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RESEARCH ARTICLE



Alignment between nationally determined contributions and the sustainable development goals for West Africa

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ABSTRACT

The UN Sustainable Development Goals (SDGs) and the 2015 Paris 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 SDG implementation plans, and Nationally Determined Contributions (NDC) under the Paris Agreement, without integrated planning and cross-sectoral alignment. This article provides a situation analysis guided by the following questions: (a) Which priority sectors are mentioned in relation to adaptation and mitigation in West African NDCs? (b) Are the NDCs of West African states well aligned with the SDGs? (c) What are the co-benefits of NDCs in contributing towards the SDGs? and (d) How are West African states planning to finance actions in their NDCs? The study uses iterative content analysis to explore key themes for adaptation and mitigation within NDCs of 11 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 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 among 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 to overcome misalignments across different sectors.

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1. Introduction

The 2015 Paris Agreement under the United Nations Framework Convention on Climate Change (UNFCCC) 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’ 2°C above pre-industrial levels and ‘pursue efforts’ to limit

this to 1.5°C. 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, Biru, Lima, Bouye, & Song, 2016) and to develop these into sectoral policies and actions at a national level (Bodansky, 2016). Prior to the 2015 twenty-first Conference of the Parties (COP 21) to the UNFCCC, where the Paris Agreement was adopted, 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 article.

The UN Sustainable Development Goals (SDGs) were agreed at the UN Sustainable Development Summit, also 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 well-being (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 within ecosystems, while providing opportunities for inclusive economic growth.

These two international policy frameworks thus 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 analysed African NDCs and their key components in terms of both mitigation and adaptation (e.g. Mbeva, Ochieng, Atela, Khaemba, & Tonui, 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, Stern, and Ward (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'. Höhne et al. (2017) have also highlighted the inconsistency between national contributions and global goals of reducing emissions. Research has started on the SDGs too. Nilsson, Griggs, and Visbeck (2016) identified interactions among the SDGs and highlighted seven interaction types between the goals and targets. Costanza, Daly, et al. (2016) and Costanza, Fioramonti, and Kubiszewski (2016) looked across the SDGs to assess the ways they interact to support human well-being, whereas Hák, Janoušková, and Moldan (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 article 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 thus 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 the 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 debates on the water–energy–food nexus (Mirzabaev et al., 2015; Rasul & Sharma, 2016) and how to improve coherence between policies in these sectors (see Antwi-Agyei, Dougill, & Stringer, 2017). 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, Stringer, Dougill, & Afionis, 2018; Stringer, Sallu, Dougill, Wood, & Ficklin, 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 and context for the study

West Africa consists of 16 states: Burkina Faso, Cape Verde, Cameroon, Cote d'Ivoire, Liberia, Ghana, Guinea, Guinea Bissau, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, The Gambia and Togo. Although these countries are together considered to be minor contributors to global GHG emissions (with the exception of Nigeria), 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 the majority of people in the region, including the poorest and most vulnerable – are dependent on the climate (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 also susceptible to frequent food crises and famines which are triggered by pest infestation, droughts, floods, economic downturns and conflicts (Kidane, Maetz, & Dardel, 2006).

Ghana was used as a case study to further elucidate some of the key insights emerging from the broad regional analysis. This country was used because, apart from representing a vulnerability hotspot (Asante & Amuakwa-Mensah, 2015; Antwi-Agyei, 2012), it has been a regional leader in developing climate policy (Mawunya & Adiku, 2013). For instance, Ghana was one of the first countries in West Africa to develop a comprehensive national climate change policy in 2012 (Ministry of Environment, Science and Technology, 2012). Ghana adopted a participatory approach in preparing its NDC and received cabinet approval for it. 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 programmes of action, aiming towards a sustainable, resilient and low carbon future Ghanaian society (Republic of Ghana, 2015). Given that the NDC cuts across different sectors and policy frameworks, it is important to understand the various alignments and possible misalignments 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, an in-depth content analysis of the NDCs was undertaken to retrieve emerging keywords (as per Kalaba, Quinn, & Dougill, 2014). Appropriate sectoral keywords were selected based on the literature on mitigation and adaptation (Appendix). 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 11 NDCs and six SDGs (1, 2, 6, 7, 13 and 15) was analysed by the lead author and then discussed/verified in the national multi-stakeholder workshop held in Ghana. For the alignment classification, we identified situations where there was explicit alignment between the NDCs and SDGs, based on indirect overlaps between the SDGs and the policies, measures, and actions communicated in the NDCs (as per Northrop 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 is judged to 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. This involved both expert interviews with Government sectoral leads ($n = 12$) and a national stakeholder workshop held in Kumasi, Ghana in June 2017. This workshop was attended by 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 ($n = 26$). This forum was designed to enable assessment of both the co-benefits and trade-offs between priority sectors and proposed actions. Through this approach, we highlighted 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 dynamic changes in systems (Rwashana, Nakubulwa, Nakakeeto-Jijambu, & Adam, 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 others, for example to show the effects of floods in Ghana (Armah, Yawson, Yengoh, Odoi, & Afrifa, 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 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, and 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.

4.2. Alignment of NDCs with SDGs

All the West African states analysed here have measures in their NDCs that will help advance 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, while 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).

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

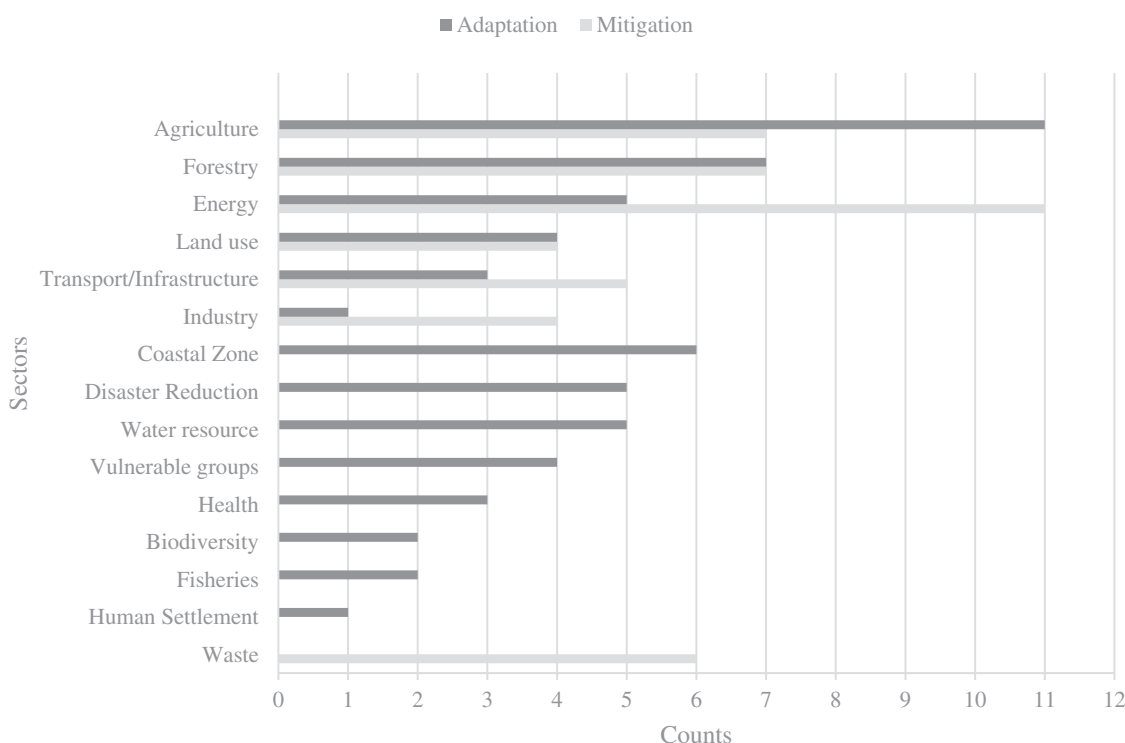


Figure 1. Priority areas for mitigation and adaptation of NDCs submitted by 11 West African states.

Gambia, 2015, p. 11). While 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 disseminate more efficient small-scale irrigation techniques and promote soil conservation schemes for farmers and rural producers’ (Republic of Cape Verde, 2015, p. 7). The Gambia aims to 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, while 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). 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).

Table 1. Alignment between the NDCs of West African states and selected SDGs.

Goals	Selected examples from West Africa states NDCs
Goal 1: End poverty in all its forms everywhere	<ul style="list-style-type: none"> • 'Development of research programmes on the resilience of forest, wildlife and fish species' (Republic of Burkina Faso, 2015, p. 11). • 'Seek to diversify income generating activities in rural areas by promoting artisanal fishing activities (providing training, equipment, micro-credit) in coastal areas' (Republic of Cape Verde, 2015, p. 7). • '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	<ul style="list-style-type: none"> • '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. 11).
Goal 6: Ensure availability and sustainable management of water and sanitation for all	<ul style="list-style-type: none"> • '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' (Republic of Burkina Faso, 2015, p. 11).
Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all	<ul style="list-style-type: none"> • '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

(Continued)

Table 1. Continued.

Goals	Selected examples from West Africa states NDCs
	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	<ul style="list-style-type: none"> '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, pp. 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). '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).
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	<ul style="list-style-type: none"> '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. 20).

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).

4.3. Ghana's NDC: a case study

Content analysis shows that several actions outlined in Ghana's NDC align well with SDGs 1, 2, 6, 7 and 13. Further, with regards to SDG 7, Ghana has stated in its NDC that it aims 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 reforestation and afforestation programmes on degraded lands. The NDC also prioritizes 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), while 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 it 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 in 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 reforestation programmes will potentially increase income for local people involved in tree planting and generate long-term carbon sequestration gains if implemented at a large enough scale for impact.

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 may interact negatively with the attainment of one or more specific SDGs. The causal loop diagrams presented in Figures 2 and 3 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 could negatively interact with other SDGs as small dams can serve as breeding grounds for mosquitoes (SDG 3) and may also result in decreased water availability for farming households because of competing demands for water (SDG 6) (Figure 3).

4.5. Financing of NDC actions

Funding remains a major issue for the implementation of mitigation and adaptation actions outlined in NDCs. Both the Ghanaian case study and the broader West African analysis reveal that most actions outlined in the NDCs remain conditional on the receipt of 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

Table 2. Co-benefits and trade-offs of mitigation and adaptation measures under NDCs in promoting the SDGs, as identified in expert interviews and national stakeholder workshop in Ghana and supported with literature.

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) (Fronde, Ritter, Schmidt, & Vance, 2010; Wei, Patadia, & Kammen, 2010). Reduced consumption of fossil fuels reduces the release of greenhouse gases (SDG 13) (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). Reduces the burden placed on women in the collection of firewood hence giving them more time to engage income-generating activities (SDG 1) (Karekezi & Kithyoma, 2002).	No trade-offs noted.
3. Renewable energy (e.g. increased use of biofuels)	Recovery of methane gas would reduce the dependency on firewood and consequently conserving the forest (SDG 15) (Gross et al., 2017).	Compromises food security as a result of land grabbing. Renewable energy is expensive and not everyone can afford (Maxwell & 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 & Chester, 2017).	No trade-offs noted.
Agriculture		
1. Early warning and disaster prevention	This reduces household's expenses on food during crop failure and reduced yield. Reduction in crop failure and consequently result in an 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., 2012; Fita, Rodríguez-Burruero, Boscaiu, Prohens, & Vicente, 2015). Increased crop productivity leads to increased farmer income thereby reducing incidence of poverty (SDG 1) (Porter & 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 (Mbow, Smith, Skole, Duguma, & Bustamante, 2014; Stinson & Freedman, 2001). Reduction in the destruction of forest resources and biodiversity (Busch, Godoy, Turner, & Harvey, 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 reduces the loss of revenue that may be generated from legal logging of forests (Odoom, 2005). This increases the carbon sinks and consequently reducing the impacts of climate change.	Livelihoods of people in this industry will be adversely affected, 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	Water supply for domestic use will be affected. Negative effects on aquatic organisms. Health hazards (breeding grounds for mosquitoes)

(Continued)

Table 2. Continued.

Sectors	Co-benefits for various SDGs	Trade-offs
	ensure uniform and continuous supply of water to farmlands and this can increase crop yield consequently improving household food availability (Keiser et al., 2005).	(Keiser et al., 2005). Also, it leads to nitrate leaching contributing to greenhouse gas
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.	emissions. 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 reduces the emission of GHGs into the environment and the dependency on fossil fuels (Shaheen & Lipman, 2007). 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 helps 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) (Fenton, Paavola, & Tallontire, 2017).	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).	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 (Hargreaves, Adl, & Warman, 2008).	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.

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 emissions relative to business-as usual by 2030. Nevertheless, it has stated that a 45% emission reduction below business-as-usual levels is only attainable with external support (Republic of Ghana, 2015). 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. 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 indication of possible sources. For instance,

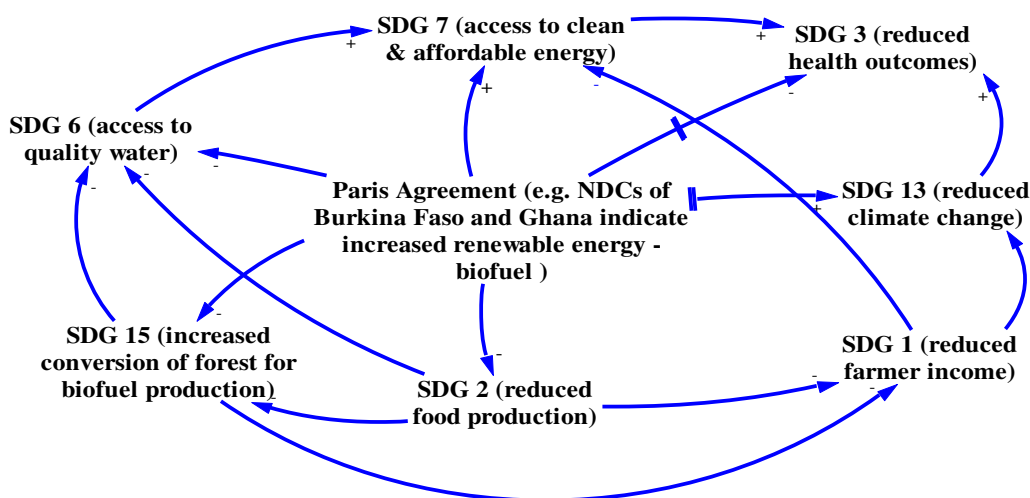


Figure 2. A simplified causal loop diagram illustrating the interactions between increased renewable energy use and SDGs.

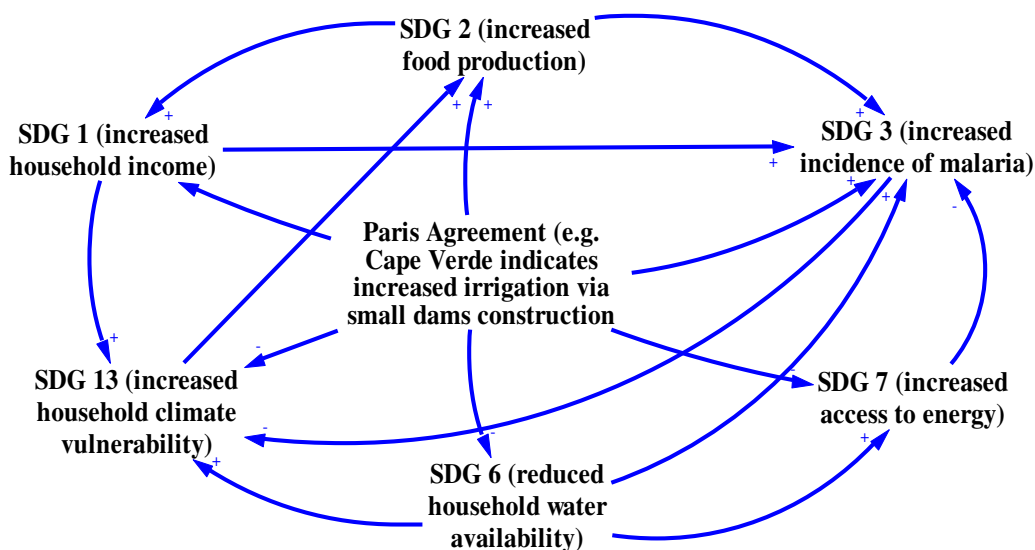


Figure 3. A simplified causal loop diagram illustrating the interactions between increased irrigation usage and SDGs.

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 that its emissions targets are dependent on: ‘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 also made an explicit domestic funding commitment (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 prioritized 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 (Bervoets, Boerstler, Dumas-Johansen, Thulstrup, & Xia, 2016; FAO, 2014). 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 renewable energy grid connection by 48% by 2030 (ECOWAS, 2013). However, it is not clear from the NDCs of West Africa states whether funding requests will also prioritize 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 African Union's Agenda 2063 that seeks to improve socioeconomic and political transformation, ensure inclusive growth and sustainable development on the continent (African Union Commission, 2015). Such alignments provide opportunities and trajectories for more integrated approaches towards development and peace, and a move away from the unhelpful tendency to put international frameworks in silos.

The various climate actions outlined in NDCs for 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. 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 11 NDCs analysed (Liberia, Ghana, Togo, Niger, Nigeria and Sierra Leone) explicitly mentioned Climate-Smart Agriculture (CSA). CSA aims to increase productivity and resilience while cutting GHGs, thereby improving national food security (Chandra, McNamara, & Dargusch, 2017; Lipper, Mann, Meybeck, & Sessa, 2010) and reducing the risks of crop failure due to drought and dry spells.

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. Although this provides an opportunity for these different sectors to contribute to the implementation of the 31 programmes of action, 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 in 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 between their NDCs and the SDGs. 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 national and international levels (GIZ & UNDP, 2017; Nilsson, 2017). Therefore, it is crucial that synergies and trade-offs are clearly identified to promote participation of the various sector ministries. This will ensure greater cross-sectoral coherence in climate adaptation planning at the national and local levels.

The analysis shows that both private and public domestic financial support will be critical 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 (GIZ & UNDP, 2017; Van Asselt, 2016). 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 commitment to mobilize US\$100 billion of finance by 2020 (Hedger & Nakhooda, 2015) may not be enough to enable developing countries to fully implement their NDCs. This becomes particularly important in the light of the recent withdrawal of the United States from the Paris Agreement, which could have significant repercussions for the Green Climate Fund.

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 is particularly vulnerable to climate change. Prioritizing 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. These alignments represent opportunities and display mutual benefits that can be derived from the integrated implementation of NDCs together with SDGs. Remaining areas where greater alignment is required include the need to improve 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 existing inequality and vulnerability.

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. Policy makers need to devise innovative approaches aimed at promoting cross-sectoral coordination in order to overcome these challenges, and thereby prevent the stifling of alignment efforts between NDCs and SDGs.

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Appendix. Keywords used in NDC searches.

Sector	References
Mitigation	
Agriculture	OECD (2016), Recha, Kapukha, Wekesa, Shames, and Heiner (2014)
Forestry	Pekka (2007)
Energy	UNFCCC (2016), Mbeva et al. (2015)
Land	Recha et al. (2014)
Transportation	Giuseppe (2010)
Industrialization	Szirmai, Naudé, and Alcorta (2013)
Waste management	Atilio (2015)
Livestock	Ahmad, Hamid, and Kazmi (2017)
Adaptation	
Human settlements	Mbeva et al. (2015)
Tourism	Lépy et al. (2014)
Coastal zone	UNFCCC (2007)
Sanitation	Oates, Ross, Calow, Carter, and Doczi (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, Kurvits, Kelman, and Mavrogenis (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)