3rd International Conference

on Public Policy (ICPP3)

June 28-30, 2017 – Singapore

Panel T 17c P 20 Session 1

(Energy multi-level governance: from central governments to local governments)

Energy Decentralisation

Social and Institutional Innovations for Enhancing Energy Decentralisation and Climate Change Mitigation in Developing Countries

Dumisani Chirambo
Department of Civil and Public Law with references to Law of Europe and the Environment, Brandenburg University of Technology Cottbus- Senftenberg.
Erich-Weinert-Str. 1, LG 10/334, 03046, Cottbus, Germany
Email: sofopportunity@gmail.com; chiradum@tu-cottbus.de

Friday 30th June 2017

Social and Institutional Innovations for Enhancing Energy Decentralisation and Climate Change Mitigation in Developing Countries

Abstract

The Sustainable Development Goals require state and non-state actors to reduce the vulnerability of communities to climate related extreme events, and other economic, social and environmental shocks; and for universal access to modern energy by 2030. Achieving this will require implementing new radical approaches for subnational governance and decentralised energy service provision. Through an analysis of data from various research articles, case studies, policy briefs and project reports, the paper discovered that polycentric governance systems can enhance Africa's renewable energy institutional capacity and create new social systems to facilitate successful climate change mitigation and energy transitions for universal energy access.

Keywords: Sustainable Development Goals (SDGs); China South-South Cooperation Fund; Intended Nationally Determined Contribution (INDC); Social Innovation; Youth Unemployment; Sustainable Energy for All (SE4All); Paris Agreement.

Social and Institutional Innovations for Enhancing Energy Decentralisation and Climate Change Mitigation in Developing Countries

1 Introduction

The provision of modern and affordable energy is highly regarded as an important factor to stimulate industrial development and economic growth, and ultimately reduce poverty in developing countries (IEA, 2016; Terrapon-Pfaff et al., 2014). Energy enhances the productivity of capital, labour, and other production factors hence making it a key driver of economic growth, industrialisation and urbanisation. Consequently, in countries where the availability of energy is limited or where energy is economically unaffordable for industries and the whole society in general, economic development is seriously impaired (Wolde-Rufael, 2009; Kebede et al., 2010). Moreover, the availability of reliable energy is not only considered a pre-requisite for economic growth but also for social prosperity and human development (AfDB, 2013).

Sub-Saharan Africa (SSA) possesses significant amounts of both renewable and non-renewable energy resources. However, the region is noted to lag in comparison to other regions in its ambitions to achieve universal access to modern energy and electricity. This follows that the electrification rate of SSA is 35%, in comparison to the World at 82%; Developing Asia at 83%; North Africa at 99%; Africa at 43%; and Developing countries at 76% (Hancock, 2015; AfDB, 2016a). While the energy resources are not distributed uniformly in SSA, their abundance is somewhat maintained by compensating a regional deficiency in some type of resource with abundance

of some other (Lior, 2012). Therefore, improving the accessibility and affordability of modern energy services requires the mobilisation of an array of actors at cross-sectoral levels in-order to develop effective institutions and implement innovative policy frameworks in a context specific environment to enable each country (or sub-region) to chart its own energy transition pathway into the future (Sokona et al., 2012).

Investments in Africa's energy sector provide better financial returns than investments in the energy sectors of other regions. This follows that while returns to investment in secure assets in Organisation for Economic Co-operation and Development (OECD) countries have been close to zero, returns to foreign investors in energy projects in SSA are higher than in any other developing region and investments in cross-border energy transmission have exceptionally high returns, typically paying for themselves in less than a year (APP, 2014). Arguably, since investments in Africa's energy sectors are relatively very profitable for private investors and the region has sufficient renewable energy potential for universal energy access, a factor that could be contributing to the under-investment in the energy sectors could be the risk perceptions of the sectors by investors, more so since people's behaviour is mostly shaped by their perceptions of matters, rather than by the actual patterns of matters as measured by scientific methods (Bryan et al., 2013).

The global ambition on energy access as presented in SDG 7 is for all countries to reach universal access by 2030 (UN, 2015). Bazilian et al. (2012) consider that there are no fundamental technical obstacles preventing

universal energy access, but rather a lack of effective institutions, good business models, transparent governance, and appropriate legal and regulatory frameworks to ensure that universal energy access can be attained by all countries. However, a more realistic projection points out that universal electrification can be achieved by 2050 by countries with at-least 60% current electrification and that countries below this level can achieve at-least 80% electrification by 2050 (Sanoh et al., 2014). Consequently, the prospects of many SSA countries to achieve SDG 7 are grim since the electrification rate of SSA is only 35%. Regardless of all these issues, it has been suggested that accelerating energy sector investments and developments call for a need to deepen energy sector reforms to allow for greater private sector participation in the energy sectors of various African countries (Eberhard and Shkaratan, 2012) and ensuring that energy access becomes a priority in both the political and developmental agendas (ADB, 2011). Africa requires investments of approximately US$41 billion to US$55 billion annually until 2030 to ensure that universal access can be attained, but current spending amounts to approximately US$8 billion annually (Johnson et al., 2017; Schwerhoff and Sy, 2017). To address this financing gap, there are calls for countries to strive to improve the participation of private companies in their energy sectors and to enhance the utilisation of private capital in their respective energy sectors. However, in the case of SSA, the region has approximately 126 Independent Power Producers (IPPs) present in 18 countries. Whilst these IPPS cumulatively account for more than 13% of the subcontinent's total installed generation capacity, there are concerns that IPP investments are concentrated in a few countries since

South Africa alone accounts for 62% of IPP capacity and most of the remaining projects are located in a handful of countries (Eberhard et al., 2016). Therefore, increasing private sector participation in SSA's energy sectors will not only call for finding investors, but also call for SSA's regulatory authorities to provide secure off-take agreements and predictable prices (APP, 2017). A failure to rectify these regulatory shortfalls might lead to under-investment in SSA's energy infrastructure since most countries will still depend significantly on government investment and resources despite the potential of IPPs to play a greater role in enhancing energy access.

An estimated 68% of current total anthropogenic greenhouse gas emissions emanate from energy related-activities (Suberu et al., 2013) hence there is a great threat that increases in energy access and demand in SSA can potentially lead to rises in anthropogenic emissions of greenhouse gases which exacerbate climate change (Lau et al., 2012). Africa currently contributes little to climate change but its population is growing rapidly hence some projections suggest that energy consumption in non-OECD countries to grow by 84% by 2035 compared to 14% in OECD countries, thereby meaning that effective climate change mitigation will not be possible without the contribution of Africa and other developing nations (Schwerhoff and Sy, 2017). Additionally, the impacts and magnitude of climate change impacts can be anticipated to increase as the Intended Nationally Determined Contributions (INDCs) containing the global ambitions to mitigate and adapt to climate change are falling short of the goal to limit temperature increase to 2°C (Hood et al., 2015). Consequently, a failure for

developed and developing countries to simultaneously address sustainable energy access and climate change challenges can arguably perpetuate inequality and food insecurity which may culminate into social and political disruptions, including forced migrations and conflict in SSA (UNECA, 2014).

Elinor Ostrom (2010), who won the 2009 Nobel Prize in Economic Sciences, suggested that climate change was a complex multi-level problem that would adequately be addressed by complex multi-level systems such as polycentric governance systems. Similarly, facilitating energy access through grid and off-grid/decentralised renewable energy technologies is a complex problem as deployment is constrained by social and economic issues such as poverty, lack of political will and wrong approaches in addressing the energy problem (Gamula et al., 2013). Since addressing climate change and energy insecurity are both complex problems, yet have synergies in that improving renewable energy deployment can promote climate change mitigation, there could be merits in determining governance systems that can effectively improve renewable energy deployment and climate change mitigation simultaneously. Some previous studies on climate change governance and renewable energy deployment include Akuru et al. (2017) who analysed how Nigeria could achieve a 100% renewable energy target. In their analysis, Akuru et al. (2017) asserted that since the Nigerian government was backsliding in adopting renewable energy technologies, it would be easier for non-state actors to drive the transition towards 100% renewable energy supply rather than to continue to depend on the government as the driver for

renewable energy transitions. van Wesenbeeck et al. (2016) tried to identify and characterise vulnerable groups in climate change prone areas of East and West Africa. In their analysis, they concluded that unlike West Africa, East Africa has remarkable differences between vulnerable groups hence generic poverty reducing strategies for climate change would be ineffective in East African areas. Elum and Momodu (2017) provided a discourse analysis on climate change mitigation and renewable energy deployment for sustainable development. In their conclusion, Elum and Momodu (2017) considered that social and political obstacles as the most significant roadblocks towards rapid implementation of a green economy through the deployment of renewable energy. Junghans and Köhler (2016) considered that climate change, and the integration of mitigation, adaptation and food security elements as a conceptual puzzle due to the significant fragmentation of international funding sources and domestic implementation processes aiming at a climate-resilient and low-carbon development in the agricultural sector. They subsequently proposed the establishment of a new institutional set-up, namely a domestic gatekeeper, which could be as single, centralised institution or as a network of several partner organisations capable of acting as a mediator linking the global finance architecture with the domestic and local levels. Despite all this research, there are still knowledge gaps on viable business models and institutional arrangements that can enable countries in SSA to increase their pace of renewable energy deployment whilst improving their capacities for climate change mitigation and reducing their climate change vulnerabilities. Consequently, through the application of the concepts of polycentric governance systems as suggested

by Ostrom (2008,2009,2010), this paper explored the constraints and opportunities for local governments and non-state actors to contribute towards the attainment of the SDGs by addressing SSA's climate change risks and enhancing renewable energy deployment in SSA. To achieve its aim, the paper analysed data from various research articles, case studies, policy briefs, and project reports focusing on renewable energy deployment, climate risk management and poverty reduction.

The paper is organised as follows: section two provides an analysis of the benefits of enhancing the deployment of decentralised energy systems in SSA. Section three explores how local governments can promote Climate Compatible Development (CCD), and this is then followed by an analysis of the roles of microfinance in promoting CCD (section four). Section five follows with a discussion focusing on how increased Foreign Direct Investment (FDI) in SSA through investments in the energy sector and other sectors can be detrimental to the sustainability of SSA's natural environment. The paper then concludes in section six by highlighting the merits of using polycentric governance systems for improved rural electrification and the merits of stipulating quotas and mandates for decentralised energy access in-order to ensure that renewable energy climate finance projects do not perpetuate a bias towards urban electrification which perpetuate inequality and constrain rural development.

2 A Case for Renewable Energy Decentralisation

Access to modern energy is considered as one of the foremost factors contributing to the disparity between developed and developing nations (Suberu et al., 2013), hence developing innovative strategies to improve access to energy through renewable energy technologies can put Africa on a stable trajectory towards economic development. SSA has a greenhouse gas mitigation potential of 740.7 million tons of CO_2eq annually, and this could attract US$158 billion of total investment to the region and could generate US$7.5 billion of carbon revenue annually at an assumed carbon price of US$10/t$CO_2$ (Timilsina et al., 2010). More importantly, such carbon mitigation projects could add 149 Gigawatts (GW) of clean electricity generation capacity, which is more than twice the region's current total electricity generation capacity of 68,675 Megawatts (MW) (Timilsina et al., 2010). However, developing such projects has proved problematic in Africa because whilst carbon markets have the potential to foster pro-poor growth and environmental conservation, in practice linking carbon markets to livelihoods is greatly constrained by the complexity of socio-economic, political and environmental conditions on the ground as well as the difficulties in building trust and linkages across scales (Benessaiah, 2012). Since carbon credits do not necessarily solve the financing problems that renewable energy project developers experience but rather provide an incentive for various stakeholders to implement projects that can contribute to reducing greenhouse gases (Amatayakul and Berndes, 2012; Timilsina et al., 2010), realising SSA's mitigation potential for enhanced renewable energy deployment might require the implementation of policies and

regulations that can provide price guarantees to IPPs and investors (e.g. Feed-in Tariffs) (Amatayakul and Berndes, 2012). Arguably, even though there is potential to capitalise on the synergies that climate finance modalities provide with private sector investment in the renewable energy sector, such potential is underutilised in SSA as there are limited business models that can provide both adequate price guarantees for carbon offsets and price guarantees for renewable energy prices.

SSA can only substantially improve its energy access rate when rural development and renewable energy rural electrification is prioritised. As it stands, the urban-rural divide in access to electricity in Africa is as high as 450% (69% urban compared to 15% rural access) (AfDB, 2016b). Such a scenario might not necessarily change as between 2010-2012 the electricity access in SSA rose from 32% to 35%, however the increases were concentrated in urban areas where energy access growth exceeded population increase by 25 million, while in rural areas it fell short by 23 million (AfDB, 2016a). This scenario of a preference to increasing energy access in urban areas can be anticipated to persist since energy sector reforms have largely focused on unbundling the power-generation segment, hence energy generation has benefited from considerable investment, while transmission and distribution are largely still under the control of government entities and have remained largely underdeveloped (APP, 2017), and this might lead to a slow connection of un-electrified rural areas to the power grid. In this regard, comparisons can be made to the electrification scenario in Zambia where although for many years the installed capacity

was significantly higher than the demand, the excess generating capacity could not be exploited to supply rural areas due to challenges in energy distribution and transmission (Haanyika, 2008).

Africa is the fastest growing continent in the world, and more than half of the global population growth between now and 2050 is expected to occur in Africa (AGRA, 2015). Consequently, Africa has the youngest population in the world whereby the continent has almost 200 million people aged between 15 and 24, and if Africa's young population continues to grow rapidly, the number of young people in Africa will double by 2045 and the continent's labour force will be 1 billion by 2040, making it the largest in the world, surpassing both China and India (UNECA, 2014). To add to this, despite high rates of migration to urban areas, most SSA youth continue to reside in rural areas and will continue to do so over the coming years to the extent that SSA is the only region where the rural population is continuing to grow in absolute terms **(Moore, 2015)**. More worrying are projections that the demand for fuelwood in SSA is projected to increase dramatically from 694 million tonnes per annum in 2012 to 1,071 million tonnes in 2040, thus greatly increasing the burden on already unsustainably managed forestry stocks – stocks that have been found to sequester 16% more carbon dioxide than previous models suggested (Leopold, 2014). With current estimates showing that approximately 600,000 deaths per year in Africa can be attributed to air pollution caused by the use of firewood and charcoal for cooking (APP, 2017), it can therefore be argued that if the existing business-as-usual energy sector strategies of focusing on increasing generation

capacity without due consideration to increasing rural access rates and investments in transmission and distribution are maintained, rural – urban inequalities will be perpetuated much to the detriment of the health, livelihoods and ambitions of SSA's rural youth.

There are three principal options for providing new connections to currently un-electrified populations in Africa, namely: i) extension of the national grid; ii) installation of separate mini-grids to operate independently from the main grid; and iii) installation of stand-alone generating systems that supply individual consumers (AfDB, 2016b). Decentralised energy systems and mini-grids are often cheaper and quicker to deploy than large centralised infrastructure, which requires much greater investment costs and regulatory approvals (Kaijage et al., 2017). However, decentralised energy systems are not used extensively in SSA's energy sector because investment strategies of many financing mechanisms prioritise large-scale results based on the tonnes of carbon offset and the mobilisation of private co-finance; and traditional financing intermediaries, such as the multilateral development banks, are less able to finance small-scale projects directly, given the higher transaction costs (Soanes et al., 2017). Consequently, in countries like Tanzania, between 2009/10 and 2016/17 the government of Tanzania allocated nearly US$2 billion to energy access, of which US$40 million – or 2% – was targeted to off-grid energy projects (Kaijage et al., 2017). However, if the numbers of people with access to energy were given greater weight, decentralised energy programmes could gain greater investment and provide

poor communities with access to energy faster that centralised grid systems (Soanes et al., 2017).

The challenges to enhanced deployment of mini-grids and decentralised electrification in SSA might be overcome should researchers, consultants and their funders expand and make accessible literature focusing specifically on Clean Energy Mini-Grids (CEMGs); and international and national development institutions should design more programmes specifically targeting mini-grids in SSA and not rural electrification as a whole (Contejean and Verin, 2017). Arguably, utilising climate change South-South Cooperation modalities can be an effective way for developing mini-grid programmes and improving access to mini-grid literature since funding through South-South Cooperation is motivated more by equity and promoting socio-economic development rather than profit and commercial viability. South-South Cooperation is a broad framework for collaboration among developing countries in political, economic, social, cultural, environmental and technical domains, through which developing countries share knowledge, skills, expertise and resources to meet their development goals through concerted efforts (Weigel, 2013). Whilst conventional climate change financial and technical support to developing countries has usually been through the Global North pledges to the Global South, there are now increased cases where Global South countries are providing climate change financial and technical support amongst themselves through South-South climate finance modalities (Yu, 2014; Chirambo, 2016; Ha and Hale, 2016). For example, emerging countries such as China, India and Brazil have been

providing climate change mitigation and adaptation related support to African countries in areas such as agriculture, disaster relief and prevention, and renewable energy deployment (Yu, 2014; Chirambo, 2016). Subsequently, through South-South Cooperation, China will provide US$3.1 billion (CNY 20 billion) to the South-South Cooperation Fund, and implement the Ten, Hundred, Thousand Project which will entail establishing 10 low-carbon demonstration zones, 100 mitigation and adaptation projects and 1,000 training opportunities for developing countries (NDRC, 2017).

Chinese energy sector investors and project developers are already familiar with undertaking business in SSA and SSA's energy sector is already beneficiating from Chinese interests in the sector (Ubi, 2014; IEA, 2016). Chinese companies operating as the main contractor were responsible for 30% of new capacity additions in SSA between 2010-15; loans, buyer/seller credits and FDI from China for SSA power sector development amounted to around US$13 billion between 2010-15 (or around one-fifth of all investments in the sector in the region); and Chinese contractors have built or are contracted to build 17 GW of generation capacity in SSA from 2010 to 2020, equivalent to 10% of SSA's existing installed capacity (IEA, 2016). Since support through South-South Cooperation and the China South-South Climate Cooperation Fund are "additional" to normal aid and investments, it can be argued that a viable means of promoting rural electrification through off-grid solutions and mini grids would be to impose quotas and/or put in place directives that would make it mandatory for

some, if not all, energy sector projects implemented through South-South Cooperation and the China South-South Cooperation Fund to focus on improving modern energy access to rural populations. Such a strategy or policy would not impair the normal energy investment patterns of SSA since commercially viable projects would still be developed through private investors and commercial business models, whilst electrifying the rural un-served and under-served populations would be done with support from climate financing modalities. Such a strategy would not only be beneficial in ensuring that SDG 7 can be attained, but it would also mean that such marginalised rural communities would be less vulnerable to climate change impacts since access to modern energy can also enhance access to irrigation, education services, health services, Information and Communications Technology (ICT); and enhance agricultural food systems and value chains (UNDP, 2014).

3 Local Governance for Climate Compatible Development (CCD)

Climate Compatible Development (CCD) is development that minimises the harm caused by climate impacts, while maximising the many human development opportunities presented by a low emissions, more resilient future (Mitchell and Maxwell, 2010). To achieve CCD, policy makers need to develop national and subnational governance systems, including legislative, institutional architecture, regulatory and accountability measures that can take advantage of combining efforts to lower emissions or keep emissions low, build resilience, grow and develop (Mitchell and Maxwell, 2010). Consequently, local governance institutions have a vital part in ensuring

that renewable energy projects and climate change initiatives get successfully implemented at local level to satisfy national and international climate change ambitions. SSA's rural and urban socioeconomic settings are markedly different, hence local government institutions require to implement different strategies even within the same country. For example, the vulnerability of rural areas is perpetuated by its greater reliance on agriculture and other climate-sensitive economic sectors for livelihoods (Bowen et al., 2012; Fankhauser and McDermott, 2014). Conversely, the vulnerability of urban areas is perpetuated by poor urban planning, gaps in public services and infrastructure, settlement in hazard-prone areas, and high levels of poverty, illiteracy, and poor health (Wilson and Smith, 2014). Since rural diversification typically facilitates a more inclusive but slower growth process and transitioning from agriculture into the rural non-farm economy is more effective in reducing poverty than promoting rural-urban migration (Christiaensen and Todo, 2014; Christiaensen et al., 2013), it can be argued that CCD cannot be achieved in SSA without having local level strategies that promote rural development through enhanced alignment of agriculture development and renewable energy based rural electrification.

The successful implementation of climate related policies is determined by the way they are integrated with sectorial policies, with policies of other levels of government, with civil society and within themselves (integration of mitigation–adaptation policies) (de Oliveira, 2009). However, in SSA, a combination of a relatively low priority to environmental education; bureaucratic delays in adopting and implementing environmental policies

and strategies; and a lack of awareness of the implications of climate change for future economic growth and development hampers the impacts of policies and programmes at implementation stage (Viljoen, 2013; UNDP, 2014). Consequently, enhancing local government capacities to facilitate successful energy transitions may only be permissible in SSA by correcting market and government policy failures, and introducing new technologies, business models and financial innovations (GCEC, 2014).

With the aforementioned factors in mind, it can be anticipated that the implementation of national climate change mitigation projects and renewable energy deployment programmes might be impaired regardless of the availability technical and financial resources that can hasten renewable energy deployment in rural areas such as through the Paris Agreement and Sustainable Energy for All (SE4All) initiative. However, local governance systems and subnational governments (cities, states, counties) have the potential to improve climate change resilience as they are often the closest entities for planning and implementing climate change strategies suitable for the particular geographic and social context in which they are located (Pasquini et al., 2013; Niang et al., 2014). Additionally, subnational governments can enhance climate change resilience through their mandates to provide local infrastructure and public services, and promulgate and regulate land use and building codes (Wilson and Smith, 2014). More importantly, even though subnational governments are not generally subjected directly to international pressure or agreements, through their local governance systems and local policies, subnational governments have

been shown to take the lead in tackling climate change even in countries where national/central governments have been reluctant to support international efforts for climate change management (de Oliveira, 2009).

Despite the potential for subnational governments to foster effective climate change planning and management, many subnational governments in SSA can be anticipated to have challenges in promoting many climate change and renewable energy agendas in their jurisdiction. This follows that these subnational governments have to overcome individual-level barriers (such as a lack of understanding of climate change and adaptation options); socio-cultural barriers (such as a lack of interest within municipal constituencies for climate change issues); and existing strains on resources and capacity (Pasquini et al., 2013). However, it can be argued that subnational governments can overcome these barriers and contribute significantly towards the effective implementation of climate change policies if they reduced their reliance on central governments but instead focused on creating CCD focused win-win partnerships with non-state actors such as financial institutions, academic institutions, renewable energy investors, impact investors, etc.

4 Microfinance for Climate Compatible Development (CCD)

In comparison to developed countries, low-income countries such as those in SSA are more vulnerable to current climate variability and future climate change (World Bank, 2013). Whilst most of the greenhouse gas emissions that contribute to global warming are attributed to the lifestyles and

economic activities of people in developed countries, it is the people in developing countries that are anticipated to suffer the most from climate change impacts (Barrett, 2013). In the case of SSA, climate change vulnerability is exacerbated by SSA's underdeveloped rural financial systems and low levels of financial inclusion which makes it problematic for rural households to access credit facilities for buying hybrid inputs and utilise risk transfer mechanisms, such as index based insurance (UMM, 2015; FAO, 2016; Meyer, 2015). Arguably, improving rural financial systems is integral to facilitating CCD in SSA.

Microfinance is a socio-economic development and climate change resilience building strategy ideal for SSA. This can be attributed to the dual roles to which microfinance has on reducing poverty, improving the social and economic situation of women and facilitating income increases through the diversification of sources of income (Chirambo, 2017). Other benefits of microfinance to households and communities include the potential to contribute to an accumulation of assets; potential to reduce vulnerability due to illness, drought and crop failures; and it may also contribute to better education, health and housing of the borrowers (Hermes et al., 2011). In other cases, microfinance is considered as a strategy for creating jobs since poor entrepreneurial individuals could earn high marginal returns through business activity but are credit constrained, and access to small loans to under-served entrepreneurs and their micro-enterprises, would then help realise growth opportunities by starting or expanding businesses, thus spurring employment (Erhardt, 2017). Equally important are the assertions

that when comparisons between lending from microfinance institutions and traditional banks are undertaken, bank loans are noted not to increase economic growth but increase investments whilst microfinance loans are shown to increase economic growth because microfinance loans may augment growth in other ways than by increasing physical capital (Donou-Adonsoua and Sylwester, 2017). Lastly, in addition to reducing the vulnerabilities of communities to climate change, microfinance modalities can also be suitable mechanisms for supporting Target 1.4 of the SDGs which suggests that by 2030 all men and women, in particular the poor and the vulnerable, should have equal rights to economic resources, appropriate new technology and financial services, including microfinance (UN, 2015).

Microfinance programmes and products can also be linked to carbon offsetting markets thereby unlocking the renewable energy and carbon offsetting potential that remains under-exploited in Africa. For example, microfinance institutions can develop renewable energy technologies based lending to off-grid communities and earn extra revenue from the carbon offsets that can be generated by transitioning the microfinance customers from using traditional energy sources such as biomass, to modern energy through renewable energy technologies (Micro Energy Credit, 2017; Hogarth, 2012). Such a strategy can enable microfinance institutions to generate extra revenues to cut their operational costs whilst improving access to clean energy especially in rural areas.

Commercial banks and other lending institutions shun funding decentralised energy access because of a lack of relevant instruments, such as risk guarantees for lenders, and relevant credit lines; thereby a lack of capital from traditional financial institutions has been a critical constraint to the potential future growth of the domestic energy sector (Kaijage, 2017; AfDB, 2016b). However, whilst the lack of interest of banks to promote renewable energy deployment was viewed as a challenge, currently this is being considered as an opportunity as some companies are filling this financing gap whereby there has been a growth of intermediary investment companies that are focused on providing capital to renewable energy sector enterprises (Kaijage 2017; Gilpin, 2015). For example, Sunfunder is a San Francisco based organisation that mobilises financial resources from development financing institutions (DFIs) and the private sector, and makes it available to off-grid/decentralised energy companies in the developing world on relatively affordable terms (Kaijage, 2017). The business model for Sunfunder principally entails the company connecting investors to high-impact solar projects that improve the lives of low-income communities in Africa, Asia and Latin America. Sunfunder is reported to have improved access to energy to over 2.7 million people by providing investments of over US$20 million to enterprises related to solar lighting, phone charging, micro-grids and commercial solar projects (Sunfunder, 2017). According to Walske and Tyson (2015), the aspects that make entrepreneurs and social enterprises to thrive and scale-up include innovation, sourcing financial capital, building out their supply chain and ensuring on-going media coverage. Arguably, now that there are emerging financial resources coming

up with the potential for intermediary investment companies to improve investments in renewable energy projects, SSA subnational governments can also play a part in increasing energy access rates by being proactive and directly engaging with intermediary investment companies to advise them of investment opportunities in their areas as well as linking local potential energy project developers with intermediary investment companies. More importantly, since microfinance institutions deal with various clients at local level, microfinance institutions can partner with intermediary investment companies so that the microfinance institutions can access funds through the intermediary investment companies in-order to develop appropriate programmes, financial products and financial services related to renewable energy deployment and climate change mitigation and adaptation.

The characteristics and vulnerabilities of households and communities vary markedly across space and time, even among seemingly homogeneous populations (FAO, 2015). Unfortunately this means that some government policies and strategies serve other communities, groups and localities well but also puts other communities, groups and localities at a disadvantage. Consequently, scholars such as Elinor Ostrom considered that the major threats to sustainable development such as poverty, climate change and the over exploitation of natural resources could best be addressed through polycentric governance approaches (Ostrom 2008; 2009; 2010). In her analysis, Elinor Ostrom argued that polycentric governance approaches provided dynamic mechanisms which could allow the experimentation of policies and governance strategies at multiple levels, leading to the

development of methods for assessing the benefits and costs of particular strategies adopted in one type of ecosystem to be compared to results obtained in other ecosystems (Ostrom 2008; 2009; 2010). Through the application of the concepts of polycentric governance approaches, microfinance institutions can also have a significant role in promoting off-grid renewable energy deployment, and climate change mitigation and adaptation. As illustrated on figure one, the Microfinance Beneficiary Led Development Framework (M-BLDF) is a polycentric climate change governance approach aimed at enabling microfinance institutions to take an active role in addressing climate change challenges at local level. Beneficiary Led Aid (BLA) paradigms are processes through which aid and assistance programmes are determined and materially designed by those at which they are aimed at benefiting hence they can be successful in addressing some development problems as they provide "real" engagement with the beneficiaries and enable the beneficiaries to be entrusted by donors and agencies to make decisions, rather than simply to offer input (Flint and zu Natrup, 2014). The M-BLDF is therefore a framework that principally aims at providing microfinance services and products that are in keeping with the needs and capacity gaps of the beneficiaries and local contexts. For example, the M-BLDF was applied in the Beneficiary-Led Climate Change Resilience Building Programme (BLCCRBP) in Malawi (SOO, 2017). In this Programme, it was envisaged that the M-BLDF would enable a Non-Governmental Organisation to provide financial and technical support to various communities to enable them to identify their climate change vulnerabilities and then decide how best the various communities and beneficiaries would

be able to address these issues. Such a bottom-up approach could potentially be more effective than hierarchical arranged or top-down managed microfinance institutions at promoting decentralised energy technologies and supporting subnational governments in their climate change ambitions since both strategic and operational interventions are planned and coordinated at local level thereby enabling the different branches or offices of the microfinance institution to align available capacity resources and endowments with what the stakeholders and subnational governments in different localities require.

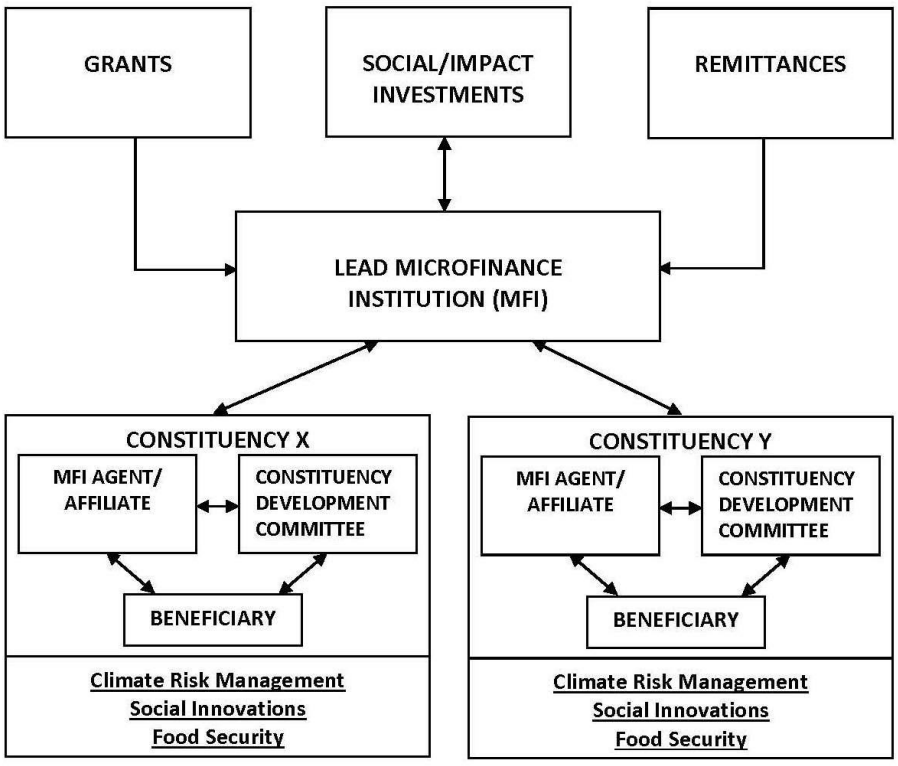

Figure 1. Microfinance-Beneficiary Led Development Framework (M-BLDF).
Source: Author

5 Discussion

SDG 7 is calling for universal access to modern energy by 2030. However, some reports have indicated that the energy gap between Africa and the rest of the world is widening (APP, 2017), and that even though energy access rates in SSA rose from 32% to 35% between 2010-2012, a significant number of countries in SSA are not improving electricity access at a pace that is compatible with achieving universal energy access in 2030 (AfDB, 2016a). Africa's energy sector challenge is not only to increase mobilisation of energy sector financial investments from the current low levels, but actually to also improve innovation in energy service provision in-order to substantially improve access to electricity in rural areas. Collecting firewood and producing charcoal are the main causes of deforestation in Africa (APP, 2017), and globally an estimated 2.7 billion people, most of which are in SSA, rely on the traditional use of biomass for cooking but this could rise to 2.8 billion people in 2030 (Kaygusuz, 2012). Arguably, the renewable energy sector in SSA is in need of new innovative approaches and governance systems for rural decentralised renewable energy deployment since meaningful and sustainable approaches to energy access remain largely unfamiliar to most actors in the energy sector. Such institutional innovations would need to radically and urgently ramp-up broad-based capacity building on decentralised approaches to energy service provision amongst practitioners, policymakers and the finance community (Leopold, 2014).

There are many promising developments and initiatives that have the potential to significantly improve investment in SSA's renewable energy sector. According to Kato et al. (2014), since the majority of public and private climate finance to date has focused on mitigation (as opposed to adaptation), even with the increased funding pledges for climate change actions, the post 2015 era is likely to see the proliferation of more climate change mitigation and renewable energy projects than adaptation projects in the developing world. This can be attributed to the fact that stakeholders and investors are likely to promote the scaling-up and replication of existing climate change interventions which have successfully mobilised private climate finance (Kato et al., 2014). This therefore means that the interest and prospects of increased investments in Africa's climate change mitigation and renewable energy sector will be greater than those for climate change adaptation.

Energy sector developments and investments may be considered as a welcome development that can enable SSA to alleviate its poverty levels, however, there are concerns that such development and investments may perpetuate environmental degradation on the continent. For example, increases in FDI inflows significantly increase environmental degradation in SSA and environmental degradation in SSA in the post 2010 era has been greater than degradation in the 1990s (Bokpin, 2017). FDI is considered a channel to which African governments can stimulate growth since FDI augments capital formation in the recipient economy, induces human capital

growth, fosters trade, helps technology transfers, generates jobs and strengthens competition (Lee, 2013; Carmody, 2009; Tang and Gyasi, 2012). Consequently, many African governments have been instituting various political and institutional reforms, including trade and investment liberalisation, privatisation, and investment incentives so as to remove barriers to trade and facilitate increased FDI inflows (Bokpin, 2017). In the energy sector, initiatives such as Power Africa and the SE4All are also instituting wide-ranging policy changes that will make the energy sectors more efficient and attractive for private sector investments and FDI. To this effect, Power Africa has singularly within three years of its implementation mobilised commitments and investments of more than US$52 billion, including more than US$40 billion in commitments from the private sector (Power Africa, 2016), and has a target to double access to power across SSA by adding 60 million new electricity connections and increase installed generation capacity by 30,000 MW by 2030 (USAID, 2017). On the other hand FDI from China to Africa between 2003 and 2011, increased thirty-fold, from US$491 million to US$14.7 billion (Ubi, 2014). A lack of infrastructure in Africa is a major constraint to doing business in the region (Ubi, 2014) and the current low rates of electrification in many African countries has been identified as the most pressing obstacle to economic growth, more important than access to finance, red tape or corruption (IEA, 2016). Arguably, with all the aforementioned initiatives providing more financial and technical support to improve African energy sectors, it can therefore be anticipated that significant energy access constraints are being reduced in many SSA countries and hence these countries will be attracting

more FDI inflows into various sectors. Consequently, there is a high probability that energy sector investments could perpetuate FDI inflows that might end up being harmful to Africa's environmental sustainability.

Minimising the harm of FDI on environmental sustainability is influenced by the governance and institutional quality whereby the presence of quality institutions to check the activities of managers of FDIs and the recipient organisations could result in positive environmental sustainability (Bokpin, 2017). It can therefore be argued that partnerships between subnational governments and non-state actors like microfinance institutions and Non-Governmental Organisations, as well as the adoption of polycentric governance systems can enhance Africa's institutional capacity and create new social systems that can facilitate successful energy transitions for universal energy access and strengthen local level institutions and systems for monitoring the impact that FDI inflows are having on local level environmental resources. To substantiate this claim, it has been reported that China's progress in improving human development and inclusive growth is based on principles of social innovation in public administration where central government's top level plans are reinforced by the work of local governments and all sectors of society in-order to allow communities to be in a better position to adapt to the uncertainties in the process of social and economic transformation and promote self-regulation (UNDP, 2016). Social innovations are practices that bring about changes in attitudes, behaviour, or perceptions, resulting in new social practices. Social innovation practices

bring about changes in the way social agents act and interact with each other and also changes in the social context in which these actions take place through the creation of new institutions and new social systems (Cajaiba-Santana, 2014). Arguably, with all these issues in mind, African policy makers and stakeholders should not therefore completely depend on traditional bureaucracies and governance systems in securing environmental sustainability, but they should focus more on creating new social systems and partnerships between formal and informal organisations. This could be very important as even though most SSA countries will likely reduce their adverse impacts on the environment by increasing their use of renewable energy technologies rather than fossil fuel systems, improvements in energy access in SSA have the potential to indirectly open up many African countries to new sources of FDI inflows in various sectors which could lead to more environmental problems due to weaknesses in existing environmental governance systems and poor enforcement of environmental regulations in many countries.

6 Conclusion

SSA is a region that requires significant improvements in its electricity access rates in-order to alleviate poverty and improve the living standards of its people especially in rural areas. Moreover, improving access to energy is imperative since energy access issues have a significant influence in enhancing education standards, health services provision and food security; hence can play a significant role in making most countries to be on a good

trajectory to achieve the SDGs. Unfortunately, the current investments and progress on energy access in the region are insufficient to guarantee that SSA will achieve universal energy access in 2030 as envisioned in SDG 7. What is even more troubling is that Africa's youth population is growing so rapidly to the extent that it is projected that more than half of the global population growth between now and 2050 is expected to occur in Africa. Such rapid population increases are anticipated to increase rural populations, and this might pose as a social problem should the youth not be provided with sufficient social services and jobs. Additionally, Africa's rapid population increases within the context of existing modern energy and electricity access constraints will likely lead to exacerbated rates of deforestation and diminish SSA's carbon sequestration potential should alternative modern energy sources not be provided.

Innovations in SSA's local governance approaches can arguably enable SSA to simultaneously improve its climate change mitigation and adaptation efforts, whilst improving access to renewable energy, especially in rural areas. This follows that a poor regulatory environment for IPPs and a poor institutional framework for accessing climate finance modalities has meant that the synergies that can be achieved through the private sector and climate funds have not yet been fully realised in SSA. Additionally, SSA's governments have not focused on improving energy access in rural areas and have not fully utilised decentralised energy systems even though decentralised energy systems provide comparatively lower investment costs, have fewer regulatory approvals than grid connected systems, and can

potentially stimulate job opportunities and youth unemployment in rural areas. However, with the Paris Agreement and various climate finance modalities promising to provide additional finances for climate change mitigation and renewable energy deployment, it therefore means that some of the financing challenges to rural electrification could be reduced, and the greater challenge now is to provide viable governance and business approaches that can enable IPPs and private sector investors and businesses to focus their efforts on developing and scaling-up rural decentralised energy systems rather than grid connected systems.

SSAs CCD strategies need to focus on creating win-win partnerships between subnational governments and non-state actors (e.g. financial institutions, academic institutions, renewable energy investors, impact investors, etc.) so that there are increased financial and non-financial resources available to enable the successful regulation of environmental resources and promotion of renewable energy. This follows that increases in FDI inflows in SSA are arguably increasing environmental degradation in the region and this could potentially get worse as access to energy improves since that will unlock more socio-economic opportunities on the continent and spur even more FDI inflows in various sectors. It is therefore not only in the interest of central governments and subnational governments to see to it that energy access is improved through sustainable means such as renewable energy deployment, but also that different governance approaches and partnerships are developed so that other non-state actors have the

mandate to help with the development, implementation and regulation of national and local environmental policies.

Africa's energy sector requires quotas and directives on decentralised energy access to ensure that renewable energy climate finance projects do not perpetuate a bias towards grid connected energy systems and urban electrification which exacerbate inequality and constrain rural development. Many climate finance modalities, especially the ones that have the involvement of the private sector, usually focus on improving climate change mitigation rather that climate change adaptation. Such a mitigation bias has usually been regarded as a factor that has worked against the ambitions of African stakeholders in the climate change fora since the demand for adaptation finance is greater than the demand for mitigation finance in Africa. Since most indications are pointing out that even with increased climate change funding sources and pledges for the post 2015 agenda, funding towards mitigation activities will continue to outstrip adaptation activities, and this might translate into an opportunity for Africa's renewable energy sector. Ensuring that this mitigation bias supports the development aspirations of SSA, there will be a need to strategically promote greater investment through decentralised energy systems and this can easily be achieved by creating policies and directives that impose mandates and quotas on the quantities of climate finance renewable energy projects that can be from decentralised or grid connected systems so as to promote rural electrification. Such an approach may not only support the global climate

change mitigation ambitions, but actually might also enhance climate change resilience in rural areas since vulnerability to climate change in rural areas, where the majority of Sub-Saharan Africans reside and lack energy, is partly attributed to a low prioritisation of decentralised approaches to energy service provision.

It therefore goes without saying that the Paris Agreement, as well as other energy focused initiatives such as Power Africa and SE4All will undoubtedly improve the availability of capital, investments and partnership opportunities to enhance climate change mitigation and renewable energy deployment in SSA. However, ensuring that such global initiatives progress at a pace that is sufficient to make SSA countries attain SDG 7 and achieve meaningful progress before 2030 will require local level actors such as microfinance institutions to take on more pro-active roles in creating social and institutional innovations and governance frameworks. Such social and institutional innovations and governance frameworks should have the potential to promote social and economic transformations based on supporting the capabilities of local communities and subnational governments to overcome their barriers related to understanding their climate change constraints, and increasing options and implementation models for enhancing renewable energy deployment.

References

ADB (Asian Development Bank) (2011). Energy for All: Viet Nam's Success in Increasing Access to Energy through Rural Electrification. Mandaluyong City: ADB.

AfDB (African Development Bank) (2013). Rwanda Energy Sector Review and Action Plan. Tunis: AfDB.

AfDB (African Development Bank) (2016a). SE for All Africa Hub: Annual Report 2015-2016. Abidjan: AfDB.

AfDB (African Development Bank) (2016b). Green Mini-Grids in Sub-Saharan Africa: Analysis of Barriers to Growth and the Potential Role of the African Development Bank in Supporting the Sector. Abidjan: AfDB.

Akuru, U.B, Onukwube, I.E, Okoro, O.I. and Obe, E.S. (2017).Towards 100% renewable energy in Nigeria. Renewable and Sustainable Energy Reviews 71 (2017) 943–953.

Amatayakul, W. and Berndes (2012). Determining factor for the development of CDM biomass power projects. Energy for Sustainable Development 16, 197–203.

APP (The Africa Progress Panel) (2014). Finance and banking in Africa: Extracts from The Africa Progress Report 2014. Geneva: APP.

APP (The Africa Progress Panel) (2017). Lights, Power, Action: Electrifying Africa. Geneva: APP

Barrett, S. (2013). Local level climate justice? Adaptation finance and vulnerability reduction. Global Environmental Change 23, 1819–1829.

Bazilian, M., Nussbaumer, P., Rogner, H., Brew-Hammond, A., Foster, V., Pachauri, S., Williams, E., Howells, M., Niyongabo, P., Musaba, L., Ó Gallachóir, B., Radka, M. and Kammen, D.M. (2012). Energy access scenarios to 2030 for the power sector in sub-Saharan Africa. Utilities Policy 20, 1-16.

Benessaiah, K. (2012). Carbon and livelihoods in Post-Kyoto: Assessing voluntary carbon markets. Ecological Economics 77, 1-6.

Bokpin G.A. (2017). Foreign direct investment and environmental sustainability in Africa: The role of institutions and governance. Research in International Business and Finance 39, 239–247.

Bowen, A., Cochrane, S. and Fankhauser, S. (2012). Climate change, adaptation and growth. Climatic Change 113, 95–106.

Bryan, E., Ringler, C., Okoba, B, Roncoli, C., Silvestri, S, and Herrero, M. (2013). Adapting agriculture to climate change in Kenya: Household strategies and Determinants. Journal of Environmental Management 114, 26-35.

Cajaiba-Santana, G. (2014). Social innovation: Moving the field forward. A conceptual Framework. Technological Forecasting & Social Change 82, 42-51.

Carmody, P. (2009). An Asian-driven economic recovery in Africa? The Zambian Case. World Development 37(7), 1197–1207.

Chirambo, D (2016). Moving Past the Rhetoric: Policy Considerations that can make Sino-African Relations to improve Africa's Climate Change Resilience and the Attainment of the Sustainable Development Goals. Advances in Climate Change Research 7(4), 253-263.

Chirambo, D (2017). Enhancing Climate Change Resilience through Microfinance: Redefining the Climate Finance Paradigm to Promote Inclusive Growth in Africa. Journal of Developing Societies 33(1), 1–24.

Christiaensen, L., De Weerdt, J. and Todo, Y. (2013). Urbanisation and Poverty Reduction: The Role of Rural Diversification and Secondary Towns. Policy Research Working Paper 6422. Washington, DC: World Bank.

Christiaensen, L. and Todo, Y. (2014). Poverty Reduction during the Rural–Urban Transformation – The Role of the Missing Middle. World Development 63, 43–58.

Contejean, A. and Verin, L. (2017). Making mini-grids work: productive uses of electricity in Tanzania. IIED Working Paper. London: The International Institute for Environment and Development (IIED).

de Oliveira, J.A.P. (2009). The implementation of climate change related policies at the subnational level: An analysis of three countries. Habitat International 33, 253–259.

Donou-Adonsoua, F. and Sylwester, K. (2017). Growth effect of banks and microfinance: Evidence from developing countries. The Quarterly Review of Economics and Finance 64, 44–56.

Eberhard, A. and Shkaratan, M. (2012). Powering Africa: Meeting the financing and reform challenges. Energy Policy 42, 9–18.
Eberhard, A., Gratwick, K., Morella. E. and Antmann, P (2016). Independent Power Projects in Sub-Saharan Africa: Lessons from Five Key Countries. Directions in Development. Washington, DC: World Bank.
Elum, Z.A. and Momodu, A.S. (2017). Climate change mitigation and renewable energy for sustainable development in Nigeria: A discourse approach. Renewable and Sustainable Energy Reviews 76, 72–80.
Erhardt, E. (2017). Microfinance beyond self-employment: Evidence for firms in Bulgaria. Labour Economics. http://dx.doi.org/10.1016/j.labeco.2017.04.009.
Fankhauser, S. and McDermott, T.K.J. (2014). Understanding the adaptation deficit: Why are poor countries more vulnerable to climate events than rich countries? Global Environmental Change 27, 9–18.
FAO (The Food and Agriculture Organisation of the United Nations) (2015). The state of food and agriculture social protection and agriculture: Breaking the cycle of rural poverty. Rome: FAO.
FAO (Food and Agriculture Organisation of the United Nations) (2016). The State of Food and agriculture 2016: Climate Change, Agriculture and Food Security. Rome: FAO.
Flint, A. and zu Natrup, C.M. (2014). Ownership and Participation: Toward a Development Paradigm based on Beneficiary-led Aid. Journal of Developing Societies 30(3), 273-295.
Gamula, G., Hui, L. and Peng, W. (2013). Development of renewable energy technologies in Malawi. International Journal of Renewable Energy Technologies 2, 44–52.
GCEC (Global Commission on the Economy and Climate) (2014). The New Climate Economy Report - The Synthesis Report September 2014. Washington, DC: World Resources Institute.
Gilpin, L. (November 30, 2015). How SunFunder is Proving to the World that Developing Countries are Great Cleantech Investments. Available from: https://www.forbes.com/sites/lyndseygilpin/2015/11/30/how-sunfunder-is-proving-to-the-world-that-developing-countries-are-great-cleantech-investments/2/#5ae50bcf75dd
Ha, S. and Hale, T. (2016). Climate finance in and between developing countries: an emerging opportunity to build on. Global Policy 7(1), 102-108.
Haanyika, C.M. (2008). Rural electrification in Zambia: A policy and institutional analysis. Energy Policy 36, 1044-1058.
Hancock, K.J. (2015). The expanding horizon of renewable energy in sub-Saharan Africa: Leading research in the social sciences. Energy Research & Social Science 5, 1-8.
Hermes, N., Lensink, R. and Meesters, A. (2011). Outreach and Efficiency of Microfinance Institutions. World Development 39(6), 938–948.
Hogarth, J.R. (2012). Promoting diffusion of solar lanterns through microfinance and carbon finance: A case study of FINCA-Uganda's solar loan programme. Energy for Sustainable Development 16, 430–438.
Hood, C., Adkins, L. and Levina, E. (2015). Overview of INDCs Submitted by 31 August 2015. Paper No. 2015(4). Climate Change Expert Group. Paris: Organisation for Economic Co-operation and Development (OECD).
IEA (International Energy Agency) (IEA) (2016). Boosting the Power Sector in Sub-Saharan Africa: China's involvement. Paris: IEA.
Johnson, O., Muhoza, C., Osano, P., Senyagwa, J. and Kartha, S. (2017). Catalysing investment in sustainable energy infrastructure in Africa: Overcoming financial and non-financial constraints. Stockholm Environment Institute Working Paper No. 2017-03. Nairobi: Stockholm Environment Institute.
Junghans, L. and Köhler, M. (2016). Cropping and cashing: institutional solutions for synergetic climate finance for mitigation and adaptation in agriculture. Climate and Development 8(3), 207-210.
Kaijage, E., Nyagawa, S., Best, S., Cosmas, R., Temba, S., Mtwanga, B. and Mahanga, N. (2017). Money is Power: Tracking finance flows for decentralised energy access in Tanzania. IIED Working Paper. London: The International Institute for Environment and Development (IIED).

Kato, T., Ellis, J., Pauw, P. and Caruso. R. (2014). Scaling Up and Replicating Effective Climate Finance Interventions. Climate Change Expert Group Paper 2014(1). Paris: OECD.
Kaygusuz, K. (2012). Energy for sustainable development: A case of developing countries. Renewable and Sustainable Energy Reviews 16(2), 1116–1126.
Kebede, E., Kagochi, J. and Jolly, C.M. (2010). Energy consumption and economic development in Sub-Sahara Africa. Energy Economics 32, 532–537.
Lau, L.C., Lee, K.T. and Mohamed, A.R. (2012). Global warming mitigation and renewable energy policy development from the Kyoto Protocol to the Copenhagen Accord – a comment. Renewable and Sustainable Energy Reviews 16, 5280–5284.
Lee, J.W. (2013). The contribution of foreign direct investment to clean energy use, carbon emissions and economic growth. Energy Policy 55, 483–489.
Leopold, A. (2014). Making Climate Change Mitigation More Meaningful: the link to universal energy access. Rugby. Practical Action Publishing.
Lior, N. (2012). Sustainable energy development: The present situation and possible paths to the future. Energy 43, 174-191.
Meyer. R.L. (2015). Financing Agriculture and Rural Areas in Sub-Saharan Africa: Progress, challenges and the way forward. IIED Working Paper. London: International Institute for Environment and Development (IIED).
Micro Energy Credit (2017). Our Story. Available from: http://microenergycredits.com/our-story/
Mitchell, T. and Maxwell, S. (2010). Defining climate compatible development. CDKN ODI Policy Brief November 2010/A. London: The Climate and Development Knowledge Network (CDKN).
NDRC (The National Development and Reform Commission) (2015). China's Policies and Actions on Climate Change. Beijing: The National Development and Reform Commission.
Niang, I., Ruppel, O.C., Abdrabo, M.A., Essel, A., Lennard, C., Padgham, J., & Urquhart, P. (2014). Africa. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Barros, V.R., Field, C.B., Dokken, D.J.,
Ostrom, E. (2008). Polycentric Systems as One Approach for Solving Collective-Action Problems. Available at http://dx.doi.org/10.2139/ssrn.1304697.
Ostrom, E. (2009). A Polycentric Approach for Coping with Climate Change. World Bank Policy Research Working Paper Series 5095. Washington, DC: World Bank. Available at SSRN: http://ssrn.com/abstract=1494833.
Ostrom, E. (2010). Beyond Markets and States: Polycentric Governance of Complex Economic Systems. American Economic Review 100, 1-33.
Pasquini, L., Cowling, R.M. and Ziervogel, G. (2013). Facing the heat: Barriers to mainstreaming climate change adaptation in local government in the Western Cape Province, South Africa. Habitat International 40, 225-232.
Power Africa (2016). Power Africa Annual Report 2016. Washington, DC: U.S. Agency for International Development (USAID).
Sanoh. A., Kocaman. A., Kocal, S., Sherpa, S., Modi, V. (2014). The economics of clean energy resource development and grid interconnection in Africa. Renew Energy 62, 598–609.
Schwerhoff, G., Sy, M. (2017). Financing renewable energy in Africa – Key challenge of the sustainable development goals. Renewable and Sustainable Energy Reviews 75, 393–401.
Soanes, M., Rai, N., Steele, P., Shakya, C. and Macgregor, J. (2017). Delivering real change: Getting international climate finance to the local level. IIED Working Paper. London: The International Institute for Environment and Development (IIED).
Sokona, Y., Mulugetta, Y. and Gujba. H. (2012). Widening energy access in Africa: Towards energy transition. Energy Policy 47, 3–10.
SOO (Seeds of Opportunity) (2017). Beneficiary-Led Climate Change Resilience Building Programme (BLCCRBP). Available from: http://seedsofopportunity.org/activities-programmes/beneficiary-led-climate-change-resilience-building-programme-blccrbp/

Suberu, M., Mustafa, M. and Bashir, N. (2013). Status of renewable energy consumption and developmental challenges in Sub-Sahara Africa. Renewable and Sustainable Energy Reviews 27, 453–463.
Sunfunder (2017). Financing solar beyond the grid. Available from: http://sunfunder.com/
Tang, D. and Gyasi, K.B. (2012). China–Africa Foreign Trade Policies: The Impact of China's Foreign Direct Investment (FDI) Flow on Employment of Ghana. Energy Procedia 16, 553–557.
Terrapon-Pfaff, J., Dienst, C., König, J., Ortiz, W. (2014). A cross-sectional review: Impacts and sustainability of small-scale renewable energy projects in developing countries. Renewable and Sustainable Energy Reviews 40, 1–10.
Timilsina, G.R., de Gouvello, C., Thioye, M. and Dayo, F.B. (2010). Clean Development Mechanism Potential and Challenges in Sub-Saharan Africa. Mitigation and Adaptation Strategies for Global Change 15, 93–111.
Ubi, E.N. (2014). Foreign aid and development in Sino-African relations. Journal of Developing Societies 30(3):243-272.
UMM (University Meets Microfinance Action Group) (2015). Enhancing Food Security and Resilience to Climate Change: What Role for Microfinance? UMM Thematic Paper from the 12th University Meets Microfinance Workshop. Paris: Positive Planet.
UN (United Nations) (2015). Transforming our world: the 2030 Agenda for Sustainable Development. New York: United Nations.
UNDP (United Nations Development Programme) (2014). Understanding Community Resilience: Findings from Community-Based Resilience Analysis (CoBRA) Assessments. Nairobi: UNDP.
UNDP (2016) China National Human Development Report 2016: Social Innovation for Inclusive Human Development. Beijing: China Publishing Group Corporation, China Translation & Publishing House.
UNECA (United Nations Economic Commission for Africa) 2014. Africa Millennium Development Goals Report 2014. Assessing progress in Africa toward the Millennium Development Goals: Analysis of the Common African Position on the post-2015 Development Agenda. Addis Ababa: UNECA.
USAID (U.S. Agency for International Development) (2017). About Power Africa. Available from: https://www.usaid.gov/powerafrica/aboutus
van Wesenbeeck, C.F.A., Sonneveld, B.G.J.S. and Voortman, R.L. (2016). Localisation and characterisation of populations vulnerable to climate change: Two case studies in Sub-Saharan Africa. Applied Geography 66, 81-91.
Viljoen, W. (2013). Addressing climate change issue in eastern and southern Africa: EAC, COMESA, SADC and the TFTA. In Cape to Cairo: Exploring the Tripartite FTA agenda. Nairobi: Trade Law Centre and the Swedish Embassy.1-35.
Walske, J.M. and Tyson, L.D. (2015). Built to Scale: A Comparative Case Analysis, Assessing How Social Enterprises Scale. The International Journal of Entrepreneurship and Innovation 16 (4), 269–281
Weigel, M. (2013). China's Climate Change South-South Cooperation: Track Record and Future Direction. Beijing: United Nations Development Programme in China.
Wilson, R.H. and Smith, T.G (2014). Urban resilience to climate change challenges in Africa: Working Paper No.4. Texas: The Robert S. Strauss Centre for International Security and Law.
Wolde-Rufael, Y. (2009). Energy consumption and economic growth: The experience of African countries revisited. Energy Economics31, 217–224.
World Bank. (2013). Turn down the heat: climate extremes, regional impacts, and the case for resilience. A report for the World Bank by the Potsdam Institute for Climate Impact Research and Climate Analytics. Washington, DC: World Bank.
Yu, Y. (2014). Climate finance, Africa and China's role. African East-Asian affairs 1, 36-57.