

Role of Climate Change Mitigation in Tanzania's Policy Frameworks

Mohamed Khamis Said *

Department of Geography, School of Social Sciences, University of Dodoma, P.O.box 250, Dodoma

Tiemo Romward Haule

Department of Geography, Mkwawa University College of Education, P.O.box 2513, Iringa, Tanzania

Francis Bagambilana

Department of Geography, Mwenge Catholic University, P.O.box 1226, Moshi, Tanzania

Sifuni N. Lusiru

Department of Education, Same District Council, P.O.Box 09, SAME - Tanzania

Abstract

There is a broad scientific consensus that the current climate change is highly attributed to human activities. The increasing greenhouse gases (GHGs) concentrations in the atmosphere raises the global temperature at very alarming rates. Consequently, the magnitude and frequency of extreme weather events, such as floods drought, storms and heat waves have been increasing. Tanzania has been highly vulnerable to climate change due to multiple stresses and low economic, financial and technological adaptive capacity. In order to avoid worst-case scenario, it has been imperative for Tanzania to mainstream the climate change mitigation measures in her policy frameworks as stated in the climate change related Multilateral Environmental Agreements (MEAs). The purpose of this paper is to review the extent to which the mainstreaming of climate change mitigation measures has influenced the formulation of policy frameworks. However, the mainstreaming of some of the nationally appropriate mitigation actions (NAMAs) is facing some challenges such as shortage of fund, poor governance and corruption. It is important to note that the amount of GHGs emitted by developing countries (non Annex 1) is less than 3 percent of the global CO₂ emissions from fossil fuels. Nevertheless, there is a need for Tanzania to continue undertaking mitigation measures in order to circumvent worst-case scenarios of climate change.

Keywords: GHGs, climate change, climate change mitigation, policy frameworks, MEAs, sector-based policies.

1. Introduction

In recent decades, the planet earth has been experiencing accelerated climate change. With high confidence, studies reveal that the current global climate change is triggered by anthropogenic activities (IPCC, 2013). Growth of the global economy and population are the main drivers of the increase of greenhouse gases (GHGs) such as CO₂, CH₄, and N₂O (UNEP, 2012; IPCC, 2013). For example, the concentration of CO₂ in the atmosphere increased from 280 ppm in the 1750 to 369.7 ppm in 2001 (Christopherson, 2012). The concentration of GHGs has raised global mean temperature by 0.6 °C since the industrial revolution around the 1880s, (IPCC, 2013). This has resulted into various impacts that have been felt in several parts of the world. In Tanzania, for instance, such impacts include; sea level rise and the associated impacts like intrusion of sea water into the fresh water wells along the coast and submergence of some islands, highland malaria and extreme weather events such as droughts and floods (Yanda *et al.*, 2006; Mashingo, 2010; URT, 2012a).

Similarly, it is projected that CO₂ concentration in the atmosphere could exceed 1000 ppm by the year 2100 based on the business as usual scenario (Ackerman and Stanton, 2013). Under this scenario, the global average temperature is projected to increase by more than 4 °C which might result into, *inter alia*; the collapse of major life systems. Indeed, there is an urgent need of mitigating GHGs so as to slow the rate at which the global climate will be changing.

Most of the countries' development plans/policies are formulated to mainstream and implement the mitigation measures stated in the climate change related Multilateral Environmental Agreements (MEAs) (IPCC, 2014). Thus, the implementation of proposed mitigations extends at various levels, i.e., global, regional, national and local levels. At the global level, mitigation measures are largely being undertaken through the implementation of the United Nations Framework Convention on Climate Change (UNFCCC) (UN, 1992). This convention, which was adopted at the Rio de Janeiro Summit in June 1992, outlines a plan to mitigate GHGs to the 1990 levels, by the year 2000, on a voluntary basis. However, several of the developed (Annex I) countries failed to cut their GHG emissions on a voluntary basis relative to the base year of 1990 (Keller, 2011). This state of affairs led to the adoption of the legally-binding Kyoto Protocol in 1997 (UN, 1998). This instrument came into force on February 16, 2005 and mandated state parties to reduce, by at least 5 percent, the emissions of six GHGs, i.e., carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrochlorofluorocarbon (HFCs), perfluorocarbons (PFCs) and

sulphur hexafluoride (SF₆), below those of 1990 during a commitment period between 2008 and 2012.

The Kyoto Protocol had three flexible mechanisms, namely, the Clean Development Mechanism (CDM), the Joint Implementation (JI) and the Emissions Trading (ET). In accordance with article 12 of the Kyoto Protocol, the CDM was designed to assist developing countries achieve sustainable development by allowing developed countries finance projects that mitigate GHGs in the developing countries (UN, 1998). The developed countries would, in return, receive the certified emission reductions (CERs) for doing so. Furthermore, article 6 on the JI enabled Annex I parties to acquire the emission reduction units (ERUs) through financing projects that reduce net GHGs in other industrialized countries. Besides, article 17 of Kyoto Protocol covers the ET, whereby Annex I parties may exchange the assigned amount units (AAUs) (*ibid*).

It is worth pointing out that the Kyoto Protocol supported, *inter alia*, afforestation and reforestation projects but did not cover initiatives to avoid deforestation. A payment for ecosystem service (PES) program entitled 'Reducing Emissions from Deforestation and Forest Degradation' (REDD) was, therefore, negotiated under the UNFCCC since the early 2000s. This program, renamed REDD+ in 2009, aimed at providing financial incentives that would enhance existing forests and forest cover in the less economically developed countries (UNEP, 2012; URT, 2012a).

It should be noted that during the COP16 to the UNFCCC and the sixth Meeting of Parties (MOP6) of the Kyoto Protocol held in 2010, in Cancun, Mexico, state parties made a commitment to limit, in the near future, global temperature rise of 2°C above the pre-industrial levels (UNEP, 2012). Following the Cancun Agreements, Annex 1 Parties were required to submit to the UNFCCC Secretariat the economy-wide emission reduction targets for 2020. Similarly, non-Annex 1 Parties (i.e., developing countries) were required to submit, to the Secretariat, the nationally appropriate mitigation actions (NAMAs) (*ibid*).

2. Methods

This paper basically relied on secondary sources. The paper reviews government policies, development plans, National Climate Change Strategy and climate related MEAs reports. Information for this paper generally was, therefore, drawn from academic literature including books and journals, non-academic literature such as reports, and internet sources. Therefore, relevant information was sourced from secondary and electronic sources that specifically address the topic of this paper.

3. Influence of Climate-based MEAs on Overarching National Plans and Policies in Tanzania

Climate change related MEAs have influenced the mainstreaming of climate change mitigation measures on overarching national plans and policies in order to, *inter alia*, achieve sustainable development. Such plans and policies include: 1) the National Development Vision 2025 (URT, 1997a), 2) the National Strategy for Growth and Reduction of Poverty (NSGRP) II (2010/11 - 2014/15) (URT, 2010a), the Zanzibar Strategy for Growth and Reduction of Poverty (ZSGRP) II (2010 - 2015) and 3) National Development Plans. For instance, the theme of the First FYDP (2011/12-2015/16) is 'Unleashing Tanzania's Latest Growth Potentials' (URT, 2010b). Two more development plans will be undertaken in order to realize the National Development Vision 2025. These are the Second FYDP (2016/17-2020/21) based on the theme of 'Nurturing an Industrial Economy' and the Third FYDP (2021/22-2025/26) based on the theme of 'Realizing Competitiveness –Export-Led Growth' (*ibid*). By implementing the three FYDPs, it is hoped that Tanzania will become a semi-industrialized country capable of withstanding competition at the domestic, regional, and global levels of markets while unleashing hope to its people (*ibid*). By becoming a semi-industrialized economy, the amounts of GHGs from fossil fuels will increase. Issues of climate change mitigation that emanate from MEAs have been incorporated in the First FYDP (2011/12-2015/16). Such issues are covered under the following operational objectives: 1) Environmental impact monitoring of large-scale industrial and infrastructural projects, 2) Creation of a coherent National Climate Change Strategy, 3) Creation of institutional framework to identify, mobilize and monitor global climate finance through earmarked funding for adaptation and mitigation activities, 4) Enhance awareness among all stakeholders about climate change and create ownership of climate change initiatives within government, 5) Synchronization of existing climate change initiatives through creation of adequate institutional framework (URT, 2010a).

The operational objective 2 was achieved in 2012 where a coherent National Climate Change Strategy (NCCS) was developed (URT, 2012a). The specific objectives of NCCS reflect the operational objectives covered in First FYDP (2011/12-2015/16). These are: 1) To build the capacity of Tanzania to adapt to climate change impacts, 2) To enhance resilience of ecosystems to the challenges posed by climate Change, 3) To enable accessibility and utilization of the available climate change opportunities through implementation, 4) To enhance participation in climate change mitigation activities that lead to sustainable development, 5) To enhance public awareness on climate change, 6) To enhance information management on climate change, 7) To put in place a better institutional arrangement to adequately address climate change, and 8) To mobilize resources including finance to adequately address climate change (*ibid*).

Besides, both NSGRP II and ZSGRP II (2010 - 2015) reflect issues pertaining to climate change

mitigation in their three major clusters of broad outcomes for poverty reduction, namely I) growth and reduction of income poverty II) improved quality of life and social wellbeing and III) good governance and accountability. With respect to cluster I, for instance, energy sector has to promote the use of renewable energy and projects which qualify for carbon credit.

Likewise, the objectives of the National Environmental policy (1997b) reflect the country's commitments to implement climate change mitigation measures in order to reduce sources of, or enhance the sinks of, GHGs. This commitment is revealed in its specific objectives with regard to various sectors such as energy, transport, industry, mining and forestry to mention but a few. However, climate change mitigation measures are not specifically stated in the main objectives of the policy regardless of the severity of climate change impacts.

The attainment of the objectives of these overarching plans and policies is dependent on the implementation of sector-specific policies. Indeed, overarching plans and policies inform the process of formulating sector-specific policies. However, the implementation of the policies and plans in developing countries in general and Tanzania in particular is negatively affected by factors such as shortage of funds, poor governance and corruption. Meanwhile, most of the programmes and projects being undertaken to achieve the plans and policies are not sustainable because they are greatly donor funded (Handley *et al.*, 2009).

4. Sector-based climate change mitigation measures

Most of the sector-based policies formulated after the 1992 Rio Earth Summit have adhered with climate change related MEAs by mainstreaming climate change mitigation measures. This practice aims at ensuring that national development policies and plans encourage adoption of mitigation technologies and practices for sustainable development. This section reviews the mainstreaming of climate change mitigation measures in five economic sectors which are potentially major sources of GHG emissions in the country namely, transportation, energy, manufacturing industry, forestry and agriculture and livestock. Although Tanzania's GHG emissions are negligible, these sectors are expected to increase the country's emissions in the near future when the objectives of Vision 2025 to make Tanzania a semi-industrialized economy are realized (URT, 2012b). This means the country's carbon footprint, in particular, will increase tremendously hence the need to mainstream climate change mitigation in the development plans.

4.1 Transportation

Transportation is among the fastest growing and important sectors in the economy of Tanzania. For instance, the sector's contribution to the GDP growth rate in percent (3 years average) was 6.5 (2001-03), 8.7 (2004-06), 11.3 (2007-09) and 14.4 (2010-12) (BoT, 2013). The sector includes road network, railways, marine, airways and pipelines. However, road transport accounts for over 70 percent of the total traffic (*ibid*). Recently, there has been an increase of imported motorized vehicles in Tanzania. For example, between 2003 and 2011 a total of 1,010,732 cars were registered by Tanzania Revenue Authority (TRA) (Kiunsi, 2013). Most of the imported cars are second hand hence release more GHGs.

Both National Environmental Policy (1997) and Transport policy (2003) emphasize sustainable transport systems through the following objectives: 1) improvement of mass transport system to reduce fuel consumption, traffic congestion and pollution, 2) Control and minimization of transport emission gases, noise, dust and particles (URT, 1997b; URT, 2003a; URT, 2012b). Similarly, the NCCS expounds strategic interventions to be undertaken in the transport sector. These include: 1) promoting fuel switch in transport facilities, 2) improving system for rapid transportation, 3) promoting use of mass transport facilities, 4) establishing infrastructures and promoting use of non-motorized transport, 5) proper urban transport planning to facilitate efficient and low GHG modes of transportation, 6) developing NAMAs on transport systems (URT, 2012a).

Various climate change mitigation measures are being undertaken in the transport sector. For instance, there is an on-going construction of 130.3 kilometres of the Bus Rapid Transit (BRT) project in Dar es Salaam in six phases (URT, 2014). The construction of the first phase (20.9 kilometres) (Figure 1) is nearing completion. Upon the completion of this phase, the Dar Rapid Transit Agency (DART) is coordinating the process of importing cleaner and quieter vehicles along BRT lanes (*ibid*).

The estimated maximum capacity of the Phase I infrastructure is 28,000 passengers per direction per hour (URT, 2014). Besides, the BRT project has been designed to accommodate pedestrians and cyclists to encourage non-motorized transport. This will lower significantly the emission of GHGs from transport sector in Dar es Salaam (*ibid*). Apart from the BRT the country is undertaking other projects aiming at reducing GHGs emission. These include the emphasis on using the trains and ships to transport people under short distance to replace the use of many buses commonly known as "Daladala".

It is worth pointing out that the implementation of the climate change mitigation strategies in transport sector encounters a plethora of hurdles. One of the challenges faced in establishing big projects to mitigate climate change like the BRT is the huge fund required compared to the amount that a developing country like Tanzania can afford (Lunogelo, 2012). Lack of state-of-the-art technology to measure the GHGs from the transport sector

is yet another hurdle.

In recent years the government through Tanzania Roads Agency (TANROADS) has made commendable efforts to expand the road network. This will encourage many people use cars which will potentially increase GHG emissions. Yet, most of the imported cars are used brand that emit higher amount of GHGs. Therefore, the government needs to put measures to ensure that the imported cars emit low amounts of GHGs. Furthermore, expansion of road network improves accessibility of remote areas which could increase transportation of forest resources and reduce carbon sink. For example, construction of the Mkapa Bridge and other road improvement in the southern regions had facilitated uncontrolled logging and timber trade activities (Milledge *et al.*, 2007). The government needs to improve compliance and enforcement to ensure sustainable utilization of forest resources.

4.2 Energy

Tanzania, as one of the developing countries with less industrial base, consumes relatively less amount of energy. In 2009, for instance, Tanzania consumed a total of 19.6 millions of tons of oil equivalent (MTOE) (URT, 2013a). Biomass represented 88.6 percent of the total energy consumption in 2009. Charcoal made from wood was the single largest source of household energy in urban areas with about half the annual consumption occurring in Dar es Salaam. Other energy sources, including fossil fuels, contributed only 11.4 percent of the total energy consumption. Unfortunately, most of the energy sources that are used generate high amounts of GHGs (*ibid*). Indeed, alternative energy sources, such as wind, solar and water, which generate fewer amounts of GHGs, are not yet well developed.

Notwithstanding the lower emissions by the energy sector, GHG emissions from biomass, i.e. firewood and charcoal, are a serious problem (Valentine *et al.*, 2014). GHG mitigation measures in this sector have been mainstreamed in the national policy frameworks. The policy frameworks outline the following mitigation initiatives: 1) enhancing use of renewable energy share in the national grid and off-grid, 2) enhancing off-grid power supply to rural areas, 3) promoting diversification of energy sources, 4) Supporting exploitation of geothermal, clean coal and safe nuclear energy, 5) promoting energy efficient technologies and practices, 6) developing NAMAs focusing on energy generation and conservation, and 7) promoting green energy related technologies (URT, 2003b; URT, 2012a; URT, 2013b). Indeed, the government through the rural energy agency (REA) has been implementing rural electrification projects in a bid, *inter alia*, to reduce the GHG emissions from biomass (URT, 2013b).

It is worth pointing out that there are several challenges facing the implementation of these mitigation initiatives. On one hand, there is a lack of political will in investing in alternative sources of energy. For instance, Tanzania has great geothermal potentials along the Rift Valley which have so far not yet been utilized. Similarly, the country has great wind energy potentials such as in the central part of Tanzania which have not yet been developed (Mnjokava, *et al.*, 2005; Mayalla, *et al.*, 2011). On the other hand, some of the established energy projects such as biofuels (e.g. jatropha) involve clearing of vegetation. For instance, Bioshape Company acquired over 50,000 hectare (ha) of land in Kilwa for planting jatropha and cleared about 30, 000 ha pretending as preparing jatropha farm, where it exported timber and logs. However, the company stopped the project when it finished clearing the forest (Hincha, 2013). Furthermore, some of the projects were reported to affect wildlife roots. For instance, the Bioshape Company of Kilwa affected wildlife migration routes that not only used for animals going into the sea shore for salt licking but also used as breeding sites for a number of animals (*ibid*).

4.3 Agriculture and livestock keeping

Agriculture is the backbone of the Tanzanian economy contributing to about 24.1 percent of GDP, 30 percent of export earnings and employs over 75 percent of the productive work force (URT, 2013b). However, the sector is greatly vulnerable to climate change since it is predominantly rain-fed (Excellensia Consulting, 2010). The main farming practices in Tanzania involve clearing forests i.e. slash and burn that contribute to both GHG emissions and reduce carbon sink (FAO, 2012). Moreover, the application of chemical fertilizers releases N₂O which is a GHG. Besides, Tanzania has a big number of livestock largely reared in nomadic way. The 2010/2011 statistics indicate that, there are about 21.3 million cattle, 15.2 million goats, 6.4 million sheep and 1.9 million pigs (URT, 2011). On one hand, livestock produces CH₄ from enteric fermentation and animal manure (URT, 2003c). On the other hand, overgrazing reduces vegetation which serves as carbon sink (URT, 2011).

Climate change mitigation measures have been integrated in the agriculture and livestock related policies. Some of the strategic interventions covered in such policies include: 1) promotion of public awareness on sustainable environmental conservation, 2) enforcement of environmental laws and regulations that minimize environmental degradation resulting from agricultural activities, 3) up-scaling activities that enhance carbon storage capacity such as conservation agriculture and agro-forestry, 4) provision of public awareness on the opportunities of agriculture as potential carbon sink and mechanism to benefit from carbon market according to international protocols, 5) enhancing management of agricultural wastes, 6) promoting efficient fertilizer utilization, 7) promoting best agronomic technologies, 8) promoting appropriate technology for animal feed stuff

production, and 9) improving rangelands productivity and complementary activities (URT, 2003c; URT, 2006; URT, 2012b; URT, 2013a).

One of the objectives of the national livestock policy (2006) is to increase both quality and quantity of livestock. The accomplishment of this objective will increase GHG emissions. Yet, the policy does not clearly indicate how emissions from the sector will be mitigated. Similarly, some agricultural programmes such as “Kilimo Kwanza” do not indicate mitigation measures to be undertaken to address GHGs emitted through their implementation. It is worth noting that these projects encourage extensive clearance of vegetation and the use of chemical fertilizers. For instance, AgriSol Energy LLC (USA) acquired 325,117 ha of land in Kigoma Region for growing corn, sorghum, soybeans, sugarcane, poultry, cattle, and ethanol (Mousseau and Mittal, 2011). The process of clearing land acquired by the company will emit more GHGs and reduce Carbon sequestration. However implementation of the current national agriculture policy 2013 (URT, 2013a) and the Climate Smart Agriculture (CSA) as promoted by the Food and Agriculture Organization (FAO) (FAO, 2010) will reduce the amount of GHGs released to the atmosphere and enhance carbon sink.

4.4 Forestry

Tanzania had about 33.5 million ha of forests and woodlands (URT, 2004). Despite the fact that the contribution of forest sector to the GDP is low (about 2-3 percent) (Milledge *et al.*, 2007), the sector provides livelihoods to majority of the rural communities (URT, 1998). It should be understood that there are many transactions related to forest products and services which fall within the informal sector, therefore are not well recorded (World Bank, 2005).

Forests are facing various environmental challenges which lead to forest degradation and deforestation. For instance, the rate of deforestation in Tanzania is approximately 1.2 percent per year. Approximately 412,000 ha of forest are lost per annum, mostly on village lands. Rates of deforestation in Tanzania’s coastal forests, a biodiversity hotspot, have been calculated at 5 percent per annum in some Districts (TFCG, 2009). Increasing utilization pressure on the forests is associated with population growth, poverty and increasing demand of forest products i.e. logs, timber and charcoal. It is estimated that the country consumes about 1 million tons of charcoal annually. This amount of charcoal is generated from about 30 million cubic meters of wood (*ibid*). The annual average loss of forest cover attributed to charcoal production is about 100,000–125,000 ha (URT, 2013b). Deforestation and forest degradation make forest sector to be the principle emitter of CO₂ in Tanzania (*ibid*). It should be noted that deforestation and forest degradation release CO₂ in the atmosphere and reduce the ability of forests to sequester CO₂.

Policies have been developed to encourage sustainable utilization of forest resources in order to reduce emissions of, and enhance sequestration of, CO₂. For instance, the strategic interventions of the NCCS include: a) promoting afforestation and reforestation, b) supporting household energy

plantations to reduce pressure on natural forests, c) supporting capacity building for community based forest carbon assessment, d) promoting reduction of emission from deforestation, e) promoting reduction of emission from forest degradation, f) promoting sustainable management of forest, g) enhancing and conservation of carbon stocks, and h) developing NAMAs in forest management (URT, 2012a).

Besides, efforts were taken to prepare the National CDM Handbook that expounds the process of approving CDM projects in Tanzania (URT, 2007). However, few CDM projects have been developed. The reasons for few CDM projects in Tanzania are probably due to the fact that CDM projects are undertaken by private companies who seek for major plants that would offset huge amount of CO₂, mostly found in middle income countries like Asia and Latin America. Other reasons for few CDM projects in Africa in general and Tanzania in particular, may include poor infrastructures and poor governance. One of the earliest CDM projects in the country is the Mapanda/Uchindile forestation project in Iringa, which is being run by a Norwegian private company of Green Resources AS (GRAS) (GRAS, 2010). The project is expected to generate 3.5 million tons of CO₂ offsets by the year 2020 (*ibid*). Likewise, efforts were taken to prepare the National Framework for REDD (URT, 2009). Only in some villages the REDD programs are progressing well. The REDD program, however, faced several challenges e.g. not covering vast areas of open forests, such as those found in the dry areas of Eastern and Southern Africa (UNEP, 2012). Furthermore, many of its rules, decisions, methodological issues, legal frameworks were still being negotiated (*ibid*).

4.5 Manufacturing Industry

Manufacturing industry has been evolving and is gradually becoming among the significant contributor to the economy of Tanzania in very recent decades. For instance, the sector’s contribution to the GDP growth rate in percent (3 years average) was 9.9 (2001-03), 10.9 (2004-06), 11.9 (2007-09) and 11.2 (2010-12) (BoT, 2013). Upon the realization of Vision 2025, the sector is expected to make the country semi-industrialized by 2025 (URT, 1997a; Wangwe *et al.*, 2014).

Generally, Tanzania is still a non-industrialized country with low GHG emissions. For instance, the value

for CO₂ emissions from manufacturing was 0.91 million metric tons in 2010 (IEA, 2011). This is very low amount compared to industrialized countries like USA whose CO₂ emission was 1,713 million metric tons of CO₂ equivalent in 2002 (USEPA, 2008). However, current development in manufacturing industry, coupled with developments in other sectors like agriculture and energy (e.g. discoveries of gas in the southern part of the country) will increase GHG emissions in the near future (URT, 2013c).

The government has anticipated the increase of GHG emissions from manufacturing industry hence climate change mitigation measures have been integrated in its policies pertaining to industrial development. The NCCS's strategic interventions with regard to manufacturing industries include; a) enhancing cleaner production practices and technologies, b) promoting diversification of energy sources and fuel switching technologies, c) promoting establishment of environmental and energy management systems, d) enhancing adoption of clean and energy efficient technologies, e) developing NAMAs focusing on energy efficiency and conservation, and f) promoting efficient production technologies (URT, 2012a).

However, the implementation of NCCS's strategic interventions such as using cleaner technologies, turning to renewable energy sources and trapping and re-use of GHGs, is not yet well achieved. For instance, decarbonation and fuel combustion in cement manufacturing industries release huge amount of CO₂ to the atmosphere. Yet, the industries lack improved technologies to trap and sequester it. Besides, manufacturing industries in the country are mostly using fossil fuels as a source of energy. Furthermore, some manufacturing industries such as tea and tobacco use a lot of biomass to dry the leaves.

5. Conclusion

Climate change is influenced by natural and human-induced factors. According to a scientific consensus, the current global climate change is mainly attributed by human-induced activities that have emitted GHGs such as CO₂, CH₄, NO₂ and CFCs into the atmosphere. Such gases have trapped heat in the atmosphere; consequently, the global climate system is destabilized due to the gradual increase of global average temperatures which resulting into several negative impacts. The impacts include the increase of the frequency and magnitude of extreme weather events, shrinkage of ice sheets / glaciers, and sea-level rise.

Tanzania is highly vulnerable to the adverse impacts of climate change despite the fact that it contributes very little to GHG emissions. The country's level of affluence cannot effectively reduce the devastating impacts of climate change that strike crucial economic sectors, such as agriculture and livestock, water resource, energy, forestry and transportation. Consequently, many people's livelihoods are compromised.

Climate change mitigation measures have been/are being integrated in policy frame works at various levels in order to reduce the amount of GHGs that have been/are being released into the atmosphere. At the global level, such measures include establishment and the implementation of climate change related MEAs which are the UNFCCC 1992, Kyoto Protocol 1997 and the Cancun Agreements 2010. The implementation of these climate change related MEAs influenced the formulation of development plans and other policy frameworks in Tanzania. For example, issues of climate change mitigation that emanate from MEAs have been mainstreamed in the First FYDP (2011-2015). Similarly, there are plans to incorporate such issues in the Second FYDP (2016/17-2020/21) and the Third FYDP (2021/22-2025/26) in order to achieve the National Development Vision 2025. Besides, issues of climate change mitigation have been mainstreamed in the NSGRP II (2010/11 - 2014/15), National Climate Change Strategy 2012 and several sector-based policies.

However, the mainstreaming of some of the nationally appropriate mitigation actions (NAMAs) in Tanzania's policy framework is facing some challenges such as shortage of fund, poor governance and corruption. Besides, there is a need to scrutinize the mitigation projects to suit the area of locality. It is important to note that the amount of GHGs emitted by developing countries (non Annex 1) is less than 3 percent of the global CO₂ emissions from fossil fuels. Therefore, Annex 1 countries that emit more than 97 percent of the global CO₂ emissions from fossil fuels need to undertake significant climate change mitigation measures.

References

- Ackerman, F. and E. A. Stanton. (2013). *Climate Economics: The State of the Art (Routledge Studies in Ecological Economics)*. Oxford: Routledge.
- BoT (Bank of Tanzania) (2013). *Financial Stability Report*. Retrieved on 19th March, 2015 from <https://www.bot-tz.org/Publications/Fin-stability/Financial%20Stability%20Report%20for%20March%202013.pdf>
- Christopherson, R. W. (2012) *Geosystems: An Introduction to Physical Geography*, 8th ed. NJ: Pearson Education Inc.
- ESRF (Economic and Social Research Foundation) (2009). *Study on the Identification of Potential Growth Drivers for Tanzania Based on an Analysis of Tanzania's Competitive and Comparative Advantages- Growth Sectors and Growth Drivers: a Situational Analysis Report*. Dar es Salaam: ESRF.
- Excellensia Consulting (2010). *Climate Change in Tanzania: Review of Potential Indicators-Final Report*. Vehkakatu 1B 6, Finland: Excellensia Consulting.

- FAO (Food and Agriculture Organisation) (2010). *Climate-Smart Agriculture Policies, Practices and Financing for Food Security, Adaptation and Mitigation*. Rome: FAO. Retrieved on 22/4/2015 from <http://www.fao.org/docrep/013/i1881e/i1881e00.pdf>.
- FAO (Food and Agriculture Organisation) (2012). *Mainstreaming Climate-smart Agriculture into a Broader Landscape Approach. The Second Global Conference on Agriculture, Food Security and Climate Change. Hanoi, Vietnam, 3-7 September 2012*. Rome: FAO.
- GRAS (Green Resources As) (2010). *Development of Clean Development Mechanism Projects in Tanzania: Lessons Learnt*. Strandveien, Norway. Retrieved on 20/03/2015 from http://www.norway.go.tz/pagefiles/402978/lessons_learned_by_gras.pdf.
- Handley, G., Higgins, K., Sharma, B., Bird, K and Cammack, D (2009). *Poverty and Poverty Reduction in Sub-Saharan Africa: An Overview of the Issues. ODI Working Papers 229*. London: Overseas Development Institute. Retrieved on 20/03/2015 from <http://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/860.pdf>
- Hincha, H. (2013). *Jatropha Production in Tanzania: Environmental and Economic Dilemmas: Policy Brief*, Vol. No 17, 4. Retrieved on 25/03/2015 from http://www.clknet.or.tz/wp-content/uploads/2014/08/PB_17_Jatropha-Production-in-Tanzania.pdf.
- IEA (International Energy Agency) (2011). *Energy Statistics and Balances of Non-OECD Countries and Energy Statistics of OECD Countries and United Nations. Energy Statistics Yearbook*. Paris: OECD / IEA.
- IPCC (Intergovernmental Panel on Climate Change) (2013). *Summary for Policymakers*. In Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.), *Climate Change 2013, the Physical Science Basis-Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press.
- IPCC (Intergovernmental Panel on Climate Change) (2014). *Climate Change 2014: Mitigation of Climate Change*. In Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.), *Working Group III Contribution to the Fifth Assessment Report of the IPCC*. Cambridge: Cambridge University Press.
- Keller, E. A. (2011). *Introduction to Environmental Geology*. 5th ed. Upper Saddle River, NJ. Pearson Prentice Hall
- Kiunsi, R.B. (2013). A Review of Traffic Congestion in Dar es Salaam City from the Physical Planning Perspective, *Journal of Sustainable Development*, Vol. 6, No. 2 page 97.
- Lunogelo, H.B., (2012). Transport Sector and Acceleration of Green Economic Transformation. *Journal of Economic and Social Research Foundation*, Vol. No. 2/2012. page 3.
- Mashingo, M.S.H. (2010). Vulnerability Assessment on Pastoral Livestock and Pasture Development to the Extreme Climatic Events in Tanzania. Paper Presented under the Study on the Economics of Climate Change in Tanzania Phase 3 at the Stakeholder Inception Round Table Meeting Held at the Peacock Hotel, Dar es salaam, Tanzania, 26 March, 2010.
- Mayalla, J., Kabaka, K., Mgejwa, N and Mbogoni, G (2011). Geothermal Development in Tanzania. Proceedings of the Kenya Geothermal Conference 2011. Kenyatta International Conference Centre, Nairobi, November 21- 22, 2011. Retrieved on 25/03/2015 from http://www.gak.co.ke/nibs/web_resources/GEOTHERMAL%20DEVELOPMENT%20IN%20TANZANIA.pdf.
- Milledge, S. A. H., Gelvas, I. K. and Ahrends, A. (2007). Forestry, Governance and National development: Lessons Learned from a Logging Boom in Southern Tanzania. TRAFFIC East/Southern Africa/ Tanzania Development Partners Group / Ministry of Natural Resources and Tourism, Dar es salaam.
- Mnjokava, T. T., Kabaka, K. and Mayalla, J. (2015). Geothermal Development in Tanzania – a Country Update. Proceedings of the World Geothermal Congress 2015, Melbourne, 19-25 pp. Retrieved on 23rd April 2015 from <https://pangea.stanford.edu/ERE/db/WGC/papers/WGC/2015/01017.pdf>.
- Mousseau, F. and Mittal, A. (eds.) (2011) *Understanding Land Investment Deals In Africa Country Report: Tanzania*. Oakland: The Oakland Institute.
- TFCG (Tanzania Forest Conservation Group) (2009). *Making REDD work for people and forests in Tanzania: Lessons learnt from participatory forest management in Tanzania*. Dar es Salaam 10 pp.
- UNEP (United Nations Environment Programme) (2012). *Global Environment Outlook GEO-5: Environment for Development*. Nairobi: UNEP
- UN (United Nations) (1992). *United Nations Framework Convention on Climate Change*. New York: United Nations.
- UN (United Nations) (1998). *Kyoto Protocol to the United Nations Framework Convention on Climate Change*. New York: United Nations.

- URT (United Republic of Tanzania) (1997a). *Tanzania Development Vision 2025*. Dar es Salaam: Planning Commission
- URT (United Republic of Tanzania) (1997b). *National Environmental Policy*. Dar es Salaam: Government Printers.
- URT (United Republic of Tanzania) (1998). *National Forest Policy.*, Dar es Salaam: Ministry of Natural Resources and Tourism.
- URT (United Republic of Tanzania) (1999). *Tanzania Development Vision 2025*. Dar es Salaam: Planning Commission.
- URT (United Republic of Tanzania) (2003a). *National Energy Policy*. Dar es Salaam: Government Printers.
- URT (United Republic of Tanzania) (2003b). *National Transport Policy*. Dar es salaam: Government Printers.
- URT (United Republic of Tanzania) (2003c). *Initial National Communication under the United Nations Framework Convention on Climate Change (UNFCCC)*. Dar es salaam: Government Printers
- URT (United Republic of Tanzania) (2004). *Management Plan for Kimboza Catchment Forest Reserve, Morogoro District, Morogoro Region*. Dar es salaam: Government Printers
- URT (United Republic of Tanzania) (2006). *National Livestock Policy*. Dar es salaam: Government Printers.
- URT (United Republic of Tanzania) (2007). *A Handbook for Clean Development Mechanism (CDM) Project activities in Tanzania*. Dar es Salaam: Government Printers.
- URT (United Republic of Tanzania) (2009). *National Framework for Reduced Emissions from Deforestation and Forest Degradation (REDD)*. Government Printer: Dar es Salaam.
- URT (United Republic of Tanzania) (2010a). *Tanzania Five Year Development Plan 2011/2012-2015/2016: Unleashing Tanzania's latent growth potentials*. Dar es Salaam: Government Printers.
- URT (United Republic of Tanzania) (2010b). *National Strategy for Growth and Reduction of Poverty II. Ministry of Finance and Economic Affairs*. Dar es Salaam: Government Printers.
- URT (United Republic of Tanzania) (2012a). *National Climate Change Strategy*. Dar es Salaam: Government Printers
- URT (United Republic of Tanzania) (2012b). *National Report for the United Nations Conference on Sustainable Development, Rio+20*. Dar es Salaam: Government Printers.
- URT (United Republic of Tanzania) (2013a). *National Agriculture Policy. Ministry of Agriculture Food Security and Cooperatives*. Dar es Salaam: Government Printers.
- URT (United Republic of Tanzania) (2013b). *Scaling-up Renewable Energy Programme (SREP) Investment Plan for Tanzania*. Dar es Salaam: Government Printers.
- URT (United Republic of Tanzania) (2014). *Dar Rapid Transit (DART) Project – Phase 1: Project Information Memorandum*. Dar es Salaam: Government Printers
- USEPA (United State Environmental Protection Agency) (2008) *Quantifying Greenhouse Gas Emissions from Key Industrial Sectors in the United States*. Retrieved on on 24th March, 2015 from www.epa.gov/sectors/pdf/greenhouse-report.pdf.
- Valentine, R., Arneith A, Bombelli A, Castaldi S, Cazzolla Gatti R, Chevallier F, Ciais P, Grieco E, Hartmann J, Henry M, Houghton RA, Jung M, Kutsch WL, Malhi Y, Mayorga E, Merbold L, Murray-Tortarolo G, Papale D, Peylin P, 7 Poulter B, Raymond PA, Santini M, Sitch S, Vaglio Laurin G, van der Werf G R, Williams C A, Scholes R J (2014). 'The full greenhouse gases budget of Africa: Synthesis, Uncertainties and Vulnerabilities'. *Biogeosciences* 11, 381-407.
- Wangwe, S., Mmari, D., Aikaeli, J., Rutatina, N., Mboghoina, T. and Kinyondo, A. (2014). The Performance of the Manufacturing Sector in Tanzania: Challenges and the Way Forward. *WIDER Working Paper* 2014/084
- World Bank (2005). *Study on Growth and Environment Links for Preparation of Country Economic Memorandum (CEM) for Tanzania: Part 2: Uncaptured Growth Potential: Forestry, Wildlife and Marine Fisheries. Final Report*. Washington DC: World Bank
- Yanda, P.Z., Kangalawe, R.Y.M. and Sigalla, R.J. (2006). Climatic and Socio-Economic Influences on Malaria and Cholera Risks in the Lake Victoria Region of Tanzania. *ICIFAI J. Environ. Econ.*, 4(3): 44-70.

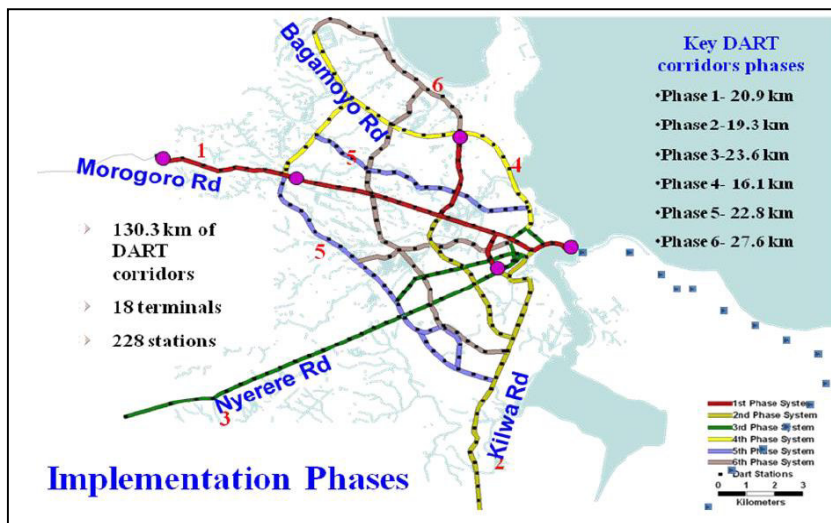


Figure 1: Six Implementation Phases for the BRT in Dar es Salaam
Source: Adapted from URT (2014: 8)