

An overview of nationally appropriate mitigation actions (NAMAs) and national adaptation programmes of action (NAPAs) in Africa

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SUMMARY

The global initiative to manage forests in response to climate change emanated from the seventh and thirteenth Conference of the Parties (COP 7 and 13) under the aegis of the United Nations Framework Convention on Climate Change (UNFCCC). This paper focuses on the role of forests and forestry in adaptation to climate change through NAPAs and in mitigation through NAMAs in sub-Saharan Africa, and is based on a review of published literature and commissioned papers. In general, climate change is now a well-recognized phenomenon in Africa and has been incorporated in environmental policies and strategies in virtually all sub-Saharan countries of Africa. However, the policies of key sectors such as agriculture, infra-structure, energy and others, have not reflected or made practical programmatic adjustments in response to climate change to the extent that the urgency of climate change would suggest. The urgency for adaptation to climate change has spawned a wide interest in NAPAs and in that regard, the majority of projects of country NAPAs are in sectors other than forestry, with a few exceptions in the NAPAs of East and Southern Africa. In mitigation based NAMAs, forestry is predictably dominant through REDD+, even though low carbon prices seem to be a disincentive at the moment. To improve the recognition and practical role of forestry, in climate change adaptation and mitigation, the forest sector at individual country levels, should further articulate evidence-based information on the role of forests in adaptation, target the agriculture sector for tree and forest-based adaptation, raise the profile of the forest sector in poverty reduction, use data for policy advocacy and engage sectors linked to drivers of forest cover change in order to safeguard forest ecosystems against injudicious losses.

Keywords: adaptation, mitigation, climate change NAMAs, NAPAs, REDD+, sub-Saharan Africa

Une vue d'ensemble des actions appropriées d'atténuation au niveau national et des programmes nationaux d'action d'adaptation en Afrique

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L'initiative mondiale pour gérer les forêts en réponse au changement climatique émanait de la septième et treizième Conférence des Parties (CDP 7 et 13) sous l'égide de la Convention Cadre des Nations Unies sur les changements climatiques (CCNUCC). Ce document met l'accent sur le rôle des forêts et la foresterie dans l'adaptation au changement climatique à travers les PANAs et dans l'atténuation à travers les NAMAs en Afrique sub-saharienne, et est basée sur une revue de la littérature publiée et des documents commandés. En général, le changement climatique est maintenant un phénomène bien connu en Afrique et a été intégré dans les politiques et stratégies environnementales dans pratiquement tous les pays d'Afrique sub-saharienne. Cependant, les politiques des secteurs clés tels que l'agriculture, l'infrastructure, l'énergie et autres, n'ont pas reflété ou fait des ajustements programmatiques concrets en réponse au changement climatique au point où l'urgence du changement climatique suggère. L'urgence pour l'adaptation au changement climatique a engendré un large intérêt dans les PANAs, et à cet égard, la majorité des projets PANAs des pays sont dans des secteurs autres que la foresterie, à quelques exceptions près dans les PANAs de l'Afrique orientale et australe. Dans les NAMAs relatifs à l'atténuation, la foresterie est dominante à travers la REDD+, même si les prix faibles d'émissions de carbone semblent avoir un effet dissuasif pour le moment. Pour améliorer la reconnaissance et le rôle pratique de la foresterie en adaptation au changement climatique et l'atténuation, le secteur forestier au niveau des pays individuels, devrait disposer des informations fondées sur des preuves sur le rôle des forêts dans l'adaptation, cibler le secteur de l'agriculture pour l'adaptation basée sur les arbres et les forêts, rehausser le profil du secteur forestier dans la réduction de la pauvreté, utiliser les données pour le plaidoyer politique et engager les secteurs liés aux moteurs de changement du couvert forestier afin de préserver les écosystèmes forestiers contre les pertes inconsidérées.

Una visión general de las acciones nacionales apropiadas de mitigación y los programas nacionales de acción para la adaptación en África

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La iniciativa global para la gestión de los bosques en respuesta al cambio climático surgió de la séptima y la decimotercera Conferencia de las Partes (COP 7 y 13), bajo los auspicios de la Convención Marco de las Naciones Unidas sobre el Cambio Climático (CMNUCC). Este artículo se centra en la función de los bosques y la silvicultura en la adaptación al cambio climático a través de los programas nacionales de acción para la adaptación (NAPA, por sus siglas en inglés) y en la mitigación mediante acciones nacionales apropiadas de mitigación (NAMA, por sus siglas en inglés) en el África subsahariana, y se basa en una revisión de la literatura publicada y artículos comisionados sobre el tema. En general, el cambio climático es hoy en día un fenómeno bien conocido en África, que prácticamente se ha incorporado a las políticas y estrategias ambientales de todos los países del África subsahariana. Sin embargo, las políticas de sectores clave como la agricultura, la infraestructura, la energía y otros, no han reflejado o realizado ajustes programáticos prácticos en respuesta al cambio climático en la medida de la urgencia sugerida por el cambio climático. La urgencia para la adaptación al cambio climático ha generado un amplio interés en los NAPA y, en ese sentido, la mayoría de los proyectos de los NAPA de los países pertenecen a sectores distintos de la silvicultura, salvo algunas excepciones en los NAPA de África Oriental y Meridional. En las NAMA que están basadas en la mitigación, no sorprende que la silvicultura predomina mediante el programa REDD+, a pesar de que los bajos precios del carbono parecen ser un desincentivo en este momento. Para mejorar el reconocimiento y la función práctica de la silvicultura en la adaptación al cambio climático y la mitigación, el sector forestal de cada país debería ofrecer información con base en pruebas más elocuentes sobre la función de los bosques en la adaptación, trabajar con el sector agrícola en la adaptación con base en los árboles y el bosque, promover el sector forestal como medio para la reducción de la pobreza, utilizar datos para la promoción de políticas e involucrar a los sectores vinculados a las causas del cambio en la cubierta forestal a fin de salvaguardar los ecosistemas forestales frente a pérdidas imprudentes.

INTRODUCTION

The issue of climate change has now become topical in Africa, not just because of the global focus and associated debates that have ensued in recent years, but because of the increasing frequency of extreme weather events attributed to climate change, among others (IPCCC 2007, 2014). These have begun to have significant social, economic, political and food security impacts, the nature and extent of which hinders human development and are also a threat to the conservation of biodiversity (Bilcha 2013, Eriksen *et al.*, 2008, IFAD 2011, IPCC 2007a, 2007b, 2007c, IPCC 2012, IPCC 2014). Although climate change effects bear on all countries and the general population, its impact is highly heterogeneous and felt greatly by the resource poor and vulnerable groups, such as those in Africa. The plight of the poor and vulnerable is further exacerbated by the fact that Africa's habitats and ecosystems are currently under threat from a number of stresses which are related to deforestation, land degradation and over-dependence on biomass for energy amongst others (IPCC 2007b). Anthropogenic emissions of GHGs are driven by population size, economic activity, energy use, land use patterns, technology and land use, and these drivers vary widely from region to region and continued emissions are most likely to increase global warming which will impact people and ecosystems (IPCC 2014). Climate change therefore represents an important additional stress on the systems that are already affected by increased resource demands, unsustainable management practices and pollution, the effects of which may, at present, be greater than those attributed to climate change. Vulnerability of systems can be viewed in the context to which a natural or social system is subjected to damage from climate change and is a function of the sensitivity of a system to climate change and the ability of the

system to adapt to those changes. For instance, Eriksen *et al.* (2008) and Reid *et al.* (2007) have stated that drought prone countries such as Botswana, Namibia, Ethiopia, Zimbabwe and Sudan have a high risk for vulnerability to climate and as a result should promote adaptation programmes, that respond to realized and anticipated climatic conditions (Boko *et al.*, 2007, Hulme *et al.*, 1996, Hulme *et al.* 2001).

Climate change as a global phenomenon inspired the development of the first international environmental treaty; the United Nations Convention on Climate Change (UNFCCC) in 1992, and a legally binding instrument which was the Kyoto Protocol. Negotiated in Kyoto, Japan, in December 1997, the protocol was open for ratification on March 16, 1998. It was essentially an amendment to the United Nations Framework Convention on Climate Change (UNFCCC), to give quantitative direction to countries to reduce global warming and to cope with the effects of temperature increases that are unavoidable after 150 years of industrialization. The provisions of the Kyoto Protocol are legally binding and countries that ratified it agreed to reduce emissions of six greenhouse gases that contribute to global warming: carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, hexa fluoro carbons (HFCs) and poly fluoro carbons (PFCs). While its achievements have been limited, largely because of countries that did not ratify it such as the United States, the Kyoto Protocol will be succeeded by yet another global agreement expected to be negotiated during COP 21 in Paris, December 2015. In this regard, the UNFCCC process hopes to secure a legally-binding global climate agreement on curbing carbon emissions and be made binding with effect from 2020.

In the global dialogue on possible responses to climate change, whether through adaptation or mitigation, the role of trees, forests and forestry have been recognized and is the cardinal theme of the Bali Action Plan (UN 2007). Trees

and forests absorb atmospheric carbon which is transformed into biomass, a natural process of the 'carbon cycle'. In an age where increased anthropogenic emissions of carbon is considered the premier cause of global warming, the conversion of atmospheric carbon into biomass is a legitimate mitigation mechanism, which if enhanced, could contribute significantly to total emission reductions, since deforestation is responsible for even more emissions than the transport sector (Stern 2007, UNFCCC 2007, UNFCCC 2014). Looking at it from an adaptation perspective, large forest ecosystems that are managed as such, are expected, due to their ecological complexity and perennial nature to be more relatively stable and resilient to change than other ecosystems. In the process they provide habitat and refuge to other species and also provide services such as soil and water conservation, and others, which can be critical for structural or physical adaptation (UNFCCC 2014). Furthermore, trees and forests in intensively managed agricultural systems perennial are expected to be critical in the production of harvestable biomass and other products that are valued by humans and other economic species such as livestock. It is in this context that the role of forests and forestry should be recognized and deliberately enhanced to help adapt to, and mitigate climate change, and as a result, forestry has now become an area of intense global discourse and negotiations.

National adaptation programmes of action (NAPAs) owe their origin to a realization that while the bulk of greenhouse gas emissions associated with climate change are contributed by industrialized countries including some emerging economies, the negative effects of climate change associated with those emissions would disproportionately affect the poor and vulnerable countries, who emit comparatively less than the more industrialized ones. As a consequence of global dialogue on this, a call for developing countries to prepare NAPAs was decided at the seventh session of the conference of parties held in Marrakesh Morocco in 2001. The decision (Decision 27/CP.7) known as "Guidance to an entity entrusted with the operation of the financial mechanism of the Convention, for the operation of the least developed countries fund" was agreed by Conference of Parties (COP 7). Among other things, the NAPAs were supposed to be clearly articulated, easy to understand, be action-oriented and country-driven and set clear priorities for urgent and immediate adaptation activities as identified by the countries.

Nationally appropriate mitigation actions (NAMAs) came out of the Bali Action Plan of 2007 during the 13th Conference of Parties (COP 13) (UNFCCC, 2007). It was agreed that developing countries would be supported through technology transfer, finance and capacity building, in order to manage their forests to mitigate climate change within the context of reduced emissions from deforestation and forest degradation (REDD). In recognition of the legitimacy of sustainable forest management (SFM) to provide multiple benefits, the concept of REDD was modified to include sustainable forest management and the enhancement of carbon stocks, hence the concept of REDD+. Since then the challenge has been to fund REDD+ programmes and in the face of diverging opinions in global dialogue on how international support for NAMAs

should be mobilized and allocated for implementation, developing countries have stressed the need for urgent action and on terms which facilitate simple but effective systems and procedures for accessing funds (Teng 2009, Muller 2009, Zhakata 2009) for purposes of mitigation. In an African context, sub-regions such as southern Africa, have singled out renewable energy and energy efficiency policies as central to global efforts to reduce emissions and feel that increased access to renewable energy and energy efficient technologies should be at the core of any programme to engage developing countries in mitigation efforts (Zhakata 2009).

With specific reference to forests and forestry, Article 2 of the UNFCCC explicitly acknowledges the importance of natural ecosystems for food production and sustainable economic management, as they are considered fundamental to environmental functions and sustainability. Climate change is projected to occur at a rapid rate relative to the speed at which forest species grow, reproduce and re-establish themselves. As a consequence of possible changes in temperature and water availability under increased carbon concentrations in the atmosphere, a substantial fraction of the existing forested area of the world and regionally is likely to undergo major changes with significant changes being experienced in the high-latitude and the least in the tropics (IPCC 2007b). In the tropics, major alterations in forest productivity and species composition will occur because of the seasonal and rainfall amount changes and increased evapotranspiration. It is in this context that forestry practice should also seriously consider adapting both natural and planted forests to changing climates. Despite the realized threats to forests, adaptation options for ecosystems remain limited and their effectiveness is uncertain (IPCC 2007b, 2007c). The available adaptation options for forests and the environment include the establishment of appropriate measures to assist, for example, the migration of ecosystems, land-use management, planting and restoration of degraded areas among others.

This paper describes the general status of NAPAs and NAMAs in the regions of sub-Saharan Africa, discusses some examples from those regions and assesses the extent to which forestry is recognized and incorporated at national levels in adaptation and mitigation programmes and actions. It was based largely on a series of papers commissioned by the Africa Forest Forum in 2012 and 2013 and a review of published literature. While the literature cited has tended to be from authors who have focussed their work in Africa, seminal publications such climate change syntheses prepared by the Intergovernmental Panel on Climate Change (IPCC), including their latest report; Fifth Assessment Report (AR5) of 2014 has also been referenced.

NAPAs IN SUB-SAHARAN AFRICA

In eastern Africa, responses to climate change, including NAPAs are reflected in regional policy processes. In this regard, the East Africa Community (EAC), has developed the Protocol on Environment and Natural Resources Management (EAC 2006), the East African Protocol for the Sustainable

Development of Lake Victoria Basin (EAC 2003), the East African Climate Change Policy (ECCP) of 2010 (EAC 2011a) and East African Climate Change Strategy (EAC 2011b). These regional policies and protocols provide a framework for regional cooperation (Milimo 2013a), but they are only effective to the extent that national policies and programmes recognize the trans-boundary aspects of climate change processes which requires both national actions and international cooperation and concerted actions. In line with these policies, all East African countries have ratified and acceded to the UNFCCC, its Kyoto protocol, and have designated focal points for programs related to the UNFCCC. In addition, some countries have individually developed National Adaptation Programs of Action (NAPAs); an outcome of Marrakesh Accord and declarations in Morocco in 2001, and Nationally Appropriate Mitigation Actions (NAMAs); an outcome of Bali action plan of 2007 (UN, 2007). The ECCP calls for cooperation among countries in response to climate change and recognizes policies and strategies including NAPAs and NAMAs that are already in existence within countries. Examples of these are NAPAs already in preparation by Burundi, Rwanda, Uganda and Tanzania and Kenya's Climate Change Response Strategy. Table 1 shows the overall priority areas for mitigation and adaptation actions in East Africa, indicating the place of forestry in both categories. Ensuing from the regional environmental policy processes, adaptation strategies have been proposed by East African countries for the most vulnerable sectors. Member states such as Burundi, Rwanda, Uganda, and Tanzania have developed their NAPAs. In general, the bulk of the priorities are in energy, infra-structure and agriculture but the forest sector is clearly mentioned in virtually all the NAPAs of the countries in eastern Africa (Viljoen 2013, UNFCCC 2013). For instance, Eritrea has proposed afforestation and agro-forestry through community forestry initiatives and even natural regeneration through enclosures, use of improved wood stoves, conservation and management of highland forest ecosystems (State of Eritrea, 2007).

In response to perceived climate change related challenges in Kenya, the government formulated a National Climate Change Response Strategy and a National Climate Change Action Plan to operationalize the strategy (Government of Kenya 2012, Government of Kenya, 2013), with interventions emanating from socio-economic sectors and a key constitutional provision for the increase of Kenya's forest cover to 10% of its land area. Furthermore, reforestation and rehabilitation of the main 'water towers', and the general restoration of forests on degraded lands, and the development of REDD+ programmes to achieve both NAPA and NAMA have also been elaborated (Government of Kenya, 2013). In Rwanda, areas for adaptation include integrated water resource management (IWRM), systems for early warning, non-agricultural income generating activities, intensive agro-pastoral activities, use of species resistant to environmental conditions and the development of alternative sources of energy, besides fuel wood. Apart from NAPA-RWANDA, other adaptation actions to climate change exist such as annual programmes of reforestation and fight against erosion (Republic of Rwanda 2006). Ethiopia has elaborated its

NAPA, which has a range of adaptation options which were consultatively identified, and in which two forestry projects ranked seventh and eighth are included. The two projects are on Community Based Carbon Sequestration Project in the Rift Valley system in Ethiopia and promotion of farm, home-stead forestry, forest restoration through enclosures and forestry practices in arid, semi-arid and dry sub-humid parts of Ethiopia at priority (Government of Ethiopia, 2007, Federal Democratic Republic of Ethiopia 2011). In Burundi, options selected include safeguarding existing woodlots and reforestation of stripped areas and promotion of drought resistant forest species. Additionally, enhancing the management of existing protected areas and to proclaim natural ecosystems identified as threatened or vulnerable as protected areas (Republic of Burundi, 2007).

In southern Africa, the Development Commission (SADC) promotes regional cooperation in environmental management, economic and political development. With specific reference to forestry and its functional links with climate change mitigation and adaptation, the SADC Treaty of 2005 enabled the development of the SADC Protocol on Forestry 2009, which was thereafter followed by the SADC Forestry Strategy of 2010 as important policy documents for the sector. Southern Africa states, with frequent incidences of droughts in countries such as Botswana, Namibia are aware of the potential economic impacts of climate change (Mfune *et al.*, 2009, Midgely *et al.*, 2005), including the vulnerability of the islands off the coast of Eastern Africa. In line with this, virtually all the countries in southern Africa have ratified the UNFCCC, its Kyoto protocol and have submitted at least one national communication to the UNFCCC. In these countries, most policies are geared towards co-ordination and proper management of the environment and the natural resource base in collaboration with line ministries or departments, the private sector, NGOs, select committees and other relevant stakeholders down to the local levels. This participatory approach is a major strength of these policies. Some of the countries have established national climate change committees to advice on and oversee the implementation of climate change activities.

In general, NAPAs in most of the Southern Africa region, like others have also spelled out actions that will facilitate adaptation to the impacts of climate. These have been developed for the various economic sectors such as agriculture, water resources, forest and land use sector, health sector, coastal resources. For example, countries of southern Africa such as Angola, Malawi, Lesotho and Zambia which have submitted their NAPAs to the UNFCCC, have put priority on early warning systems, disaster preparedness, infra-structure and agriculture (UNFCCC 2013). However, in each of them there are direct forestry or forestry related projects proposed as legitimate climate change adaptation programmes. In addition, all the CDM Projects in SADC are in energy efficient programmes; hydro-power, waste heat recovery, solar PV and wind-power projects and none on forestry. In Lesotho, for example, afforestation meant to rehabilitate degraded rangelands, often on steep slopes, is a major and politically recognized approach (Kojwang 2010a, Kojwang 2010b).

TABLE 1 *Priority areas for adaptation and mitigation actions in East Africa (EACCP 2011)*

Adaptation Actions	Mitigation Actions
Improve water efficiency, conservation and sustainability	Increase, availability accessibility and reliability and affordability of renewable energy resources
Develop agricultural productivity and food security	Decrease greenhouse gases (GHGs) associated with the transport sector by promoting public transport systems
Develop harmonize and adopt common policies, laws, for conservation and sustainability of wildlife	Support the sustainable development needs of Member States in the forest sector
Enhance the adaptive capacity and resilience of coastal and marine ecosystems, communities and infra-structure	Promote sustainable agricultural practices
Create sustainable land use and soil management practices	Promote waste management for improved air and water quality
Promote sustainable use of forestry and wetlands	
Reduce the vulnerability of human beings to climate sensitive diseases and enhance the adaptive capacities in the health sector	
Ensure resilient tourism infra-structure and ensure climate proofing of wildlife habitats	
Develop climate proof infra-structure	
Develop climate resilient human settlements	
Employ disaster risk reduction to reduce the vulnerability of socio-economic systems to climate related disasters	

Faced with its hilly terrain and fragile soils which are erosion prone, the Government through the Parliament has put a high priority on land rehabilitation and in that regard, the ministry mandated to implement its forestry policy has been reorganized and renamed Ministry of Forestry and Land Reclamation. In South Africa, genetic engineering is being used to develop more fire and drought tolerant varieties or tree provenances which would allow the forestry industry to counter the threat of climate change and also maintain current production areas (Kojwang 2010a). Other country NAPA processes in which forestry has been recognized include Malawi, Mozambique, Zambia, Seychelles (Chadza *et al.*, 2011, Republic of Malawi 2011, Government of Seychelles 2000, Republic of Mozambique 2003, Kojwang 2010a).

Eastern and southern Africa are further linked through the Common Market of East and Southern Africa (COMESA) which has in recent times developed a climate change programme in the interest of the region and the countries it serves. Of particular note is the Tripartite Agreement that COMESA has co-signed with the EAC and SADC, hence the name EAC-COMESA-SADC Tripartite Agreement for the Implementation of the Programme on Climate Change Adaptation and Mitigation in east and southern Africa (COMESA-EAC-SADC 2011):

The West African Region and the Sahel, present a mixture of different levels of participation in climate change mitigation and adaptation through forest related policies and activities (Milimo 2013b). Out of a total of 18 countries, 11 countries which have relatively low forest cover such as Burkina Faso, Mauritania, Niger, Chad, are also classified as

Least Developed Countries (LDCs). Some afforestation and reforestation programmes have been recognized as National Adaptation Programmes of Action (NAPAS) under UNFCCC rules, particularly in the Sahelian Belt (Locatelli *et al.*, 2008, Okali 2013), possibly because of the recognized role of trees in environmental amelioration associated with soil stabilization, shade, habitat, and production fuelwood and fodder. With respect to preparing NAPAs, the countries seem to prefer climate change adaptation programmes through NAPAs and much less for mitigation actions (Okali 2013). This is evident from the fact that all 18 countries have prepared NAPAs and only 6 have prepared NAMAs as well. Among the NAPAs, forestry is not as eminent as it is in other regions. The exceptions to this include countries such as the Gambia, Ghana, Ivory Coast, Nigeria, Sierra Leone and Senegal which have prioritized forestry in their NAPAs and also NAMAs. Senegal, being a relatively dry country has an interesting proposal which calls for increased tree cover, by way of hedge rows of boundary plantings around its groundnut fields. The expected mitigation benefits, explained in its second National Communication to the UNFCCC is an estimated 27,967, 500 tons of carbon over a 20-year period and a wood equivalent of 900,000 m³ or 30 m³ per hectare on land that has been previously bare (<http://unfccc.int/resource/docs/natc/sennnc2.pdf>). The example from Senegal illustrates how forestry can provide both adaptation through environmental amelioration in a farmed landscape, and mitigation through carbon stock enhancement and appears to be an initiative that is worth emulating and multiplied in the region, particularly in the Sahel. This illustrates the linking of climate change adaptation

and mitigation through agro-forestry (Verchot *et al.* 2007). A general observation that has been made is that West Africa still needs to mainstream adaptation programmes into national development policies (<http://www.gcca.eu/intra-acp/gcca-regional-programme-for-western-africa>).

In the ECCAS Region or Central Africa, a number of countries such as Equatorial Guinea, Gabon and Cameroon, are not considered least developed and therefore have not received support from international organizations to develop National Adaptation Programs of Action (NAPAs), but instead have received support under the African Adaptation Programme (AAP) run by UNDP (Donfack, 2013, Milimo 2013b, UNDP/Japan ODS, 2010). However, a number of Central African countries, namely Central Africa Republic (CAR), the Democratic Republic of Congo (DRC), Sao Tome & Principe, and Chad, qualify for adaptation funds for their NAPAs. In general, the countries of Central Africa, being in the Congo Basin endowed with relatively high forest cover, have been targeted for support by the international community to enable them to manage their forest cover more for mitigation, than adaptation purposes. One however hopes that this greater focus on mitigation will not inadvertently prejudice their own needs on adaptation to climate change.

NAMAs IN SUB-SAHARAN AFRICA

In Eastern Africa, deforestation and forest degradation are well recognized problems and in addition to other land uses, are the key sources of GHG emissions, even though the forests of Kenya, Ethiopia and also Uganda, are reported to be net sinks of carbon (Milimo 2013, Government of Kenya 2002, Government of Ethiopia 2001). In Tanzania for example, land use, land use change and forestry (LULUCF) as in many other countries of Africa, remains the biggest source of GHG emissions accounting for 87% of all emissions in 1990 (Government of Tanzania, 2007) and in Sudan, emissions from the forest sector exceed sequestration, as is in Burundi and Eritrea (Republic of Burundi 2007, State of Eritrea, 2007). Eritrea, in response, has an ambitious plan to rehabilitate over 17, 000 ha of degraded forests. These facts, in addition to pressures of growing populations and others to a large extent, have provided the motivation for the countries to develop climate change mitigation through improved forest management and the creation of new forest resources. In this regard, countries such as Ethiopia, Uganda, Sudan and Tanzania have joined the World Bank FCPF and UN-REDD processes to develop national REDD+ Programmes as is the case for both Kenya and Ethiopia (Government of Ethiopia 2007 and 2011, Government of Tanzania, 2009, Republic of Uganda, 2007). In line with their commitment under the convention to reduce GHGs in the atmosphere, the countries have outlined and or proposed mitigation strategies in their NAMAs. Prioritized in these policies are afforestation, reforestation, and promotion of energy efficiency, efficient crop and livestock production systems, efficient transport systems, and waste management. In Kenya's proposal to the FCPF of the World Bank, improved governance of the forest sector,

reducing pressures on forests and increasing tree cover to 10% of its land surface are emphasized (Government of Kenya 2010). In Ethiopia, mitigation actions in the forestry sector, includes, plantations, agroforestry, area enclosures for natural recovery, participatory forest management and forest-based Clean Development Mechanisms (CDM) projects (Government of Ethiopia, R-PP 2011). In Tanzania, a National REDD+ Programme with 10 result areas has been drafted and in addition a National Carbon Monitoring Centre, housed at Sokoine University of Agriculture (SUA) has been set up (Government of Tanzania R-PP, 2010).

In southern Africa, the land use sector (LULUCF) emits significant quantities of GHG with emissions that outweigh sinks even though energy sector remains the largest emitter of carbon dioxide. If well managed though, this sector can also provide mitigation services. In Zambia for example, LULUCF emitted 59398 Gg of GHG in 1994 (Republic of Zambia, 2009), 87% of which came from on-site burning. In Namibia, the sector emitted 10560 Gg of GHGs in 2000 (Republic of Namibia, 2011) while in Mozambique the sector emitted some 7679540 tCO₂ in 1994 (Republic of Mozambique 2003). In Malawi, LULUCF was the major source of CO₂ emissions in 1994 as it generated 18528 Gg of CO₂ while in Seychelles the sector emitted some 18528 tons of GHG in 1994 (Government of Seychelles 2000). In Lesotho, LULUCF was the largest emitter in 1994 accounting for 39% of the country's total GHG emissions. In view of emissions emanating from forestry and other land use sectors, southern African countries such as Lesotho and South Africa and virtually all in the sub-region have developed national papers on climate change adaptation and mitigation. In addition, countries such as Madagascar, Mozambique, and Zambia are developing their forest based mitigation through REDD+ and in so doing, have joined the World Bank, Forest Carbon Partnership Fund (FCPF) and UN-REDD respectively. South Africa, Lesotho, Namibia Swaziland have official policies on climate change adaptation that are not restricted to forestry (Mfune *et al.*, 2009). In Malawi, a number of community based afforestation and reforestation programmes serve both mitigation and adaptation purposes. Mozambique is in the process of developing its national REDD+ Programme, in addition to private sector investments in plantations, which will offer carbon offset (www.greenresources.no) in the voluntary carbon markets. Virtually all the countries have identified afforestation and reforestation as a major mitigation strategy while others have identified creation of communal forests as an additional option (Dlamini 2012). Angola has proposed management of national humid zones, rehabilitation of parks and national reserves as strategies to curb emissions from the sector and has also earmarked particular provinces for afforestation and reforestation (*Republic of Angola undated*). Swaziland has embarked on increasing the area covered by trees and intends to increase to 218000 ha by 2030 while that of woodland will be increased to 133000 ha by the same year (Republic of Swaziland, 2012). Arid and semi-arid Botswana wants to bring forested areas under management, some of which will be achieved by afforestation, to 1086 000 ha by 2030 (Government of Botswana 2001). It had also planned

to reduce by 70% the area subjected to wild fires through establishment of fire breaks around new fields by 2005, and through improved wood stoves which would be 30–40% more efficient than traditional ones. Botswana is also replacing wooden fencing posts with steel fence and droppers thereby sparing the wood and forest land. South Africa has planted an additional 330000 ha, and the increased cover is expected to reduce the total emissions by 116000 Gg CO₂e (Republic of South Africa, 2011). Angola, Namibia, Malawi and South Africa have additionally proposed to reduce emissions from the sector via ‘savanna thickening’, essentially the protection and management of savannas to increase their carbon stocks and control of wild fires that contribute immensely to the GHG emissions. South Africa estimates that if ‘savanna thickening’ is promoted to over 40% of the current total area, emissions will be reduced by 237000 Gg CO₂e (Republic of South Africa 2011). The Seychelles has proposed a unique pathway to mitigation, by reclaimed land from the sea that will be used to build residential houses (Republic of Seychelles, 2000) and thereby reduce encroachment on forest. It must be noted however that efforts of many countries in adaptation and mitigation of climate change are still in the early stages of policy and strategy development. South Africa and Lesotho have however developed clear national papers on climate change adaptation and mitigation.

West African countries with the exception of Burkina Faso, Ghana, Liberia, Nigeria, have tended to prepare climate change adaptation programmes through NAPAs and much less for mitigation actions through NAMAs. This is evident from the fact that all 18 countries have prepared NAPAs and only 6 have prepared NAMAs as well (Okali 2013). This preference could be motivated by more frequent extreme weather events such as floods, droughts and erratic rainfall patterns, which call for mechanisms to adapt production to protect their vulnerable populations. Countries such as the Burkina Faso, Gambia, Ghana, Ivory Coast, Nigeria, Sierra Leone and Senegal have included forestry in their NAPAs and NAMAs. As already stated in the preceding section, Senegal has proposed an interesting case in which forests are used for both adaptation and mitigation in a farmed landscape (<http://unfccc.int/resource/docs/natc/senn2.pdf>). Furthermore, Burkina Faso, Ghana, Nigeria, Liberia have joined the FCPF and initial support for REDD+ in Nigeria was supported by UN-REDD.

The countries in Central Africa have the distinction of being the home of the Congo Basin Forests; the second largest formation of the Tropical Rain Forests of the world. The global significance of the forests and development needs of the member states of the Congo Basin is what has brought together the countries which formed the Central African Forestry Commission or COMIFAC (de Wasseige *et al.*, 2010) to manage the forests through concerted and coordinated actions supported by a collaborative framework, also represented by the Central African Forest Convergence Plan. Given the relatively high forest cover in each of the countries, international pressure has tended to steer the countries of Central Africa towards mitigation through REDD+ (Donfack 2013, Olufunso *et al.* 2011) as already stated and six countries namely, Cameroon, CAR, Congo, DRC, Equatorial

Guinea and Gabon (Mhuedd 2011) have elaborated forestry based NAMAs. Of these, the first five countries are participating in the World Bank funded Forest Carbon Partnership Facility (FCPF), and Gabon, which has not joined the FCPF, is developing its own programme on forest based mitigation, even though it has a very low rate of net deforestation (de Wasseige *et al.* 2010, Mhuedd 2011).

OBSERVATIONS ON THE NAMAs AND NAPAs IN SUB-SAHARAN AFRICA

As already stated, all sub-Saharan countries recognize adaptation as an issue but in most countries it has not filtered from overall environmental policies down to the policies of sectors that should directly implement adaptation measures. Discourse on climate change also seems to be more active at international fora particularly at climate change negotiations but the same level of dialogue seems to be limited in national discussions, particularly among the sectors sensitive to climate change or those whose programmes can influence vulnerability.

Overall, the majority of projects within the NAPAs of countries are in energy, early warning systems, disaster reduction, food security and coastal protection. In West Africa, forestry is not explicitly strong in a majority of the countries’ NAPAs (Okali 2013), but in East and Southern Africa forestry is present in virtually all the NAPAs, even though it is not given high priority. Despite this, the resilience of large forest ecosystems to disturbance and their functions as habitats and refuge for dispersing flora and fauna is a legitimate reason why forestry should be at the core of any NAPA. Obviously there is ample opportunity for the forest sector to be more visible in adaptation programmes of individual countries.

At a national scale, one of the best examples of forest based adaption, with mitigation benefits in the dry zones of Africa is the programme that Senegal has elaborated in which the expected benefits of increasing tree cover in agricultural fields is an estimated 27,967, 500 tons of carbon over a 20-year period and a wood equivalent of 900,000 m³ or 30 m³. hectare⁻¹ on land that has been previously bare. The Senegal example offers an example in which mitigation is linked to food security and sustainable land management in general and it is in this context that agro-forestry can be applied both in mitigation and adaptation since trees on farm land also ameliorate farm lands under cultivation with annual crops. Lesotho also values increases in tree cover to rehabilitate its degraded pastures on steep terrain and provides an example where tree cover is valued much less for its timber than for its protective functions. On another aspect of adaptation, South Africa and Sudan (Government of Sudan, 2007, Kojwang 2010a) have recognized the importance of adaptation to safeguard their industrial timber and gum Arabic plantations respectively, despite the fact in South Africa the industrial plantations are based on exotic tree species, as opposed to *gum Arabica* that is indigenous to Sudan. In Africa and elsewhere, forest based adaptation and adaptation of forest

ecosystems to climate change is recognized (Seppala *et al.*, 2009, Paquette and Messier 2010) and Africa would be well served to pursue the two simultaneously.

With respect to climate change mitigation, African countries, particularly those that have relatively large areas of forest and woodland cover have developed national REDD+ Programmes, which are in effect large forest-based NAMAs. In the moist forests, this covers most of the countries in Central Africa, operating under national programmes and also as a region organized through COMIFAC and its Central Africa Forest Convergence Plan. In West Africa, countries such as Ghana, Nigeria, Liberia, Ivory Coast and even Burkina Faso falling within the Sahel have joined international REDD+ processes in order to meet their own national objectives and also make global contributions in emission reductions. Countries in Eastern Africa such as Ethiopia, Kenya, Tanzania, Sudan and Uganda, and those in Southern Africa, represented by Mozambique and Zambia have joined the global effort through the FCPF of the World Bank or UN-REDD. Forestry is clearly favoured as a mitigation mechanism for climate change; a fact supported by the global processes that have been created. Despite these developments, the REDD+ processes have been beset by challenges such as the slow pace of developing national programmes, lengthy procedures for approval of national programmes and low carbon prizes which do not seem sufficient to off-set the opportunity costs that are implied in managing forests and woodlands under REDD+.

Despite progress which has been made in all types of forests in Africa, NAPAs and NAMAs elaborated by African states have encountered several but almost similar challenges that are responsible for the slow rate of their implementation. These obstacles are in the form of; financial constraints, low level of research and inadequate institutional capacity, weak policy framework to implement NAPAs and NAMAs, duplication of roles by different state agencies, and social and cultural problems. As explicit in the NAPAs, any delay in the implementation could increase vulnerability or lead to significant cost increases at a later stage. This requires the preparation of bankable programmes and projects in order to access funds from the Global Environment Facility and other agencies. In this regard, the rate at which NAPA documents are prepared does not seem to sufficiently respond to the threats of climate change, some of which are already being realized. Notwithstanding the shortcomings, there is a strong recognition in the reports from all sub-Saharan Africa, that the interests of the rural poor and vulnerable are foremost in government efforts in climate change adaptation programmes.

RECOMMENDATIONS ON FOREST ADAPTATION AND MITIGATION

To make adaptation and mitigation programmes and actions more effective, there is an urgent need in Africa to improve the link between the adaptation and mitigation needs and national policymaking. Despite a fairly well-developed adaptation action plans by the environment sectors of countries

substantial efforts to sensitize policymakers to the threats and risks in key sectors are still necessary, and calls for cross-sector structures to coordinate concerted efforts.

Since the use of forestry in adaptation to climate change is still highly variable in Africa, except for a few that have put it as priority in NAPAs, there is therefore need for more efforts from the forest sectors of Africa and their support organizations to improve this. As such the onus is on the forest sector to communicate the scientific basis of ecological resilience of large forest ecosystems to disturbances in more practical ways. What is therefore needed are evidence based messages from the forest sector in order to influence land and natural resource use options that favour forests and forestry. In this respect, this paper strongly recommends that the Senegal example, which combines both mitigation and adaptation aspects to climate change using increase in tree cover, be emulated.

Since a number of adaptation programmes target the agriculture sector and protection of fragile or highly vulnerable ecosystems such as coastal zones, there is need for policies and programmes that call for forestry based adaptation aimed at the agricultural sector. In the dry woodland areas, policies that improve the micro-climatic conditions for crop production through tree cover and the development and promotion of drought tolerant tree crops such as cashew nuts, mangoes and others in degraded farmed landscapes, would be a way of getting marketable agricultural commodities and carbon at the same time. In that way, the requirement of 'permanence' in negotiating carbon credits will be assured since tree crops such as cashews, mangoes, some nitrogen fixing trees, marula, shea butter trees and others, are perennial crops.

The poverty reduction elements of emission reducing production systems is also an important objective that tree based land use options should stress and promote to show that supporting agricultural production and poverty reduction through forestry is an objective that will ensure the relevance of forestry in adaptation and mitigation.

Since adaptation of natural and planted tree species to climate change is not being given the necessary focus, national policies should correct this. So far, only a few countries have made progress in that area. South Africa has made provisions for research on their industrial plantation species to climate change threats and the research is targeted on improving resistance to diseases and pests, whose natural range will be expanded by changing climates, or whose virulence or ability for infestation would have been increased by changing climate. This is in line with predicted increases in mean temperatures which will most likely result in *lower rainfall in much of southern Africa* with major consequences for its dry woodlands and savannahs, particularly their distribution (Prentice *et al.*, 1992) and conversion to other cover types. Elsewhere in Africa predictions on changes in productivity in forests and woodlands have been made. In Sudan, its first communication to the UNFCCC reported a vulnerability assessment on *gum arabic (Acacia senegal)* production to climate change and their prediction is that, increases in water stress would significantly reduce gum production by between 25 to 35%, and also lead to a southward shift in its natural

range (Government of Sudan 2003). As such, efforts to select provenances that can survive in the northern fringes of its natural range are already underway.

It is strongly recommended that research focusing on the likely challenges of climate change to production and remedial strategies and actions be increased and effectively used to guide and influence decisions made by governments and resource managers. Specifically, research on the potential vulnerability of forest ecosystems to climate change should not be ignored, to the extent that mankind wishes to continue to benefit from the capacity of forests to play their role in climate change adaptation and mitigation.

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