UNIVERSITY OF LEEDS

This is a repository copy of *Alignment between nationally determined contributions and the sustainable development goals for West Africa*.

White Rose Research Online URL for this paper:
http://eprints.whiterose.ac.uk/130209/

Version: Accepted Version

Article:
Antwi-Agyei, P, Dougill, AJ orcid.org/0000-0002-3422-8228, Agyekum, TP et al. (1 more author) (2018) Alignment between nationally determined contributions and the sustainable development goals for West Africa. Climate Policy, 18 (10). pp. 1296-1312. ISSN 1469-3062

https://doi.org/10.1080/14693062.2018.1431199

© 2018 Informa UK Limited, trading as Taylor & Francis Group. This is an Accepted Manuscript of an article published by Taylor & Francis in Climate Policy on 1 February 2018, available online: https://doi.org/10.1080/14693062.2018.1431199. Uploaded in accordance with the publisher's self-archiving policy.

Reuse
Items deposited in White Rose Research Online are protected by copyright, with all rights reserved unless indicated otherwise. They may be downloaded and/or printed for private study, or other acts as permitted by national copyright laws. The publisher or other rights holders may allow further reproduction and re-use of the full text version. This is indicated by the licence information on the White Rose Research Online record for the item.

Takedown
If you consider content in White Rose Research Online to be in breach of UK law, please notify us by emailing eprints@whiterose.ac.uk including the URL of the record and the reason for the withdrawal request.

White Rose university consortium
Universities of Leeds, Sheffield & York

eprints@whiterose.ac.uk
https://eprints.whiterose.ac.uk/

Abstract

The UN Sustainable Development Goals (SDGs) and the Paris Climate Agreement are two of the most important policy frameworks of the twenty-first century. However, the alignment of national commitments linked to them has not yet been analysed for West African states. Such analyses are vital to avoid perverse outcomes if states assess targets and develop Nationally Determined Contribution (NDC) and SDG implementation plans without integrated planning and cross-sectoral alignment. This paper provides a situation analysis guided by the following questions: i) Which priority sectors are mentioned in relation to adaptation and mitigation in the NDCs of West African states? ii) Are the NDCs of West African states well aligned with the SDGs? iii) What are the co-benefits of NDCs in contributing towards the SDGs? and iv) How are West African states planning to finance actions outlined in their NDCs? The study uses iterative content analysis to explore key themes for adaptation and mitigation within NDCs of eleven West African states and their alignment to selected SDGs. A national multi-stakeholder workshop was held in Ghana to examine the co-benefits of the NDCs in contributing towards the SDGs and their implementation challenges. Results show that agriculture and energy are priority sectors where NDCs have pledged significant commitments. The analysis displays good alignment between mitigation and adaptation actions proposed in NDCs and the SDGs. These represent opportunities within the NDCs that can be harnessed through integration into national sectoral policies. However, cross-sectoral discussions in Ghana identify significant challenges relating to institutional capacity, a lack of coordination amongst institutions and agencies, and insufficient resources in moving towards integrated implementation of national planning priorities to address successfully both NDC priorities and the SDGs.

Key Policy Insights

- Positive alignments between West African NDCs and SDGs present opportunities for mutual benefits that can advance national development via a more climate resilient pathway.
- NDCs of West African states can provide mutual benefits across the water – energy – food nexus, such as through climate-smart agriculture and low carbon energy technologies.
- Ghanaian multi-sectoral insights show the need to empower national coordinating bodies required to overcome misalignments across different sectors.

Keywords: climate change; Paris Climate Agreement; policy coherence; mitigation, Sustainable Development Goals, ECOWAS, Ghana

1. Introduction

The Paris Climate Agreement has been hailed a "landmark achievement in multilateral diplomacy in the discourse on climate change" (FAO, 2016, p. 1). It seeks to hold global warming to well below 2ºC above pre-industrial levels and pursue efforts to limit this to 1.5ºC. Adopting a bottom-up approach, the Paris Agreement enables countries to present the types and scopes of their contributions based on their particular national circumstances (Northrop et al., 2016) and to develop these into legally binding actions at a national level (Bodansky, 2016). Prior to the 2015 United Nations Framework Convention on Climate Change (UNFCCC) COP21 meeting, West African states submitted their Intended Nationally Determined Contributions (later ratified as Nationally Determined Contribution (NDC) to the UNFCCC Secretariat. Analysing these submissions is at the core of this paper.

The UN Sustainable Development Goals (SDGs) were also agreed in 2015 incorporating 17 Goals, with 169 specific targets (UNDP, 2015). The SDGs "reflect new global consensus on the major imbalances generated by existing economic and environmental trajectories, such as growing inequalities, climate change, biodiversity loss, and on the need to rapidly achieve sustainable development by reconciling economic, social and environmental concerns" (Northrop et al., 2016, p. 9). The 17 goals tackle, inter alia, issues pertaining to poverty (SDG 1), food security and sustainable agriculture (SDG 2), good health and wellbeing (SDG 3), quality education (SDG 4), gender equality (SDG 5), access to clean water and sanitation (SDG 6), affordable and clean energy (SDG 7), infrastructure (SDG 9), sustainable cities and communities (SDG 11), climate action (SDG 13), land degradation (SDG 15) and partnership for sustainable development (SDG 17). Together, the 169 targets aim to build resilience to climate change and ecosystem resilience whilst providing opportunities for inclusive economic growth.

These two international policy frameworks set a new trajectory for addressing climate change and offer important opportunities for countries to develop in a low-carbon, climate-resilient way. Various analyses have dissected African NDCs and their key components in terms of both mitigation and adaptation (e.g. Mbeva et al., 2015; Richards et al., 2015). Many have noted that the implementation of the NDCs would not achieve the least-cost 2°C scenarios by 2030 as envisaged in the Paris Agreement (UNFCCC, 2016). For instance, Boyd et al.

(2015, p. 7), reported a "mismatch between the ambitions presented in the NDCs and the overall objective of having a reasonable chance of avoiding global warming of more than 2°C". Research has started on the SDGs too. Nilsson et al. (2016) identified interactions amongst the SDGs and highlighted seven interaction types between the goals and targets. Costanza et al. (2016a, b) looked across the SDGs to assess the ways they interact to support human well-being, whilst Hak et al. (2016) highlighted the need to have relevant indicators for measuring progress towards the SDGs. At the global level, Northrop et al. (2016) examined the alignment between the NDCs and SDGs. However, the interactions, synergies and trade-offs between the SDGs and the NDCs have not yet been analysed in depth for West Africa. Such analyses are vital as their absence risks perverse outcomes for states if they start assessing targets one after another without a coherent approach. In particular, there is a limited analysis of how the NDCs can advance progress towards achieving the SDGs.

This paper aims to provide a better understanding of how NDCs might facilitate SDG progress in West Africa, particularly across goals 1 (no poverty), 2 (zero hunger), 6 (access to clean water and sanitation); 7 (affordable and clean energy); 13 (climate action) and 15 (life on land). Our analysis focuses on six thematic areas – poverty, food security, water, energy, climate action and land degradation – that are of core importance to the national economies of West Africa and sub-Saharan Africa more widely (Niang et al., 2014). Agriculture, water, energy and forest and wildlife sectors face considerable direct and indirect threats from climate change but at the same time support the livelihoods of the majority of the region's population (Niang et al., 2014). This analysis also contributes to important contemporary water – energy – food nexus debates and how policies in these sectors can promote coherence (see Antwi-Agyei et al., 2017; Rasul and Sharma, 2016; Mirzabaev et al., 2015). This analysis is also important for the African Union's Agenda 2063, which details development objectives for all African states (Africa Union Commission, 2015). Our West African analysis builds on studies of trade-offs and synergies between sector policies and climate compatible development in the Southern African Development Community (England et al., 2018; Stringer et al., 2017) and global analyses of, and guidance for, NDC Implementation Planning (CDKN, 2016; Levin et al. 2015; Rogelj et al., 2016). Specifically, the study asks:

(i) Which priority sectors are mentioned in relation to adaptation and mitigation in the NDCs of West African states?

(ii) Are the NDCs of West African states well aligned with the SDGs?

(iii) What are the co-benefits of NDCs in contributing towards the SDGs? and

(iv) How are West African states planning to finance actions outlined in their NDCs submitted to the UNFCCC?

2. Background/context for the study

West Africa consists of 16 states (Burkina Faso, Cape Verde, Cameroun, Cote d'Ivoire, Liberia, Ghana, Guinea, Guinea Bissau, Mali, Niger, Nigeria, Senegal, Sierra Leone, The Gambia and Togo). Although, together these countries are considered a minor contributor to the global greenhouse gases emissions, the region is one of the most vulnerable to the threats of climate change. This is because agriculture and forestry which provide the livelihood of majority of people in the region, including the poorest and most vulnerable, are quite vulnerable to climate change (FAO, 2016). Climate projections indicate that West Africa will continue to experience significant temperature increases coupled with considerable rainfall variability (Niang et al., 2014). The region is susceptible to frequent food crises and famines which are triggered by pest infestation, droughts, floods, economic downturns and conflicts (Kidane et al., 2006). Ghana was used as a case study to further elucidate some of the key insights emerging from the broad regional analysis.

Ghana was used as a case because, apart from representing a vulnerability hotspot (Asante and Amuakwa-Mensah, 2014; Antwi-Agyei, 2012), and it has been a regional leader in developing climate policy and has taken a number of policy decisions towards mitigating the adverse impacts of climate change (Mawunya and Adiku, 2013). For instance, Ghana was one the first countries in West Africa to develop a comprehensive national climate change policy in 2012 (Ministry of Environment, Science and Technology, 2012). In 2015, Ghana submitted its Intended Nationally Determined Contribution, which was ratified in 2017 as Nationally Determined Contribution (NDC). Ghana adopted a participatory approach in preparing its NDC and received cabinet approval. The NDC is underpinned by Ghana's 40-year long-term development plan, the National Climate Change Policy as well as the Low Carbon Development Strategy (Republic of Ghana, 2015). The NDC contains 31 actions programme of actions. Ghana's NDC aims towards a sustainable, resilient and low carbon future Ghanaian society (Republic of Ghana, 2015). The NDC cuts across different sectors and policy frameworks and there is the need to understand the various alignments and mis-alignments of the NDC with sector policies and to highlight what these mean for national policies in both Ghana and the wider West Africa region.

3. Research Design and Methods

The study adopted a two-stage methodology. In stage one, the submitted NDCs of 11 West African states (Burkina Faso, Cape Verde, Liberia, Ghana, Guinea, Guinea Bissau, Niger, Nigeria, Sierra Leone, The Gambia and Togo), which submitted their NDCs in English, were analysed using an iterative content analysis approach. To identify the priority sectors mentioned in relation to adaptation and mitigation in the NDCs of West African states, an in-depth content analysis of the NDCs was undertaken to retrieve emerging keywords (as per Kalaba et al., 2014). Appropriate sectoral keywords were selected based on the literature on mitigation and adaptation (Appendix 1). Dominant keywords that emerged from the content analysis were cross-checked and coded against the SDGs to highlight similarities and contradictions. This approach followed Mbeva et al. (2015) with the frequency at which keywords appeared in all NDCs analysed being recorded. We equated frequency of mentions of a particular sector within the NDC with its importance. Positive and negative alignment between the eleven NDCs and six SDGs (1, 2, 6, 7, 13 and 15) was considered. We identified situations where there was explicit alignment between the NDCs and SDGs, often based on indirect overlaps between the SDGs and the policies, measures, and actions communicated in the NDCs (as per Northorp et al., 2016). Positive alignment in this analysis means the measures/actions taken in the NDC are consistent with helping to achieve the specific SDG being considered within the 2030 timeframe of their application. The alignment becomes negative when the action stated in the NDC will detrimentally affect the achievement of a particular SDG by 2030.

In stage two of the research, the interactions between the identified priority sectors and their co-benefits were examined in more depth for the case of Ghana. Using both expert interviews with Government sectoral leads (n = 12) and a national stakeholder workshop held in Kumasi, Ghana in June, 2017, with 40 experts drawn from across Government Departments (n = 8) including national sectoral representatives and regional extension officers, NGOs (n = 4), international bodies (n = 2) and academic researchers (n = 26), both the co-benefits and trade-offs between priority sectors and proposed actions were identified. Through this approach, we highlighted the co-benefits and trade-offs, according to a timeframe to 2030.

Finally, we identified the interactions between the NDCs and SDGs by employing causal loop diagrams to show how one variable can interact positively or negatively with another. Causal loop analysis utilises diagrams to map the relationships between multiple variables and represent dynamical changes in systems (Rwashana et al., 2014). In constructing the causal loops, this study employed the Vensim PLE software (Ventana Systems Inc. (2009)

Vensim, version 5.9) in a similar fashion described by Sarriot et al. (2015). In the loop analysis "a positive (+) arrow from one variable to the next means that a change in the first causes a change in the second in the same direction, while a negative (−) arrow means that a change in the first variable causes a change in the second in the opposite direction" (Sarriot et al., 2015, p.149). Causal loops have been employed by other to show the effects of floods in Ghana (Armah et al. 2010) and to explore the sustainability of integrated community case management in Rwanda (Sarriot et al., 2015).

4. RESULTS

4.1 Priority sectors for mitigation and adaptation identified in NDCs

This section presents the priority sectors and areas identified in West African NDCs. The sectors are classified as predominantly addressing either climate mitigation or climate adaptation planning or both.

Figure 1 shows that sectors of high mitigation priority include energy, forestry, agriculture and waste management. Most of the NDCs provided evidence on quantified targets for the energy sector. For instance, Ghana's mitigation commitments include 10% renewable penetration by 2030 and the promotion of clean rural household lighting (Republic of Ghana, 2015). Cape Verde has indicated "30% renewable energy penetration rate into the electric grid by 2025" (Republic of Cape Verde, 2015, p. 3). The analysis also shows that mitigation goals typically focus on combating deforestation and forest degradation, promoting sustainable forest management through afforestation and agroforestry.

The main focus of adaptation commitments relates to building resilience in the most vulnerable sectors. Analysis of the West African NDCs shows agriculture as the most important adaptation sector, being mentioned in all the NDCs reviewed (Figure 1). Other sectors of significant importance included forestry, disaster management including coastal zone management, water and energy.

<Insert Figure 1 around here>

4.2 Alignment of NDCs with SDGs

All the West African states analysed here have measures in their NDCs that will help advance towards the SDGs 1, 2, 6, 7, 13 and 15. Table 1 shows significant positive alignments between

the NDCs and various SDGs. For instance, all the 11 NDCs detailed interventions aimed at ending poverty by 2030. The analysis reveals different approaches to poverty eradication by different countries. For example, whilst Cape Verde "seeks to diversify income generating activities in rural areas by promoting artisanal fishing activities (providing training, equipment, and micro-credit) in coastal areas" (Republic of Cape Verde, 2015, p. 20), Nigeria encourages informal savings and insurance schemes to make medium term credit available to vulnerable groups and industry in crisis (Federal Ministry of Environment, 2015, p. 21).

All 11 NDCs indicated a commitment to improving the food security situation. Gambia's NDC indicates "value addition of products will be promoted to complement and support crop diversification" (Republic of The Gambia, 2015, p. 11). Whilst Liberia promotes the "establishment of a gene bank of climate resilient varieties of indigenous food crops (Republic of Liberia 2015, p.14), Cape Verde seeks to promote efficient irrigation systems. Cape Verde "seeks to disseminate more efficient small-scale irrigation techniques and promoting soil conservation schemes for farmers and rural producers" (Republic of Cape Verde, 2015, p. 7). The Gambia "adopt improved agricultural systems for both crops and livestock and adopt better soil management practices (Republic of the Gambia, 2015).

Improving water quality and protecting water-related ecosystems is also a major issue in many of the NDCs (Table 1). Actions include "promoting integrated water resources management, guaranteeing stable and adequate water supply" (Republic of Cape Verde, 2015, p.6 & 19) and the "construction and/or improvement of reservoirs for micro-irrigation and livestock watering in rural areas" (Republic of Togo, 2015, p.18). West Africa continues to grapple with challenges of providing reliable energy and clean energy supply for economic growth. Our findings suggest that most of the countries plan to diversify their energy sources. For instance, Guinea makes an ambitious proposal to "produce 30% of its energy (excluding wood-energy) from renewable energy sources" (Republic of Guinea, 2015, p. 10).

To address SDG 13 on climate action, different countries have stated different mechanisms in their NDCs (Table 1). For instance, whilst The Gambia seeks to "mainstream climate change adaptation priorities into its national agriculture and livestock policies, plans and programmes" (Republic of The Gambia 2015, p.10), Liberia seeks to "enhance resilience to increasing rainfall variability through the diversification of crop cultivation and small ruminants rearing" (Republic of Liberia 2015, p. 15). On the contrary, Togo offers "support for the mapping of areas vulnerable to climate change and reforestation and protection of zones with fragile ecosystems (mountainsides, river banks) in the fight against floods, violent winds and erosion." (Republic of Togo, 2015, p.18). Nigeria adopts a different approach by indicating

that it will empower children for climate change adaptation by "developing skills-based curriculum in subjects like science, geography, social studies, language arts, environmental education and technology" (Federal Ministry of Environment, 2015, p.22).

Burkina Faso seeks to implement prudent forestry and agroforestry practices through selective cutting of firewood to address SDG 15 (Republic of Burkina Faso, 2015). Niger adopts a different approach by upscaling sustainable land management practices that will increase the resilience of ecosystems and sequester carbon (Republic of Niger, 2015). Guinea Bissau indicates that it will "develop a national reforestation and sustainable management of forest and agroforestry ecosystems programme by 2025 and establish and schedule a new forestry policy." (Republic of Guinea Bissau 2015, p.5).

<Insert Table 1 around here>

4.3 The case study of Ghana's NDC

Content analysis shows that several actions outlined in Ghana's NDC align well with the SDGs 1, 2, 6 and 13. Further, with regards to SDG 7, Ghana has stated in its NDC to scale up renewable energy penetration through increased access and adoption of efficient cook stoves. The NDC pledges "2 million efficient cook stoves up to 2030" (Republic of Ghana, 2015, p.12). Ghana has also promised to "promote Sustainable utilization of forest resources through REDD+" (Republic of Ghana, 2015, p. 13). This will be achieved through re-afforestation and afforestation programmes on degraded lands. The NDC also prioritises action to build the resilience of women and the vulnerable by implementing "community-led adaptation and livelihood diversification for vulnerable groups" (Republic of Ghana, 2015, p.15), whilst promoting innovations in post-harvest storage and food processing.

Experts in the multi-stakeholder workshop identified the challenges likely to confront the implementation of the NDC. Both technological and financial challenges were highlighted as critical for the successful implementation of Ghana's NDC. In addition, participants reported a lack of reliable data for tracking the success of the NDC across different sectors and governance levels. Authorities at national, regional and local levels will be key for the successful implementation of the NDC stated plans. However, there is a lack of capacity within regional and local levels of governance. Nationally, the Environmental Protection Agency (EPA) is mandated to coordinate the implementation of the NDC across sectors, yet, is constrained in terms of political influence to deliver this mandate. A workshop participant

remarked: “The EPA is confronted with lots of challenges that need to be addressed to ensure successful implementation of the actions outlined in the NDC. At the district levels where many of the mitigation and adaptation actions will be carried out, the EPA will not be represented there because of lack of personnel at these levels” (Workshop participant, Kumasi, June, 2017). Another workshop participant stated: *“the EPA needs to be fully resourced and supported* [by both national and international agencies] to play its coordinating role of implementing the *actions in the NDC. This will include providing the necessary logistical support.”* (Workshop participant, Kumasi, June, 2017).

Participants at the multi-stakeholder workshop also explored the co-benefits and trade-offs associated with the various mitigation and adaptation actions (Table 2). The co-benefits and trade-offs identified by workshop participants were supported with appropriate literature from other regions (Nunan, 2017). For instance, they highlighted that under the agricultural sector, improving resource management (e.g. increased use of irrigation systems) can compete with household water supplies, thereby promoting the incidence of diseases associated with floods such as cholera, dysentery and malaria. They also indicated that afforestation and reforestations programmes under the forestry sector will potentially increase income for local people involved in tree planting and generate a long-term carbon sequestration gains if implemented at a large enough scale for impact.

<Insert Table 2 around here>

4.4 Non-alignments and trade-offs between NDC statements and SDGs

In the short-term (to 2025 as the mid-year when many of the NDCs will be reviewed and at which point some of the SDG targets should have been achieved), many of the actions under the NDCs align positively with the SDGs. Nevertheless, in the long-term (2030 and beyond) some of the adaptation and mitigation actions outlined in NDCs will interact negatively with the attainment of one or more specific SDGs. The causal loop diagrams are presented in Figures 2 and 3 and show the kinds of interactions that may occur between the NDCs and SDGs. For example, Figure 2 shows that the drive towards increased use of alternative energy sources (including solar and biofuels, as in NDCs for Burkina Faso and Ghana) could adversely affect food production, resulting in increased food insecurity (SDG 2). This results from the displacement of marginalised households from fertile agricultural lands in favour of

commercial biofuel cultivation. Reduced food production could also imply reduced farm income, which will perpetuate poverty (SDG 1). Low agricultural output has the tendency to also affect household food consumption which can then affect the health of household members (SDG 3), making them more vulnerable to the adverse impacts of climate change (SDG 13).

Several NDCs seek to use small-scale irrigation facilities in promoting agricultural outputs. For instance, Cape Verde states that it will "seek to disseminate more efficient small-scale irrigation techniques and promote soil conservation schemes for farmers and rural producers" (Republic of Cape Verde, 2015, p.7). Increasing irrigation through the construction of small dams in farming communities can boost agricultural productivity (SDG 2). This can negatively interact with other SDGs as small dams will serve as breeding grounds for mosquitoes (SDG 3) and will also result in decreased water availability for farming households because of competing demands for water (SDG 6) (Figure 3). Liberia has pledged to increase the use of fuelwood and cookstoves. Its NDC states "Produce and distribute 280,543 energy saving cook stoves that use fuelwood and 308,004 energy saving cook stoves that use charcoal by 2030" (Republic of Liberia, 2015, p. 12). In the long-term, this will adversely affect efforts at mitigating the impacts of climate change.

<Insert Figure 2 around here>

<Insert Figure 3 around here>

4.5 Financing of NDC actions

Funding remains a major issue for the implementation of mitigation and adaptation actions outlined in NDCs. Both the West Africa and Ghana case study analysis reveal that most actions outlined in the NDCs remain conditional on the ability of West African states to receive international or foreign assistance in the form of both funds and technology. For instance, based on 2010 emission levels, Togo has indicated its readiness to achieve unconditionally an emission reduction target of 11% but has stated a conditional emission reduction target of 31% by 2030 (Republic of Togo, 2015). Ghana's emission reduction goal is contingent on its ability to attract external support for the implementation of its Programmes of Action. For instance, it has pledged to achieve 15% reduction of its GHG emission relative to business-as usual by 2030. Nevertheless, it has stated that a 45% emission reduction below business-as-usual levels with external support is attainable (Republic of Ghana, 2015, p.3). Many West African states

have formally requested international financial support via the Green Climate Fund to implement the actions outlined in their NDCs.

Our analysis shows differences in terms of countries' financial requirements for the implementation of the NDCs. Three clear groups emerge. First, countries such as Nigeria, Cape Verde and The Gambia did not specify how much they would need to finance the implementation of the actions outlined in their NDCs. For example, Nigeria's NDC states "International finance and investment, technology and capacity-building will be needed to achieve the ambitious intended contribution" (Federal Ministry of Environment, 2015, p.18). The second group includes Togo and Guinea which provided details on funding required for the implementation of mitigation and adaptation actions in their NDCs, yet provided no details on their possible sources of funding. For instance, Togo states it will "need $3.54 billion, $1.54 billion of which for adaptation, $1.10 billion of which for mitigation, $0.5 billion for technology transfers and $0.4 billion for capacity building (Republic of Togo, 2015, p. 14). The third category includes Burkina Faso, Ghana, Guinea Bissau and Niger which provided details of both their funding requirements and the proposed sources of these funds. For example, the NDC of Sierra Leone states: "this target [maintaining Sierra Leone emission levels relatively low close to the world average of 7.58 $MtCO_2e$ by 2035 via green growth pathways in all economic sectors] will only be achieved by Sierra Leone with the availability of international support that will come in the form of finance, investment, technology development and transfer, and capacity building. This would require substantial donor support estimated at about $900 million" (EPA Sierra Leone, 2015, p. 7). Importantly some states have made an explicit domestic funding commitment also (e.g. $6.3 billion in Ghana, compared to an international request for $16.3 billion; Niger committed 13% of funding from domestic sources), but even in such cases, there remains reliance on international funds if all NDC commitments are to be delivered.

5. Discussion

Our analysis indicates that the energy sector is viewed as the top priority sector for West African states for climate mitigation, but that agriculture is prioritised for adaptation planning. The importance of the energy sector can be attributed to the low coverage of national grid across the region and because economic growth is closely linked to the availability and accessibility of clean energy by industry. Access to clean energy is especially problematic for West African states as many people rely on fuelwood (FAO, 2014; Bervoets et al., 2016). Many of the countries analysed have indicated their readiness to improve energy infrastructure whilst

promoting renewable energy sources. Such findings support other studies suggesting that energy is the key mitigation sector for many African NDCs (Mbeva et al., 2015). The actions outlined for the energy sector are in line with regional energy policy commitments which seek to increase grid connection by renewable energy by 48% by 2030 (ECOWAS, 2013). However, it is not clear from the NDCs of West Africa states whether funding requests will also prioritise energy investment.

The analysis also demonstrates that the specific mitigation and adaptation actions outlined in West African NDCs are typically well-aligned with the SDGs aimed at ending extreme poverty (SDG 1), improving food security (SDG 2), improving access to water (SDG 6), ensuring clean energy (SDG 7), tackling climate change (SDG 13) and halting land degradation and deforestation (SDG 15). These actions also have implications for the Africa Union's Agenda 2063 that seeks to, among other things, improve socioeconomic and political transformation, ensure inclusive growth and sustainable development on the continent (Africa Union Commission, 2015). Such alignments provide opportunities and trajectories for more integrated approaches towards development and peace and a move away from the approaches that tend to put international frameworks in silos.

The various climate actions outlined in the agricultural sector can thus be seen as important opportunities for climate compatible development (Nunan, 2017) and as pathways for the eradication of extreme poverty through ensuring food security and improved nutrition. West African states have stipulated measures to ensure food accessibility through the expansion and construction of roads leading to farming communities. For instance, Ghana's development plans including economic and social transformation, as stated in the Ghana Shared Growth and Development Agenda (GSGDA), are based on the modernisation of the agricultural sector (NDPC, 2010) and investments to ensure improved market linkages. The agricultural sector remains the key priority for international assistance given the importance in NDCs and the potential of the sector to enhance both adaptation and mitigation ambition (FAO, 2016). Six of the eleven NDCs analyzed here (Liberia, Ghana, Togo, Niger, Nigeria and Sierra Leone) explicitly mentioned Climate-Smart Agriculture (CSA). CSA aims to increase productivity and resilience whilst reducing GHGs (mitigation), thereby improving national food security (Chandra et al., 2017; Lipper et al., 2010) and reducing the risks of crop failure due to drought and dry spells.

Many of the NDCs have outlined key actions aimed at increasing the adaptive capacity and promoting agricultural systems that are less vulnerable to the adverse impacts of climate change. Many of the NDCs have indicated the need for integration of climate change into

national sectoral policies as their programme of actions cut across different sectors and require revisions of sectoral policies to align with the NDC. This is vital to enable states to adopt a more holistic and coherent approach in dealing with climate change. SDG 15 aims at sustainably managing forests and ecosystems, combating desertification and restoring degraded land and increasing natural forests. Indeed, many of the NDCs reviewed have highlighted actions to safeguard forest resources. Protecting natural resources will help to improve livelihoods of many low-income households who depend on natural resource based livelihoods. Such positive alignments present opportunities that will maximise the mutual benefits from the implementation of the NDCs and SDGs (Minjares et al., 2013). Such mutual benefits offer opportunities to advance national development via a more climate resilient pathway that can reduce current and future climate vulnerability.

One key finding emerging from the Ghana case analysis is that its NDC cuts across different sectors including water, energy, agriculture, forestry, transport, health, waste, land use, gender, transport and industry. Whilst this provides an opportunity for these different sectors to contribute to the implementation of the 31 programmes of actions, it also presents challenges because of inherent competing institutional agendas and interests as well as intense competition for limited national resources. The base of the EPA in the Ministry of Environment, Science, Technology and Innovations means that its funding and political influence is less well-developed than other countries where such a role is mandated by Finance or Presidential Offices (Stringer et al., 2014).

West African states will need to sufficiently resource their institutions and build the needed capacity and leadership to achieve alignment. Promoting alignment would involve pursuing climate change opportunities that boost national social economic agendas and deliver broader sustainable development (Chevallier, 2015). Improving interactions and coherence between the SDGs and the NDCs presents a formidable institutional challenge at both national and international levels (Nilsson, 2017; GIZ & UNDP, 2017). The Ghana case study highlighted the difficulties in achieving alignment because different national ministries have responsibilities for the implementation of the NDCs and SDGs. Therefore, it is crucial that synergies and trade-offs need to be clearly identified to promote participation of the various sector ministries. Workshop participants highlighted challenges relating to institutional capacity, a lack of coordination amongst various institution and agencies, insufficient resources as well as budgetary constraints. These challenges confront the Environment Planning Authorities in West Africa states in terms of taking steps towards greater cross-sectoral coherence in climate adaptation planning and the implementation of these plans at the district

level. Policy makers need to make conscious efforts and devise innovative approaches of promoting cross-sectoral coordination to overcome these challenges that could stifle alignment efforts between the NDCs and SDGs. For instance, competing interests by various actors and players within the policy arena could constrain policy coordination and hence alignment (Tyler, 2010). Overcoming such challenges will also promote policy coherence to achieve greater alignments (Antwi-Agyei et al., 2017; Weitz et al., 2017).

Various pathways for funding have been highlighted in the NDCs including the Green Climate Fund, bilateral agreements and international carbon market. The analysis also shows that both private and public domestic financial support will be critical in making the needed funds available for the implementation of NDC actions. The role of private sector actors in shaping the implementation and the success of the Paris Agreement has been documented (Van Asselt, 2016; GIZ & UNDP, 2017). The private sector was hugely represented at COP21 in Paris with CEOs of industries ranging from cement, transportation to energy – pledging to adopt more renewable energy sources whilst making commitments to decrease their carbon footprints (World Bank, 2015). The private sector also made commitments to finance climate actions. For instance, the International Finance Corporation (IFC) has indicated its readiness to help clients contribute to mitigation and adaptation aimed at reducing the impacts of climate change in emerging economies (IFC, 2015). There is also the need to translate the various commitments outlined in the NDCs into investment opportunities for the private sector (GIZ & UNDP, 2017). Fulfilling commitments by the private sector will require efforts by national governments to remove existing regulatory barriers as well as the creation of a conducive business environment (World Bank, 2015).

Many developed countries have pledged financial and technological support as well as capacity building, but the proposed US$100 billion of finance to be mobilised by developed nations by 2020 (Hedger & Nakhooda, 2015) may not be enough in helping developing countries implement their NDCs. This becomes particularly important in the light of the recent withdrawal of the United States from the Paris Agreement. This could have significant repercussions for the Green Climate Fund, thus hampering the capacity of developing countries, such as those in West Africa, who need such funds to support their adaptation and mitigation actions.

6. Conclusion

Analysis from across West Africa identifies agriculture and energy as the priority sectors for mitigation and adaptation where NDCs have pledged significant commitments. This is

important because agriculture, which provides the livelihoods of many households in West Africa, is particularly vulnerable to climate change. Prioritising agriculture in the NDCs of West Africa states will provide opportunities for policy makers to devise appropriate mechanisms to reduce the impacts of climate change on livelihoods through climate-smart agriculture interventions such as agroforestry, conservation agriculture and enhanced soil and water conservation schemes.

Our findings reveal strong alignment between mitigation and adaptation actions proposed in the NDCs and SDGs, particularly across goals 1 (no poverty), 2 (zero hunger), 6 (access to clean water and sanitation), 7 (affordable and clean energy); 13 (climate action) and 15 (life on land). These alignments represent opportunities and display mutual benefits that can be derived from the integrated implementation of NDCs together with SDGs. Nevertheless, the analysis also highlights some non-alignments and negative interactions between the NDCs and SDGs. These relate to areas of improving renewable energy sources including biofuels and conflicts across the water – energy – food nexus. It is vitally important that national governments analyse the potential interactions to identify areas of convergence and avoid situations where SDG plans could perpetuate the existing inequality and vulnerability across West Africa and that lessons from studies elsewhere in Africa are considered more explicitly.

Cross-sectoral discussions in Ghana identified significant challenges relating to institutional capacity, a lack of coordination amongst various sectors, institutions and agencies, and insufficient resources for the EPA in moving towards integrated implementation of national planning priorities for both NDCs and SDGs. National governments need to provide strong institutional and funding support for coordinating bodies to ensure greater alignment between the NDCs and SDGs.

Our analysis further demonstrates that although there are various opportunities for the NDCs of West African member states to contribute to the attainment of the SDGs, states will need international assistance (in the form of financial, technological and capacity building) to implement the mitigation and adaptation actions outlined in their NDCs. There is a need to consider innovative finance mechanisms that draw on new approaches and that in monitoring and evaluating NDCs, countries should be clearer about ensuring all the necessary funding required is stated and the possible sources are indicated.

References

Africa Union Commission. (2015). Agenda 2063. The Africa we want. Retrieved from http://www.un.org/en/africa/osaa/pdf/au/agenda2063.pdf (accessed 19 June 2017).

Ahmad, N., Hamid, I. & Kazmi, S. T. H. (2017). Beyond COP 21: What did Asian countries pledge in the Paris Agreement? (Working Paper). Retrieved from: https://cdkn.org/wp-content/uploads/2017/03/INDCs-in-Asia-WEB-final.pdf (accessed 2 June, 2017).

Antwi-Agyei, P. (2012) *Vulnerability and adaptation of Ghana's food production systems and* rural livelihoods to climate variability. PhD Thesis, University of Leeds, UK.

Antwi-Agyei, P., Dougill, A. J., & Stringer, L.C. (2017). Assessing Coherence between Sector Policies and Climate Compatible Development: Opportunities for Triple Wins. Sustainability, 9(11), 2130; doi: 10.3390/su9112130.

Armah, F. A., Yawson, D. O., Yengoh, G. T., Odoi, J. O., & Afrifa, E. K. A. (2010). Impact of floods on livelihoods and vulnerability of natural resource dependent communities in northern Ghana. Water, 2, 120-139. doi:10.3390/w2020120.

Asante, F. A., & Amuakwa-Mensah, F. (2014). Climate change and variability in Ghana: Stocktaking. Climate, 3, 78 – 99. doi:10.3390/cli3010078.

Atilio, S. (2015). Mitigation via waste management. Retrieved from https://handshake.pppknowledgelab.org/wp-content/uploads/2015/07/hs_waste_mitigationviawastemanagement.pdf (accessed 31 March, 2017). Handshake, World Bank Group.

Bervoets, J., Boerstler, F., Dumas-Johansen, M., Thulstrup, A., & Xia, Z. (2016). Forests and access to energy in the context of climate change: the role of the woodfuel sector in selected NDCs in sub-Saharan Africa. Unasylva, 67, 53.

Bodansky, D. (2016). The legal character of the Paris Agreement. Review of European, Comparative & International Environmental Law, 25(2), 142-150.

Boyd, R., Stern, N., & Ward, B. (2015). What will global annual emissions of greenhouse gases be in 2030, and will they be consistent with avoiding global warming of more than 2°C?' Policy Paper May 2015. London: ESRC Centre for Climate Change Economics and Policy, Grantham Research Institute on Climate Change and the Environment.

Busch, J., Godoy, F., Turner, W. R., & Harvey, C. A. (2011). Biodiversity co-benefits of reducing emissions from deforestation under alternative reference levels and levels of finance. Conservation Letters, 4(2), 101-115.

Carter, J. G., Cavan, G., Connelly, A., Guy, S., Handley, J., & Kazmierczak, A. (2015). Climate change and the city: Building capacity for urban adaptation. Progress in Planning, 95, 1-66. doi:10.1016/j.progress.2013.08.001.

CDKN (2016). Planning for NDC Implementation: Quick Start Guide and Reference Manual. Climate and Development Knowledge Network and Ricardo Energy and Environment.

Chandra, A., McNamara, K. E., Dargusch, P. (2017). Climate-smart agriculture: perspectives and framings, Climate Policy, 1 -16. doi: 10.1080/14693062.2017.1316968.

Chappin, E. J., & van der Lei, T. (2014). Adaptation of interconnected infrastructures to climate change: A socio-technical systems perspective. Utilities Policy, 31**,** 10-17. doi:10.1016/j.jup.2014.07.003

Chevallier, R. (2015). Aligning Sustainable Development Goals with Climate-Resilient Growth. Governance of Africa's Resources Programme. Retrieved from dspace.africaportal.org/jspui/bitstream/.../1/saia_spi_27_chevallier_20151013.pdf. (accessed 25 March, 2017)

Costanza, R., Fioramonti, L., & Kubiszewski, I. (2016a). The UN Sustainable Development Goals and the dynamics of well-being. Frontiers in Ecology and the Environment, 14, 59–59. doi:10.1002/fee.1231.

Costanza, R., Daly, L., Fioramonti, L., Giovannini, E., Kubiszewski, I., Mortensen, L. F., … Wilkinson, R. (2016b). Modelling and measuring sustainable well-being in connection with the UN Sustainable Development Goals. Ecological Economics, 130, 350–355. doi:10.1016/j.ecolecon.2016.07.009

ECOWAS (2013). ECOWAS Renewable Energy Policy. Economic Community of West Africa States. Retrieved from http://www.ecreee.org/sites/default/files/documents/ecowas_renewable_energy_policy.pdf (accessed 8 May 2017).

England, M. E., Stringer, L. C., Dougill, A. J., & Afionis, S. (2018). How do sectoral policies support Climate Compatible Development? An empirical analysis focusing on southern Africa. Environmental Science and Policy, 79, 9 - 15. https://doi.org/10.1016/j.envsci.2017.10.009.

EPA Sierra Leone (2015). Sierra Leone's Intended Nationally Determined Contribution (NDC). Government of Sierra Leone. Retrieved from UNFCCC NDC Registry: http://www4.unfccc.int/ndcregistry/PublishedDocuments/Sierra%20Leone%20First/SIERRA%20LEONE%20NDC.pdf (accessed 20 February, 2017).

Fan, M., Shen, J., Yuan, L., Jiang, R., Chen, X., Davies, W.J., & Zhang, F. (2011). Improving crop productivity and resource use efficiency to ensure food security and environmental quality in China. Journal of Experimental Botany, 63(1), 13 – 24.

FAO (2016). The agricultural sectors in nationally determined contributions (NDCs) Priority areas for international support. Food and Agriculture Organization of the United Nations, Rome. Retrieved from http://www.fao.org/3/a-i6400e.pdf

FAO (2014). State of the World's Forests 2014. Enhancing the socioeconomic benefits from forests. Rome. Food and Agriculture Organization of the United Nations Statistics Division, Rome. Retrieved from http://www.fao.org/3/a-i3710e.pdf

Federal Ministry of Environment (2015). Nigeria's Intended Nationally Determined Contribution (NDC). 2015. Abuja, Nigeria. Retrieved from UNFCCC NDC Registry: http://www4.unfccc.int/submissions/NDC/Published%20Documents/Nigeria/1/Approved%20Nigeria's%20NDC_271115.pdf (accessed 19 January 2017).

Fenton, A., Paavola, J., & Tallontire, A. (2017). The role of microfinance in household livelihood adaptation in Satkhira District, Southwest Bangladesh. World Dev. 92, 192-202. doi.org/10.1016/j.worlddev.2016.12.004.

Fita, A., Rodríguez-Burruezo, A., Boscaiu, M., Prohens, J., & Vicente, O. (2015). Breeding and domesticating crops adapted to drought and salinity: a new paradigm for increasing food production. Frontiers in Plant Science, 6.

Frondel, M., Ritter, N., Schmidt, C. M., & Vance, C. (2010). Economic impacts from the promotion of renewable energy technologies: The German experience. Energy Policy, 38(8), 4048 – 4056.

Giuseppe, I. M. I. (2010). The role of transport in mitigation and adaptation to climate change impacts in urban areas. Retrieved from http://resilient-cities.iclei.org/fileadmin/sites/resilient-cities/files/docs/H_Sessions/H1-Bonn2010-Inturri.pdf (accessed 31 March, 2017).

GIZ & UNDP (2017). Global NDC Conference Report. Integrated governance, finance, and transparency for delivering climate goals. 02-06 May 2017, Berlin, Germany. Conference Report. Jointly published by GIZ and UNDP. Retrieved from http://www.ndcconference2017.org/de/documentation.html (accessed 26 July, 2017).

Gross T, Zahnd A, Adhikari S, Kaphre A, Sharma S, Baral B, Kumar S and Hugi C (2017) Potential of biogas production to reduce firewood consumption in remote high-elevation Himalayan communities in Nepal. Renew. Energy Environ. Sustain., 2 8.doi.org/10.1051/rees/2017021.

Hák, T., Janoušková, S., & Moldan, B. (2016). Sustainable Development Goals: a need for relevant indicators. Ecological Indicators, 60, 565–73. doi:10.1016/j.ecolind.2015.08.003.

Hargreaves, J.; Adl, M.; & Warman, P. (2008). A review of the use of composted municipal solid waste in agriculture. Agric. Ecosyst. Environ., 123, 1–14.

Harvey, C. A., Rakotobe, Z. L., Rao, N. S., Dave, R., Razafimahatratra, H., Rabarijohn, R. H., … & MacKinnon, J. L. (2014). Extreme vulnerability of smallholder farmers to agricultural risks and climate change in Madagascar. Philosophical Transactions of the Royal Society B, 369(1639), 20130089.

Hedger, M., & Nakhooda, S. (2015). Finance and Intended Nationally Determined Contributions (NDCs): Enabling implementation (Overseas Development Institute Working Paper 425). https://www.odi.org/publications/9506-finance-intended-national-determined-contribution-NDC-enabling-implementation-cop21-bonn (acessed 8 May 2017).

IFC (2015). We have an agreement in Paris: So, what's next for the private sector? Retrieved from http://www.ifc.org/wps/wcm/connect/news_ext_content/ifc_external_corporate_site/news+and+events/news/we-have-agreement-paris-so-what-s-next-private-sector.

Kalaba, F. K., Quinn, C. H., & Dougill, A. J. (2014). Policy coherence and interplay between Zambia's forest, energy, agricultural and climate change policies and multilateral environmental agreements. International Environmental Agreements: Politics, Law and Economics, 14, 181-198. doi:10.1007/s10784-013-9236-z

Kapos, V., Kurz, W. A., Gardner, T., Ferreira, J., Guariguata, M., Koh, L. P., … & Barlow, J. (2012). Impacts of forest and land management on biodiversity and carbon. Retrieved from: https://www.illegal-logging.info/sites/default/files/uploads/IUFROREDD2012.pdf#page=51 (accessed 17 November 2017).

Karekezi, S., & Kithyoma, W. (2002). Renewable energy strategies for rural Africa: is a PV-led renewable energy strategy the right approach for providing modern energy to the rural poor of sub-Saharan Africa? Energy Policy, 30(11), 1071 – 1086.

Keiser, J., de Castro, M. C., Maltese, M. F., Bos, R., Tanner, M., Singer, B. H., & Utzinger, J. (2005). Effect of irrigation and large dams on the burden of malaria on a global and regional scale. The American Journal of Tropical Medicine and Hygiene, 72(4), 392 – 406.

Kidane, W., Maetz, M., & Dardel, P. (2006). Food security and agricultural development in sub-Saharan Africa. FAO, Subregional Office for Southern and East Africa, Rome.

Kumar, S., Smith, S. R., Fowler, G., Velis, C., Kumar, S. J., Arya, S., … & Cheeseman, C. (2017). Challenges and opportunities associated with waste management in India. Open Science, 4(3), 160764.

Lenton, T.M. (2011). Early warning of climate tipping points. Nature Climate Change, 1, 201-209. doi:10.1038/nclimate1143.

Lépy, É., Heikkinen, H. I., Karjalainen, T. P., Tervo-Kankare, K., Kauppila, P., Suopajärvi, T., … Rautio, A. (2014). Multidisciplinary and participatory approach for assessing local vulnerability of tourism industry to climate change. Scandinavian Journal of Hospitality and Tourism, 14(1)**,** 41-59. doi:10.1080/15022250.2014.886373.

Levin, K., Rich, D., Bonduki, Y., Comstock, M., Tirpak, D., Mcgray, H., ... Waskow, D. (2015). Designing and preparing intended nationally determined contributions (INDCs). World Resources Institute and UNDP, Retrieved from http://www.wri.org/publication/designing-andpreparing-indcs.

Lipper, L., W. Mann, A., Meybeck., & Sessa, R. (2010). 'Climate-smart' agriculture: Policies, practices, and financing for food security, adaptation and mitigation. Rome: FAO. Retrieved from http://www.fao.org/fileadmin/user_upload/newsroom/docs/the-hague-conference-fao-paper.pdf

Mawunya, F. D. & Adiku, S. G. K. (2013). Implications of climate change for agricultural productivity in Ghana: An agrometeorological perspective. special issue climate change in Ghana: impacts on agriculture and the policy implications. Ghana Policy Journal Special Edition on Climate Change, 7-26.

Maxwell, M. J., & Scholar, G.W. (2015). Can Low-Income Households Afford Alternative Energy? Retrieved from https://www.creighton.edu/fileadmin/user/EconomicInstitute/Research_Scholars/Alternative_Energy_White_Paper_-_4-6-15.pdf (accessed 13 November 2017)

Mbeva, K., Ochieng, C., Atela, J., Khaemba, W., & Tonui, C. (2015). Intended Nationally *Determined Contributions as a Means to Strengthening Africa's Engagement in* International Climate Negotiations (Climate Resilient Economies Working Paper 001/2015). Nairobi: African Centre for Technology Studies.

Mbow, C.; Smith, P.; Skole, D.; Duguma, L.; Bustamante, M. Achieving mitigation and adaptation to climate change through sustainable agroforestry practices in Africa. Curr Opinion in Environ Sustain, 2014, 6: 8-14. doi:10.1016/j.cosust.2013.09.002.

Mercer, J., Kurvits, T., Kelman, I., & Mavrogenis, S. (2014). Ecosystem-based adaptation for food security in the AIMS SIDS: integrating external and local knowledge. Sustainability, 6, 5566-5597. doi:10.3390/su6095566.

Ministry of Environment, Science, and Technology (2012). Ghana national climate change policy. Accra, Government of Ghana. Retrieve from http://www.pef.org.gh/documents/climate-change/national-climate-change-policy.pdf. (accessed 10 March 2017).

Minjares, R., Blumberg, K., & Sanchez, F. (2013). Alignment of policies to maximize the climate benefits of diesel vehicles through control of particulate matter and black carbon emissions. Energy Policy, 54, 54-61. doi:10.1016/j.enpol.2012.09.053

Mirzabaev A, Guta D, Goedecke J, Gaur V, Börner J, Virchow D, (2015) Bioenergy, food security, and poverty reduction: trade-offs and synergies along the water-energy-food security nexus. Water International, 40, (5-6) 772-790.

NDPC (2010). Implementation of the Ghana Shared Growth and Development Agenda (GSGDA), 2010-2013, Vol 1 – Policy Framework. National Development Planning Commission, Accra.

Niang, I., Ruppel, O. C., Abdrabo, M. A., Essel, A., Lennard, C., Padgham, J., White, L. L, (editors) (2014). Climate change 2014: impacts, adaptation, and vulnerability. Cambridge: Cambridge University Press, 1199–265.

Nilsson, M. (2017). Important interactions among the Sustainable Development Goals under review at the High-Level Political Forum 2017 (Stockholm Environment Institute Working Paper 2017-06). Retrieved from: https://www.sei-international.org/mediamanager/documents/Publications/SEI-WP-2017-06-Nilsson-SDG-interact-HLPF2017.pdf

Nilsson, M., Griggs, D., & Visbeck, M. (2016). Map the interactions between sustainable development goals. Retrieved from https://sustainabledevelopment.un.org/content/documents/commitments/496_12066_commitment_Map%20the%20interactions%20between%20SDGs.pdf (accessed 26 Apil, 2017).

Northrop, E., Biru, H., Lima, S., Bouye, M., & Song, R. (2016). Examining the Alignment Between the Intended Nationally Determined Contributions and Sustainable Development Goals. Working Paper. Washington, DC: World Resources Institute. Retrieved from: https://www.wri.org/sites/default/files/WRI_INDCs_v5.pdf (accessed 15 February, 2017)

Nunan, F. (2017). Making climate compatible development happen. Taylor & Francis.

Oates, N., Ross, I., Calow, R., Carter, R., & Doczi, J. (2014). Adaptation to climate change in water, sanitation, and hygiene: assessing risks, appraising options in Africa London: Overseas Development Institute. Retrieved from: https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/8858.pdf (accessed 21 November, 2017).

Odoom, F. K. (2005). Chainsawing in the Natural Forests of Ghana: An Assessment of the Socio-economic Impacts of the Practice (Vol. 21). Food and Agriculture Organization of the United Nations, Rome, Italy

OECD. (2016). Agriculture and climate change: impacts, mitigation, and adaptation. Retrieved from: http://www.oecd.org/tad/sustainable-agriculture/agriculture-and-climate-change.htm (accessed 31 March 2017).

Pekka, P. (2007). Forests and Climate Change: Mitigation and Adaptation through Sustainable Forest Management. 60th Annual DPI/NGO Conference. 5-6. Retrieved from http://www.un.org/esa/forests/pdf/notes/FCC_60_6092007.pdf (accessed 31 March 2017).

Porter, M. E., & Kramer, M. R. (2011). The big idea: Creating Shared Value–how to reinvent capitalism and unleash a wave of innovation and growth. Harvard Business Review, 89 (1 – 2).

Rasul, G., & Sharma, B. (2016). The nexus approach to water–energy–food security: an option for adaptation to climate change, Climate Policy, 16(6), 682-702, doi:10.1080/14693062.2015.1029865

Recha, J., Kapukha, M., Wekesa, A., Shames, S., & Heiner, K. (2014). Sustainable Agriculture Land Management Practices for Climate Change Mitigation. Retrieved from https://cgspace.cgiar.org/rest/bitstreams/31927/retrieve (accessed 31 March 2017).

Republic of Burkina Faso (2015). Intended Nationally Determined Contribution (NDC) in Burkina Faso. Retrieved from UNFCCC NDC Registry: http://www4.unfccc.int/ndcregistry/PublishedDocuments/Burkina%20Faso%20First/NDC%20Burkina_ENG.%20version_finale.pdf (accessed 20 February, 2017).

Republic of Cabo Verde (2015). Intended Nationally Determined Contribution of Cabo Verde. Retrieved from UNFCCC NDC Registry: http://www4.unfccc.int/submissions/NDC/Published%20Documents/Cabo%20Verde/1/Cabo_Verde_NDC_.pdf (accessed 20 February 2017).

Republic of Ghana (2015). Ghana's intended nationally determined contribution (NDC) and accompanying explanatory note. Retrieved from UNFCCC NDC Registry: http://www4.unfccc.int/submissions/NDC/Published%20Documents/Ghana/1/GH_NDC_2392015.pdf (accessed 20 February 2017).

Republic of Guinea (2015). Intended Nationally Determined Contribution (NDC) under the United Nations Framework Convention on Climate Change (UNFCCC). Retrieved from UNFCCC NDC Registry: http://www4.unfccc.int/ndcregistry/PublishedDocuments/Guinea%20First/NDC_Guinea_english_version%20UNFCCC.pdf (accessed 20 February 2017).

Republic of Guinea Bissau (2015). Intended Nationally Determined Contributions (NDC). Retrieved from UNFCCC NDC Registry: http://www4.unfccc.int/submissions/NDC/Published%20Documents/Guinea%20Bissau/1/GUINEA-BISSAU_NDC_Version%20to%20the%20UNFCCC%20(eng).pdf (accessed 20 February, 2017).

Republic of Liberia (2015). Intended Nationally Determined Contributions (NDC). Retrieved from UNFCCC NDC Registry: http://www4.unfccc.int/submissions/NDC/Published%20Documents/Liberia/1/NDC%20Final%20Submission%20Sept%2030%202015.002.pdf (accessed 20 February 2017).

Republic of Niger (2015). Intended Nationally Determined Contributions (NDC) of Niger. Retrieved from UNFCCC NDC Registry: http://www4.unfccc.int/ndcregistry/PublishedDocuments/Niger%20First/Niger-NDC-final_Eng.pdf (accessed 20 February 2017).

Republic of The Gambia (2015). Intended Nationally Determined Contribution of the Gambia. Retrieved from UNFCCC NDC Registry: http://www4.unfccc.int/ndcregistry/PublishedDocuments/Gambia%20First/The%20NDC%20OF%20THE%20GAMBIA.pdf (accessed 20 February 2017).

Republic of Togo (2015). Intended Nationally Determined Contribution (NDC) within the framework of the United Nations Framework Convention on Climate Change (UNFCCC) Retrieved from UNFCCC NDC Registry: http://www4.unfccc.int/submissions/NDC/Published%20Documents/Togo/1/NDC%20Togo_english%20version.pdf (accessed 20 February 2017).

Reyna, J. L., & Chester, M. V. (2017). Energy efficiency to reduce residential electricity and natural gas use under climate change. Nature Communications, 8.

Richards, M., Gregersen, L., Kuntze, V., Madsen, S., Oldvig, M.B., Campbell, B.M. & Vasileiou, I. (2015). Agriculture's prominence in the NDCs. Retrieved from https://cgspace.cgiar.org/rest/bitstreams/62364/retrieve (accessed 5 June 2016).

Rogelj, J., Den Elzen, M., Höhne, N., Fransen, T., Fekete, H., Winkler, H., & Meinshausen, M. (2016). Paris Agreement climate proposals need a boost to keep warming well below 2 °C. Nature, 534, 631-639. doi:10.1038/nature18307.

Rwashana, A., Nakubulwa, S., Nakakeeto-Jijambu, M., & Adam, T. (2014). Advancing the application of systems thinking in health: understanding the dynamics of neonatal mortality in Uganda. Health Research Policy and System, 12 (36).

Sarriot E., Morrow, M., Langston, A., Weiss J., Landegger J., Tsuma L. (2015). A causal loop analysis of the sustainability of integrated community case management in Rwanda. Social Science & Medicine, 131,147-155.

Schmitz, O. J., Lawler, J. J., Beier, P., Groves, C., Knight, G., Boyce Jr, D. A., & Pierce, D. J. (2015). Conserving biodiversity: practical guidance about climate change adaptation approaches in support of land-use planning. Natural Areas Journal, 35(1), 190-203. doi:10.3375/043.035.0120.

Shaheen, S. A., & Lipman, T. E. (2007). Reducing greenhouse emissions and fuel consumption: sustainable approaches for surface transportation. Iatss Research, 31(1), 6 – 20.

Stinson, G., & Freedman, B. (2001). Potential for carbon sequestration in Canadian forests and agroecosystems. Mitigation and Adaptation Strategies for Global Change, 6(1), 1 – 23.

Stringer, L. C., Dougill, A. J., Dyer, J. C., Vincent, K., Fritzsche, F., Leventon, J., … & Kalaba, G. (2014). Advancing climate compatible development: lessons from southern Africa, Regional Environmental Change, 14, 713-725. doi: 10.1007/s10113-013-0533-4

Stringer, L. C., Sallu, S. M., Dougill, A. J., Wood, B. T., & Ficklin, L. (2017). Reconsidering Climate Compatible Development as a new development landscape in southern Africa. In, Nunan, F. (ed.) (2017). Making Climate Compatible Development Happen. Routledge, London. 22-43.

Szirmai, A., Naudé, W., & Alcorta, L. (2013). Pathways to Industrialization in the twenty-first century: New challenges and emerging paradigms. OUP Oxford.

Tyler, E. (2010). Aligning South African energy and climate change mitigation policy. Climate Policy, 10, 575-588. doi:10.3763/cpol.2010.0094.

UNDP. (2015). Sustainable Development Goals. Retrieved from http://www.undp.org/content/undp/en/home/sdgoverview/post-2015-development-agenda.html (accessed 31 March 2017).

UNEP. (2014). The Adaptation Gap Report 2014. Nairobi : United Nations Environnent Programme.

UNEP. (2011). Towards a green economy: pathways to sustainable development and poverty eradication – a synthesis for policy makers. Geneva: United Nations Environmental Programme.

UNFCCC. (2016). Aggregate Effect of the Intended Nationally Determined Contributions: An Update. Synthesis Report by the Secretariat. Retrieved from http://unfccc.int/resource/docs/2016/cop22/eng/02.pdf (accessed 31 March 2017).

UNFCCC (2007). Impacts, vulnerabilities, and adaptation in developing countries. In United Nations Framework Convention on Climate Change (UNFCCC), Germany.

UNFCCC (2014). Lima Call for Climate Action Decision 1/CP.20 FCCC/CP/2014/10/Add.1.

Van Asselt, H. (2016). The role of non-state actors in reviewing ambition, implementation, and compliance under the Paris Agreement. Climate Law, 6, 91–108. doi:10.1163/18786561-00601006.

Wei, M., Patadia, S., & Kammen, D. M. (2010). Putting renewables and energy efficiency to work: How many jobs can the clean energy industry generate in the US? Energy policy, 38(2), 919 – 931.

Weitz, N., Strambo, C., Kemp-Benedict, E., & Nilsson, M. (2017). Governance in the water-energy-food nexus: Gaps and future research needs. Working Paper No. 2017-07. Stockholm Environment Institute. Retrieved from https://www.sei-international.org/mediamanager/SEI-2017-WP-Nexus-Governance-Weitz.pdf (accessed 2 July 2017).

WHO (2014). WHO guidance to protect health from climate change through health adaptation planning. Retrieved from http://apps.who.int/iris/bitstream/10665/137383/1/9789241508001_eng.pdf (accessed 31 March 2017).

World Bank (2015). Private Sector - an Integral part of Climate Action Post-Paris. Retrieved from http://www.worldbank.org/en/news/feature/2015/12/30/private-sector-an-integral-part-of-climate-action-post-paris (accessed 5th July 2017).

LIST OF FIGURES

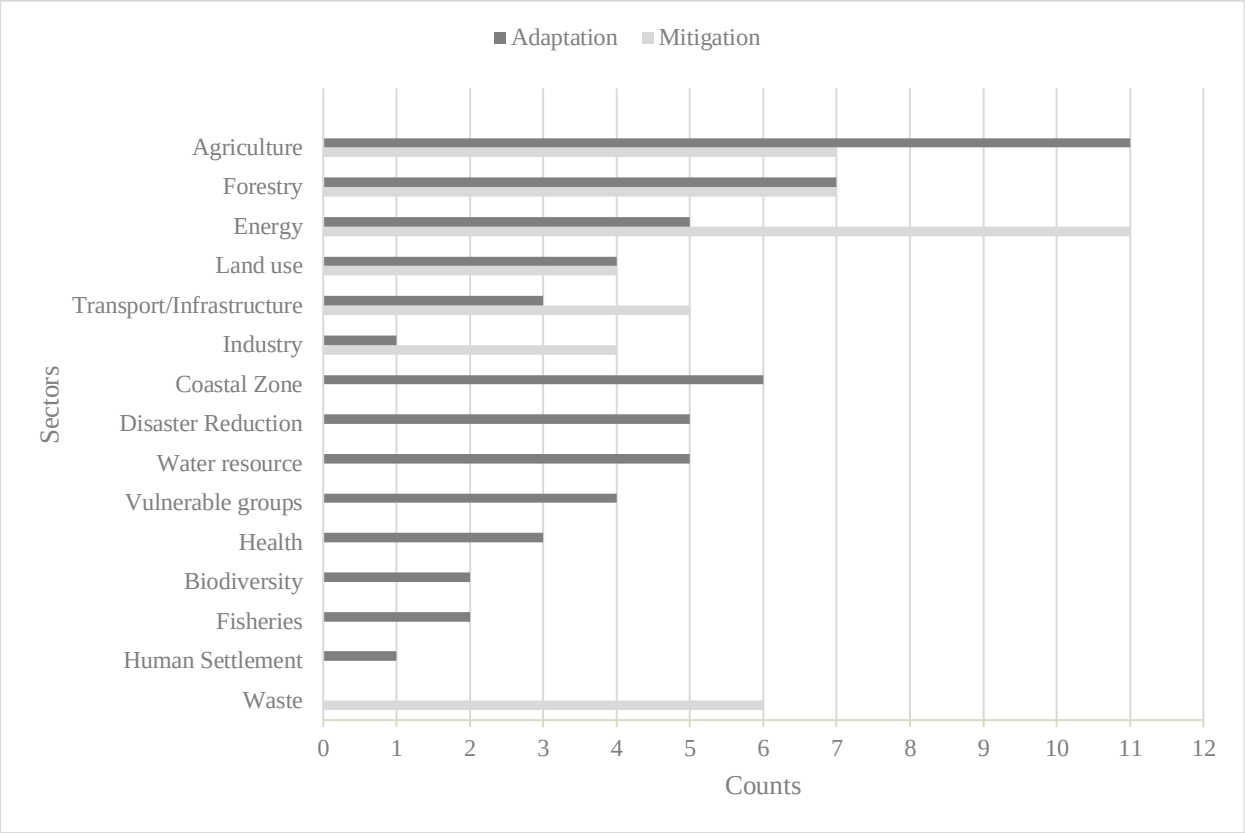

Figure 1: Priority areas for mitigation and adaptation of NDCs submitted by 11 West African states

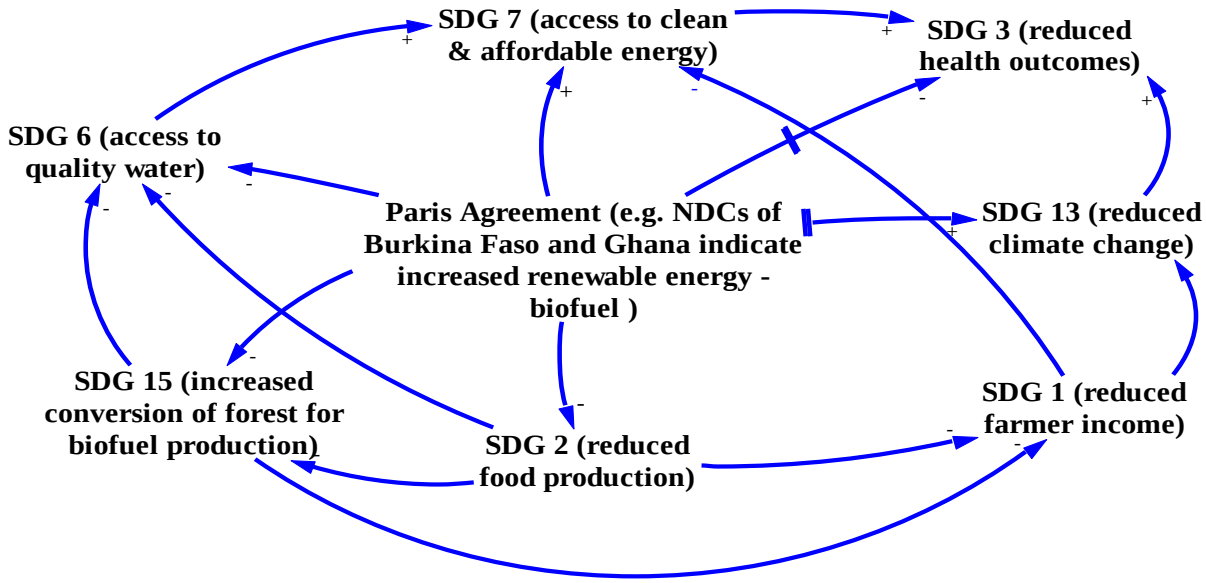

Figure 2: A simplified causal loop diagram illustrating the interactions between increased renewable energy use and SDGs

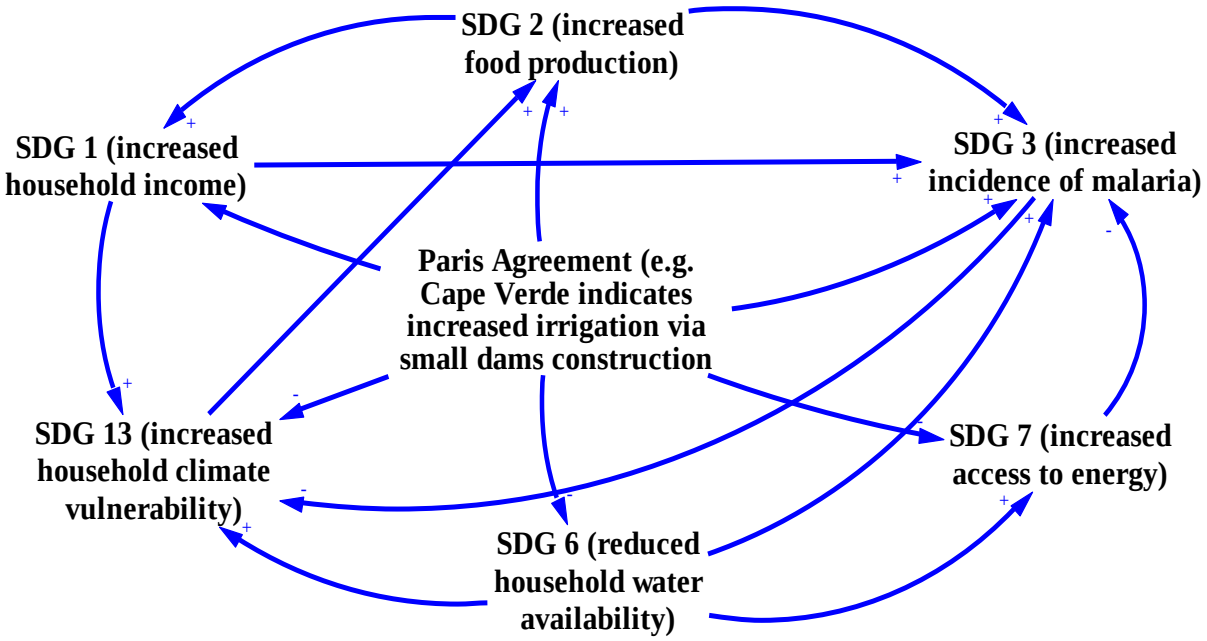

Figure 3: A simplified causal loop diagram illustrating the interactions between increased irrigation usage and SDGs

LIST OF TABLES

Table 1 Alignment between the NDCs and selected SDGs

Goals	Selected examples from West Africa states NDCs
Goal 1: End poverty in all its forms everywhere	• "Encourage informal savings and insurance schemes, and arrange for the availability of medium term credit" (Federal Ministry of Environment, 2015, p.8). • "Development of research programmes on the resilience of forest, wildlife and fish species" (Burkina Faso, 2015, p.11). • "Promotion and facilitation of early warning and disaster preparedness system, strengthen the adaptive capacity of the most vulnerable groups and communities through social safety nets and insurance schemes and enhance the resilience of the tourism value chain" (EPA Sierra Leone, 2015, p.9).
Goal 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture	• "Develop rice production by improving yields through use of varieties better able to cope with the impact of climate change (particularly ingress of salt water)" (Republic of Guinea, 2015, p.7) • "Adoption and application of climate-smart and conservation agriculture through best agricultural practices that enhance soil fertility and improve crop yield" (EPA Sierra Leone, 2015, p.8). • "Promotion of rice production systems with very low water consumption and low GHG emissions" (Republic of Togo, 2015, p.18). • "Sustainable crop intensification will be enabled by introducing innovative crop improvement and management practices" (Republic of The Gambia, 2015, p.10). • "Seek to disseminate more efficient small-scale irrigation techniques and promoting soil conservation schemes for farmers and rural producers" (Republic of Cape Verde, 2015, p 7). • "Establishment of a gene bank of climate resilient varieties of indigenous food crops (Republic of Liberia 2015, p.14).
Goal 6: Ensure availability and sustainable management of water and sanitation for all	• "Improved sanitation and drainage of rainwater in the main urban centres and rational and sustainable management of waste in urban areas" (Republic of Togo, 2015, p. 18). • "Intensify programmes to survey water quality and quantity for both ground and surface water" (Federal Ministry of Environment, 2015, p.20). • "Adopt alternative urban solid waste management and integrated water resources management" (Republic of Ghana, 2015, p.3 & 7). • "Conservation of rainwater and reuse of wastewater and improvement of groundwater management" (Republic of Togo, 2015, p.18). • "Increased access to potable water, integrated water management policy, greater water security for communities, increased protection of infrastructure from extreme climate events" (Republic of The Gambia, 2015, p.10). • "Development of master plans for water development and management and implementation of water-efficient irrigation techniques" (Burkina Faso, 2015, p. 11).
Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all	• "Improvement of the rate of access to electricity (overall, exceed 10% in 2010, 60% in 2030, of which 47% to 100% is in the urban zone and 0.4% to 30% in 2030 is in the rural zone" (Republic of Niger, 2015, p.2). • "Rehabilitate existing hydro-power plants and build new hydro-power plants to increase hydro-power production capacity (Republic of Liberia, 2015, p.12). • "Scale up renewable energy penetration by 10% by 2030" (Republic of Ghana, 2015, p.3). • "Produce and distribute 280,543 energy saving cook stoves that use fuel wood and 308,004 energy saving cook stoves that use charcoal by 2030" (Republic of Liberia, 2015, p.12)

	• "Improving energy efficiency of large consumers, with particular focus on hotels, hospitals and public administration offices by 2030 or before, including through mandatory installation of solar-water-heater components" (Republic of Cape Verde, 2015, p.4). • "Promotion of energy efficiency, enhanced management and expansion of the energy mix through uptake of renewable energy sources particularly in the rural areas of Sierra Leone" (EPA Sierra Leone, 2015, p.7).
Goal 13: Take urgent action to combat climate change and its impacts	• "Climate information services to the agriculture sector and dissemination to wider rural communities will be promoted and strengthen disaster risk reduction institutions through institutional strengthening and capacity building" (Republic of The Gambia, 2015, p.11-12). • "Promote forestry/plantation of species resistant to drought and low rainfall by 2030" (Republic of Guinea Bissau, 2015, p.6). • "Promotion of efficient varieties resistant to climate change and making structural investments in coastal protection" (Republic of Togo, 2015, p.18). • "Building of a national hydro-meteorological monitoring system and improved networking for the measurement of climatic parameters" (Republic of Liberia, 2015, p.13). • "Support for the mapping of areas vulnerable to climate change and reforestation and protection of zones with fragile ecosystems (mountainsides, river banks) in the fight against floods, violent winds and erosion." (Republic of Togo, 2015, p.18). • "Diversification of economic growth through strengthened transport sub-sector, particularly the infrastructure to contribute to the reduction of regional and global emissions of greenhouse gases and build a stable economy" (EPA Sierra Leone, 2015, p.8). • "Develop skills-based curriculum in subjects like science, geography, social studies, language arts, environmental education and technology that will empower children to better respond to the threat of climate change" (Federal Ministry of Environment, 2015, p.22).
Goal 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	• "Implementation of good forestry and agroforestry practices (selective cutting of firewood, assisted natural regeneration, controlled land clearing, etc.)" (Burkina Faso, 2015, p.11). • "Upscaling of good sustainable land management practices over all agro-ecological areas in order to increase the resilience of ecosystems and households and sequester carbon" (Republic of Niger, 2015, p.2). • "Promote Sustainable utilization of forest resources through REDD+" (Republic of Ghana, 2015, p.3). • "Management of rangelands and pastures by managing grazing systems and grazing intensity, fire management and pasture rehabilitation" (EPA Sierra Leone, 2015, p.9). • "Ensure effective conservation of classified forests and protected areas by means of strengthening supervisory arrangements (Guinean Parks and Nature Reserves Office and nature conservators); awareness-raising; participatory management; and enforcement of the criminal sanctions set out in the Forest Code" (Republic of Guinea, 2015, p.12). • "Develop and maintain a frequent forest inventory system to facilitate monitoring of forest status; and initiate a research programme on a range of climate change-related topics, including long term impacts of climatic shifts on closed forests" (Federal Ministry of Environment, 2015, p.7).

Table 2: Co-benefits and trade-offs of mitigation and adaptation measures/projects under NDCs in promoting the SDGs, as identified in expert interviews and national stakeholder workshop in Ghana

Sectors	Co-benefits for various SDGs	Trade-offs
Energy 1. Increased energy penetration through small-medium hydro-electric	Create employment for the youth and ensures energy security for rural communities (SDG 1) (Frondel et al., 2010; Wei et al., 2010). Reduced consumption of fossil fuels reduces the release of greenhouse gases (SDG 13) (Wang et al., 1999; Wei et al., 2010). Reduce the dependency on firewood and hence reduce the destruction of forest resources.	Loss of biodiversity and livelihoods. Negative impact on fisheries (for food and income for rural communities), river bank agriculture will be affected.
2. Biomass energy (e.g. improved cook stoves)	Improves health of women by avoiding disease caused by inhaling carbon monoxide (SDG 3) which results in saving from reduced healthcare costs (SDG 1) (Shailaja, 2000; Karekezi and Kithyoma, 2002). Reduces the burden placed on women in the collection of firewood hence giving them more time to engage in other activities, especially income-generating activities (SDG 1) (Karekezi and Kithyoma2002).	No trade-offs noted.
3. Renewable energy (e.g. increased use of biofuels, solar)	Recovery of methane gas would reduce the dependency on firewood and consequently conserving the forest (SDG 15).	Compromise food security, land grabbing. Renewable energy is expensive and not everyone can afford (Maxwell and Scholar, 2015).
4. Strengthening existing energy infrastructure	Reduction in energy cost for households leading to improved savings for other things. This would create job opportunities for the local people (Reyna and Chester, 2017).	No trade-offs noted.
Agriculture 1.Early warning and disaster prevention	This would reduce household's expenses on food during crop failure and reduced yield. Reduction in crop failure and consequently result in increased crop productivity.	No trade-offs noted.
2. Develop and promote drought-resistant, flood-tolerant and early maturing crop species (e.g. climate smart agriculture).	Contributes to sustaining productivity hence increasing crop yield and food availability (Fan et al., 2011; Comas et al., 2013; Fita et al., 2015). Increased crop productivity leads to increased farmer income thereby reducing incidence of poverty (SDG 1) ((von Braun, 2007; Gallagher, 2008 Porter and Kramer, 2011). Reduce the vulnerability of crops to agriculture consequently reducing the impact of climate change.	Extinction of indigenous varieties enhancing climate vulnerability.

Forestry 1.Sustainable utilization of forest resources through REDD+	Sustainable REDD+ increases the carbon sinks and consequently reduces GHGs emitted into the atmosphere (Singh et al., 2000; Stinson and Freedman, 2001). Reduction in the destruction of forest resources and biodiversity (Busch et al., 2011; Kapos et al., 2012). Protecting natural forest also conserves soil and water by reducing erosion (Kapos et al., 2012).	Shut down of wood industry due to lack of raw materials. Increasing pressure on land used for food production, possibly reducing food security and redirecting labour towards scarce off-farm income opportunities
2. Reduce illegal and indiscriminate felling of trees	This would reduce the loss of revenue that may be generated from legal logging of forests consequently resulting in economic growth (Odoom, 2005). This would increase the carbon sinks and consequently reducing the impacts of climate change.	The wood industry will be shut down due to inadequate supply of raw materials. Livelihoods of those involved in illegal and indiscriminate felling of trees will be reduced leading to poverty.
Water 1. Irrigation	Energy-efficient methods and techniques of irrigation can ensure agricultural productivity and consequently economic growth. Increasing the area under irrigation can also ensure uniform and continuous supply of water to farmlands and this can increase crop yield consequently improving household food availability (Keiser et al., 2005; Domenech, 2013).	Water supply for domestic use will be affected. Negative effects on aquatic organisms. Health hazards (breeding grounds for mosquitoes) (Keiser et al., 2005). Also, it leads to nitrate leaching contributing to greenhouse gas emissions
2. Integrated water resource management including watershed management	Allow people especially women and girls to devote more time to other activities that will enhance their economic and social empowerment such as literacy programmes, and promotion of income generating activities to improve the quality of their lives.	Land could be lost in the quest to protect water preventing farming activities in and around those areas. Women empowerment may lead to loss of land due to abundance of water. Breakdown of social network.
Transport 1. Sustainable mass transportation	This would reduce the emission of GHGs into the environment and also the dependency on fossil fuels (Shaheen. and Lipman, 2007; Federal Transit Administration, 2017). Improvement in road infrastructure will reduce the amount of time for commuters thereby increasing productivity and reducing GHGs emission.	This could reduce household incomes as drivers would have to seek for alternative income.
Industry 1.Increased knowledge and awareness of climate change	This would inform people to plan ahead so that they do not incur any unplanned expenses which derail their household income. This would help farmers to know what to plant and when to do it so as to increase crop productivity and availability (Harvey et al., 2014).	No trade-offs noted.

2.Encourage informal savings and insurance schemes	This would help increase the income levels of households and also provide some form of support/relieve in case of disaster. This could help farmers expand their farms and also ensure proper farm management to increase crop yield (SDG 2).	This could lead to loss of property and income as informal saving groups may mismanage savings.
3.Adoption of green technology in industry	This would create jobs for people and also allows for rapid and sustained increases in living standards for all people (UNEP, 2011; Bowen and Kuralbayeva, 2015). Rural industry for preserving food or perishable crop will improve household food availability.	No trade-offs noted.
Waste 1.Efficient urban solid waste management system	The urban population would make a living from the recovering recyclable materials from waste (Kumar et. al., 2017). Degradable waste can be used as manure to boost crop yield and also waste from manufacture of food products can be given to animals as feeds (Dotaniya et. al., 2016). Efficient management of waste would reduce the impact of methane and CO2 from poorly managed dumpsites.	Increase the cost involved in waste management.
2. Increased private sector involvement in waste management	This would generate employment for the private sector and ensure efficient collection of wastes (Kumar et. al., 2017).	Increase the cost of waste disposal on the household. It will encourage erode means of waste disposal.

Appendix 1: Keywords used in NDC searches

Sector	Reference
Mitigation	
Agriculture	OECD (2016), Recha et al. (2014)
Forestry	Pekka (2007)
Energy	UNFCCC (2016); Mbeva et al. (2015)
Land	Recha et al. (2014)
Transportation	Giuseppe (2010)
Industrialization	Szirmai et al. (2013)
Waste management	Atilio (2015)
Livestock	Ahmed et al. (2017)
Adaptation	
Human settlements	Mbeva et al. (2015)
Tourism	Lépy et al. (2014)
Coastal zone	UNFCCC (2007)
Sanitation	Oates et al. (2014)
Floods	UNFCCC (2007)
Capacity building	Carter et al. (2015)
Biodiversity	Schmitz et al. (2015)
Disaster management	Mbeva et al. (2015)
Fisheries/marine	UNFCCC (2007)
Food security	Mercer et al. (2014)
Health	WHO (2014), UNFCCC (2007)
Infrastructure	Chappin and van der Lei (2014)
Agriculture	OECD (2016), Recha et al. (2014), UNFCCC (2007)
Energy	UNFCCC (2016) Mbeva et al. (2015)
Forestry	Pekka (2007), Mbeva et al. (2015)
Land management	Recha et al. (2014)
Water management	UNFCCC (2007)