

AfricaInteract: Enabling research-to-policy dialogue for adaptation to climate change in Africa

Synthesis of Findings and Assessment of Gaps in Research and Policy: *Urban Areas, Agriculture and Health*

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About *AfricaInteract*

AfricaInteract (<http://africainteract.coraf.org/en/>) is a platform enabling research-to-policy dialogue for adaptation to climate change among a broad range of African stakeholders in sub-Saharan Africa. These include civil society, researchers, policy-makers, donors, and the private sector working on adaptation to climate change in the agriculture and health sectors as well as urban areas with water and gender as cross cutting issues. The overall objective of *AfricaInteract* is to develop a platform for the effective and efficient transfer of information to policy makers, with the ultimate aim of enhancing the resilience of vulnerable populations.

AfricaInteract is funded by the International Development Research Centre (IDRC) and coordinated by the West and Central African Council for Agricultural Research and Development (CORAF/WECARD) under the auspices of the Forum for Agricultural Research in Africa (FARA). The regional focus of *AfricaInteract* is based on the Regional Economic Communities in the four sub regions of sub-Saharan Africa. Focal organizations coordinating regional activities are as follows: The Association for Strengthening Agricultural Research in East and Central Africa (ASARECA) – East Africa; Food, Agriculture and Natural Resources Policy Analysis Network (FANRPAN) – Southern Africa; Commission des Forets d'Afrique Centrale (COMIFAC) – Central Africa; and Energie-Environnement et Developpement (Enda) – West Africa.



The West and Central African Council for Agricultural Research and Development (CORAF/WECARD) is a constituent of the Forum for Agricultural Research in Africa, and comprising 22 National Agricultural Research Systems in West and Central Africa. CORAF/WECARD's mission is "Sustainable improvements to the competitiveness, productivity and markets of the agricultural system in West and Central Africa by meeting the key demands of the sub-regional research system as expressed by target groups" with strong alignment and commitment to the overall goal of the Comprehensive Africa Agriculture Development Programme of the New Partnership for Africa's Development. www.coraf.org

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Acronyms and abbreviations

CAPA	City Adaptation Programme of Action
CORAF/WECARD	West and Central African Council for Agricultural Research and Development
CSA	Climate-smart agriculture
HIV/AIDS	Human immunodeficiency virus/Acquired immunodeficiency syndrome
IDRC	International Development Research Centre
NAP	National Adaptation Plan
NAPA	National Adaptation Programme of Action
NEPAD	New Partnership for Africa's Development
SADC	Southern African Development Community
SSA	Sub-Saharan Africa

Executive Summary

This report provides a synthesis of key headline findings from 12 regional reviews (see Annex 1) on research-policy linkages on adaptation in sub-Saharan Africa (SSA). The reviews covered three separate themes – urban areas, agriculture and health – in the four regions of West, Central, Southern and East Africa. The reports set out to review the state of knowledge on research and policy, identifying gaps as well as opportunities for collaboration. The reviews were carried out as part of the *AfricaInteract* programme, aimed at helping to enhance the knowledge base and support research-based policy formulation for climate change adaptation throughout SSA.

The goal of this report is to bring together key findings from the regional reviews, and to reflect on key gaps as well as opportunities for supporting evidence-based policy formulation for climate change adaptation across SSA. This is a considerable task, and the report can merely cover major findings with a broad brush; it does not make a claim to do justice to the rich detail in the regional reviews. The report is targeted primarily at regional and national level policy- and decision-makers, but is expected to be of interest to an audience well beyond these groups.

Climate change poses challenges to natural and human systems in SSA. It may create new hazards or exacerbate existing ones, and it may put considerable strains on societies and ecosystems that are themselves undergoing change. Fundamentally, however, it is the underlying development pathways, and the choices these are based upon, that most determine the ability of a country to tackle the challenges of climate change. This review – and the reports it is based on – are a response to the urgent need to improve the knowledge base for policy responses, as evidence of climate change implications is increasing and a growing number of SSA countries are developing their own national policy frameworks for responding to climate change. Key headline findings for the three themes include the following:

Urban areas

Climate change is a major challenge to the sustainability of urban areas in SSA. Rapid urbanisation rates are leading to increasing numbers of people living in slums on marginal land with high exposure to climate risks, increasing the already high vulnerability of the poorest urban residents. In most cases, infrastructure development and service delivery have not kept pace with urbanisation rates across SSA. The review highlighted that so far, the majority of research on urban adaptation has focused on major cities, typically along the coast, and there is a need to increase focus also on inland cities and smaller urban centres. The reviews also highlighted the increasing prevalence and success of urban and

peri-urban agriculture in cities like Maputo, Nairobi and Dakar, which could make significant contributions to adaptation. On the policy side, there is a growing, but as yet still limited focus on climate change in urban-specific policy and planning. At the same time, climate change policy documents such as National Adaptation Programmes of Action (NAPAs) and national climate change policy frameworks tend to put most focus on rural areas. Some positive lessons are emerging, however. For example, there are documented cases of successful integration of climate change in city strategies in South Africa that could be used to inform urban sector policies elsewhere.

Agriculture

There is a rapidly growing body of evidence on impacts of climate change on agriculture, particularly on crop system productivity, but also on adaptation actions by crop farmers, pastoralists and fisheries communities, as well as the factors that underpin decision-making for adaptation at different levels. Some promising examples also exist of how processes of co-production of local and scientific knowledge can help improve adaptation outcomes. One example is in the area of seasonal weather forecasts to support agricultural decision-making, where significant research efforts have been carried out over recent years. The concept of 'climate-smart' agriculture (CSA) has gained in popularity over recent years, and is increasingly shaping efforts that aim to support adaptation in conjunction with goals for mitigation and development. Several large funded programmes on CSA are underway. While it may be too early to draw lessons from these, there is some emerging research that shows the potential benefits while also highlighting the challenges of balancing the three goals and reaching the poorest and most vulnerable. Research also suggests that a significant share of adaptation actions by smallholders happens independently and autonomously, despite weak formal institutional support. Importantly, impacts of climate change and variability on agriculture are moderated by political, economic and social factors. Agriculture is a key focus in NAPAs and national climate change strategies, but there has so far been limited, albeit growing, consideration of climate change in agriculture sector policies.

Health

It is clear that climate change will increase the burden on already overstretched health services across SSA. To date, research evidence on the linkages between climate change and health in the region is limited to a few major diseases, notably malaria, rift valley fever and meningitis. The regional reviews noted that there is increasing research focus on the direct and indirect linkages between climate change and HIV/AIDS, an area that has so far been given limited consideration.

There is also growing attention to climate change and malnutrition. The reviews found that in some cases, adaptation is hampered by the health sector being institutionally set up to manage disasters rather than preventing negative health effects and outbreaks of diseases. Changing this institutional mindset remains a major challenge. To date, few projects specific to health and climate change projects have been implemented, despite health being a top priority in many countries' NAPAs. At the same time, climate change is rarely integrated into health sector policies.

Overall findings and recommendations

The reviews demonstrate a growing knowledge base on how people and societies across SSA are responding to changes in climate-related shocks and stressors, and there are signs of emerging best practices and lessons that could be used to support adaptation in policy and practice. Importantly, the regional reviews also show a strengthening of the research capacity on adaptation and urban areas, agriculture and health across the four SSA sub-regions. However, as noted above the reviews also identify significant gaps in research, policy and research-policy linkages.

The following four key recommendations emerge:

First, the need to better understand adaptation actions and their outcomes. There are still important gaps in understanding adaptation in practice, for example the role of technology in supporting just and equitable adaptation outcomes. Similarly, there is a need to better monitor how particular adaptation actions or interventions – whether autonomous or planned, by people or by external agents – affect adaptation outcomes for different groups, facilitate learning and improve use of scarce resources.

Second, the need to address gaps in policies and increase policy coherence. Reviews for all themes and regions identified a need for more attention to climate change in sector-specific policies as well as across sectors. Several of the reviews noted that there is still very little, if any, attention to climate change in major policy documents and instruments, despite climate change being high on the international agenda over a number of years. This suggests that there are considerable challenges in ensuring that sector policies do not lead to maladaptive development pathways, for example creating technological 'lock-ins' that undermine the

future capacity of people or societies to adapt. One example that was highlighted is the urgent need for urban development policies and plans to consider current and future flood risks.

Third, the need to ensure improved uptake of research evidence. This is an area with significant challenges. As the regional reviews demonstrated, there is rapidly expanding literature on climate change and urban areas, agriculture and health, and a range of potential adaptation options have been identified in these three areas, but a major challenge remains in using this knowledge to inform policy and practice. Several reviews highlighted the need for better coordination both within research and professional communities, and between research and policy. There is a need to acknowledge complexities and non-linearity in policymaking, and that there are opportunities for meaningful engagement by the research community with policy- and decision-makers at multiple points throughout the research process. The reviews highlighted the need for researchers to engage with a wider audience and feed into policy processes at earlier stages.

Fourth, the need to address gender concerns. The need to better consider gender in adaptation research and policy was highlighted in all themes and across all regions. This synthesis observes that by and large, gender is framed as an issue relating mainly to women and children, and there is a tendency to view the same groups as victims of climate change with little capacity to act. Arguably, this view may be counterproductive and potentially disempowering for the poorest and most marginal groups. A broader perspective is needed on gender, focusing on the many different roles played by men and women in different social contexts. Some reviews highlighted the need for not only promoting functional needs in terms of relieving work pressure of vulnerable groups, but to also tackle strategic needs such as increased participation in decision-making processes.

While it was outside the scope of this review to look at mitigation or low carbon development, it is clear that there is an urgent need to consider interactions, synergies and trade-offs between goals for adaptation and resilience, development goals, and considerations for low carbon development strategies. This link is most apparent in the agriculture sector with the rise in attention to CSA, but such considerations are also key to urban planning (infrastructure and energy, for example) and the health sector (such as implications of changes in energy fuels).

1 Introduction

This report provides a synthesis of 12 regional reviews on research-policy linkages on adaptation to climate change in sub-Saharan Africa (SSA) (see Annex 1). The reviews covered the themes of urban areas, agriculture and health across SSA's four sub-regions: West, Central, Southern and East Africa. The scope of these reports was to review the state of knowledge on research and policy, identifying gaps as well as opportunities for collaboration. The main purpose of the reviews – and the programme they are part of, *AfricaInteract* – is to help enhance the knowledge base and to support research-based policy formulation for climate change adaptation in SSA. The mandate for the regional reports was to cover the state of knowledge on research and policy, identifying gaps as well as opportunities for collaboration.

The goal of this report is to bring together key findings from the regional reviews, and to reflect on key gaps as well as opportunities for supporting evidence-based policy formulation for climate change adaptation across SSA. The report is targeted primarily at the continental New Partnership for Africa's Development (NEPAD), as well as regional and national level policy- and decision-makers, but is expected to be of interest to an audience well beyond these groups.

Climate change presents a significant risk to SSA (Niang and Ruppel 2014). The three themes of urban areas, agriculture and health are of major importance to economies and livelihoods across the region. While climate risks have always been a part of life in SSA, climate change poses significant new challenges to the continent. The nature of these future risks, whether gradual or sudden in onset, may create new hazards or exacerbate existing ones, in turn putting significant strains on societies and ecosystems. Importantly, the societal ability to tackle risks is changing, for social, economic and political reasons.

Successful societal adaptation to such changing risks is not inevitable, nor without significant potential costs and trade-offs. Adaptation actions benefitting some groups may put others at a disadvantage. Adaptation may take many forms: reactive and proactive, as adjustments to current systems, and as deeper transformative change. Delaying adaptation actions may increase costs.

This review – and the 12 reports it is based on – are a response to the urgent need to improve the knowledge base which policy responses to climate change are built upon, as evidence of climate change implications is increasing and a growing number of SSA countries are developing their own policy frameworks for responding to climate change. Attention to how available research evidence can best inform policy is thus urgently needed. Particular attention is needed to the poorest and most vulnerable groups, as they have the least individual or collective resources to cope with or adapt to changes.

The paper is structured as follows. Section 2 provides the analytical framework and methodology for the reviews and this synthesis. Sections 3-5 then reviews findings by sector – urban areas, agriculture and health – drawing out some of the key findings and gaps in research and policy, including potential impacts, the policy situation and research-policy linkages. Particular attention is given here to gender as a key crosscutting concern. Section 6 offers some further reflections across the sectors, conclusions and policy implications.

Against the background of the continental and regional approach of this project, it is worthy to note NEPAD and its overarching framework comprising the regional economic communities – the Economic Community of West African States (ECOWAS), Economic Community of Central African States (CAEC), East African Community (EAC) and Southern African Development Community (SADC) – with a view to coordinating the overall development of the continent. It is also interesting to note that against the obvious socio-cultural differences between the regions, there are significant similarities among them, including commonalities in agroecology. It is therefore not surprising that there are several similarities across the regions in the impacts of climate change as well as in approaches to tackling adaptation challenges. For example, all the regions are to varying extents bordered by the sea with many urban areas along the coast, which has implications for sea level rise. Furthermore, in all the regions there are rainfall and temperature gradients with associated agro-ecologies, which have important implications for agriculture and health. These regional similarities provide a basis for a common approach to issues related to the sectors considered in this review, and also provide an opportunity to share experiences.

2 Background

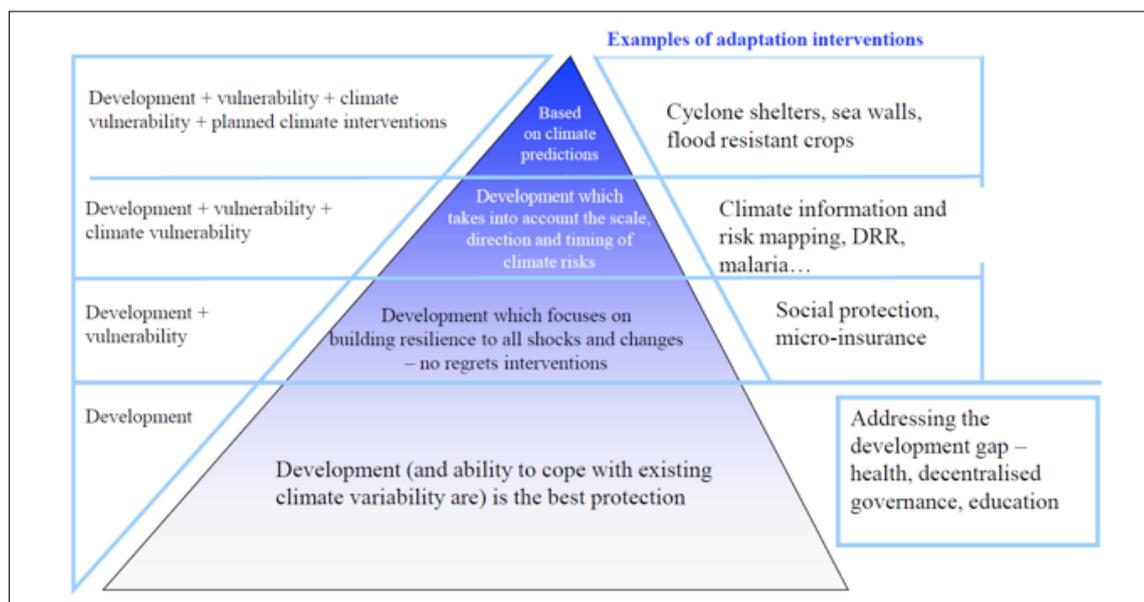
2.1 Key concepts

The ultimate goal of *AfricaInteract* is to support enabling research to policy linkages to promote adaptation. This section sets out the understanding of key concepts and research-policy linkages, which provides the framework for the sectoral synthesis sections that follow.

Adaptation to climate change is commonly defined as 'adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities' (Adger et al. 2007: 720). Adaptation can be anticipatory, in expectation of future change, or reactive, in response to observed events. A distinction is also often made between autonomous (or spontaneous)¹ and planned adaptation.

The way society is organised not only affects greenhouse gas emissions, it also to a large extent determines the ability to cope and adapt by different

Figure 1. Categories of adaptation interventions (Source: Tanner et al. 2012)



groups in the society. Effects of climate change are the result of a combination of vulnerability, caused by structural and individual factors, coupled with climate change and variability, and the hazards they produce, that in turn cause challenges to livelihoods.

Over recent years, aims for adaptation have increasingly been formulated around resilience. Resilience can be understood narrowly as the ability of a system to maintain its structures and functions in the face of shocks and stressors, or more broadly (as in much of the adaptation literature) in terms of the ability of systems to transform in the face of shocks and stressors (Béné et al. 2012).

Efforts to support adaptation can take many shapes and forms. McGray et al. (2007) categorised adaptation activities according to whether they addressed broad development challenges, climate risks or specific projected changes in climate parameters. The first two types are actions taken to improve development and address current adaptation deficits, and do not include a specific climate change focus, whereas the latter relies on clear knowledge of future climate risks. Figure 1 shows an operationalisation of this approach. At the bottom are the development challenges that determine the range of vulnerabilities and the adaptation options that are available and accessible. This layer represents the underlying drivers of vulnerability, whereas further up in the 'pyramid' are increasingly targeted climate change interventions, which also tend to be increasingly technical/managerial in nature.

Tanner et al. (2012) take this classification further by adding two key elements: first the assumption that all levels are needed, and secondly the suggestion that the most important interventions revolve around the bottom layer, namely the ability to cope with existing variability. The figure does not, however, engage directly with debates around transformation, i.e. the need to go beyond adjustments to existing development

approaches and programmes and to address how current development trajectories affect vulnerability.

It is obvious that research evidence is needed for policies to adequately respond to the new challenges brought about by climate change. However, it is not obvious or inevitable that it is the most robust research evidence that shapes policies. Linkages between research and policy are determined by a complex set of factors, including how the issue is framed, how it enters the policy processes, and importantly, who supports or champions particular actions or types of interventions.

Linkages can be conceptualised in different ways. A stylised view of policymaking is that it is a linear process with a clearly defined start and finish, from formulation to implementation and evaluation. In this model, research evidence is collated at the start of the process, where the options are weighed and the best options are selected. Of course, real world policy processes are often rather different. This report considers policymaking to be a complex and 'messy' set of processes, and research-policy engagement is not limited to the formal process of policy formulation: rather, there are multiple entry points or 'policy spaces' for research-policy interaction (Tanner and Allouche 2011; Keeley and Scoones 2003).

2.2 Methodology

The synthesis primarily draws on the reported findings and recommendations on research and policy within the three sectors and with regard to cross-cutting considerations, organised around the key conceptual linkages outlined above.²

Research findings outline, first, the evidence for sector-specific impacts of climate change, including both slow- and sudden-onset risks and hazards. Second, it reviews the evidence for how sector-specific structures, such as institutions and policies, determine vulnerability.

Throughout, particular focus is on crosscutting issues like gender and water, and connections to other sectors and thematic areas. Overall, areas discussed are selected from the issues highlighted by the regional reports, in particular those findings that are deemed to present new knowledge as compared to the IPCC or other recent reviews of research and policy across SSA.

On policy, the report documents how and to what extent climate change and urban, health and agricultural concerns have been integrated, both in climate change-specific policies and in respective sector policies. Policy coverage here includes climate change-specific policy instruments, such as NAPAs and national climate change strategies, and level of integration of climate change in sector-wise policies. Overall the reports were more comprehensive on the former than the latter, but some evidence is available.

Finally, the sections assess key research and policy gaps across the regions. Tables in text provide some further detail on the findings by sector and region, along with key crosscutting findings.

The reviews covered literature which had a particular focus on climate change. In most cases, however, reference was made to related areas of relevance to climate change, even if climate change was not the primary focus. The majority of the references were from English-speaking literature, but with significant French literature particularly for the Central and West Africa reviews.

3 Urban areas

3.1 Context and scope

There is growing international focus on climate change challenges in urban areas, and urban areas in sub-Saharan Africa face particular challenges (Bicknell et al. 2009; Satterthwaite et al. 2009). SSA has some of the highest urbanisation³ rates in the world, and urban populations are expected to grow significantly in Africa over the coming years. This presents considerable challenges in a climate change perspective; first because of the potential for changing patterns of climate hazards, and second because of increased populations in hazard-prone areas along with increased pressures on livelihood resources sensitive to climatic changes.

For the purposes of the reviews, urban areas are defined according to administrative boundaries of settlements. Urban areas include municipalities, towns and cities, and are generally characterised by a high population density, a high degree of specialised land use and a wide variety of social and economic structures (Joshua et al. 2014).

With increasing urban populations, and growing, as well as increasingly complex, rural-urban movements,

more attention is needed to adaptation in urban areas. The regional reports stressed the complexity of interrelations between urbanisation and climate change, and the need to avoid simplistic 'urban explosion' or 'rural push/urban pull' stereotypes. Urbanisation can reduce as well as increase vulnerability, and it has been pointed out that urbanisation is not so much a driver as a result of other drivers. Rapid urban growth does not only constitute a problem; it is also a reflection of economic growth and can present new opportunities. The following sections provide a summary of research and policy findings, with regional examples in Table 1.

3.2 Climate change and urban areas in SSA: key findings

Reviews highlight that scholarship on adaptation in urban areas is still in its infancy across SSA. First and foremost, they demonstrate that climate change presents major challenges to the sustainability of urban areas in Africa. Challenges include, on the one hand, the direct impacts of climate related risks on urban populations, and on the other, improvement in urban governance to increase the climate change resilience of growing urban populations.

Reviews emphasised how changing climate patterns put increasing stresses on a number of resources such as water, energy and food systems. The impacts are particularly acute for the poorest parts of the population, with clear health implications. Several reviews also noted research evidence of the impacts of climate change already being felt by urban residents, which include gradual as well as sudden onset changes.

Ultimately, the impacts of climate related risks are mediated by the quality and location of housing, extent of government services, and the ability of people to adapt autonomously. Rapid urbanisation rates in many parts of Africa have left increasing numbers of people living in slums on marginal land with high exposure to climate risks. For a variety of reasons, new migrants for the most part settle in marginal areas where institutional support and service provision are poor. Infrastructure development and service delivery have not kept pace with urbanisation rates.

A number of reviews highlight the particular challenges faced by women and children, to a large extent because of traditional household roles, for example in fetching water. Challenges of water – both quality and quantity – are particularly urgent in urban areas, for example in terms of water sources drying up due to overuse, or frequent flooding contaminating sources of drinking water.

Urban agriculture represents an increasing trend in major cities like Nairobi, Maputo and Dakar, and has become an important livelihood strategy in the face of increasing food prices and shortage of other income opportunities (Joshua et al. 2014; Mubaya et al. 2014).

Table 1: Urban areas and adaptation – key findings from regional reviews

Region (Reference)	Research	Policy
East Africa (Mubaya et al. 2014)	<ul style="list-style-type: none"> • There have been few urban-specific climate change research projects • Urban agriculture has become a significant adaptation strategy • A small research community limits ability to influence policymakers • Adaptation studies are lacking for inland cities 	<ul style="list-style-type: none"> • Limited space is given to urban areas in national climate change policies • There is very little integration of climate change in urban policies • Overly simplistic understandings of rural-urban migration prevail • Community engagement in policy processes is lacking
Central Africa (Wouapi et al. 2014)	<ul style="list-style-type: none"> • Economic growth and infrastructure have not kept pace with urbanisation rates, leading to increased vulnerability of urban populations 	<ul style="list-style-type: none"> • Poor implementation of policies and weak institutions hamper adaptation
Southern Africa (Wouapi et al. 2014)	<ul style="list-style-type: none"> • High urbanisation rates lead to increasing numbers of people living in slums on marginal land without social amenities and with high exposure to natural hazards 	<ul style="list-style-type: none"> • Current climate change policy focuses overwhelmingly on rural areas, neglecting urban issues • There is lack of capacity to integrate adaptation into urban policies and planning instruments
West Africa (Sanni et al. 2014)	<ul style="list-style-type: none"> • Impacts of climate stressors are already felt by urban residents • Very little research has been done on urban areas and climate change in West Africa, and with few exceptions mainly on coastal cities • Climate change impacts are mediated by quality of housing and government services 	<ul style="list-style-type: none"> • Weak interaction between actors results in little coordination between climate change and development concerns

3.3 Key policy findings

Urban-related concerns figure in several climate change policy processes across SSA, including NAPAs, NAPs and national climate change strategies. The dominant framing is one of rural-urban migration, with the main focus on rural areas, rather than considering rural-urban linkages a dynamic relationship, with positive synergies as well as negative effects. In Southern Africa, Joshua et al. (2014) found that with the exception of South Africa, the climate change policy focus is overwhelmingly on rural areas, and urban-related concerns and issues appear all but overlooked. The East Africa review (Mubaya et al. (2014) similarly found limited acknowledgement of the importance of urban areas in NAPAs and national climate change strategies.

In urban-specific policies, there is so far very limited focus on climate change. In policies such as on land use planning in cities and urban infrastructure planning, the integration of climate change is limited. In East Africa, Mubaya et al. (2014) found very little focus or integration of climate change in urban related policies and strategies. Joshua et al. (2014) highlight lack of capacity to integrate climate change adaptation into urban policies and planning instruments as an important constraint across Southern Africa.

Overall, a common finding of the regional reviews was that even where policies exist, they are poorly implemented, and weak institutional capacity hampers

adaptation. The reviews showed that key challenges included, first, that policymakers are not sufficiently informed or aware of climate change and its implications on the urban poor (Mubaya et al. 2014). Further, there is a lack of formal and informal engagement of communities, government departments and agencies in policy processes. Weak interaction between actors results in little coordination between climate change and development concerns (Sanni et al. 2014).

Sanni et al. (2014) argue that scenario uncertainty is no excuse for not taking adaptation action, given the amount of information already available on risk in urban areas for different social groups. The authors stress the particular need to plan for flexibility in view of future climate change. Satterthwaite et al. (2009, p.28) argue that one key challenge is that urban development policymakers often focus on non-disaster risks, which in most urban areas in low- and middle-income nations contribute far more to health burdens and poverty than do disasters. However, this means that they may miss the potential links between risk reduction for everyday hazards and small and large disasters.

While the overall picture remains one of poor integration between climate change and urban planning, there are also emerging positive lessons (see also Table 2). One example cited by Joshua et al. (2014) is successful integration of climate change in city strategies in South Africa.

Table 2: Urban areas and adaptation – examples of challenges and opportunities

Key research/policy gaps and challenges	Opportunities and examples of positive engagement
<ul style="list-style-type: none"> • The dominance of external actors driving research and policy agendas and lack of national leadership (Joshua et al. 2014) • Limited efforts on knowledge exchange for adaptation (Mubaya et al. 2014) • Challenge of shifting focus from rural-urban migration as a problem to the role of urban planning in supporting and accommodating mobility (Mubaya et al. 2014) • The need to overcome the bias towards rural areas (Joshua et al. 2014) 	<ul style="list-style-type: none"> • South Africa provides a case of successful projects to integrate climate change concerns into urban policies • Opportunities for downscaling NAPAs to city levels (CAPAs) • Need to look at rural-urban interdependencies and develop rural and urban policies alongside each other (Joshua et al. 2014)

3.4 Gaps and recommendations

Several key research and policy gaps were pointed out in the regional urban adaptation reviews. First, the historical emphasis on adaptation in rural areas mean there are still key knowledge gaps on urban areas and rural-urban interconnections. Despite increasing interest and attention, there are still comparably few urban-specific research projects to draw on. Several reviews noted the particular need for research on the poorest and most marginalised groups, in view of the need to understand who is most vulnerable, and why. Most commonly noted were women, children and the elderly, highlighting the need for better analysis of gender and other social difference in assessing impacts of climate change and the capacity to adapt in urban areas.

The East and West African regional reviews (Mubaya et al. 2014; Sanni et al. 2014) note that with a few exceptions, research on urban adaptation tended to focus on coastal cities, with a particular need to fill knowledge gaps on inland urban areas.

In the West African review, Sanni et al. (2014) noted that knowledge gaps include early warning systems, adaptation technologies, and strategies for strengthening the capacity of urban institutions to effectively manage adaptation strategies at the city level. The authors also highlight a particular need for improved assessments of what they call ‘critical city infrastructure’, such as transportation and water supply systems. Despite improvements over recent years, Joshua et al. (2014) note that there is still a need for better downscaled climate models for cities.

Reviews also noted that while there is considerable (and increasing) knowledge on urban adaptation within the research communities, the relatively small community of professionals and researchers remains a constraint to analytical capacity, and in turn the ability to influence policymakers. Mubaya et al. (2014) point to the need for researchers to better engage with different policy spheres, not only in scientific conferences, and to address the current limited knowledge exchange.

On the policy side, gaps in awareness and governance capacity were noted by many of the reviews. There is a need for more awareness and focus on rural-urban interconnectedness and migration dynamics, and to look at rural-urban interdependencies and develop rural and urban policies alongside each other. The East African review (Mubaya et al. 2014) argued for the need to shift the view on rural-urban migration away from only seeing it as a problem, giving attention instead to how urban planning may support and accommodate mobility. Furthermore, a better integration of urban agriculture into urban policy could help enhance adaptive capacity and food security of vulnerable urban populations.

Reviews also highlighted the need for investment in building the capacity of urban authorities in areas such as fiscal management and M&E of climate related plans (Mubaya et al. 2014). Some also focused on the need for more active – and proactive – urban authorities with improved capacity, as well as improved institutional frameworks to support this capacity.

To support integration of climate change concerns amidst the need to keep pace with the rate of growth of urban populations and their demands for essential services and security, it was suggested to develop ‘downscaled NAPAs’, by some called ‘City Adaptation Programmes of Action’ (CAPAs). It was argued that CAPAs have the advantage of reinforcing adaptation governance at the scale where the vulnerable are located (Sanni et al. 2014), supporting decentralisation and empowering local authorities. South Africa was mentioned as case of successful projects to integrate concerns with climate change into urban policies (Joshua et al. 2014).

Other instruments to support adaptation governance included improved forecasts and various insurance mechanisms for smallholders, building on experiences emerging particularly over the past five to ten years. See Table 3 below for further recommendations for research and policy from the regional reviews.

Table 3: Urban areas and adaptation – research and policy recommendations

Region	Key recommendations
East Africa	<ul style="list-style-type: none"> • Shift focus to the role of urban planning in supporting and accommodating mobility and addressing the inequalities in the region's urban areas • Shift focus of researchers from presenting findings only in academic fora to engaging with policymakers and involving them from the research design stage • Invest in equipment to improve the quality of climate forecasts and projections • Create a favourable policy environment for urban and peri-urban agriculture • Invest in capacity strengthening of urban authorities on M&E of climate related plans
Central Africa	<ul style="list-style-type: none"> • Invest in infrastructure to keep pace with the rate of growth of urban populations and their demands for essential services and security • Plan urban development as sustainable development while also fulfilling core obligations under the Habitat Agenda
Southern Africa	<ul style="list-style-type: none"> • Improve institutional frameworks for integrating climate change into urban planning, such as through CAPAs • Promote climate change education, research and awareness programmes through universities • Improve linkages between urban agriculture into urban policy to enhance adaptive capacity and food security of vulnerable urban populations
West Africa	<ul style="list-style-type: none"> • Improve understanding of the vulnerability of critical city infrastructure such as transportation and water supply systems • Improve understanding of the vulnerability of socially disadvantaged urban dwellers • Evolve policies on 'CAPAs' and support adaptation through innovation frameworks

4 Agriculture

4.1 Context and scope

Attention to climate change's implications for agriculture and food security has grown tremendously over the past few years, most recently related to support to 'triple wins' and so-called 'climate smart agriculture' (CSA)⁴. Agriculture is unique among major economic sectors in that it is both a 'villain' and 'victim' with respect to climate change (Hedger 2011). Recent research highlights the risks to agriculture from climate change, but also the potentials for synergies and co-benefits.

For the purposes of this review, the agriculture sector covers economic and subsistence activities to support livelihoods through crop farming, livestock (including pastoralism) and fisheries. Forest resources were covered where relevant for crop, livestock and fisheries (i.e. mangroves), not as a standalone issue. Table 4 summarises research and policy status across the regions.

4.2 Climate change and agriculture: implications for SSA

There is a growing literature on potential impacts of and adaptation to climate change for agriculture, particularly for crop systems, across SSA. These impacts include crop pests, livestock diseases and agricultural ecosystems at risk, notably forests and fisheries. The regional reviews highlighted documentation of the impact of changing rainfall patterns, notably rainy seasons commencing later or finishing earlier than before, and the increased

prevalence of crop diseases such as Colocasia leaf spot disease. Climate change is also considered one cause behind the development of a 'highly virulent strain' of the African cassava mosaic disease (ACMD), and an increased severity of African swine fever and related pests (Ngeve et al. 2014). The authors also argue that biodiversity in the form of fish species, mangrove ecosystems and coral reefs is being depleted or damaged due to the combined effects of increased resource pressures and marine pollution with floods, changed salinity, rise in river and sea surface temperatures, and rising sea levels.

Crop modelling exercises suggest significant impacts on agroecological zones, crop suitability, and yields, with knock-on effects on food security. Concerns over food security have led to programmes aimed at developing new crop varieties that are suitable for changing climate patterns while also socially acceptable and economically feasible. Reviews also pointed to a lack of knowledge on new strains of aquaculture species tolerant of lower quality water and higher levels of salinity induced by climate change.

Importantly, the social and economic impacts of climate change and variability on agriculture – and responses to these – are moderated by political, economic and social factors. At the household and individual level, these include livelihoods, assets, and access to resources and institutions, as well as whether policies support or undermine adaptation pathways. Assessments of climate change impacts only ever provide a partial picture of what role climate change plays. A key determinant for vulnerability is land access. Processes of land acquisition by private and government actors (so-called 'land grabbing') may overshadow any climate

change impacts in the short to medium term. While there is strong evidence that pastoral systems represent the most appropriate use of semi-arid lands over large parts of Africa, pastoral communities remain among the most politically and economically marginalised groups (Liwenga et al. 2014). There is an emerging literature on political economy aspects of agriculture and climate change (e.g. Yirgu et al. 2013, Maina et al. 2013, Chinsinga et al. 2012, and Sarpong and Anyidoho 2012).

There is considerable evidence of autonomous adaptation across SSA by crop farmers, pastoralists and fisherfolk. Much – if not most – of this adaptation happens despite lack of institutional support. Current literature in agriculture is missing evidence of resource use efficiencies and trade-offs under current institutional systems, i.e. those that regulate interactions among cropping, livestock and natural resources management schemes within rural communities and between rural and urban/peri-urban communities. Local knowledge was highlighted in a number of the regional reviews on agriculture, including local knowledge on observations of changes in the climate, as well as local knowledge underpinning a range of adaptation options. While several barriers exist to meaningful integration, there are some promising examples, such as the co-production of seasonal forecasts for improved agricultural productivity by local people and scientists (Liwenga et al. 2014).

A range of adaptation options are being suggested, linking across scales of governance as well as in terms of technologies, institutions and policies. In particular, there is a growing focus around climate-smart agriculture (CSA). To proponents, CSA represents a way of supporting specific interventions and technologies as well as creating policy and institutional frameworks that encourages adaptation while also supporting income generation, food security and mitigation goals. However, concerns have been raised that despite the growing focus on CSA, there is so far little documented evidence on whether and how CSA outcomes are beneficial in particular for the poorest and most vulnerable farmers. Arguably, by a broad definition, efforts may be considered as ‘climate smart’ even if they do not target or even benefit the poorest. Some reviews noted a limited knowledge in areas such as adaptation at a broader landscape or watershed level, as opposed to farm or community level, and on the feasibility and productivity of biofuel crops under water-stressed conditions. There are also studies suggesting trade-offs between different policy goals for ‘triple wins’ (Suckall et al. 2014).

The sustainability of adaptation within the agriculture sector has been called into question, with potential shifts in rainfall patterns and a drying of the climate, linked also to concerns that climate change will deter young farmers from investing their future in agriculture. However, evidence suggests that a number of ‘push’ and ‘pull’ factors are driving movements out of agriculture,

Table 4: Agriculture and adaptation – research and policy status

Region (reference)	Key findings on research	Key findings on policy
East Africa	<ul style="list-style-type: none"> • Farmers are adapting in the absence of government assistance • Pastoral systems are highly adaptive but remain politically and economically marginalised 	<ul style="list-style-type: none"> • There is a lack of policies that can provide for adaptation in the agricultural sector; and few efforts to integrate climate resilient approaches
Central Africa	<ul style="list-style-type: none"> • Research-user interface does not exist in most countries in the region • Changing rainfall is leading to increases in crop diseases • Loss of biodiversity is resulting from climate change and resource pressures 	<ul style="list-style-type: none"> • Mechanisms for integrating research into policy need to broaden from their current focus on extension services
Southern Africa	<ul style="list-style-type: none"> • There is a lot of documentation on the potential impacts on crop agriculture, less so on livestock/pastoralism and fisheries • Current literature in agriculture is missing evidence of resource use efficiencies and trade-offs 	<ul style="list-style-type: none"> • Significant research evidence is available, but a number of factors hinder uptake in policy processes • Policy and strategy documents emphasise importance of seasonal weather forecasting and early warning systems but not clear how progress is to be monitored • Many areas of CSA systems are lacking supporting research evidence
West Africa	<ul style="list-style-type: none"> • Knowledge is limited in areas such as adaptation at the watershed level and the productivity of biofuel crops in water stressed conditions • There is also limited knowledge on new strains of aquaculture species tolerant of lower quality water and higher levels of salinity induced by climate change 	<ul style="list-style-type: none"> • Climate change and adaptation are often missing in Agricultural Development Policies and Strategies • Some policies to the benefit of one sector have been to the detriment of another

and there is little concrete evidence on whether climate change is a major driver. Still, adaptation *within* agriculture cannot be understood separately from development pathways and broader policy contexts, or from priorities such as large scale land investments, a very important process in many parts of Africa which is in some cases also relevant to adaptation-mitigation connections. Using land for growing non-food crops such as biofuels, sometimes in the context of 'land grabbing' by multinational companies, may according to some present opportunities for diversification in response to climate change and increases in incomes of rural communities and national GDPs (Brittaine and Lualadio 2010; Ngigi 2009). However, Rhodes et al. (2014) point out in the West Africa review that caution is required because biofuels may compete with food crops for land, nutrients and water, resulting in landless people and social unrest. In the Central Africa review Ngeve et al. (2014) note the conflict between strategies to reduce deforestation amidst plans by various countries in the region to open up new land for food and biofuel production.

4.3 Key policy findings

The reviews show that agriculture is a key concern in NAPAs and national climate change strategies. However, there has so far been limited climate change consideration in sector policies. For example, Liwenga et al. (2014) noted the failure of agricultural sector policies in East Africa to consider adaptation strategies, and also that there have been few efforts so far to increase integration of climate resilient approaches within the agricultural sector.

In Central Africa, the review highlighted that even though some policies exist that combines agriculture and climate change, implementation is hampered by the low priority given to funding adaptation as compared with, for example, forest conservation (Ngeve et al. 2014). In Southern Africa, Mapfumo et al. (2014) noted that there is a lot of available research evidence on climate change impacts in the agricultural sector, but that a range of political and economic factors hinder uptake in policy processes. This highlights the need for a better understanding of barriers to uptake and how they may be overcome. The authors also point out that while most national policy and strategy documents emphasise the importance of seasonal weather forecasting and early warning systems, there is a lack of evidence of how to monitor and measure progress. They also note that while there is a strong intention in policy documents for gender mainstreaming in agriculture and natural resources management, the substance on how this may be achieved is lacking.

The West Africa review (Rhodes et al. 2014) noted that climate change and adaptation are typically missing in agricultural development policies and strategies. More seriously, some policies to the benefit of one sector have been to the detriment of another. In Chad, for example, policies for dam construction to adapt economies to climate change in catchment areas have led to a decline

of seasonal flooding that supported fisheries resources in flood plains.

4.4 Gaps and recommendations

The reviews noted gaps in knowledge, capacity, institutional set-up and governance, and ultimately uptake of research evidence in policies.

Knowledge gaps. Regional reviews emphasised gaps in knowledge in the following areas: First, there is a need more focus on fisheries and pastoralist systems. To date, crop farming has been the dominant focus. This is natural given SSA's critical challenges for food security, but it has also been at the expense of other subsectors (e.g. Mapfumo et al. 2014). Second, projections are required on the relative importance of developing different crop and livestock types and cultivars/breeds as changes occur nationally, regionally and globally in food supply patterns. While there is evidence on autonomous adaptation by crop farmers, pastoralists and fisherfolk, using local knowledge, these are not without costs. Moreover, there are huge disparities between different actors and social groups in the sector in their vulnerability and ability to adapt. In the case of Southern Africa, Mapfumo et al. (2014) noted that there is a lack of evidence on how impacts from climate change and variability on commercial agricultural production systems would affect collaborative linkages and conflicts within the predominantly smallholder agricultural systems across SSA. Finally, there is growing focus on 'climate-smart' agricultural systems, but also concerns around who may win and lose from increased support to CSA.

Capacity constraints and technology. Reviews noted gaps in the suitability of measures to support adaptation in the agriculture sector, including the need to address gaps in technology and service delivery, such as crop varieties, credits, markets, extension services and forecasts, and how these suit the particular local contexts in which they are developed. It was also stressed that adaptation measures should be tested for contribution to resilience through the whole food chain from producers to consumers. For example, a need for further research to field test promising CSA technologies and practices was noted. Conservation agriculture is among the promising CSA strategies, but empirical studies are needed in different agro-ecological zones to test its contribution to adaptation planning (Liwenga et al. 2014). Many of the reviews highlighted the value and potential benefits that could be gained from combining local and scientific knowledge systems, for example for making climate information relevant locally and for empowering communities. Rhodes et al. (2014) recommended strengthening of access by smallholders to credit and markets; agricultural product value addition; and improvement of feeder and major roads, electricity and water supply. Despite considerable research and action in this area, it was noted that there is still a need for improved capacity and efficiency in the generation and dissemination of climate information at short to medium timescales (e.g. early warning and seasonal

weather forecasts), and knowledge of how these are interpreted and used by intermediaries as well as farmers.

Institutions and governance. Reviews emphasised gaps in institutional structures. Some argued for a need for national and regional policy shift to focus on supporting transformative change processes that move agriculture beyond today's subsistence farming systems and to more dynamic, market-oriented systems that may reduce climate risks (Mapfumo et al. 2014). There was further emphasis on the need for better coordination across ministries such as agriculture and environment. At both national and regional scales, there is a need to review and harmonise agricultural and environmental policies. National ministries of environment coordinate climate change policies, but many of the climate change adaptation processes will occur in the agriculture sector (Mapfumo et al. 2014). The West Africa review (Rhodes et al. 2014) suggested that the national agricultural research centres, apart from more funding, also needs improved links with advanced laboratories in developed countries and CGIAR centres. Reviews also pointed out the need to find the right balance between the role of technical improvements and needs for structural change within

the agriculture sector, including institutions, policies and land access regimes (Mapfumo et al. 2014).

Improving research uptake in policy. Reviews highlighted a critical need to bridge gaps between regional policy formulation and capacities for action planning and implementation at the national and sub-national levels, and that thinking around policy engagement needs to move away from the linear 'research to policy model' (Rhodes et al. 2014). Mapfumo et al. (2014) recommended that regional policy development must be matched by capacity strengthening at national and regional levels to be effective. One review recommended increased support for regional organisations such as ACMAD (African Centre of Meteorological Application for Development) and AGRHYMET⁵, to build 'centres of excellence' around evidence on climate change matters for crop farming, livestock keeping, pastoralism and fisheries, while producing robust evidence that may lead to policy change (Rhodes et al. 2014).

Table 5 provides some further detail on recommendations from the regional reviews.

Table 5: Agriculture and adaptation – selected research and policy recommendations

Region	Key recommendations
East Africa (Liwenga et al. 2014)	<ul style="list-style-type: none"> • Test adaptation measures through the whole chain from smallholder producers to consumers • Combine local and scientific knowledge systems to make climate information locally relevant while empowering communities • Further test the contributions of conservation agriculture to adaptation
Central Africa (Ngeve et al. 2014)	<ul style="list-style-type: none"> • Build mechanisms for transferring research results to end-users that include not only the extension services but also the civil society, to ensure integration of adaptation research findings into agriculture sector policies • Strengthen regional governance of the fisheries industry, especially in the Lake Chad Basin area, so as to reduce over-harvest in the region
Southern Africa (Mapfumo et al. 2014)	<ul style="list-style-type: none"> • Support transformative change processes that take agriculture beyond current models of smallholder farming to more dynamic and market oriented but less risky production systems • Strengthen capacity and efficiency in the generation and dissemination of seasonal weather forecast and early warning information and knowledge of its interpretation by farmers and extension agents • Develop interactive platforms at community, sub-national, national and regional scales to promote research to policy engagements on adaptation
West Africa (Rhodes et al. 2014)	<ul style="list-style-type: none"> • Improve access by smallholders to credit and markets through strengthening rural banks and microcredit schemes • Replace the linear 'research to policy model' with more participatory, interactive strategies for adapting food systems to climate change • Explore a range of decision support tools from sensitisation to more concrete joint scenario building and analysis to examine trade-offs of policy options • Support ACMAD and AGRHYMET to become genuine centres of excellence on climate change matters for crop farming, livestock keeping, pastoralism and fisheries

5 Health

5.1 Context and scope

Health is defined by the World Health Organization as 'a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity' (WHO 1948). For the purposes of this review, the health sector refers to all organisations and resources in place in SSA to cope with human well-being in its environment. The health reviews focused on food and water borne diseases, vector borne diseases and HIV/AIDS, as well as other major diseases such as meningococcal meningitis. Other health implications such as mortality rates due to heat stress and malnutrition were also covered. As with the other themes, particular attention was given to the crosscutting concerns of water resources management, as well as gender considerations. This section will go through the research evidence, drawing out key regional differences. The policy review was divided between, on the one hand, health coverage in climate-change specific policies, and on the other, climate change coverage in health sector policies at national and regional levels. Table 6 provides a summary of research and policy status from the regional reviews.

5.2 Climate change and health in SSA: An overview of the evidence

The regional reviews demonstrate that climate change will have an impact on health in SSA in direct and indirect ways, as climate change is likely to alter the balance of many key health determinants. First, it will affect the prevalence of infectious diseases such as incidences of food poisoning, and water borne diseases are projected to increase following floods or other events affecting water quality. Second, climate change may alter the patterns through which vector borne diseases are transmitted, due to changes in the habitats of vectors (Amis et al. 2014). Third, it will affect illnesses such as HIV/AIDS through impacts on general health and wellbeing, and through reducing treatments' effectiveness. Importantly, climate change arrives in a situation where health services are already overstretched and in poor condition.

Further highlights from the review include the following:

Food and water borne diseases are linked to climate change in different ways. The prevalence of food borne diseases is made worse by raising temperatures, increased pest species including flies, rodents and cockroaches, and other factors. Evidence shows that water borne diseases have a strong correlation with high temperatures.

An increased prevalence of *vector borne diseases* is expected due to projected changes in environmental

conditions as a result of climate change. Diseases such as malaria, dengue fever, schistosomiasis (flat worm), tick borne diseases and cholera all have climate sensitive vectors (Amis et al. 2014). Climate change will also affect pathogen development in vectors, and the population dynamics of non-human vertebrate reservoirs (Amis et al. 2014). It is clear that vector borne disease transmission dynamics will also be influenced by many social, political and economic factors (Sogoba et al. 2014).

HIV/AIDS is affected directly through heat stress, and indirectly through malnutrition reducing the immune system. Lack of clean water reduces effectiveness of treatment. The links between climate change and HIV/AIDS are fast attracting increasing focus and resources (Doumbia et al. 2014).

The relationship between climate and *meningitis* has been the most widely studied in West Africa and shows evidence that the distribution of the epidemics is compatible with changes in climatic conditions, including dust (Doumbia et al. 2014). Research also suggests that the meningitis belt may expand eastwards into Uganda and Kenya as the region becomes drier (Githeko et al. 2014).

Heat effects on mortality rates: In Ghana and Burkina Faso, research has shown strong associations between higher temperature and daily mortality rates, using Health Demographic Surveillance System (HDSS) time series. The short-term direct heat effect was particularly strong on the under-five child mortality rate (Doumbia et al. 2014).

Malnutrition: FEWS NET climate data and DHS health data suggest links between livelihoods and each measure of malnutrition, as well as a link between climate and stunting (Doumbia et al. 2014).

Obviously, the overall health effects of climate change will be a complex picture determined by both individual and collective factors. For example, the risk of outbreaks of water borne diseases will be closely connected to water quality as well as sanitation and personal hygiene standards (Amis et al. 2014). Weak health care systems may create conditions that are maladaptive, in turn increasing the severity of climate change impacts.

As pointed out by Amis et al. (2014), individual factors such as age, gender, education levels and pre-existing health problems are important in determining vulnerability to climate change. For example, better education can give people the potential to make lifestyle choices to reduce their susceptibility to disease risk.

An example from Zimbabwe⁶ also illustrates how diseases can have knock-on effects in depriving households of labour during critical periods, in turn exacerbating their vulnerability to climate change.

Table 6: Health and adaptation - research and policy status

Region (reference)	Key findings on research	Key findings on policy
East Africa	<ul style="list-style-type: none"> Climate change will increase burden on overstretched health services Few efforts have been made to project expansion of climate sensitive diseases 	<ul style="list-style-type: none"> Policy is following a disaster management rather than disease prevention mode There is little policy support for development of epidemic prediction models Researcher engagement with policy processes on health and climate change is poor
Central Africa	<ul style="list-style-type: none"> The relationship between vector borne diseases and climate change is poorly studied in Central Africa There is increasing research to understand climate change-HIV/AIDS linkages 	<ul style="list-style-type: none"> Central Africa has a low human capacity in the public health domain Climate change is not yet fully integrated in health sector policy
Southern Africa	<ul style="list-style-type: none"> Most models to project health effects of climate change are limited to a few infectious diseases, thermal extremes and air pollution 	<ul style="list-style-type: none"> Incorporation of climate change in health policies is inadequate in most countries in the region No comprehensive strategies for managing the health impacts of climate change have been developed
West Africa	<ul style="list-style-type: none"> Strong associations have been made between higher temperature and daily mortality, particularly for under-five children There is evidence of links between livelihoods and each measure of malnutrition Links between climate change and HIV/AIDS are becoming the subject of increasing concern and study 	<ul style="list-style-type: none"> Despite most NAPAs considering health one of the key sectors, there are very few comprehensive health-vulnerability plans Only 4% of funds are allocated to the health sector

5.3 Key policy findings

In climate change policies and strategies, potential health effects typically figure among the top priority areas across SSA. For example, South Africa's National Climate Change Response Strategy (DEAT 2004) identified the Health Sector as a key adaptation sector, and suggested a number of important interventions such as reducing the incidences of respiratory diseases and efforts to improve air quality, recognising that nutritional status of individuals is key to building resilience.

However, implementation is typically lacking. For example, in West Africa, Doumbia et al. (2014) note that while nearly all NAPAs in the region considered that climate change could have significant impacts on the health sector, less than a quarter of the NAPAs had a comprehensive vulnerability assessment in the health sector. The authors also note that even though the Least Developed Countries Fund (LDCF) has approved the largest volume of adaptation finance for Africa, only a small share of these (four percent) have gone to health, and of the West African countries only Ghana, Nigeria and Senegal are among the top ten recipient countries. A barrier to effective responses is also noted in the fact that adaptation policies in most countries are based on

a disaster management approach rather than prevention (Githeko et al. 2014).

In health sector policies, integration of climate change is missing. Most countries in SSA have health policies, but few have incorporated climate change considerations into their implementation. Apart from the major diseases noted above, the health sector has been slow in linking climate change and variability to other diseases (Githeko et al. 2014). In other cases climate change is recognised as a threat to the health sector, but without any comprehensive strategy for managing these impacts (Amis et al. 2014). Examples of countries which have made progress toward integration include South Africa, Cameroon and Gabon. Zimbabwe was noted as an example of a country which acknowledges in its national health strategy that climate change may increase the country's disease burden (Amis et al. 2014).

At the regional level, SADC has a Protocol on Health, which is a legal instrument for coordinating and harmonising health sector activities in the region, as well as a Health Policy Framework, which aims at raising "the regional standard of health through promoting, coordinating and supporting member states to improve access to high impact health interventions" (Amis et al.

2014: 29). The authors note, however, that while the framework recognises climate change as a threat, particularly in relation to desertification, it does not state explicitly what the links between health and climate change are.

5.4 Gaps and recommendations

The reviews demonstrate considerable research evidence on the sensitivity of key diseases to climate change and variability, particularly malaria and Rift Valley fever. At the same time, several research and policy gaps remain.

On the research side, a clear gap seems to be in the focus to date on a few major diseases (malaria, Rift Valley fever, meningitis), and there is an urgent need to expand the range of diseases that are considered. Even though some robust models have been developed that project health effects of climate change, most of these models are still limited to a few infectious diseases, thermal extremes and air pollution (Amis et al. 2014). Knowledge is also lacking on the prediction of likely geographic range expansion of climate sensitive diseases, and early warning systems have been proposed to correct for this (Githeko et al. 2014).

For example, knowledge on the relationship between vector borne diseases and climate change still appears patchy. There is also little, albeit increasing research on the direct and indirect linkages between climate change and HIV/AIDS. Doumbia et al. (2014) discuss the proposal for an Early Warning Rapid Response System (EWRRS) for HIV/AIDS, based on the concept of hotspots. The authors note that as hotspots often follow specific patterns, there is potential to project their occurrence and development, which could be a significant and useful input to HIV/AIDS early warning systems.

There are also several gaps on policy, including update of research evidence. Despite health being a key priority in national adaptation policies, few health and climate change projects have been implemented. Climate change is often not integrated in health sector policies. Policy support is lacking, e.g. for the development of epidemic prediction models, for reasons of lack of awareness, capacity and funding. To link research to policy and practice, it is important to establish collaborative partnerships with climate and environment services and research communities, to overcome policy and institutional barriers and identify opportunities for the effective use of climate information in public health policy and decision-making. One example that was noted was 'National Policy Dialogues' in Senegal, Ghana and Nigeria. These initiatives are designed to address the need for better communication at the science-policy interface on climate change issues. The dialogues bring together participants from many countries, and may include members of parliament; natural resource management professionals; senior management and officials from various ministries, departments and agencies; media; members of the university and academic

community; and local and international non-governmental organisations.

Githeko et al. (2014) notes that adaptation in the health sector is hampered by the health sector being programmed to be in a 'disaster management' – and rapid response – mode, rather than having a prevention (early warning) mindset.

Many reviews also stressed the need for more focus on a gender-sensitive approach to interventions on climate and health in cross-sectoral disaster risk reduction and preventive health strategies.

Finally, there is as yet little formal recognition of the contribution of local knowledge in health policies. There are significant gaps in the integration of the contributions of local health personnel as well as local knowledge to climate change adaptation. In the Southern African region review, Amis et al. (2014) notes that although there is wide recognition of how communities across the region depend on traditional medicines, it is as yet unclear whether and how these may be mainstreamed into adaptation policies or strategies in the health sector.

See table 7 for a summary of research and policy recommendations from the regional reviews.

6 Conclusions and reflections

The reviews demonstrate an increasing knowledge base on how people and societies are responding to changes, and signs of emerging best practice and lessons to support adaptation. Importantly, they also show an increasing regional research capacity. On the other hand, they highlight the gaps in research, policy and research-policy linkages that still remain, and the need for more resources for research, awareness raising and capacity strengthening to tackle these.

For example, In Central Africa, Ngeve et al. (2014) argue that a perception among key actors that 'climate change is for the future' puts it low on the political agenda. The authors suggest that many actors, including policymakers, are not convinced that climate change is a real problem. Even those who are aware of climate change impacts do not necessarily see why there is a need for adaptation to an uncertain future amidst other pressing concerns. This highlights the need not only for awareness raising of the reality and importance – in combination with other stressors – of climate change, but also for development of tools and methods for robust decision-making under uncertainty.

6.1 Knowledge gaps

Knowledge gaps range from technologies to tackle expected changes in climate patterns (agriculture, health), vulnerability assessments to map changes in risks, and mapping of social groups and their changing abilities to tackle change (e.g. urban and health reviews).

Table 7: Health and adaptation - research and policy recommendations

Region	Key recommendations
East Africa	<ul style="list-style-type: none"> • Build capacity of health personnel with skills to use climate information, and improve application of tools such as predictive and spatial models • Improve interaction between researchers, practitioners and policymakers to increase knowledge sharing and implementation of adaptive strategies • Increase research funding to support development of predictive tools, monitoring the climate risks and disease surveillance • Develop models on how meteorological parameters modulate the rate of disease transmission • Build capacity to develop a critical mass of experts on climate change and health • Increase the policy space and capacities in evaluating the risks posed by climate change
Central Africa	<ul style="list-style-type: none"> • Build capacity in interdisciplinary and multi-sectoral domains to strengthen research and health systems and the integration of the policies • Strengthen community-based organisations to develop locally owned sustainable strategies for adaptation, taking account of local knowledge • Promote gender-sensitive approaches to interventions on climate change and health
Southern Africa	<ul style="list-style-type: none"> • Develop and test approaches to effectively quantify the current impact of climate change on a range of diseases • Develop longitudinal health data to ensure effective attribution of adverse health outcomes to observed climate trends • Develop health-impacts models for projecting climate change-related impacts under different climate and socio-economic scenarios • Take climate change into consideration at all stages of the project conceptualisation and implementation • Investigate the projected costs of climate change related impacts on the health sector
West Africa	<ul style="list-style-type: none"> • Develop a cross-disciplinary research agenda to enhance understanding of the health effects of climate change in different eco-climatic settings • Strengthen the health system and improve the surveillance of disease and mortality in climate sensitive regions • Establish collaborative partnerships with climate/environment services and research communities to overcome policy and institutional barriers and identify opportunities for effective use of climate information in public health policy and decision-making

Returning to the adaptation intervention ‘pyramid’ introduced at the outset, it is clear that all layers are covered in the reviews, from specific technologies suited to a changing climate (e.g. seeds, agricultural inputs), systems for risk monitoring and vulnerability mapping (early warning mechanisms for epidemics, insurance systems for pastoralists), through to structural challenges to reduce vulnerability (policy and institutional coordination, resource access of the poorest).

The reviews demonstrate the complementary nature of these layers, and the fact that none of them are sufficient on their own. Arguably, tackling only the top end of the pyramid would raise obvious questions about the uncertainty of climate projections, and the appropriateness of the suggested responses. Even in cases where climate projections are strong, improving the availability of options may not necessarily improve access and ability to use resources by the most vulnerable groups unless underlying structural development constraints are tackled. Likewise, focusing on the bottom layer exclusively would not only risk ignoring climate change considerations, it could also lock societies into maladaptive pathways that it would be very difficult and expensive to change later on.

6.2 Policy gaps

First, most reviews stressed the need for *more attention to climate change in sector-specific policies*. Reviews noted that there were little if any focus on climate change in major policy documents and instruments, for reasons such as lack of awareness, capacity and political leadership. Again, this suggests that there are considerable challenges in ensuring better integration of climate change into sector policies to strengthen adaptive capacity, for example in making urban planning processes better at considering climate resilience goals, as well as better integration and coherence across sectors.

Second, and importantly, *ensuring strong uptake of research evidence* is an area with significant gaps. Several of the reviews highlighted the need for better coordination both within research and professional communities, and between research and policy. There is a need to acknowledge complexities in policy processes, including the non-linearity and multiple entry points for research engagement. In the same vein, researchers must stop seeing themselves as completely separate from policy contexts, and engage with a wider audience, at earlier stages in research processes.

Table 8: Gender in the thematic reviews: Examples of points raised

Key arguments on gender	Key gaps and recommendations
<ul style="list-style-type: none"> • Women framed as victims: A number of the reviews talk about women and girls as particularly vulnerable due to traditional roles and labour division • Despite increasing focus, gender still remains a 'missing voice' in research and policy • South Africa integrates gender in policy documents on adaptation (Joshua et al. 2014) 	<ul style="list-style-type: none"> • There is only marginal focus on gender in national policy responses (Joshua et al. 2014) • It is important to recognise women as powerful agents of change and ensure they are fully integrated into climate change mitigation and adaptation strategies at all levels (Doumbia et al. 2014) • Adaptation options targeting women have addressed women's practical needs but not their strategic interests (Rhodes et al. 2014)

Third, there is a great need for *addressing crosscutting concerns such as water resources and gender*. For example, water shortage is highlighted as particularly important as it adds to burdens and exposes households to increased disease risks. The need to tackle gender issues was stressed in most reviews, and across all areas and regions. The key role of water for health, agriculture and in urban areas was also stressed by many. Table 1 summarises some key points that were highlighted on these. The table illustrates that by and large, gender is framed as an issue of women and children, and there is a tendency towards a 'victim focus', which many argue is only part of the picture, and in some cases is counterproductive and potentially disempowering (e.g. Okali and Naess 2013). Some reviews highlighted the need for not only promoting functional needs of women (labour, reduced work pressure) but also strategic needs, such as increased participation in decision-making processes and control over resources.

The reviews have demonstrated considerable challenges within the three themes and sectors, and the synthesis has also highlighted the need for policy coherence across themes. While a theme or sector-wise approach is justified as a starting point, it is clear that broader reviews also need to be undertaken, considering cross-theme linkages as well as interactions, synergies and trade-offs between goals for adaptation, development and mitigation. The link between the three is clearest in the agriculture sector with the raise in attention to 'climate smart' agriculture, but such considerations are also key to urban planning (infrastructure and energy, for example) and the health sector (such as implications of changes in energy fuels).

In addition to throwing light on the status of research and policy including gaps, AfricalInteract has during the process of conducting the studies also made considerable contributions in fostering interaction and dialogue

between researchers and policymakers across the regions in sub-Saharan Africa. This apparent growing relationship should be supported to ensure that the respective regional and continental policies are effectively informed by the findings and options proposed. It is, however, assumed that this synthesis is by no means exhaustive but has certainly provided basis for further updating in due course. Moreover, even though these reviews may represent one of the very few efforts that has attempted to have such in-depth and multi-sectoral consideration, the coverage of other relevant sectors could be of added value.

End Notes

- ¹ Autonomous adaptation is defined by Agard and Schipper (2014: 3) as 'adaptation in response to experienced climate and its effects, without planning explicitly or consciously focused on addressing climate change'.
- ² The reviews complements earlier reviews such as Crawford et al. (2011), Hove et al. (2011) and Kissinger et al. (2013).
- ³ Urbanisation is here understood to mean the increase in the proportion of national populations living in urban areas.
- ⁴ Defined as agriculture that sustainably increases productivity and resilience, reduces or removes greenhouse gases, and enhances achievement of national food security and development goals (FAO 2010: ii).
- ⁵ AGRHYMET (Agriculture, Hydrology, Meteorology) is a specialized agency of the Permanent Inter-State Committee against Drought in the Sahel. Its headquarters are in Niamey, Niger.
- ⁶ Chaguta (2010), cited in Amis et al. (2014)

References

- Adger, W.N., Agrawala, S., Mirza, M.M.Q., Conde, C., O'Brien, K., Pulhin, J., Pulwarty, R., Smit, B., and Takahashi, K. (2007) 'Assessment of Adaptation Practices, Options, Constraints and Capacity', in *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge, UK: Cambridge University Press
- Agard, J. and Schipper, L. (2014) 'WGII AR5 Glossary', in *Climate Change 2014: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge, UK: Cambridge University Press
- Amis, M.A., Jalloh, A. and Hachigonta, S. (2014) *Review of Research and Policies for Climate Change Adaptation in the Health Sector in Southern Africa*, Brighton, UK: AfricalInteract/Future Agricultures Consortium
- Béné, C., Godfrey-Wood, R., Newsham, A. and Davies, M. (2012) *Resilience: New Utopia or New Tyranny? Reflection About the Potentials and Limits of the Concept of Resilience in Relation to Vulnerability Reduction Programmes*. IDS Working Paper 405, Brighton, UK: Institute of Development Studies
- Bicknell, J., Dodman, D. and Satterthwaite, D. (eds) (2009) *Adapting Cities to Climate Change: Understanding and Addressing the Development Challenges*, London, UK: Earthscan
- Brittaine, R. and Lutaladio, N. (2010) *Jatropha, a Smallholder Bioenergy Crop: The Potential for Pro-Poor Development*. Integrated Crop Management Bulletin 8-2010, Rome, Italy: Food and Agriculture Organization
- Chinsinga, B., Chasukwa, M. and Naess, L.O. (2012) *Climate Change and Agricultural Policy Processes in Malawi*. FAC Working Paper, Brighton, UK: Future Agricultures Consortium
- Crawford, A., Hove, H. and Parry, J-E. (2011) *Review of Current and Planned Adaptation Action: Middle Africa*, Winnipeg, Canada: International Institute for Sustainable Development Adaptation Partnership
- DEAT, 2004. A National Climate Change Response Strategy for South Africa. Pretoria, South Africa: Department for Environmental Affairs and Tourism
- Doumbia, S., Jalloh, A. and Diouf, A.G. (2014) *Review of Research and Policy for Climate Change Adaptation in the Health Sector in West Africa*, Brighton, UK: AfricalInteract/Future Agricultures Consortium
- Githeko, A.K., Jalloh, A. and Mogaka, H. (2014) *Review of Research and Policy for Climate Change Adaptation in the Health Sector in East Africa*, Brighton, UK: AfricalInteract/Future Agricultures Consortium
- Hedger, M. (2011) *Agriculture and Climate Change in the UN Climate Negotiations*. FAC Policy Brief, Brighton, UK: Future Agricultures Consortium
- Hove et al. (2011) *Review of Current and Planned Adaptation Action: East Africa*, Winnipeg, Canada: International Institute for Sustainable Development Adaptation Partnership
- Joshua, M., Jalloh, A. and Hachigonta, S. (2014) *Review of Research and Policy for Climate Change Adaptation in Urban Areas in Southern Africa*, Brighton, UK: AfricalInteract/Future Agricultures Consortium
- Keeley, J. and Scoones, I. (2003) *Understanding Environmental Policy Processes: Cases from Africa*, London, UK: Earthscan
- Kissinger, G., Lee, D., Orindi, V.A., Narasimhan, P., King'uyu, S.M. and Sova, C. (2013) *Planning Climate Adaptation in Agriculture. Meta-Synthesis of National Adaptation Plans in West and East Africa and South Asia*. CCAFS Report No. 10, Copenhagen, Denmark: CGIAR Research Program on Climate Change, Agriculture and Food Security
- Liwenga, E.T., Jalloh, A. and Mogaka, H. (2014) *Review of Research and Policy for Climate Change Adaptation in the Agriculture Sector in East Africa*, Brighton, UK: AfricalInteract/Future Agricultures Consortium
- Maina, I., Newsham, A. and Okoti, M. (2013) *Climate Chaos, Policy Dilemmas: Agriculture and Climate Change in Kenya*. FAC Working Paper 70, Brighton, UK: Future Agricultures Consortium
- Mapfumo, P., Jalloh, A. and Hachigonta, S. (2014) *Review of Research and Policy for Climate Change Adaptation in the Agriculture Sector in Southern Africa*, Brighton, UK: AfricalInteract/Future Agricultures Consortium
- McGray, H., Bradley, R. and Hammill, A. (2007) *Weathering the Storm: Options for Framing Adaptation and Development*. Washington, DC: World Resources Institute
- Mubaya, C.P., Jalloh, A., and Mogaka, H. (2014) *Review of Research and Policy for Climate Change Adaptation in Urban Areas in East Africa*, Brighton, UK: AfricalInteract/Future Agricultures Consortium
- Ngve, J.M., Jalloh, A. and Ndjatsana, M. (2014) *Review of Research and Policy for Climate Change Adaptation in the Agriculture Sector in Central Africa*, Brighton, UK: AfricalInteract/Future Agricultures Consortium
- Ngigi, S.N. (2009) *Climate Change Adaptation Strategies: Water Resources Management Options for Smallholder Farming Systems in Sub-Saharan Africa*, New York, NY: The MDG Center for East and Southern Africa, Earth Institute of Columbia University

- Niang, I. and Ruppel, O.C. (eds) (2014) 'Africa', in *Climate Change 2014: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge, UK: Cambridge University Press
- Okali, C. and Naess, L.O. (2013) *Making Sense of Gender, Climate Change and Agriculture in sub-Saharan Africa: Creating Gender-Responsive Climate Adaptation Policy*. FAC Working Paper 57, Brighton, UK: Future Agricultures Consortium
- Rhodes, E.R., Jalloh, A., and Diouf, A. (2014) Review of Research and Policy for Climate Change Adaptation in the Agriculture Sector of West Africa, Brighton, UK: AfricaInteract/Future Agricultures Consortium
- Sanni, M., Jalloh, A., and Diouf, A. (2014) *Review of Research and Policy for Climate Change Adaptation in Urban Areas of West Africa*, Brighton, UK: AfricaInteract/Future Agricultures Consortium
- Sarpong, D.B. and Anyidoho, N.A. (2012) *Climate Change and Agricultural Policy Processes in Ghana*. FAC Working Paper 46, Brighton, UK: Future Agricultures Consortium
- Sathertwaite, D., Huq, S., Reid, H., Pelling, M. and Romero Lankao, P. (2009) 'Adapting to Climate Change in Urban Areas: The Possibilities and Constraints in Low- and Middle-Income Countries', in Bicknell, J., Dodman, D. and Sathertwaite, D. (eds), *Adapting Cities to Climate Change: Understanding and Addressing the Development Challenges*, London, UK: Earthscan
- Sogoba, N., Jalloh, A., and Ndjatsana, M. (2014) Review of Research and Policy for Climate Change Adaptation in the Health Sector in Central Africa, Brighton, UK: AfricaInteract/Future Agricultures Consortium
- Suckall, N. Tompkins, E.L. and Stringer, L. (2014) 'Identifying Trade-Offs Between Adaptation, Mitigation and Development in Community Responses to Climate and Socio-Economic Stresses: Evidence from Zanzibar, Tanzania', *Applied Geography*, 46:111-121
- Tanner, T. and Allouche, J. (2011) 'Towards a New Political Economy of Climate Change and Development', *IDS Bulletin*, 42:1-14
- Tanner, T.; Lockwood, M.; Seballos, F. (2012) *Learning to Tackle Climate Change*, Brighton, UK: The Learning Hub, Institute of Development Studies
- WHO, (1948) *Preamble to the Constitution of the World Health Organization as Adopted by the International Health Conference, New York, 19-22 June, 1946*. Official Records of the World Health Organization, No. 2, Geneva, Switzerland: World Health Organization
- Wouapi, N., Jalloh, A., and Ndjatsana, M. (2014) *Review of Research and Policy for Climate Change Adaptation in Urban Areas in Central Africa*, Brighton, UK: AfricaInteract/Future Agricultures Consortium
- Yirgu, L., Nicol, A., and Srinivasan, S. (2013) *Warming to Change? Climate Policy and Agricultural Development in Ethiopia*. FAC Working Paper 71, Brighton, UK: Future Agricultures Consortium

Annex 1: List of regional reviews

Urban areas

Central Africa: Wouapi et al. (2014)
East Africa: Mubaya et al. (2014)
Southern Africa: Joshua et al. (2014)
West Africa: Sanni et al. (2014)

Agriculture

Central Africa: Ngeve et al. (2014)
East Africa: Liwenga et al. (2014)
Southern Africa: Mapfumo et al. (2014)
West Africa: Rhodes et al. (2014)

Health

Central Africa: Sogoba et al. (2014)
East Africa: Githeko et al. (2014)
Southern Africa: Amis et al. (2014)
West Africa: Doumbia et al. (2014)

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