etc.), changes in livestock practices (e.g., changes in feeding and animal health practices, transhumance, etc.), changes in land use and land management (e.g., fallowing, tree planting or protection, irrigation and water harvesting, soil and water conservation measures, tillage practices, soil fertility management, etc.), and others (Boko, et al. 2007). In designing interview guidelines and survey questionnaires, we will be able to draw upon recent research on smallholders' adaptation to climate change led by IFPRI and collaborators in the Nile River Basin of Ethiopia and the Limpopo River Basin of South Africa (Ringler 2007).

Information collection will proceed according to the following steps:

1. **Initial analysis of available secondary information.** Available secondary information on each selected site will be assembled at the outset of the project in a GIS and used to characterize the sub-regions and sites with regard to the nature of climate change and climate variability in the sites, vulnerability to climate change, adaptation responses to climate change and variability (with particular emphasis on changes in land use and land management), and the factors affecting vulnerability and adaptation (such as the level of poverty, population pressure, and access to markets, infrastructure and services). This will help to identify hot spots and bright spots of land use and land management change from which studies can draw useful operational recommendations. Analysis of available remote sensing images (satellite or aerial photos) will be used in the analysis of land use changes in the selected sites. Beyond being used for site selection and assessing climate change and adaptation in particular sites, GIS analysis will also be used to identify other areas in SSA with similar agro-ecological and socioeconomic characteristics and similar exposure and vulnerability to climate change to the case study sites. This will facilitate extrapolation of the findings of the case studies to similar domains elsewhere (external validity).
2. **Consultations with key experts and stakeholders** in each of the selected sub-regions and sites to i) present and discuss the results of the initial secondary data analysis; ii) discuss the key responses to climate variability and change that appear to be occurring and the factors affecting them, in order to identify key issues to focus on in the case studies; iii) identify additional knowledge and sources of information about the nature of climate change and variability,

vulnerability and responses to it; land management policies, institutions and programs affecting land management responses, and other key factors affecting responses and outcomes; iv) discuss selection of the study sites and villages; and v) obtain feedback concerning the objectives and methodology of the case studies.

3. **Collection of additional information for the selected sites as a whole.** Based on the consultations, additional sources of information will be identified and consulted, and relevant data assembled for the selected sites. Examples of types of information that will be collected include stakeholder perceptions of changes in climate occurring in the site and communities' and households' responses to it; information about SLM programs that have operated in the site over time, implementation of land policies and land use regulations in the site, locally initiated changes in land use and management and the reasons for it, and other important changes occurring in the site that could be affecting changes in land management or other livelihood changes (e.g., infrastructure development, insecurity, migration, etc.). Both secondary sources of information (data bases and documents) and primary information collection methods (consultations with experts and key informants) will be used.
4. **Collection of information at the village level in selected villages.** In the selected villages, focus group discussions (including discussions involving community resource mapping), key informant interviews and survey questionnaires will be used to collect information on community members' perceptions of past climate change and variability and expectations for the future, people's vulnerability to it, responses that people have made or expect to make in the future (including changes in land use and management as well as other responses), other factors affecting responses, and impacts of the responses. In addition to community members' perceptions, natural scientists will be involved in assessing changes in key natural resource conditions, such as in vegetative cover and tree density, drawing upon remote sensing information, community perceptions and field measurements and assessments. Based on these assessments, estimates of the impacts of land use and land management on carbon sequestration will be made.
5. **Collection of household level information in the selected villages.** Within each SLM program-affected village, a household survey will be conducted with ten households who have participated in such programs and ten non-program households. In non-program villages, ten households will be selected. Households from each of these groups will be randomly selected for the survey. As at the village level, the household survey will obtain information on household members' perceptions and expectations regarding climate change and variability, their vulnerability and responses to it, and the impacts of their responses. Detailed information will be collected on the household's vulnerability characteristics (e.g., endowments of physical, natural, human, social and financial capital, and access to information, infrastructure, markets and services) and how these are affected by climate change and variability; on household level coping and adapting strategies; on other factors affecting their responses; and on the impacts of responses on the household's agricultural production, income and other outcomes.
6. **Sharing and obtaining feedback of findings from stakeholders in study villages, sites and countries,** to correct errors, improve interpretations and obtain additional insights. After initial analysis of the information collected, consultations will be conducted in each of the study villages, and at the site and sub-regional level (including formal workshops in Western Africa and in Eastern Africa). Information and insights obtained from these consultations and workshops will be incorporated into the final outputs from the case studies. Operational recommendations will be based on inputs from stakeholders in these workshops as well as on the analysis.

Analysis of Information

The analysis will focus specifically on identifying what land management practices are best suited to address vulnerability, adaptation to and mitigation of climate change and variability in particular contexts, including consideration of synergies between land and water management, and what actions (information, institutions and instruments) are needed in those contexts to promote uptake of such SLM practices.

Multiple methods of analysis and interpretation of the information collected will be used, with the objective being to obtain a coherent understanding of what has happened in recent history and what may happen in the future (in terms of climate change, responses to it and impacts of the changes and responses) in each study site and village and why, using triangulation of different sources of information and methods of analysis. For example, remote sensing information on land use changes will be interpreted based on consultations with local people and field observations. Secondary data and perceptions on vulnerability, responses, and impacts will be validated through assessment of changes measured through remote sensing, community and household surveys and field observations. Statistical analysis of the survey data will be used to test hypotheses about the causes of responses and impacts that are suggested by stakeholders, helping to rule out other possible causal explanations (internal validity). Stakeholder feedback on the initial analytical results will be used to check the validity of the results and deepen understanding about why and how observed changes (or non-changes) occurred (also contributing to internal validity).

Using GIS analysis of the data collected, the patterns of climate change and vulnerability and the pathways of responses and outcomes observed in the study sites will be synthesized into a typology of common patterns and pathways, linked to their key driving and inhibiting factors, giving particular emphasis to the impacts of land management policies, institutions and programs on these pathways. The resulting typology will be used to help scale up the knowledge gained in the study sites, providing the basis for comparing the patterns and pathways observed in these sites to findings of studies conducted in other locations in the same countries and regions of SSA, as well as in similar situations in other regions (external validity).

Identifying Operational Recommendations

Operational recommendations will be derived from these analyses, in consultation with stakeholders at the village and site level and in the sub-regional workshops. Recommendations will focus on “what”, “who”, “how”, “when” and “where”: what needs to be done to promote SLM in a way that facilitates adaptation to and mitigation of climate variability and change; who should be responsible for which actions; how and when these recommendations should be implemented, considering the need for appropriate sequencing of actions within a continuous learning cycle; and where the recommendations apply, recognizing that no “one-size-fits-all” strategy is likely to be successful.

Identification of what needs to be done where can be based largely (but not solely) on analysis of the information collected in the case studies, combined with review of the broader literature and program experience on SLM and climate change adaptation and mitigation, and consultations with key

stakeholders in the study countries. These recommendations will be focused at the technical level (i.e., what land management practices are most suited to adapting to or mitigating climate variability and change in particular contexts) as well as the policy, institutional and program level (e.g., what policy or institutional changes or program approaches are needed and likely to be most effective in facilitating SLM that adapts to and/or mitigates climate variability and change).

Identification of appropriate technical options for different contexts will be based on quantitative and qualitative assessments of the impacts of different practices on agricultural productivity, profitability, risks, income level and diversification, carbon sequestration, and other outcomes in different case study contexts; on the biophysical and socioeconomic requirements of different land management options and how these fit with local resource endowments and communities' and households' capacities in particular contexts; and on households' and other stakeholders' perceptions of potential future changes in climate variability and trends and the needs, opportunities and constraints to address these changes through changes in land management or other responses. Identification of appropriate policy, institutional, and program options will build upon the technical options that are found to be suitable; i.e., they will identify key policy, institutional and program requirements to facilitate adoption and effective implementation of appropriate technical options. For example, if planting and protecting trees is a suitable technical option in a particular context, then policy and institutional measures that support this – such as improving local management authority and security of tenure over land and trees in communal lands – as well as program options such as programs that promote investments in tree nurseries and provide financial and technical assistance in managing these investments, may be recommended. Operational recommendations on such policy, institutional and program options will be based on consultations with key policy makers, program officials, representatives of civil society and others involved in designing and implementing these options, as well as upon the results of the case study analysis.

Identifying recommendations on who, how and when to implement recommended actions will also depend very much on consultations with key stakeholders, as well as review of literature and policy documents. It will be necessary to understand who the key actors are; what are their roles and responsibilities (formal and informal), incentives, capabilities and constraints; and what are the politically feasible and socially acceptable entry points for pursuing the needed actions. This type of institutional and political economy analysis is envisioned as part of the case study analysis at the village and site level, and will be augmented by consultations with stakeholders at the national and sub-regional levels through the workshops to be held after the initial fieldwork. Our research team will collaborate with the team leading the SDV project on “area-based development and community-driven climate adaptation” in defining the methods to use and questions to address in this institutional and political economy analysis, since that team will be conducting similar types of analysis. We will also draw upon the substantial experience with this type of analysis among other researchers at IFPRI (e.g., in IFPRI's development strategy governance division).

In addition to the case studies, a TerrAfrica paper on climate change and SLM will be prepared during the first three months of the project, which will serve as theoretical support to the case studies. The paper will explain the conceptual linkages between climate change and land management by i) describing linkages between land degradation, depletion of natural resources, vulnerability to climate variability and change, and greenhouse gas emissions; and ii) highlighting the important contribution of sustainable land management policies and practices to climate change mitigation and adaptation. A draft outline of this paper is included in the Annex. It is envisioned that the paper will be endorsed by TerrAfrica partners as a key information and outreach document. The concepts and technical issues pertaining to land management, climate mitigation and adaptation will reflect current scientific thinking and be adequately communicated to a general audience.

The TerrAfrica paper will build upon the "Land Management and Climate Change" issues paper that has already been developed in the TerrAfrica context. The content of that paper will be refined by i) providing inputs and filling data gaps, ii) refining the logical flow and strengthening the analysis if needed, iii) refining and expanding the executive summary, and iv) expanding the references section. The paper will be written in collaboration with a Science Advisory Group (SAG) including representatives of TerrAfrica partner organizations including the World Bank, FAO, the Global Mechanism of the UNCCD, IFAD, NEPAD, the Norwegian Ministry of Foreign Affairs, Ecoagriculture Partners and government representatives of selected African countries (Chad and Lesotho). The SAG will review and comment on the outline and drafts of the paper, and provide background materials for the paper.

In addition to the issues already addressed in the "Land Management and Climate Change" issues paper, the TerrAfrica paper will draw upon additional literature and data to explore the implications of several issues for sustainable land management, including reduced availability of freshwater in much of sub-Saharan Africa (SSA); exacerbation of droughts and increased climate variability; impacts of climate change on soil fertility, livestock productivity and production costs, and displacement of rural populations; and emissions from land use and land use change. The paper will take into account current work being led by FAO assessing SLM potential for climate change mitigation and adaptation and developing guidelines for SLM best bet technologies and approaches for SSA.

After completion of the case studies, a short chapter summarizing the main findings and implications will be added to the TerrAfrica paper, and the messages of the TerrAfrica paper revised as necessary. The TerrAfrica paper will be reviewed, revised, finalized and disseminated after the case study findings are incorporated.

Dissemination of Results

Dissemination of all results will be done within the context of the TerrAfrica work program and integrated with dissemination activities under Pillars One and Three of this ESW, and with other related activities, such as the SDV project on area-based development and climate change adaptation, which will be working during the same time frame in Niger (among other study countries for that project). The Climate Change Portal developed under Pillar One will be used to disseminate the study results, background materials and data. Outputs of this project will be fed into the dissemination activities of

Pillar Three of the ESW. We will conduct the sub-regional workshops and associated media outreach activities in collaboration with the Pillar Three team. In addition, a joint workshop and dissemination activities will be pursued in Niger with the team leading the SDV project on area-based development and climate change adaptation.

Initial dissemination of results of the case studies will begin with stakeholder consultations and workshops held in the study regions which will provide valuable feedback and inputs into the analysis before the results are finalized. The results of the case studies will be published in a pair of reports – one for each study sub-region – and a synthesis report for all regions (provided in paper form and on CD). Policy briefs and materials for the media (e.g., press releases, photos, etc.) will be prepared and widely disseminated. The joint TerrAfrica paper on climate change and SLM will also be widely disseminated. All materials will be made available on the websites of TerrAfrica, IFPRI, the World Bank, and study collaborators, and through CD-ROMs distributed to the World Bank, local authorities of the selected study sites and other stakeholders interested in the findings. Peer-reviewed publications based on these studies will be completed and disseminated as well.

Activities and Work Plan

The activities, work plan and deliverables of the project are summarized in Table 6. A first draft of the TerrAfrica paper on climate change and SLM will be completed by the end of February, 2009, with advice and materials provided by the SAG for that paper. The paper will be revised and finalized by the end of March, subject to a final review by the SAG, and then validated by the TerrAfrica Executive Committee. After approval by those committees, the initial version of the paper will be printed and disseminated. The paper will later be revised to incorporate lessons from the case studies, finalized (with another review by the SAG), printed and disseminated (by December 2009).

The methodology for the case studies will be reviewed by the Advisory Committee (AC) for the project, revised if necessary and finalized during January 2009. The site selection for the case studies will be completed by March, 2009, with a preliminary selection based on analysis of secondary data completed by February, and then the selection finalized based on consultations with stakeholders in the sub-regions during March. Further consultations and analysis of available secondary data within each selected site will be used to select the study villages within each site by April.

Collection of secondary and primary information at the site and village levels will begin soon after the sites and villages have been selected, beginning in March and completed by the end of May. Based on analysis of that information, preliminary reports on the site and village level analysis (one each for the West African and East African sub-regions) will be completed by the end of June. After review of these reports by the AC, they will be revised during July and August (to be combined later with results of the household survey analysis in the full case study reports).

Implementation of the household surveys in each country will begin at the same time that the village level work is ongoing, beginning by May and completed by July. The data collected in these surveys will

be entered into a database and cleaned by the end of August. Analysis of these data will be used to prepare reports on household level land management responses to climate variability and change and their impacts (one each for West and East African sub-regions), which will be completed prior to the stakeholder workshops in October.

The stakeholder workshops will review and discuss the findings of these analyses and identify recommendations based on working group deliberations during the workshops. Media outreach activities such as press briefings on key findings and implications of the case studies by members of the project team and key stakeholders will be conducted in conjunction with the workshops. The involvement of the Pillar Three team on dissemination activities in the organization of the workshops and the media outreach activities will be sought.

Based on feedback received from the stakeholder workshops, the results of analyses of the site, village and household level information will be compiled into full case study reports (one each for West and East Africa sub-regions), to be completed by November. These will be reviewed by the AC and then revised, finalized and disseminated in December. Short policy briefs on the findings (one for each sub-region) will also be prepared, reviewed, finalized and disseminated as soon as possible after the case study reports are finalized.

The findings of the case studies from the two sub-regions will be synthesized into long and short versions of the final report by December. Following review of these by the AC, the final report will be finalized and disseminated.

Table 1. Characteristics of proposed sub-regions of study

Sub-region	Example countries and regions	Agro-ecology	Dominant farming systems	Exposure to climate change (Boko, et al. 2007)	Vulnerability to climate change (Boko, et al. 2007)
West Africa	Southern Niger, northern and central Nigeria	Lowland semi-arid and sub-humid	Agro-pastoral, mixed cereals/root crops	Increasing temperatures, mixed mean rainfall impacts (increased in some areas, reduced in others), increased risks of drought and flooding	Very high due to high exposure and extreme poverty, low institutional and infrastructure development
East Africa	Western and central Kenya, eastern and northern Uganda	Mid to highland semi-arid and sub-humid	Maize mixed crops, highland perennial, root crops, agropastoral	Increasing mean temperatures and precipitation, increased risks of flooding and drought	High due to high exposure and poverty, low institutional and infrastructure development

Table 2. Project Outputs

<i>Type of output</i>	<i>Audience</i>	<i>Content</i>	<i>Dissemination</i>
TerrAfrica paper on climate change and land management	Broad audience, media	Cf. Sector Note on climate change and land management	Pdf designed document available and 500 hard copies printed
Full synthesis report on case studies	World Bank, local and national authorities linked to the selected sites, and broader audience	Executive summary, objectives, methodology, main findings, generic recommendations ² , comprehensive bibliography	Pdf document available on TerrAfrica website and Knowledge Base + CD-Rom
Short synthesis report	World Bank	Main objectives, findings, recommendations	This will be inserted in the ESW ³ report as the summary of Pillar II (approx. 25 pages)
Two case study reports (one for each case study region)	World Bank, local authorities of the sites selected, other stakeholders interested in the findings	Specific objectives of the case study, customized methodology, detailed findings, specific recommendations	Hard copies disseminated via a final workshop (100 hard copies of each), and electronic version available on TerrAfrica website and Knowledge Base + CD-Rom
CD-Rom of each case study including all data grouped in a GIS with a user-friendly demonstration	World Bank, local authorities of the sites selected, other stakeholders interested in the findings	Specific objectives of the case study, customized methodology, detailed findings, specific recommendations	100 CD-ROM copies
Policy brief for each case study region (4 pager)	Broad audience	Main objectives, main findings and main recommendations	500 hard copies of each, disseminated on demand + electronic version on TerrAfrica website and Knowledge Base
Communication media (photos, press releases, etc.)	Broad audience, media	n/a	Press, launching/final workshops, TerrAfrica website

² The report will highlight overall lessons and recommendations to help spread out the findings to other sub-regions. These recommendations, along with the spatially-customized strategies, will inform both World Bank future projects and local institutions and policies. The TFESSD Project led by SDV will complement the analysis on the role of local institutions to better ensure adaptive policies.

³ Economic and Sector Work

Table 3. Approach to selecting case study sites

Country	Sub-region	Agro-ecology	Access to markets, infrastructure	Farming system	Site (commune, LGA, or district)
Niger	Southern Zinder or Diffa region	Semi-arid	Poor	Cereals/livestock	A
Nigeria	Northern Jigawa, Yobe, or Borno state	Semi-arid	Poor	Cereals/Livestock	B
Niger	Southern Maradi region	Semi-arid	Good	Cereals/oilseeds/Livestock	C
Nigeria	Northern Katsina state	Semi-arid	Good	Cereals/oilseeds/Livestock	D
Nigeria	Central Nigeria (e.g., Niger, Kaduna, Bauchi, Plateau, Gombe, or southern Borno)	Sub-humid	Good	Cereals/root crops	E
			Poor	Cereals/root crops	F
Kenya	Western Lake Victoria region (e.g. Busia district in Kenya)	Sub-humid/humid	Good	Perennnial crops	G
Uganda	Eastern Lake Victoria region (e.g., Tororo or Busia district)	Sub-humid/humid	Good	Perennial crops	H
Kenya	Western highlands (e.g., Bungoma or Kakamega district)	Sub-humid/Humid	Medium to good	Maize/perennial crops/livestock	I
Uganda	Eastern highlands (e.g., Kapchorwa, Sironko or Mbale district)	Sub-humid/humid	Poor to good	Maize/perennial crops/livestock	J
Kenya	Central or southern lowlands (e.g., Laikipia, Machakos or Kitui district)	Semi-arid	Poor to good	Cereals/livestock	K
Uganda	Northern lowlands (Soroti, Lira, Apac, or Gulu district)	Semi-arid	Poor to good	Cereals/livestock	L

Table 4. Inventory of Spatial Datasets of Relevance to Assessing CC-SLM-Vulnerability in SSA

Group	Theme Variable/Indicator	Time Period/ Time Step	Resolution/ Extent	Data Source	Description/ Notes	URL/ Contact
Terrain	DEM	2000	90m Global	CSI/USGS	SRTM 30m tiled and with data holes corrected	CGIAR/CSI
Hydrology	Hydrosheds	(as SRTM)	1km Global	CIAT/CGIAR	Modelled and calibrated hydrological properties	CGIAR/CSI
	Runoff	1965-95 Monthly	0.5 degree Global	IFPRI- IMPACT/Water	Pixel specific RO (mm) from generic crop areas	Tingju Zhu
Climate	Rainfall, Temp, PE	1900-2005 Monthly	60km Global	CRU TS 2.1	East Anglia monthly	CGIAR/CSI
	Rainfall, temp,	1965-1995(?) Monthly means	1km Global	Downscaled from CRU (elev. covariate)	WORLDCLIM	Robert Hijmans
	CC scenarios	??	1-2 degree Global	(1) Downscaled individual SRES (2) SRES ensembles	(1) WORLDCLIM (2) IFPRI-IMPACT	Robert Cai/Tingju
	Station rainfall	Varies by station / daily	Point level / West Africa	Agrhymet on behalf of West African NHWS, NCDC	Daily records from about 700 stations for West Africa – incomplete series for East Africa (GSOD)	ICRISAT
Land Cover / vegetation	Cropland extent and intensity	1993-4 2000	1km Global	IFPRI Ver 2 GLC2000 & MODIS	A number of products with different ability to capture cropland cover	
	Pasture/grazing extent and intensity	1993-94	10km Global	SAGE	Pastor product from Ramankutty & Foley	
	Vegetation / biosphere dynamics	1981-2006 / bi-weekly	0.07deg / global	GLCF, UMD, UCL, others (public domain)	GIMMS, Spot Vegetation For trends and variability analyses (as in Herrmann et al., 2005)	GLCF/UMD website, others
	Landscape to district level cropland extent	1970s, 1980s, 1990s, Y2Ks / ~every 10 yrs	15 to 30m / 100+ km	USGS, GLFC, others (public domain)	Historical Landsat MSS, TM, ETM+, Terra ASTER granules	GLCF/UMD website, others
	Community level biomass estimation	1960s, 2000s / ~40 years apart	1 to 4 m / 8+ km (selected sites only)	USGS, Digital Globe, others (subject to approval)	Scanned Corona cliches, QuickBird subscenes	ICRISAT
Soils	Soil mapping units Top soil and sub soil attributes	1960s-1990s Composite	1:500K- 1:5M Africa	IIASA/FAO/ISRIC/JRC	Harmonized World Soil Database (pre-release)	IFPRI (beta) FAO
	Soil profile descriptions	1960s-1990s Composite	Points Global	ISRIC (compilation)	WISE 1.1 Soil Profile Database (~3000 profiles)	IFPRI (v1.1)
Population	Human settlement location and extents.	2000? 1km(?)	Global	GRUMP (CIESIN, WB, IFPRI,		CIESIN web site

Theme		Time Period/ Time Step	Resolution/ Extent	Data Source	Description/ Notes	URL/ Contact
Group	Variable/Indicator					
	Rural pop density and head counts Urban pop density and head counts			CIAT)		
Administrative	Admin boundaries	Variable	Variable / global	Compilation	GADM v0.9	U. Berkeley website
Crop production	Area, Yield Production	Calibrated to 2000	10km Global & SSA versions	IFPRI SPAM	For 20 crops. Crops aligned with IMPACT model crop groupings	IFPRI
	Area, Yield Production	1985-1998 / yearly	Admin3 level / CILSS	Ap3a / Agrhymet	17 crops	ICRISAT
Productivity response	Changes in yield, biomass, soil C, N and water use	Past (validation) & projected (e.g. with CC)	10km – 60km SSA	IFPRI HarvestChoice	CGIAR Crop modeling group is modeling location and crop specific responses to potential changes in management, technology & env.	IFPRI HarvestChoice
Market access	Distance, time and cost of travel from specified target/source locations (e.g. towns, ports, airports) to every other location	Indeterminate, many layers – e.g. human settlement and road network are composites over time	1km-10km Global and SSA versions	Andy Nelson (time) IFPRI	Maps and tables computed for time of travel to human settlements of 20k, 50k, 200k, 250k, 500k and summarized by population and cropland area with 1,2,4,6,8,10 hours of travel.	IFPRI (heavy reliance on Andy's work as input)
Input cost and profitability	Combines crop yield response to N with computed farmgate prices of fertilizer	Daily crop growth simulation, X years (99-01)	ASARECA region (10 countries)	IFPRI Jawoo Koo	This analysis can be extended to a range of potential interventions	IFPRI (prototype) East Africa

Source: Stan Wood, IFPRI and Pierre Traoré, ICRISAT.

Table 5. Information collection in the case studies

Information to collect	Sources of information	Level to collect info
<i>Climate change and variability</i>	Interpolated climate data, local weather station data	National, site
	Local people's perceptions of past changes, expectations of future changes	Site, village, household
<i>Vulnerability to climate change and variability</i>	Secondary data on poverty, infrastructural development, livelihoods	National, site
	Primary data on poverty, infrastructural development, livelihoods	Village, household
	Local perceptions of vulnerability	Site, village, household
<i>Responses to climate change and variability</i>		
- Land use changes	Remote sensing data (satellite, aerial photos), photographic records, other historical records	Site, village
	Local perceptions of past changes and reasons, expectations of future ones	Site, village, household
	Actual changes in recent past	Village, household
- Changes in land management practices, cropping practices, livestock practices, livelihood strategies	Local perceptions of past changes and reasons, expectations of future ones	Site, village, household
- Changes in cropping practices (planting dates, variety selection, etc.)	Actual changes in recent past	Village, household
<i>Factors affecting responses (besides climate change)</i>		
- Land policies and regulations, land tenure institutions	Laws and regulations, other official documents, local leaders' views on implementation	National, site, village
- Development and natural resource management programs	Program documents, consultations with program officials, local leaders' views on implementation	National, program, site, village
- Demographic changes	Secondary data, local perceptions	National, site, village
- Development of markets and infrastructure	Secondary data, local perceptions	National, site, village
- Shocks, other than climate-related (conflicts, diseases, large	Secondary data, local perceptions	National, site,

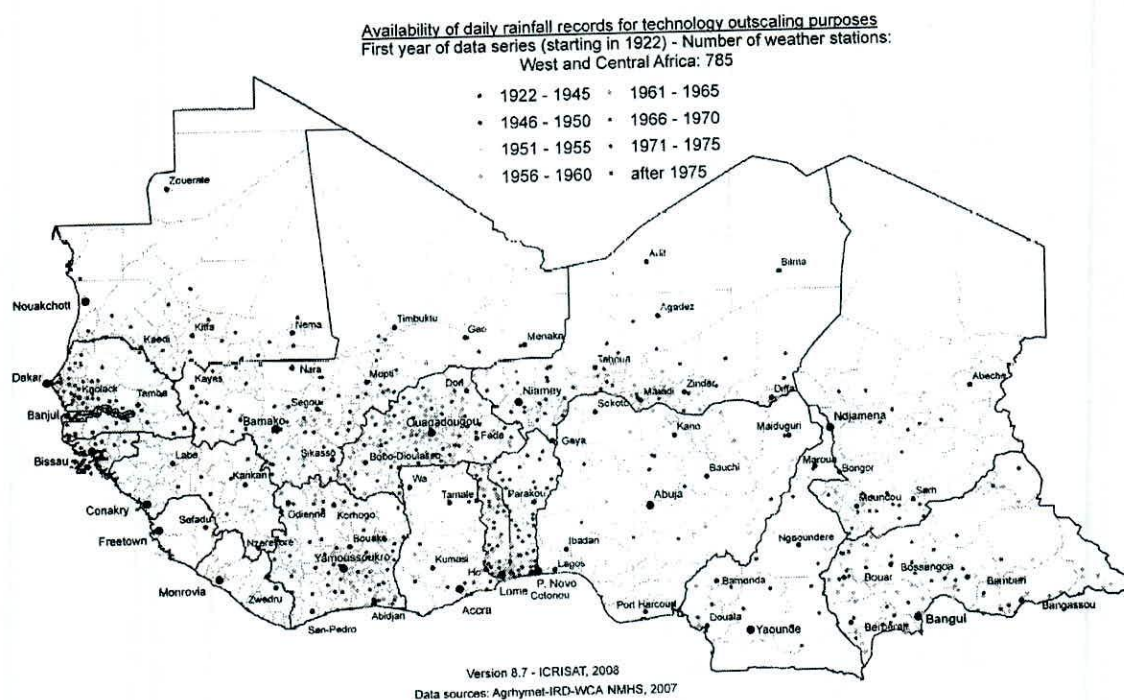
Information to collect	Sources of information	Level to collect info
changes in prices of inputs or outputs, etc.)		village
<i>Impacts of responses</i>		
- Impacts on economic development, poverty and vulnerability (e.g., assets, income, access to infrastructure and services)	Secondary data, primary data (village and household surveys), local perceptions	Site, village, household
- Impacts on local natural resource and environmental conditions (e.g., land degradation, water availability and quality, natural vegetation, plant and animal biodiversity)	Secondary data, primary data (village and household surveys, assessments by natural scientists), local perceptions	Site, village, household
- Impacts on carbon sequestration	Predicted impacts based on observations of land use changes, changes in vegetation	Site, village, household

Table 6. Activities, work plan and deliverables

Component	Activity	Month of 2009												Deliverable
		1	2	3	4	5	6	7	8	9	10	11	12	
TerrAfrica paper on climate change and SLM	Circulate and discuss outline with Scientific Advisory Group (SAG), revise and finalize outline													Outline of paper
	Obtain materials from SAG members for paper													
	Complete and circulate draft paper for comment from SAG													Draft paper
	Revise and finalize paper after further review by SAG and validation of TerrAfrica Executive Committee													Final paper (initial version)
	Print and disseminate paper (initial version)													Paper disseminated
	Revise and finalize paper incorporating lessons from case studies, with review/input of SAG													Final paper (final version)
	Print and disseminate paper (final version)													Paper disseminated
Case studies	Circulate and discuss inception report with Advisory Committee (AC), revise and finalize methodology													Inception report
	Compile available information in a GIS for site characterization and selection													GIS database
	Preliminary selection of case study sites based on analysis of secondary data													
	Finalize site selection based on stakeholder consultations in study countries													
	Select study villages in each site based on consultations and analysis of available data													Reports on site and village selection (1 each for W & E Africa)
	Collect information at site and village levels													
	Initial analysis of site and village level information													Reports on site and village analysis (1 each for W & E Africa)
	Review of site and village level reports by AC, revise reports													Revised site/village analysis reports
	Design, pretest and conduct household surveys													Survey questionnaires
	Enter and clean data from household surveys													Survey database
	Analyze household survey and write reports													Draft reports on household survey
	Conduct sub-regional workshops to present and discuss findings, identify recommendations													Workshops completed

Component	Activity	Month of 2009												Deliverable
		1	2	3	4	5	6	7	8	9	10	11	12	
Case studies (continued)	Conduct media outreach work in conjunction with sub-regional workshops													Media kits released, media events
	Prepare draft case study reports and databases (one each for West and East Africa)													Case study reports and databases (1 each for W&E Africa)
	Revise, finalize and disseminate case study reports based on AC feedback													Case study reports and databases disseminated on CD-ROM
	Prepare draft long and short synthesis reports													
	Revise, finalize and disseminate long and short synthesis reports based on AC feedback													Synthesis reports disseminated on CD-ROM and websites
	Prepare and disseminate policy briefs (one each for West and East Africa)													Policy briefs disseminated on CD-ROM and websites

Map 1. Locations of meteorological stations (daily rainfall) in West and Central Africa



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Annex. TerrAfrica Paper on Climate Change and Sustainable Land Management in Sub-Saharan Africa

Draft Outline (1/7/09)

1. Land degradation, its causes and impacts in SSA
 - a. Nature and extent of land degradation in SSA – in addition to earlier studies already cited in the draft issues paper, cite findings of more recent studies (e.g., Millennium Ecosystem Assessment (MEA); GLADA – Bai, et al; CGIAR - Vlek, et al.: TerrAfrica Vision paper)
 - b. Economic, ecological and social impacts of land degradation, including the direct and indirect impacts of degradation on carbon sequestration, greenhouse gas emissions, and hence on climate change (indirect impacts include continued deforestation, for example) and impacts of degradation on the vulnerability of ecosystems services, agricultural production and rural livelihoods to climate variability and change (and other threats), and on people's ability to adapt to these – these arguments should be supported by evidence from the literature as much as possible
 - c. Drivers and conditioning factors of land degradation in SSA - including climate variability and change – citing specific evidence from the literature to the extent possible. This discussion can draw upon the DPSIR framework as in the draft issues paper, the framework of the MEA, or a combination of the two (as proposed by Niemeijer)
 - d. Summary – this section will have demonstrated the importance of addressing land degradation in its own right as an issue related to poverty and vulnerability, and illustrated some important linkages of land degradation to climate variability and change (which will be taken up in more detail in the third section, after discussing the issue of climate variability and change in SSA).
2. Climate variability and change in SSA, and impacts on land resources
 - a. Climate variability and change in different sub-regions of SSA in the recent past, and implications for livelihoods and land management
 - b. Projected future climate variability and change in different sub-regions in the next century, and likely implications for livelihoods and land management (this will use some modeling results of climate change on agriculture, including some at large scale and some more concrete examples at meso scale (based on historical data and on modeling by ICRISAT, CIAT, IRRI, CIMMYT, etc.- see on-going work under the TerrAfrica work program on "Managing Land in a Changing Climate")
 - c. Summary – this section will build on the first section, by arguing that the problems caused by land degradation are likely to become worse in the face of increasing climate variability and change; it will also highlight where and how different priorities and new opportunities for more sustainable land management may arise in the context of climate change
3. The case for SLM to address land degradation and climate variability and change - we want to make the case as strongly as possible that sustainable land management is essential to improve the ability to mitigate and adapt to climate change in SSA. This point is made in the draft issues paper, but needs to be strengthened by conceptual arguments and more evidence where possible.

- a. Synthesis of linkages between land degradation and climate variability/change (tentative points to make, based on evidence, examples):
 - i. Climate variability and change can contribute to land degradation by making current land use and management practices less sustainable (e.g., increased extreme rainfall events causing increased erosion and flooding in cultivated sloping lands; prolonged drought periods causing depletion of vegetation and soil in cultivated lands and rangelands), or by causing changes in land use and management that are unsustainable (e.g., increased deforestation and new cultivation or grazing in fragile soils as a result of climate changes).
 - ii. However, degradation is not an inevitable result of climate variability and change – for example, many of the predicted rainfall and length of growing season decreases will not be new to communities although they will increase in prevalence – their impact much depends on the capacity of households and communities to mitigate and adapt to such changes, and on whether policies financing and institutions facilitate mitigation and adaptation
 - iii. Climate change also may offer new opportunities for improved land management and livelihoods (e.g., as a result of increased rainfall or temperature in some areas, such as in highland areas of East Africa; carbon payments for improved land use and management); but the ability to exploit such opportunities also depends on people's adaptive capacities and whether policies and institutions are supportive of this
 - iv. Land degradation increases vulnerability of people to climate variability and change, by restricting the range of viable rural enterprises, reducing average agricultural productivity and incomes, increasing production vulnerability (e.g., by reducing soil water holding capacity and organic matter content), reducing local resource asset levels (broadly defined), thus undermining people's ability to adapt to climate change (e.g., reduced ability to collect forest products or produce livestock in response to shortfalls in crop production due to climate variation)
 - v. Conversely, sustainable land management can reduce vulnerability to climate change and increase people's ability to adapt – specific SLM practices will be cited as evidence (drawing from the table in the annex of the draft issues paper)
 - vi. Sustainable land management also contributes to mitigating climate change by sequestering carbon in vegetation and the soil, both on and off farm (e.g. by reducing pressure for land conversion)
 - b. Implications of these linkages:
 - i. SLM is an essential component of efforts to mitigate and adapt to climate variability and change in SLM
 - ii. Achieving SLM in a way that mitigates the negative impacts of climate variability and change while exploiting new opportunities that arise depends on improving the adaptive capacity of households and communities, and ensuring a supportive policy and institutional environment for such adaptation.
4. Policies, approaches and institutions to support adaptation and mitigation of climate variability and change through SLM – discussion of approaches with examples, considering both the state of current capacities and examples of improved approaches

- a. Developing adaptive capacity and exploiting new opportunities for mitigation
 - i. Research and extension on context-suitable SLM options to adapt to climate change and/or opportunities for carbon finance/other PES approaches
 - ii. Development of knowledge management and early warning systems – improving knowledge on SLM and integrating climate change into SLM decision-making processes at national and local levels
 - iii. Investments in infrastructure, education, market development – enabling diversification of livelihoods, investments in new mitigation opportunities
 - iv. Potential for payments for activities in smallholder agricultural landscapes in global carbon markets
 - b. Ensuring a supportive policy and institutional environment for adaptation and mitigation
 - i. Adopting and implementing a policy framework for addressing climate change and SLM, integrated with broader poverty reduction and rural development strategies, with real political and financial support
 - ii. Improving the capacity of governments to assess benefits of SLM investment options under climate change
 - iii. Addressing land policy and tenure issues (including rights and duties with respect to carbon benefits) with a flexible approach that facilitates adaptation, recognizing and building on customary property rights and norms, preserving transhumance rights of pastoralists, etc.
 - iv. Decentralizing authority over management of natural resources to the lowest political levels consistent with the needs to address problems of externalities (e.g., upstream – downstream impacts), assure adequate enforcement capacity and representation of the interests of less powerful groups
 - v. Increasing access to financing for SLM initiatives; e.g., through community driven development planning processes and CDM financing
 - vi. Strengthening capacity of government institutions and other organizations to perform essential roles in implementing the above actions; such as strengthening capacities of local governments, land commissions, extension services, and community based organizations involved in SLM activities
 - c. Promoting best bet technologies and approaches
5. Proposed priorities and actions – based on the discussion in section 4, including role of TerrAfrica