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Unmet needs and opportunities for climate change adaptation and mitigation in the G5 Sahel region

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About this report

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Contents

Boxes

1. Overview

This report provides an overview of potential opportunities and gaps in the G5 Sahel countries (Burkina Faso, Chad, Mali, Mauritania, and Niger) in relation to the impacts of climate change. The report focuses on four main areas of interest, with additional sections giving a brief outline of the expected impacts of climate change in the Sahel and national policies related to climate change. The main sections are: 'Low-carbon development trajectories and strategies'; 'Adaptation and management'; 'Climate change and migration'; and 'Climate change and conflict'. The review is not exhaustive, but provides a summary of key literature, findings, and where appropriate, opportunities for engagement.

Low-carbon development trajectories and adaptation

The G5 Sahel countries are vulnerable to the impacts of climate change due to a combination of biophysical factors including aridity, and socioeconomic characteristics including the reliance on natural resources for livelihoods, the importance of agriculture and pastoralism for national economies, and weak governance. Despite the existence of a wide range of national climate change commitments across the G5 Sahel countries, integration of climate change into sectoral policies, ministries, and local development plans is limited, although varies by country. Technical capacity to implement climate change policies, plans, and programming is also limited at both the national and local government levels.

Economic growth and development are key concerns of the G5 Sahel countries particularly in the context of climate change, which is likely to impact yields of key crops as well as other economic sectors. Chad, Mali, and Niger are interested in pursuing low-carbon growth strategies and their Intended Nationally Determined Contributions (INDCs) and economic development plans identify agriculture and energy as key sectors. Across the G5 Sahel, the agricultural sector is highly underdeveloped (Sartori & Fattibene, 2019). There is also a huge potential for developing renewable energy sources including solar and wind, with some evidence suggesting that micro grids and a focus on decentralised provision could be effective in addition to work at the national level. Investments in the two sectors could also be complementary: increasing rural access to electricity could strengthen agricultural value chains, increasing productivity and rural incomes.

Adapting to and managing the impacts of climate change is also a challenge at the local, community, and household levels. Key sectors include agriculture, pastoralism, and water. Climate-smart agriculture, including drought-resistant seeds, extension services, and weather information are widely suggested as appropriate intervention strategies in the Sahel. Livelihoods, coping strategies, and natural resources use and management are inherently linked. Negative coping strategies, such as cutting trees to sell as fuelwood in times of drought, can increase deforestation and affect soil fertility, which in turn can negatively impact agricultural yields. Changing rainfall patterns due to climate change will interact with these dynamics, and are predicted to decrease crop yields. In Mali, a number of donors are supporting projects in the agricultural space; however, fewer projects focus on pastoralists.

Water resources in the Sahel limit the region's development (USAID, 2017). Drought is a key risk to the G5 Sahel's agricultural and pastoral sectors. In Burkina Faso, there are limited donor programmes addressing the water sector, despite it being identified as a priority sector in the country's INDC. Similarly, in Mali a 2016 review of donor-supported projects argues that few projects consider water resources and no projects specifically target fisheries or fishing

communities, despite fisheries being a priority sector in the INDC (for more information, see Zamudio, 2016). Access to water and sanitation is also low across the region. Poor sanitation in Chad's urban areas also poses risks to health if climate change increases flooding. Chad's INDC identifies waste management as a key sector.

Opportunities for engagement and unmet needs in the G5 Sahel include:

- Irrigation: Supporting small-scale irrigation development could increase agricultural productivity. However, there is some limited evidence that micro-drip irrigation in Burkina Faso, for example, fell into disuse once donors stopped promoting the projects.
- Cooking stoves: Across the G5 Sahel there is a reliance on wood and charcoal for cooking, especially in rural areas. This is a key driver of deforestation. Use of fuel-efficient cooking stoves could reduce deforestation. As well as supporting the production of the stoves and expansion of existing producers, opportunities for engagement in Mali include supporting the development of national standards and regulations.
- Tree planting and management: Evidence from Niger suggests that farmer-managed natural regeneration, whereby farmers plant and tend to trees on their land, can increase agricultural yields.
- Pastoralism: Opportunities for engagement include supporting cross-border and regional coordination including transit permits and local-level agreements between communities. Information services on potential grazing areas via mobile phone is an emerging but promising area that could help pastoralists to manage the impacts of climate change.

The literature consulted for this review also identified a number of barriers to the implementation of climate change adaptation and mitigation programming in the G5 Sahel. Culture, land tenure, and gender all condition which adaptation strategies households and communities adopt. Farmers are more likely to invest inputs in land they own, whilst across the G5 Sahel, women generally have limited access to land, credit, and technology, and limited input to decision-making, which makes them more vulnerable to climate change (MOFA, 2018a).

Information on cost–benefit analyses and returns-on-investment for Sahel country interventions were considered. However, quality information and evidence on these could not be found during the course of this review.

Climate change and migration

There has been much rhetoric recently in international policy spheres and the media about climate change fuelling conflict and being a major driver of migration in the Sahel. However, empirical support and theoretical foundations of a causal relationship between climate change, conflict, and migration are scarce (Brzoska & Fröhlich, 2016). Although a direct causal link between climate change and migration is contentious and difficult to support, there is growing agreement in the environment–migration sphere that intervening factors determine if and how environmental change causes population movements (see Freeman, 2017 for a more in-depth summary of the current environment–migration and climate change–conflict debates).

The overwhelming majority of West African migration takes place within West Africa itself; only a small minority is directed towards Europe. Importantly, there is no single story of Sahelian migration or single explanation. Recent research in the Sahel indicates that environmental factors appear to mainly cause internal migration; outmigration (to Europe) is most related to

migrants' aspirations and agency shaped by cultural, social, and economic (specifically labour demand) factors (see Hochleithner & Exner, 2018).

Key findings in relation to migration in the Sahel and links to climate change include:

- The Sahel has a long history of population movement and represents a multitude of migration patterns and trajectories. Movement in the Sahel is complex and multi-faceted in nature, and is deeply rooted in history and culture. In particular, seasonal and circular migration are enduring and continuing, and most movement is regional, especially rural to urban within the same country (Hummel & Liehr, 2015).
- Within West Africa, freedom of movement is underpinned by regional treaties, initiatives, and regulations that facilitate regular migration (Raineri & Rossi, 2018). Land tenure reform in the G5 Sahel has influenced and restricted traditional transhumance[1] patterns.
- Context matters. The review shows that the influence of environmental change on migration pattern is highly context dependent, and it is important to consider the full context of migration. Furthermore, migration can be seen as a social process, not just a reaction to stimuli, and people's decision to migrate is multidimensional and can change (Hummel & Liehr, 2015, p. 4).
- No evidence was found that environmental change is a sole cause of migration in the G5 Sahel. There is a general lack of consensus about what is driving migration in the Sahel. Economic, social, political, and environmental factors have all been highlighted as drivers, and it is not possible to define one distinct and complete list of migration drivers in the Sahel because of frequent interactions between drivers (Neumann & Hermans, 2017).
- In general, environmental change appears to mainly trigger internal migration in West Africa (Hochleithner & Exner, 2018). The pathways that lead to migration through environmental change are likely to be complex, and contextual factors (such as political, social, and economic) are key in explaining *whether* and *how* this may happen (Freeman, 2017).
- Migrants' aspirations are of crucial importance to understand migration, and are also subject to change (Hochleithner & Exner, 2018). Migration choices are partly based on perceptions of vulnerability (to climate change) and opportunities, which are often based on limited information (Zickgraf et al., 2016).
- Migration is only one of several ways to minimise risks and compensate for climate variability, and people adopt different coping strategies other than migration. Even with environmental changes and stressors, people may not necessarily migrate.

Climate change and conflict

The connections between climate change and security are also complex, dependent, and not fully understood. They remain highly controversial. There is an ongoing debate about the links between climate change, conflict, scarcity, and migration. Evidence suggesting that conflict occurs as a direct result of climate-related or climate-sensitive factors is contested (see Adger et al., 2014), and this report does not seek to make a direct connection between climate-related

[1] According to UNOWAS (2018, p. 12): 'Pastoralism generally requires some form of mobility of herders and their animals, often on a seasonal basis between dry and rainy seasons, and day-to-day between pastures and water points. The migration of pastoralists and their livestock between seasonal pastures is called transhumance.'

impacts and instability. There is, however, some evidence of indirect links and mediating factors between climate change and social conflict (although these indirect links also remain contested by some; see Hartmann & Selby, 2015). Therefore, this report explores the evidence of indirect links between environmental change and localised conflict in the G5 Sahel region; for example, increasing strains on communal resources, and looking at intervening variables (e.g. political issues, institutions, resource management systems) that also determine climate impacts. There was not scope within this report to explore the debates surrounding the climate–security nexus; for a more in-depth understanding of the climate change and security debate it is recommended that other reviews and analyses be consulted (see, for example, Adger et al., 2014; Busby, 2018; Freeman, 2017; Price, 2019).

Key findings in relation to climate change and conflict in the Sahel include:

- In general, indirect causal pathways between climate change and conflict identified in the academic literature are related to food price shocks or changes in agricultural production, economic growth, environmentally driven migration, natural disasters, and the role of institutions (Busby, 2018).
- Analysis of these issues is often based upon high-quality but local-level case studies, and so generalisations are difficult and should be made with care.
- Intermediary social, political, and economic variables need to be analysed to understand if environmental change will lead to political violence (Freeman, 2017). On the other hand, trying to understand the conflict dynamics in vulnerable countries in the Sahel *without* taking into account the impact of climate change could result in an incomplete and flawed analysis (Snorek, Stark & Terasawa, 2014).
- Conflict and climate change are both context specific. Conflict dynamics are extremely complex, and different causes are often important at different periods of a conflict (Seter Theisen, & Schilling, 2018). Climate risks may heighten insecurity, but are unlikely to be the most important cause of conflict (Moran et al., 2018). The same can be said for resource scarcity. The wider historical, socioeconomic, and political context is much more important in explaining violent conflict in the Sahel (Buhaug, Benjaminsen, Sjaastad & Theisen, 2015).
- There is some agreement in the literature that (local) conflicts in the Sahel region are a result of both external and internal factors (demographic, economic, social, environmental), driven by widespread fragmentation of societies across the region and ineffectual institutions (Ferdi, 2016). Incomplete institutionalisation of the clear, commonly accepted rules on rural land tenure and management of natural resources have allowed many conflicts over natural resources to continue, for example in **Burkina Faso** and **Niger** (Snorek et al., 2014).
- Livestock mobility, through the movement of herders and their cattle during the dry season to other pastures and to trade, forms a key strand of the resilience of pastoralist communities in the Sahel. It is important to appreciate that West African herders and farmers have long coexisted in symbiotic relationships, which endure both peace and discord. However, a recent United Nations Office for West Africa and the Sahel (UNOWAS) study on pastoralism and security finds that ‘growing competition between herders and farmers over access to water and pasture is a primary driver’ of an increase in violent conflicts involving pastoralists in parts of West Africa and the Sahel in recent years (UNOWAS, 2018, p. 10).

- Common factors in the literature related to farmer–pastoralist conflicts in the Sahel include marginalisation and political discontent, corruption and rent seeking among government officials, incomplete or unclear national policies and laws, agricultural encroachment that obstructs pastoral movement, power vacuums from state withdrawal, and weak governance (Benjaminsen, Alinon, Buhaug & Buseth, 2012; Benjaminsen & Ba, 2009; Brooks, 2012). As Benjaminsen (2016) argues, changes in rainfall (leading to droughts and floods) may 'potentially escalate tensions but evidence suggests that the root causes of land disputes are historical and political'. Hence, climate change has the potential to further exacerbate tensions over land and resources (Snorek et al., 2014).
- The frequency and severity of resource conflicts varies across and within Sahelian countries according to context (Vivekananda, Wall, Sylvestre & Nagarajan, 2019). Herder–farmer conflicts in the Sahel need to be considered as a dynamic process, and a better understanding of why some conflicts escalate and others do not is needed (Moritz, 2010). Pastoralists are a common target for 'crisis' narratives in the Sahel.
- The importance of rural land tenure and rules for management of natural resources in relation to localised conflict in the Sahel is highlighted throughout the literature, especially as much of this legislation is incomplete, unclear, or not fully implemented.
- A recent conflict and climate risk assessment of the **Lake Chad** region by Vivekananda et al. (2019) finds that although the current conflict was triggered by violence linked to armed groups, the crisis has deep roots in long-standing developmental challenges, with widespread inequality and decades of political marginalisation, and that these challenges are further exacerbated by climate change.
- Local-level engagement is key for addressing conflict in the Sahel as environmental variability and climate change are more likely to be linked to small-scale conflicts such as cattle raiding, agrarian–pastoral clashes, and rural labour competition (Freeman, 2017). This reflects the importance of context and understanding the history of these societies, the political economy of institutions, and the needs of local populations to understand conflict dynamics and any links to environmental change. This level of information can only be obtained through in-depth assessments of the situation on the ground (Ferdi, 2016). Hence, there is also a need for capacity building of local government. On the other hand, support to regional organisations (especially the Economic Community of West African States (ECOWAS)) has also been recommended to strengthen cooperation on transhumance issues across the region.
- Caution is needed when exploring the links between natural resources, climate change, and conflict to not overestimate the propensity of such conflicts to turn violent, as counterfactuals where conflict mitigation has been successful are mostly not reported in the research field (Seter et al., 2018). Furthermore, there is a lack of consideration in the climate–security discourse of poor people's ability to cope and cooperate in times of resource stress, further biasing findings (Hartmann & Selby, 2015).

Evidence base

This report is based on academic literature assessing potential adaption strategies, changes in migration patterns, and drivers of localised conflict; donor and international organisation literature detailing both donor strategies and programmes, and potential areas for engagement; and literature suggested by geographic and sectoral experts.

There is a large body of work related to both agriculture and pastoralism in the G5 Sahel region including the impacts of climate change, and potential adaptation and management strategies. However, there is only a small body of work related to low-carbon development strategies for the countries included in this study. Scant information could be found on how to develop the extractives or transport sectors in the region in a low-carbon way.

The debates around the connections between climate change, migration, and conflict remain contentious and nuanced. Research into these spheres has increased in the last 20 years, but consensus has not been reached and the debates continue. Differences in the definitions, conceptual frameworks, study designs, and analytical methods used hamper the study of the migration–climate change nexus and climate–security nexus. Another important challenge to consider is the lack of distinction between climate variability, climatic events, and climate change in the climate, security, and migration literature (Jónsson, 2010). Furthermore, with all these issues context is key, and findings remain context specific. This makes it difficult to draw general conclusions on the relationship between environmental change, migration, and security. Further empirical research is needed to tease out the patterns of interconnectedness between these issues (Freeman, 2017). Furthermore, there needs to be more research into counterfactuals, i.e. why some locations with observed environmental stresses also observe conflict or migration and others do not. Further research is also needed into the effectiveness of policy interventions and efforts to prevent the onset of conflict, and peace-building (Gilmore, Risi, Tennant & Buhaug, 2018).

It was outside the scope of this report to review literature in the French language.

2. Climate change in the Sahel

This section provides a summary of historical and projected climate changes in the Sahel to provide some context for the rest of the report. It is a brief overview; for more detailed information see Niang et al. (2014), Netherlands Ministry of Foreign Affairs (MOFA, 2018a), and USAID (2017).

The Sahel region is one of the most vulnerable to the impacts of climate change, not only because of its biophysical features but also because of its environmental degradation, 'poverty, food insecurity, rapid population growth, gender inequality, political instability and conflict' (MOFA, 2018a, p. 3). Climate change is likely to compound these existing vulnerabilities (USAID, 2017). According to the ND-GAIN Index for 2017,[2] which summarises a country's vulnerability to climate change and other global challenges in combination with its readiness to improve resilience, all of the G5 Sahel countries rank among the 20% most vulnerable to climate change (of 181 countries ranked), and three (Chad, Mali, and Niger) are among the most vulnerable 10%. In particular, climate change poses a threat to farmers and herders in the region, where agriculture (specifically subsistence farming) and transhumant livestock rearing are major sources of livelihood (Lewis & Buontempo, 2016). Agriculture in the Sahel is 'almost entirely reliant on the limited three to four months of variable summer rainfall (June–September), making it highly vulnerable to climate variability and change' (USAID, 2017, p. 3), and the region often faces serious food security challenges. Furthermore, as highlighted in a climate profile for the

[2] The ND-GAIN framework 'breaks the measure of vulnerability into exposure, sensitivity and adaptive capacity, and the measure of readiness into economic, governance and social components'. For more information and data see https://gain.nd.edu/our-work/country-index/ (accessed 22 July 2019).

West African Sahel by the Ministry of Foreign Affairs of the Netherlands (MOFA, 2018a, p. 3), 'The current and expected effects of climate change differ locally, nationally and regionally', as do the impacts on 'livelihoods, food and water security, ecosystems, infrastructure' in each country. Gender is a particularly important factor in relation to climate change; in the Sahel, women are among the most vulnerable to its impacts. Women's resilience to climate change and external shocks in the Sahel is reduced by 'existing social and economic disparities, which are the result of their limited access to land, credit, technology and low level of participation in decision-making' (MOFA, 2018a, p. 8).

The IPCC Fifth Assessment Report notes that near surface temperatures over West Africa and the Sahel have increased over the last 50 years (Niang et al., 2014, p. 1206). Furthermore, there is general agreement that temperatures over West Africa are projected to increase in the future between 3°–6°C above the late twentieth century baseline for the end of the twenty-first century (ibid., p. 1209). Precipitation projections are less certain.

The Sahel region is characterised by highly variable precipitation: a wet period during the 1950s and 1960s was followed by severe drought during the 1970s and 1980s, with rainfall being more abundant again during the past 20 years (Nagarajan et al., 2018, p. 18). However, there is also significant inter-annual variability. Panthou et al. (2018, p. 6), based on an updated set of daily observations covering the Sahel since 1950, support the findings of previous studies of a recent 'trend towards more intense rainfall in the Sahel concomitant with a persisting low occurrence of rainfall events'. Their other key finding is support of a clear contrast between the west and east parts of the Sahel, with the east Sahel generally experiencing a stronger increase of extreme rainfall overall than the west – although uncertainties remain. The paper emphasises the complexity of the rainfall patterns in tropical semi-arid regions such as the Sahel, and cautions against oversimplifying the Sahelian rainfall trend using a 'single misleading word' (ibid., 2018, p. 8).

Uncertainty in projections of rainfall changes for the Sahel and West Africa remains a critical issue, with a lack of consensus over the magnitude and direction of future precipitation changes (Lewis & Buontempo, 2016). A recent study by Diedhiou et al. (2018) applied an empirical sampling approach to model changes in temperature and precipitation extremes over West and Central Africa as a function of global mean temperature, focusing on the implications of global warming of 1.5°C and 2°C. There remain significant uncertainties and a large spread in results in precipitation projections, but in general, most models showed 'high-impact changes in climate extremes at subregional scale' (ibid., 2018, p. 1). In the majority of models, precipitation was projected to increase with increasing global mean temperature over the central and east Sahel (also see Biasutti, 2019). Biasutti (2019) highlights how projections generally show decreases in the westernmost regions of the Sahel and a concentrated rainy season characterised by more intense and intermittent rainfall. However, uncertainties remain, and more refined projections of rainfall changes are needed that focus on metrics of intra-seasonal characteristics and risk of extreme events (ibid.).

3. National policies related to climate change

All five of the G5 Sahel countries have signed and ratified the Paris Agreement on climate change and have submitted their Intended Nationally Determined Contributions (INDCs). The five countries have also ratified a number of relevant climate change and environmental conventions including the UN Convention on Biological Diversity (CBD), the UN Convention to Combat Desertification (CCD), the UN Framework Convention on Climate Change (UNFCCC), and the Kyoto Protocol (MOFA, 2018a).

In terms of national commitments, all G5 Sahel countries developed a National Adaptation Programme of Action (NAPA) between 2004 and 2007. Relevant country policies include:

- Burkina Faso: The Strategic Framework for Investment in Sustainable Land Management (SFI-SLM); Strategy for Accelerated Growth and Sustainable Development (SAGSD); and the National Strategy for implementing the Climate Change Convention (2001).
- Chad: Country Resilience Priorities AGIR Chad; and the National Investment Plan for the Rural Sector (PNISR) (2014–2020).
- Mali: National Policy on Climate Change (2008); National Climate Change Strategy (NCCS) (2011); a Climate Change Scenario Elaboration; and a Sub-Regional Action Programme for the Reduction of the Vulnerability to Climate Change.
- Mauritania: National Environmental Action Plan (PANE).
- Niger: Strategic Framework for Sustainable Land Management (SF-SLM); the 3N Initiative (Nigeriens Nourishing Nigeriens); the National Policy on Climate Change; and the National Strategy and Plan of Action for Climate Change and Variability (MOFA, 2018b; Republic of Niger, 2015).

All G5 Sahel countries have a nationally designated authority for the Green Climate Fund (GCF) and the Adaptation Fund and all five countries have received international funding for climate-related projects (MOFA, 2018a). Both Chad and Mali have developed new financial mechanisms to fund climate change adaptation and mitigation. In 2013, Chad established the Special Fund for the Environment to mobilise its own resources through the establishment of specific taxes (Republic of Chad, 2015).[3] In conjunction with the United Nations Development Programme (UNDP), Mali developed the Mali Climate Fund to combine funding from donors and the private sector (MOFA, 2018b). Funded by Sweden and Norway, the Fund's call for proposals has resulted in funding for nine projects in agriculture, water resources, forestry, and solar energy (ibid.). However, the NDC Partnership (2017) argues that the Fund's governance needs to be reviewed and improved. Mali is also pursuing GCF accreditation for its Local Authorities National Investment Agency, the Mali Folk Centre, and the Malian Development Bank (BDM-SA) (ibid.). Currently, the national government's Environment and Sustainable Development Agency (AEED) is the only GCF-accredited agency (ibid.; NDC Partnership, 2017). Mali also has 40 Clean Development Mechanism projects, which complement its mitigation efforts (NDC Partnership, 2017). See Box 1 for more information on Mali's national climate change context.

In the Sahel, there are a number of regional-level interventions and bodies that are relevant to climate change. More detail on these and other national interventions can be found in Cooper (2018) and Cooper and Price (2019).

[3] During the course of this report, no detailed information could be found on this fund.

Box 1: Mali's policy context

Mali's 2011 National Policy on Climate Change focuses on combating desertification and the transnational effects of climate change with the goal of eliminating poverty (MOFA, 2018b). Its 2011 National Climate Change Strategy has three focus areas: securing agricultural productivity and production; implementing a sovereign energy strategy; and capacity building for climate change research (ibid.). The strategy has eight axes, four of which are: implementation of a national institutional framework on climate change; organisation of access to international climate funds; national capacity building; and integrating climate change issues into activities across the different sectors and administrative levels (ibid.). This strategy resulted in the establishment of the Institutional Framework on Climate Change (SNCC – Strategic Area I) headed by a National Committee with AEED as its secretariat (ibid.).

Mali is working to integrate its climate change policies and its economic growth and development policies. For example, in 2011 it developed a Strategic Framework for a Resilient and Green Mali, which provides a link between the National Climate Change Strategy and 'low-carbon and resilient economic growth and poverty reduction targets' (NDC Partnership, 2017).

4. Low-carbon development trajectories and strategies

The governments of the G5 Sahel countries are interested in pursuing low-carbon economic growth strategies, which can dovetail with their climate change adaptation and mitigation plans. The five countries are vulnerable to climate change impacts, with Chad being rated the most vulnerable country to climate change out of 186 countries that were assessed in 2017.[4] Common priority sectors identified in both the countries' economic development plans and Intended Nationally Determined Contributions (INDCs) include climate-smart agriculture, sustainable land management, and increasing access to energy with a strong focus on developing their renewable energy potentials.

Agriculture is extremely important across the G5 Sahel, accounting for 40% of combined regional GDP and employing large proportions of the labour force (70% plus in Burkina Faso, Chad, Mali, and Niger, and 52% in Mauritania) (USAID, 2017). Cereal production is important in Burkina Faso, Chad, Mali, and Niger, which export foodstuffs to neighbouring countries (ibid.). Pastoralism is a key livelihood activity in the Sahel, contributing 10–15% of GDP in Burkina Faso, Chad, Mali, and Niger (ibid.). In Mauritania, 50% of the population are pastoralists (ibid.). Agriculture is a strong focus of the G5 Sahel's climate change strategies due to its importance for both livelihoods and national economies (ibid.). The agricultural sector is highly underdeveloped; for example, there is a lack of access to markets and increasing its productivity could accelerate poverty reduction (Sartori & Fattibene, 2019).

[4] https://theconversation.com/chad-is-the-country-most-vulnerable-to-climate-change-heres-why-78423 (Retrieved 27 May 2019).

It is important to note that extractives including gold, oil, and uranium are important industries across the G5 Sahel countries.[5] As such, GDP in these countries can be sensitive to fluctuations in global commodity prices. For example, Chad has been sensitive to fluctuations in global oil prices and recognises the need to diversify its economy. In Mali, gold is the country's number one export and accounts for 30% of GDP; however, it is also water intensive. During the course of this review, no literature could be found on low-carbon development strategies for the G5 Sahel's extractives sector. However, a 2015 Overseas Development Institute (ODI) report on low-carbon development in sub-Saharan Africa outlines two transitions the extractives sector could make: (1) strengthen the use of energy-efficient processes and techniques; and (2) switch to lower carbon fuel sources and renewable energy (Hogarth, Haywood & Whitley, 2015).

Burkina Faso and Mauritania

Burkina Faso's high dependence on climate-sensitive economic activities both at national and household levels makes it vulnerable to climate change, with the rural poor being the most vulnerable group (Crawford, Price-Kelly, Terton, & Echeverría, 2016). Agriculture represents approximately 38% of GDP despite only 22% of the country's land being arable, recurrent drought, and poor soils (ibid.). Cotton and gold are Burkina Faso's key exports, whilst the industrial sector, representing approximately 22% of GDP, includes cotton lint, beverages, agricultural processing, soap, cigarettes, and textiles (ibid.).

Burkina Faso's INDC identifies a number of priority activities for adapting to climate change including: restoring and maintaining fertility of 1.575m ha of cropland; restoring 1.125m ha of degraded land for pasture and forest; collecting and storing 10,000 tons of fodder annually; protecting 30,000ha of stream banks; and using compost from biodigesters to fertilise 750,000ha (MOFA, 2018a).

Priority sectors in Mauritania's INDC include:

- Agriculture and land management: Aerial seeding of degraded land (10,000ha per year) to promote regeneration of the natural environment; restoration of natural pastures (deferred grazing and rangeland management); and exploration of aquifers (drilling).
- Fisheries and aquaculture: Promotion of fish-farming and responsible fishing on Lake Foum Gleita.
- Water and water management: Rehabilitation and integrated management of sustainable wetlands against the effects of climate change; and equipping drinking water supply systems in rural areas with solar energy;
- Climate risk management: Protecting the cities of Nouakchott and Nouadhibou against risks of marine emersion and silting (MOFA, 2018a).

Chad

Economic development and climate change priorities

Chad's development vision is to become an emerging country by 2030 with a middle-income economy, driven by diversified and sustainable sources of economic growth, creating added

[5] For more information about the management of extractives in the G5 Sahel, see Cooper (2018).

value and decent jobs (Republic of Chad, 2017). Steps to achieve economic growth include: increasing energy self-sufficiency based on renewable sources; developing leading sectors and their access to markets (i.e. livestock, farming, and fishing, and their value chains); infrastructure development including roads, water, and processing and storage facilities for products for export; and the establishment of new sectors including agri-food and manufacturing (ibid.).

The government of Chad states that risks to achieving this vision include climate change, the country's dependence on oil, and public administration and governance challenges (Republic of Chad, 2017). Identified risk mitigation measures include diversifying the economy by promoting the agro-sylvo-pastoral sectors and improving the governance of environmental management by strengthening the institutional framework (ibid.).[6]

The Republic of Chad's (2015) INDC identifies water, agriculture/agroforestry, livestock, and fishing as the key adaptation sectors and outlines priority actions for each sector as well as cross-cutting priorities. These include:

- Cross-cutting: Reinforcing the capacities of farmers, fishermen, and pastoralists and their revenue-generating activities; improving production techniques through water infrastructure development, access to agricultural inputs, and developing storage and conservation units to limit post-harvest losses; and improving climate information services and people's ability to respond.
- Water: The creation and development of irrigation structures including retention ponds; application of integrated water resources management (IWRM) and water governance.
- Agriculture: Developing intensive and diverse cultivation using improved agricultural inputs, agroforestry, improved land and water conservation (implementation of soil restoration works), and preparation and distribution of new cropping calendars.
- Livestock: Securing pastoralism and transhumance through common grazing zones, creating and popularising fodder banks, enabling the diversification of activities, and cross-breeding animal species/promoting genetic diversity.
- Fish: Developing enclosed aquaculture areas (Republic of Chad, 2015).

Priority target zones for adaptation activities are: Kanem, Barh El Ghazal, Batha, Guéra, Hadjer Lamis, Wadi Fira, Ouaddai, Dar Sila, Lac, Moyen-Chari, Borkou, Tibesti, Ennedi East, and Ennedi West (Republic of Chad, 2015). These areas are especially vulnerable to climate change and are also home to displaced populations from Sudan, the Central African Republic, Nigeria, and Libya (ibid.).

Opportunities for engagement

Chad's INDC identifies the development of renewable energy and the sustainable development/management of waste management, agriculture, livestock, land use, and forestry sectors as key priorities (Republic of Chad, 2015). Chad's INDC identifies a number of barriers to adaptation including governance and implementation challenges at the national level (e.g. climate change is not integrated into national and sectoral policies, and there is no climate change governance structure), financial challenges (e.g. insufficient international funding), and

[6] 'Agro-sylvo-pastoral sectors' usually refer to integrating crops-trees-livestock systems.

capacity challenges (e.g. low capacity of rural communities to adapt to climate change impacts) (ibid.).

Renewable energy: Access to electricity in Chad is low and the high production costs of thermal electricity by the national electricity company, SNE, as well as the absence of an interconnected national grid resulting in isolated production facilities supplying different cities, means that electricity is expensive with high costs being an obstacle to the economy's effectiveness (Republic of Chad, 2015). Chad's INDC proposes increasing the renewable electricity supply from 0 to 750GWh/year by 2030 (ibid.). The Sustainable Energy for All (SEforALL) Africa Hub argues that Chad's current energy crisis is undermining its development possibilities.[7]

Government-identified priorities include developing renewable energies for the agriculture and pastoral sectors; interconnection of the Chad–Cameroon power grids to supply Chad with hydro-generated energy; developing wind energy; a cross-country power grid (between adjacent cities) and a national transmission line; and the use of butane gas and promotion of efficient domestic energy (Republic of Chad, 2015).

Donor and private sector activities in this space identified during the short time frame of this report include:

- In 2019, Chad signed a Memorandum of Understanding (MoU) with Dubai energy company Amea Power to build a 120MW solar farm.[8]
- In 2017, the African Development Bank (AfDB) announced it will fund a 32MW solar plant in N'Djamena, as well as support the electrical interconnection project between Chad and Cameroon, and the rehabilitation of SNE's current plant.[9]
- In 2016, the first phase of the Amdjarass Wind Farm in East Chad was completed.[10] However, no further information about this project could be found during the course of this review.
- In 2015, the Djermaya Solar Project, partially financed through a 0% concessional loan from the EU–Africa Investment Trust Fund, was launched. The project will construct a 60MW solar power plant in Djermaya in two phases in order to gradually integrate renewable power into Chad's electricity grid, and is under a 22-year power purchase agreement with SNE.[11]
- Between 2012 and 2015, the United Nations Industrial Development Organization (UNIDO) implemented a Global Environment Facility (GEF)-funded project, 'Promoting Renewable Energy Based Mini-Grids for Rural Electrification and Productive Uses'. A 2016 terminal evaluation of the project found that feasibility studies for five planned mini solar grids had been completed; three of the five grids had been constructed; and

[7] For more information, see https://www.se4all-africa.org/seforall-in-africa/country-data/chad/ (Retrieved 23 May 2019).

[8] http://northafricapost.com/29738-chads-renewable-energy-revolution-is-well-underway.html (Retrieved 23 May 2019).

[9] https://www.afdb.org/en/news-and-events/afdb-to-finance-construction-of-32-megawatts-solar-power-plant-in-chadian-capital-ndjamena-17172/ (Retrieved 23 May 2019).

[10] http://www.vergnet.com/news/phase-one-amdjarass-wind-farm-chad-complete/ (Retrieved 23 May 2019).

[11] For more information about the project, see https://ec.europa.eu/europeaid/blending/djermaya-solar-project-0_en (Retrieved 23 May 2019).

technical trainings had been delivered to 109 stakeholders (UNIDO, 2016). However, the project did not achieve all of its planned institutional, policy, and financial mechanism outputs: an institutional framework to allow private sector operation in renewable energy is not in place; and an Electrification Policy and Law on Renewable Energy were drafted but have not been amended and passed by the government, although the project did support the creation of the Chadian Renewable Energy Development Agency (ADER) (ibid.).[12] The project evaluation ranked the project's sustainability as moderately unlikely due to concerns over whether revenues generated at each site would cover management and operation costs; a lack of co-funding reduced the number of sites from five to three with concerns that this may mean the sites are not profitable enough for a private sector operator to take over the maintenance; as well as institutional and governance risks (ibid.). The UNIDO (2016) project also hoped to combat deforestation by increasing household access to electricity, which in turn could reduce the cutting of firewood.

- In 2019, the USA's Overseas Private Investment Corporation committed USD10m to support off-grid home solar kits.[13]

Agro-sylvo-pastoral sectors: Government-identified priorities include developing access to water; promoting water-efficient and intensive agriculture; securing animal and fisheries production and promoting associations; reinforcing cloud-seeding objectives; improving access to agriculture production and livestock zones; and the Great Green Wall Initiative and a national programme to develop green belts around Chad's cities (Republic of Chad, 2015).[14]

Relevant donor-funded projects in this space include the International Fund for Agricultural Development's (IFAD) 'Project to Improve the Resilience of Agricultural Systems in Chad', GIZ's 'Adaptation to Climate Change in the Lake Chad Basin', and EU support for the NAPA including support for the National Agency for the Great Green Wall (for more information on these projects, see Cooper & Price, 2019).

Chad's INDC also identified strengthening meteorological and climate networks, and improving weather and climate forecasting tools as a priority. During the course of this review, no current donor-funded project in this space was identified.[15]

[12] ADER was established in 2014 by the government to mobilise private sector investment in renewables. It is possible that some of the reforms allowing private sector involvement in the sector have now been passed by the government. A 2018 news article from *Afrik 21* states that from 2019, private operators will be able to obtain operating, transmission, and distribution licences, as well as tax breaks for the acquisition of materials and equipment used for renewable energy. For more information, see https://www.afrik21.africa/en/chad-state-targets-20-re-in-its-energy-mix-by-2030/ (Retrieved 23 May 2019).

[13] http://northafricapost.com/29738-chads-renewable-energy-revolution-is-well-underway.html (Retrieved 23 May 2019).

[14] The Great Green Wall Initiative is planting trees across the Sahel, from Senegal to Djibouti, to restore degraded lands. For more information, see https://www.greatgreenwall.org/about-great-green-wall (Retrieved 5 June 2019).

[15] Chad was part of a Norwegian Aid-funded regional project to improve the capacity of National Hydrological and Meteorological Services to provide timely and accurate severe weather forecasting. However, no Chad-specific results were identified during this review. For more information, see https://public.wmo.int/en/projects/gfcs-%E2%80%93-adaptation-and-disaster-risk-reduction-africa (Retrieved 23 May 2019).

Mali

Economic development and climate change priorities

Mali's economy, similar to the other G5 Sahel countries, is vulnerable to climate change due to its reliance on agriculture, despite only 14% of the country's land being suitable for farming (MOFA, 2018b). Mali's three main exports are gold, cotton, and beef (ibid.). Gold accounts for 30% of Mali's GDP (NDC Partnership, 2017). Both gold and cotton production have high water demands and could be affected by water availability (MOFA, 2018b). Cotton yields are predicted to drop linked to a reduction in the length of the rainy season, whilst reductions in the flow of the Niger River could affect power production at the Selingue dam (ibid.). The Malian government has ranked sectors in terms of vulnerability from the highest to the lowest as: agriculture, health, fishing, energy, water resources, livestock rearing, forest-fauna, biodiversity, transport, industry, and education (Zamudio, 2016).

Mali's 2016 INDC outlines its aim to develop a green and climate-smart economy with focus sectors for adaptation being forestry, climate-smart agriculture, renewable energy, pastoral management, and implementing IWRM (MOFA, 2018b[16]). Cross-cutting priorities include: technology transfer needs in land management; resilience building of all sectors including building institutional and legal structures around resilience; increasing access to information on climate change; and increasing scientific knowledge on climate change and knowledge on new technologies and how to use them (World Bank, 2016).

Mali's 2016 INDC identifies agriculture, land use and forestry, and water resources as the key adaptation sectors and outlines priority actions for each, including:

- Agriculture: Having 92,000ha under climate-smart agriculture and sustainable land management; improving livestock rotation over 400,000ha of pasturelands to reduce farmer–livestock conflict; making more use of improved crop and livestock varieties and grain banks; increasing small-scale agricultural development, including fruit trees for reforestation, and vegetation cover and erosion prevention (post 2020).
- Land use and forestry: Implementing anti-desertification and protection of 9m ha, and reforestation of 325,000ha.
- Water resources: Increasing rainwater harvesting and storage to ensure universal potable water access; building 20 drinking water systems and 200 water collection structures to serve 75,000 rural households; developing watershed management and wastewater treatment (post-2020) (MOFA, 2018a; World Bank, 2016).

Opportunities for engagement

Agriculture: A 2010 McKinsey & Company article on how Africa can adapt to climate change argues that climate-resilient agricultural development in Mali could generate millions of dollars in additional revenues annually (de Chaisemartin, Normann & Pestiaux, 2010). Under their climate projections, rising temperatures and decreases in rainfall could result in economic losses of between USD120m and USD300m annually due to impacts on agriculture and livestock (ibid.).

[16] During the course of research for this report, an English language version of Mali's INDC could not be found. Therefore, this section draws on English reports from high-quality sources, which present parts of Mali's INDC.

Options to mitigate these losses include climate-smart agriculture and livestock practices, and developing cash crops: for example, revenue-generating cash crops in the Mopti region could compensate for most of the expected economic losses (ibid.).

Donors active in this space include USAID through its Feed the Future programme focusing on millet and sorghum, rice, and livestock for food security and poverty alleviation; and its Global Climate Change Initiative addressing pressing climate adaptation issues through the extension of small irrigation infrastructure (rice), improved natural resources management practices, and improved agronomic practices (MOFA, 2018b). A number of other donors and NGOs are active in this space including CGIAR. More information on current climate-smart agriculture programmes can be found in Cooper and Price (2019).

Renewable energy: Mali's INDC identifies a number of targets for renewable electricity including: 10% production of renewable energy, 100MW renewable energy by 2020, and increases in rural electrification (World Bank, 2016). Access to electricity was 35% in 2016, although there are strong disparities between rural and urban areas.[17] By 2030, Mali aims for renewables to make up 37% of its electricity.[18] Some bigger villages currently use unprofitable diesel mini-grids.[19] Activities in this space include:

- The Dutch and German government partnership, Energising Development (EnDev), in conjunction with other donors including DFID, has supported 61,300 people in rural areas to access electricity between 2006 and 2017.[20] EnDev has provided communities in Mali with photovoltaic (PV)-driven battery charging stations that provide basic electricity services to households, operated by private service providers; and mini-grids to power communal infrastructure, for example schools and health posts. It has also facilitated the distribution of small PV devices, for example solar lanterns, with the aim of promoting a basic distribution network and installations in rural Mali on a lease-purchase basis.[21]

A number of donors are interested in Mali's solar power potential including AfDB in partnership with the Climate Investment Funds' (CIF) Scaling-up Renewable Energy Program in Low Income Countries financing the Segou solar power plant, and a 2019 GCF-approved West African Development Bank (BOAD, Banque Ouest Africaine de Développement) project to improve access to solar power in rural Mali (for more information, see Cooper & Price, 2019).

Other key priorities identified by the Malian government include developing an early warning system to enable the country to 'respond proactively to prevent climate pressures' (NDC Partnership, 2017). Mali is part of the Africa Hydromet Programme with activities running until 2021 that include expanding and upgrading existing automatic weather stations and hydrological stations (for more information, see Cooper & Price, 2019).

[17] https://www.se4all-africa.org/seforall-in-africa/country-data/mali/ (Retrieved 23 May 2019).

[18] https://www.se4all-africa.org/seforall-in-africa/country-data/mali/ (Retrieved 23 May 2019).

[19] https://endev.info/content/Mali (Retrieved 27 May 2019).

[20] https://endev.info/content/Mali (Retrieved 27 May 2019).

[21] https://endev.info/content/Mali (Retrieved 27 May 2019).

Niger

Economic development and climate change priorities

The economic development objectives of the *Sustainable Development and Inclusive Growth Strategy (SDIGS) Niger 2035* include diversification of the economy, development of a private sector, development of basic infrastructure, increased agricultural production and productivity, and absorption of young people in the labour market (Republic of Niger, 2017). Currently, the agro-pastoral sector represents 37% of GNP and 80% of employment (Republic of Niger, 2015). The strategy argues that an average annual agricultural growth rate of 6% between 2015 and 2035 will enable reductions in poverty and under-employment, economic growth, and structural transformation (Republic of Niger, 2017). It is envisaged that a more productive agriculture sector should lead to a more dynamic rural economy and stem rural outflow by providing youth with decent jobs (ibid.). The 2035 Strategy also argues that increasing farming incomes and diversifying the rural economy will reduce household vulnerability to climate change (ibid.). In order to achieve these objectives, the government's strategy argues that modernisation of the government administration is necessary (ibid.).

Niger's national objectives as outlined in their 2015 INDC include promoting rational management of natural resources, a low-carbon and green growth development strategy, and enhancing the resilience of populations, agriculture, and forest and pastoral ecosystems (Republic of Niger, 2015). Mitigation measures largely focus on energy (residential, industrial, and transportation), whilst adaptation measures mostly focus on application of the Strategic Framework for Sustainable Land Management (SF-SLM) (ibid.). The vision underpinning the INDC is 'climate-smart agriculture and access to modern energy services for everyone in 2030' (ibid.).

Priority actions in terms of sustainable land management include: restoration of 1,030,000ha of agricultural/forestry/pastoral lands; assisted natural regeneration of 1,100,000ha; fixation of 550,000ha of dunes; management of 2,220,000ha of natural forests and 145,000ha of hedgerows (145,000km); planting of multi-use species on 750,000ha; planting of *Moringa oleifera* over 125,000ha; seeding of 304,500ha of roadways; and private forestry over 75,000ha (Republic of Niger, 2015).

Opportunities for engagement

Niger's INDC identifies climate-smart agriculture, sustainable land management, and energy sector development as priorities. It also identifies a number of implementation barriers including institutional (coordination between institutions, synergies between policies and strategies, strengthening rural leadership); high population growth; high illiteracy of the rural population making dissemination of climate-smart agriculture and sustainable land management techniques difficult; the rural extension system; and land tenure issues for both agriculture and pastoralism (Republic of Niger, 2015).

Agriculture, pastoralism, forestry, and other land use: Approximately 80% of Niger's population is dependent on agriculture, which is sensitive to climatic variability, demonstrating the need for climate-smart agriculture (Republic of Niger, 2015). Climate-smart activities will also bring co-benefits including recovery of degraded land, improving food security, developing local

agro-climate information, job creation helping stem the rural exodus, and strengthening social cohesion (ibid.).

Development of Niger's water resources could bring a number of benefits. For example, Niger has a considerable potential for animal husbandry, including access to a sizeable consumer base in neighbouring Nigeria; however, exploiting this potential requires development of large above-ground water resources (Republic of Niger, 2015). In terms of irrigation, currently only 30% of a potential 330,000ha is irrigated, with this potential largely located in the Niger River valley (ibid.). Rice is an important crop and developing irrigation potential could lead to increases in the rice-growing area (ibid.).

Donor and private sector activities in this space identified during the short time frame of this report include:

- UNDP's Community Based Adaptation Program operating in Dakoro and Bermo departments, amongst others. For example, one component works with three communities (approx. 6,000 people) in Maradi Region to promote more sustainable agricultural and pastoral practices.
- The World Bank's 'Climate-Smart Agriculture Support Project', 2016–2022, in 20 departments.

More information on these activities can be found in Cooper and Price (2019).

Renewable energy and energy efficiency: Niger's INDC argues that large investments are needed in its energy sector to facilitate access to cheap, sustainable, and clean energy (Republic of Niger, 2015). Nationally, 16% of Niger's population had access to electricity in 2016. There is a sharp rural–urban divide in electricity access, with urban access rates surpassing 65% in 2016 yet rural areas remain mostly unconnected.[22] Identified measures in the INDC include: rural electrification, conservation and replacement of wood energy, improving energy efficiency, promoting renewables (wind, solar, and hydro), constructing frame-free buildings, and managing energy consumption in the transport sector (ibid.). By 2030, the government aims to reach universal urban access and 30% access in rural areas, with renewables accounting for around 57% of the electricity mix.[23] Co-benefits from the development of the energy sector include improvements in living conditions and alleviation of women's domestic duties (ibid.).

Donor and private sector activities in this space identified during the short time frame of this report include:

- Agence francaise de developpement (AFD) support to the extension of the NIGELEC electrical network and management of natural forests for sustainable wood energy supply to Bamako, Ouagadougou, and Niamey.
- A 2013–16 GEF and UNDP-funded project to improve access to energy in the Safo commune, Maradi Region as well as capacity building for state and private sector structures. The project's terminal evaluation rated the provision of equipment and infrastructure for accessing energy services as highly satisfactory; however, it rated the technical training for beneficiaries/users, institutional capacity building and the service

[22] https://www.se4all-africa.org/seforall-in-africa/country-data/niger/ (Retrieved 23/05.2019).

[23] https://www.se4all-africa.org/seforall-in-africa/country-data/niger/ (Retrieved 23/05.2019).

operators as unsatisfactory, which could affect the sustainability of the project (GEF, 2016).

No detailed project information could be found on activities related to the transport and industrial energy sectors, which could be a potential opportunity for engagement.

Opportunities for engagement

Agriculture and energy

A 2018 blog by two UNEP Africa experts argues that ecosystems-based adaptation-driven agriculture and the clean energy sector can drive socioeconomic transformation in the Sahel, whilst also strengthening climate resilience (Munang & Mgendi, 2018). However, it is important that the two sectors be developed in an amalgamated manner as opposed to in sectorial silos as this will maximise productivity; for example, targeting energy infrastructure investments in areas where climate-smart agriculture is being promoted or practised (ibid.). A focus on these sectors could support the development of agro-industry and allow the Sahel to take advantage of developments such as the African Continental Free Trade Agreement (ibid.). Interestingly, in terms of financing mechanisms, Muang and Mgendi (2018) outline how diasporas' remittances could be leveraged to finance investments in agro-industry based on the model of Nigeria's Incentive Based Risk Sharing Facility for Agricultural Lending, which used public funding to leverage private finance investments.

In 2018, the UN launched its Climate Resilient Agriculture Initiative, which aims to create value and business volume for trade and access to markets as well as creating an enabling policy environment for smallholder farming with a particular focus on women and youth (UN, no date b). Activities to improve agricultural productivity include land use rights for women and youth, and sustainable land management (including access to agricultural inputs, diversifying production, combating land degradation and desertification, sustainable agro-sylvo-pastoral systems, access to climate information and training, and more efficient irrigation) (ibid.). Activities to create efficient and diversified value chains include increasing the use of renewable energy along value chains, boosting the use of appropriate technologies in transformation, storage, transport, and retail processes, and enhancing access to markets, information, knowledge and ICTs, and risk reduction measures (e.g. access to insurance schemes) (ibid.).

In 2018, the UN also launched its Sahel Renewable Energy Initiative.[24] The visionary note outlining the initiative argues that in order to achieve universal energy access in the Sahel by 2030 a much more rapid rollout of energy investments is needed (UN, no date a, p. 3). Energy provision is a key area because it can act as a constraint on economic growth, including through high electricity costs, meaning that businesses and economic activities in the Sahel rely on diesel generators, which are expensive (ibid., pp. 3–4). The Sahel has a huge potential for renewable energy including solar and wind and the countries 'strongly believe that it is in their interest to quickly transition towards renewable energy systems' to both tackle climate change and foster economic growth (ibid., p. 4).

[24] https://unowas.unmissions.org/climate-smart-agriculture-and-renewable-energy-initiatives-aim-transform-sahel (Retrieved 29 May 2019).

The UN's initiative favours decentralised development of renewable energy as opposed to a centralised model based on the national grid model, partly due to the sparse nature of rural settlements in the Sahel (UN, no date a). It argues that solar especially is diverse and flexible with a spectrum of options involving solar lanterns, solar home systems, and micro/mini-grids that can be installed in rural, urban, and peri-urban areas (ibid.).

The initiative focuses on the small-scale farming sector, arguing that access to electricity will bring a number of benefits, including power for irrigation and value chain activities (processing crops, cooling and heating systems for product storage, and transport to market) (UN, no date a). This could particularly benefit women who comprise a large proportion of agricultural labour on smallholder farms (ibid.). In terms of small enterprises in the manufacturing and service sectors in rural and peri-urban areas, these are often critically important and their development could provide income-generating opportunities for youth (ibid., p. 6). However, currently, the energy demand is relatively low, and demand will need to be stimulated in order to make investments in renewable energy systems more attractive (ibid., p. 6).

Governance

Across the G5 Sahel, there are weak institutions and poor resource management (MOFA, 2018a). For example, in terms of the Lake Chad basin, the Basin Commission only manages approximately 20% of the basin's total area (ibid.). As an institution, it is underfunded and has little authority in terms of influence on the area under its management (ibid.). In Mali, weak governance meant that international donors had concerns about investing in its national climate fund.[25] Zamudio (2016, p. 7) argues that Mali's vulnerability to shocks and stresses is exacerbated by high population growth, the dire economic situation, and weak governance. This includes weak land use planning (MOFA, 2018b). De Chaisemartin et al. (2010) argue that a portfolio of climate resilience measures can be assembled for Mali at limited cost, but 'the key is to create the right enabling environment to provide for effective adaptation to climate change as well as economic development'.

The World Bank's *Doing business 2018* report places the Sahel countries in the last 50 of 190 countries analysed, meaning they are some of the least business friendly. Reasons for this include poor human capital, weak governance, shrinking foreign investments, lack of infrastructure and political instability (World Bank, 2018). Climate change exacerbates these issues, for example, by limiting the proactivity of local small and medium enterprises, whose activities are negatively affected by extreme weather events (Sartori & Fattibene, 2019, p. 3).

Decentralisation in Chad and Mali needs to be accompanied by capacity building for both natural resources management and climate change adaptation (Republic of Chad, 2017; MOFA, 2018a). In Mali, Zamudio (2016, p. 22) argues that 'local-level government entities have very limited institutional, technological, and financial capacity to manage climate risks and implement local adaptation strategies'. Zamudio (2016) identified only two projects aimed at specifically building local government capacity to implement climate change adaptation strategies; one of them, 'Decentralising Climate Funds', is detailed further in Cooper and Price (2019).

In both Burkina Faso and Mali, there are also no climate change units in key ministries (Crawford et al., 2016; Zamudio, 2016). Other governance challenges in Burkina Faso include the lack of a

[25] https://www.giz.de/en/worldwide/31402.html (Retrieved 1 June 2019).

national climate change policy, and climate change is largely only integrated into national sectoral policies in terms of risks and possible actions related to agriculture (Crawford et al., 2016). Climate change is not integrated into key national policy sectors in Mali, including agriculture, livestock, water, energy, and health (Zamudio, 2016). A number of donor-funded climate change programmes include elements that focus on strengthening institutional capabilities at the national level and integrating climate change concerns, with some programmes including support for the integration of climate change concerns into local development plans (for more information, see Cooper & Price, 2019).

5. Adaptation and management

Key sectors

Agriculture

Agriculture in the Sahel is mainly rain-fed and therefore dependent on the summer rains (June–September), which are becoming increasingly variable (MOFA, 2018a). Agricultural yields in **Burkina Faso**, **Chad**, **Mali**, and **Niger** are low when compared to global standards, and are predicted to decrease due to climate change. Projected potential impacts of a 2°C scenario include a 15–20% reduction in millet and sorghum yields by 2080 and the collapse of rain-fed agriculture in **Chad** and **Niger** by 2100, and a 30% decrease in cereal yields in **Mali** by 2100 (ibid.). Rising temperatures and more variable rainfall are likely to alter the distribution and timing of crops and pests (USAID, 2017). In **Mali**, it is possible that negative effects on agricultural yields will lead to Mali's farmers switching from mixed livelihood systems (crops and livestock) to more livestock-dominated food production (MOFA, 2018b).

A 2018 climate change profile produced by the Ministry of Foreign Affairs of the Netherlands argues that yields will not only decrease as a result of the biophysical changes associated with climate change, but also because of 'the limited economic and institutional capacity to cope with and adapt to climate variability and change' (MOFA, 2018a, p. 8).

Soil fertility and the links with environmental degradation

The region's soils are generally limited in nutrients and are being degraded by overgrazing, continuous cropping, and deforestation as well as being at risk of further degradation due to desertification and sand intrusion following higher temperatures and reduced rainfall (MOFA, 2018a). A driver of deforestation is the need for firewood, particularly in times of drought as people cut trees for additional income (USAID, 2017). This land cover change alters the moisture content of the soil, which increases water stress and lowers crop productivity (ibid.). In **Niger**, the expansion of cultivated land combined with low fertilisation and reduced summer fallow periods contributes to soil degradation by increasing water and wind erosion, threatening the biomass of the soil (Republic of Niger, 2015).

Pastoralism

Climate change threatens pastoralism in a number of ways including: affecting food and forage production, water availability, and livestock production (e.g. decreased milk production, fertility, fitness, and reduced calving rates) (MOFA, 2018a). For example, drought can reduce calving rates to 25–30% as opposed to the normal 60–70% (USAID, 2017). Drought and changing

rainfall patterns are also altering traditional pastoral corridors as herders seek new seasonal watering holes and grazing, which could lead to increases in farmer–herder conflict (this is discussed further in section 6 of this report) (MOFA, 2018a; USAID, 2017). The expansion of cultivated land also affects grazing areas; for example, between 1975 and 2013 approximately 4m ha of shrub-steppe area (used as grazing areas by pastoralists) has been cleared for agriculture and firewood, resulting in a loss of grazing areas (Republic of Niger, 2015).

A 2010 report examining pastoralists' and agro-pastoralists' perceptions of climate change, shocks and stressors, and their adaptation strategies focused on the Gao and Mopti regions of **Mali** (Naess et al., 2010). In both areas, pastoralists and agro-pastoralists perceive the climate to be changing, including changes to the onset and durations of the rainy season, and changes to the winds (ibid.). Community members conceptualise the droughts of the 1970s as a turning point, triggering changes in the natural and social environment in which livelihoods are embedded (ibid., p. 24). In both Gao and Mopti, communities identified a range of shocks and stressors including limited access to (improved) seeds, cattle diseases, grazing lands being too far away, degradation of grazing areas, lack of water in grazing areas, and drought leading to forest degradation as poorer households exploit forest resources (ibid., p. 24).

Pastoralists and agro-pastoralists adopt a number of adaptation strategies, including renting or purchasing motor pumps for irrigation, planting early-maturing varieties, transforming wet grasslands into rice croplands, dune fixation, transhumance, livestock food purchase, selling cattle, purchasing medicines and vaccines for cattle, off-farm livelihood diversification, and eating wild food (e.g. vegetable gardening) (Naess et al., 2010, p. 27). However, different households have different levels of access to adaptation strategies; for example, often only the wealthiest households are able to access early maturing varieties of seeds to plant, whilst other strategies such as selling livestock are only accessible to men (ibid., p. 27). Mechanisms such as cooperatives and cereal banks are also often out of the reach of the poorest households (ibid.).

Consequently, for poor households livelihood strategies are often defined by socioeconomic status, gender relations, and the institutional support at hand (Naess et al., 2010, p. 26). Labour migration is a frequent adaptation strategy adopted by the poorest households; however, it can have negative consequences for the family as it deprives them of farm labour at a time when it is most needed (ibid.). Livelihood diversification can also place additional burdens on women, who still have to complete their regular tasks such as childcare, and collecting water and fuelwood (which due to environmental changes have become more time consuming) (ibid.).

Water

Development in the Sahel is limited by the region's water resources, which are unevenly distributed, poorly accessible due to underdeveloped water supply systems, and in a number of cases transboundary, which creates management challenges (USAID, 2017). Groundwater is often used for supply due to the seasonal availability of limited surface water (ibid.). **Burkina Faso**, **Mauritania** and **Niger** are predicted to experience physical water scarcity by 2025 (ibid.).

Drought is the biggest risk to **Niger's** agricultural and pastoral sectors according to the World Bank,[26] whilst in **Mali** drought hotspots are located in its pasturelands (MOFA, 2018b). Droughts

[26] http://www.worldbank.org/en/news/feature/2013/04/03/tackling-climate-change-in-niger (Retrieved 1 June 2019).

and desertification are the main environmental issues facing **Burkina Faso** and have historically impacted agricultural activities, population distribution, and the economy (Crawford et al., 2016). In Burkina Faso, the north and central plateau are the most exposed to drought risks with a number of factors resulting in communities in the north being more vulnerable to changes in rainfall patterns (ibid.). This includes aridity, a short growing season, less diversified agricultural systems, and recurrent drought exposure, which has undermined the resource base and weakened the adaptive capacity and coping strategies of farmers and agro-pastoralists (ibid.).

In **Chad**, urban areas suffer from poor sanitation services, including sewerage and storm water drainage, which were unable to cope with the flood events of 2010, 2011, and 2012.[27] There is a risk of untreated sewerage infecting water supply during flood events, which could spread cholera.[28]

The Sahel's water resources have undergone changes in the past 50 years. For example, the flows of the Niger and Senegal rivers have decreased by 25–60% due to population growth and planned irrigation schemes, and Mali's Lake Faguibine has been dry or nearly dry since the 1970s (resulting in over 200,000 farmers and fishermen abandoning their livelihoods), whilst Lake Chad has shrunk by an estimated 95% according to some estimations (USAID, 2017). Climate change interacts with a number of other factors affecting water availability. For example, MOFA (2018a) argues that in Lake Chad, resource misuse and overuse (between 1983 and 1994 large volumes of water were used for irrigation compared to the previous 25 years) as well as population growth (35m in 2007 compared to 13m in 1960) have also driven the contraction of the Lake Chad basin in conjunction with declining rainfall (ibid.).

Opportunities for engagement

Burkina Faso

Crawford et al.'s (2016) review of climate change adaptation programmes in **Burkina Faso** found that the majority of programmes being implemented were regional- or global-scale projects. This suggests there may be limited capacity within Burkina Faso to lead large adaptation projects (ibid., p. 23). The only water initiative identified was the Water Infrastructure Solutions from Ecosystem Services to Underpin Climate-Resilient Policies and Programmes, which tests, develops, and demonstrates approaches for the use of mixed water infrastructure (ibid., 2016). Programming that addresses the water sector could be an opportunity for engagement as the sector has been identified as a priority for adaptation by the government of Burkina Faso.

Mali

A 2016 review of current and planned climate change adaptation activities in **Mali** finds that most ongoing projects focus on the agricultural sector, whilst pastoralists and other vulnerable sectors such as fisheries have received much less attention (Zamudio, 2016, p. iii). Fishing is practised in all the country's major water bodies, for example the Niger River, and has increased around urban centres, including Bamako, with women often dominating the commercialisation of fish

[27] https://theconversation.com/chad-is-the-country-most-vulnerable-to-climate-change-heres-why-78423 (Retrieved 27 May 2019).

[28] https://theconversation.com/chad-is-the-country-most-vulnerable-to-climate-change-heres-why-78423 (Retrieved 27 May 2019).

(ibid., p. 8). There are twice as many projects focusing on agriculture (crop farmers and agro-pastoralists) than on pastoralists (ibid.).

Agricultural projects largely focus on capacity building for farmers, drought-tolerant seeds and other technologies, and mainstreaming climate change into agricultural and livestock sector planning at the national and sub-national level (Zamudio, 2016, p. 25). To date, most agricultural investments have focused on cotton and rice production, and as such, the yields of main food crops have been static over the last 50 years (MOFA, 2018b). Consequently, the agriculture sector is insufficiently developed to respond to both climate change and the food needs of Mali's growing population (ibid.). One challenge identified by the Ministry of Foreign Affairs of the Netherlands in its climate risk profile of Mali is the lack of processing infrastructure for agricultural products, which is related to the poor energy network that cannot support large-scale food processing (ibid.).

Whilst fishing has been identified by the government of Mali as a vulnerable sector, Zamudio's (2016) review found no projects specifically targeting the climate resilience of fishermen or fishing habitats. Fishing communities in the Inner Delta area are unlikely to be able to develop new migration routes or settled sites due to high population density, which will affect their ability to adapt (MOFA, 2018b). Related to this, Zamudio (2016) argues that few projects could be identified that focus primarily on water resources. Gao and Kidal in the north of Mali are also less covered by adaptation projects, partly because current efforts prioritise agriculture over pastoralism and partly because of the state's weak legitimacy in these areas (ibid.).

Kalkavan's (2017, p. 6) policy brief for the Clingendael Institute recommends the following actions to reduce vulnerability to climate change in Mali, address inequalities between groups, and reduce the potential for clashes between different groups:

- Promote pastoralism as a form of proactive climate change adaptation: This could include developing transit permits, cattle corridors, and (de)stocking programmes; diversifying feeds and introducing new breeds; as well as ensuring safe and free pastoral mobility across borders (which would require cooperation with Mali's neighbours and legal frameworks).
- Strengthen synergies between agricultural and pastoral communities: Adopt mixed crop–livestock farming systems that allow grazing for fodder on cultivated land.
- Establish a unified framework for natural resources management, particularly land management: There is a lack of legal clarity around land rights due to the existence of conflicting decrees, codes, and laws, and low educational levels, which means different land users have difficulty understanding their rights.

Climate-smart agriculture

A number of climate-smart agricultural projects are currently under way across the G5 Sahel (for more information, see Cooper & Price, 2019). In terms of opportunities for engagement, Gubbels (2015) recommends a number of measures including the development of short cycle drought-resistant seeds, robust extension services, weather information and early warning systems, cereal and seed banks, and on-farm quality seed production.

Farmers across the G5 Sahel have also adopted a range of adaptation measures, which could potentially be scaled-up. For example, in **Mali**, farmers are already widely practising adaptation

strategies including diversity in crop cycles (de Chaisemartin et al., 2010). In **Chad**, farmers are using *zai* pits, an indigenous rainwater harvesting technique that involves digging small pits and sowing crops in them: these pits retain water for longer and are efficient when there is not a lot of rain.[29] By introducing manure and compost into the pits, the crops are provided with nutrients and this helps to rehabilitate the soil, and increase crop yields.[30]

Irrigation

Sartori and Fattibene (2019) argue that agricultural productivity can be strengthened by investing in small-scale irrigation technologies, infrastructure development, and access to finance, as opposed to expanding the amount of agricultural land. They argue that international donors should support more modern irrigation systems as well as less invasive fertilising techniques (ibid., pp. 7–8). This would boost productivity in the sector without increasing land degradation (Sartori & Fattibene, 2019).

A 2019 Joint Research Centre review of the literature on the Sahel's irrigation potential finds that in a growing number of contexts, small and micro-irrigation schemes are more desirable than large-scale schemes (van der Wijngaart et al., 2019, p. 64). Xie, You, Wielgosz and Ringler's 2014 study, which estimates the potential for expanding smallholder irrigation in sub-Saharan Africa, presents estimates of the potential for four types of technology: motor pumps, treadle pumps, communal river diversions, and small reservoirs. The results for the Sudano–Sahelian countries (Burkina Faso, Chad, Eritrea, Mali, Mauritania, Niger, Senegal, Somalia, Sudan, and The Gambia) estimated potential irrigation expansion of 1–3m ha, with communal river diversions having the lowest potential of the four technologies (1.07m ha) and motor pumps having the highest (3m ha) (ibid.). Modelling by van der Wijngaart et al. (2019) argues that support for the development of irrigated agriculture needs to be integrated with support to agriculture in general, including access to agricultural inputs and risk mitigation.

Solar drip irrigation: The African Market Garden system has been promoted by a number of actors after it was developed in the early 2000s by the International Crops Research Institute for the Semi-Arid Tropics as a method to improve vegetable production and food security.[31] Under this system, manual irrigation (whereby farmers in the Sahel collect water from local sources such as the Niger River) is replaced by a solar pump, which delivers water for a drip irrigation system.[32] No evidence of the efficacy or reach of solar pump irrigation in the G5 Sahel could be found during the course of research for this report. However, a 2016 article on the website of the Global Water Forum argues that in **Burkina Faso**, farmers cease using drip irrigation systems once the projects promoting them have ended.[33]

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[29] https://theconversation.com/chad-is-the-country-most-vulnerable-to-climate-change-heres-why-78423 (Retrieved 27 May 2019).

[30] https://theconversation.com/chad-is-the-country-most-vulnerable-to-climate-change-heres-why-78423 (Retrieved 27 May 2019).

[31] For more information on the system, see https://blog.nationalgeographic.org/2010/09/01/drip-irrigation-to-solve-famine-in-the-sahel/ (Retrieved 29 May 2019).

[32] https://blog.nationalgeographic.org/2010/09/01/drip-irrigation-to-solve-famine-in-the-sahel/ (Retrieved 29 May 2019).

[33] The article can be viewed here: http://www.globalwaterforum.org/2016/08/16/the-dubious-success-of-micro-drip-irrigation-kits/ (Retrieved 29 May 2019).

Cooking stoves

The high reliance across the G5 Sahel on wood for energy, including fuelwood and charcoal, is a driver of deforestation:

- In **Chad**, estimates vary with some projecting that 93% of the population use solid fuels for cooking. Households are mainly using wood fuels for cooking (88%) and oil lamps for lighting (69%); in the capital, 25% of households use gas for cooking (UNIDO, 2016).[34]
- 80% of **Burkinabe** rely on fuelwood and/or charcoal to meet their energy needs (Crawford et al., 2016).
- Access to non-solid fuels for cooking is extremely limited, estimated at 1%–2%.[35]
- In **Niger**, 94% of the population use solid fuels for cooking.[36]

The rationale for implementing cooking stove projects includes combating deforestation by reducing wood fuel and charcoal demand, and avoiding CO_2 emissions as the stoves are more energy efficient and therefore save money for families as they need to buy less fuel.

Between 2005 and 2016, GIZ supported a project to increase access to energy-efficient cooking stoves in **Burkina Faso** in rural areas and two cities.[37] The project supported local people to become independent stove producers, making the stoves and then selling them, with additional activities since 2013 to address fuel production (planting fast-growing trees, associations of wood consumers, and investigating the use of agricultural waste as fuel).[38] Project results include the production of over 0.5m cooking stoves, with more than 1,200 trained craftspeople producing clay, ceramic, and metal stoves, formation of producer associations, and development of an independent trademark. The project was funded by the EnDev energy partnership, and since 2011, has also received EU funding.

In **Mali**, efforts to expand access to more energy-efficient cooking stoves began in 2004 with the launch of the GEF/World Bank-funded 'Household Energy and Universal Access Project', which aimed to produce and distribute 500,000 stoves. Project activities included subsidies to companies such as Katene Kadji in Bamako, Mali's largest cooking stove manufacturer and distributor (Lambe, Jurisoo, Wanjiru & Senyagwa, 2015). Katene Kadji produces ceramic liners for charcoal stoves, which are then distributed to a network of metal artisans in Bamako who sell the stoves under the SEWA brand name (ibid., p. 17). In their 2015 working paper, Lambe et al. estimated that 18,000 stoves had been sold. In order to remain competitive in the face of new vendors entering the market, the company worked with US carbon project developer, E+Carbon, to sell carbon credits to private US and European companies from 2009 (ibid., p. 17). Socioeconomic and environmental benefits include reducing families' fuel costs by approximately 25% (ibid.). A cooking stove costs approximately USD5 (ibid.).

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[34] https://www.cleancookingalliance.org/country-profiles/9-chad.html and https://www.se4all-africa.org/seforall-in-africa/country-data/chad/ (Retrieved 23 May 2019).

[35] https://www.cleancookingalliance.org/country-profiles/26-mali.html and https://www.se4all-africa.org/seforall-in-africa/country-data/mali/ (Retrieved 23 May 2019).

[36] https://www.cleancookingalliance.org/country-profiles/30-niger.html (Retrieved 23 May 2019).

[37] For more information about the project, see https://www.giz.de/en/worldwide/19120.html (Retrieved 31 May 2019).

[38] https://www.giz.de/en/worldwide/19120.html (Retrieved 31 May 2019).

Potential opportunities for engagement in the cooking stove sector in **Mali** include the development of national standards and regulation. In their 2015 working paper, Lambe et al. argued that there were no regulations or incentives in place to facilitate the long-term adoption of energy-efficient cooking technologies, and no national-level cooking stove quality standard, making it difficult for companies to build trust and brand loyalty with customers (ibid. p. 18). Weak regulation of the charcoal sector also results in the under-pricing of charcoal, and undercuts potential demand for more efficient, fuel-saving stoves (ibid. p. 18).

Tree planting and management

Agroforestry is often neglected in policy formation in the Sahel as it falls between agriculture and forestry (Gubbels, 2015). However, there is evidence that farmer-managed natural regeneration (FMNR), whereby trees are planted and managed by farmers on their land, can increase agricultural yields as they improve soil fertility and combat wind and water erosion (ibid.).

In **Niger**, small-scale farmers in the late 2000s were producing an estimated 500,000 tons of additional grain, enough to feed approximately 2.5m people (Gubbels, 2015, p. 18). In 2011, the World Bank estimated the annual production value of new trees in Niger as USD260m (ibid., p. 18). Consequently, Gubbels (2015, p. 18) argues that FMNR can combat food insecurity and build resilience to the effects of climate change as it is accessible to even poor farming households. A 2015 commentary by the New Climate Economy also cites the example of Niger where farmers using new agroforestry techniques produced more grain and increased their annual income: gross annual incomes went up for over a million households by an average of USD1,000, more than doubling real incomes.[39]

At the formal level, a number of reforestation activities are also taking place across the G5 Sahel. For example, UNDP with support from France is planting over 4,000ha of drought-tolerant seedlings on five vulnerable sites in the **Chadian** portion of the **Lake Chad basin.**[40] Over 40,000 acacia trees have been planted at pilot sites and local communities have been enlisted to protect the trees.[41]

Pastoralism

Little and McPeak's (2014) paper on resilience and pastoralism in the Horn of Africa and West African Sahel identifies a number of promising development interventions to increase pastoralists resilience to shocks and stressors:

- Drought cycle management: A feasible plan including triggers, responses, and multiple dimensions; for example, the *Livestock Emergency Guidelines and Standards*[42] manual which has been used by NGOs in Sudan.
- Index-based livestock insurance: This will require extension efforts to ensure pastoralists understand the product.

[39] https://newclimateeconomy.net/content/commentary-green-energy-poor (Retrieved 31 May 2019).

[40] https://stories.undp.org/how-to-stop-the-decline-of-lake-chad (Retrieved 3 June 2019).

[41] https://stories.undp.org/how-to-stop-the-decline-of-lake-chad (Retrieved 3 June 2019).

[42] See http://www.fao.org/emergencies/resources/documents/resources-detail/en/c/177304/

- Safety nets: In designing an effective social protection programme for pastoralists, it will be necessary to develop complementary activities so that they are not a variation of unconditional food distribution programmes.[43]
- Regional and cross-border coordination: This includes both formal and informal protocols at the national/regional level, and local-level coordination including agreements between communities near the border.
- Education: There are a number of challenges in ensuring access to education for pastoralists; however, a number of possible strategies, such as text messages that include market information, require literacy and numeracy.
- Asset and livelihood diversification: Encouraging pastoralists to adopt strategies that will enhance their resilience instead of negative coping strategies could include targeted extension services, occupational training, and applied research for development (e.g. what animal feeds are the best for fattening, what techniques exist for milk processing, and what is the market for milk? etc.) (ibid., pp. 24–25).

Climate information services via mobile phone for pastoralists are an emerging area and a potential opportunity for engagement. The 'Sustainable Technology Adaptation for Mali's Pastoralists' project is a public–private partnership, with 70% of the funding coming from the Netherlands Space Agency.[44] Launched in 2017 in **Gao**, **Mali**, the Garbal mobile service is used by 21,000 pastoralists to assess potential pastures for their herds based on the availability of surface water in a particular area, the quality and quantity of biomass, livestock concentration, and other factors.[45] The service uses real-time satellite imagery cross-referenced with on-the-ground observations and after one year of operation, 98% of users were satisfied or very satisfied with the service and 97.6% praised the accuracy of the information.[46] The first phase of the project closed in 2018.

Research from **Burkina Faso** also suggests that mobile phones are a suitable vehicle for disseminating climate information. Rasmussen, Mertz, Rasmussen and Nieto's (2015) article examining how meteorological information is used by pastoralists in Burkina Faso outlines how mobile phones are used informally by pastoralists to gather information on potential grazing areas. In order to be effective as formal vehicles, Rasmussen et al., (2015) argue that information should be available as voice messages in local languages rather than as texts.

Barriers

Culture

Culture partly conditions which adaptation strategies are chosen by communities and households

[43] A full discussion of the potential for social protection programmes in the Sahel was not possible during the time frame of this report. However, it is important to note that there is some interest from NGOs in developing these types of programmes.

[44] https://g4aw.spaceoffice.nl/en/projects/g4aw-projects/80/sustainable-technology-adaptation-for-mali-s-pastoralists-stamp-.html (Retrieved 3 June 2019).

[45] https://www.unenvironment.org/news-and-stories/story/sahel-pastoralists-rely-satellites-search-water (Retrieved 3 June 2019).

[46] https://www.unenvironment.org/news-and-stories/story/sahel-pastoralists-rely-satellites-search-water (Retrieved 3 June 2019).

at the local level. Drawing on field work carried out in the village of Biidi 2, **Burkina Faso,** Nielsen and Reenberg's (2010) case study argues that for the Fulbe, one of two main ethnic groups in the village, culture was a major barrier to the adoption of labour migration, working for development projects, gardening, and women undertaking economic activities.

Naess et al. (2010) also identify the importance of culture in **Mali's** pastoral communities where the symbolic importance of livestock means that pastoralists still seek to maximise their herds even when conditions are unfavourable. In Gao, Mali, the type of cow that is the biggest symbol of wealth is also the least drought resistant (ibid.). However, some pastoralists are beginning to invest in and breed a new type of cow from the north, which needs less drinking water and produces more milk (ibid.).

Land tenure and governance

Land tenure across the G5 Sahel countries affects the abilities of households and communities to adapt and manage the impacts of climate change on their livelihoods. For example, in **Niger**, land tenure influences whether or not farmers practise agroforestry, with farmers who own their land being more likely to plant trees.[47] Land tenure is also identified as a potential obstacle to implementation of Niger's INDC, which argues that both agricultural and pastoral land tenure needs to be secured (Republic of Niger, 2015).

In **Mali**, local communities in the areas investigated by Naess et al. (2010) have implemented their own natural resources governance arrangements. For example, in the Niger valley, fishing was prohibited for a whole fishing season to enable stocks to recover and local conventions were made for when and which areas herders could pass through (ibid.). These types of informal arrangements highlight both a need for capacity building for local communities and government support to ensure locally derived arrangements are implementable as a large number of people may pass through local areas each year (ibid., p. 30).

Gender

Women across the G5 Sahel generally have limited access to land, credit, and technology, and limited input to decision-making processes, which makes them more vulnerable to climate change (MOFA, 2018a). In **Mali**, women's agricultural activities often include small livestock keeping, fish processing, and sale of processed food, all of which are often not assigned an economic value but are vulnerable to climate change (MOFA, 2018b). Men often migrate as an adaptation strategy, which leaves rural women to support their families (MOFA, 2018a). Changes in water availability mean women and girls often spend longer collecting water as well as fuelwood (ibid.). Gubbels (2015) argues for the explicit targeting of women-specific needs in terms of land access, extension services, and credit schemes, as well as agricultural research, as a way of targeting the largely gender-blind nature of these and climate information systems.

[47] For more information, see https://www.stockholmresilience.org/research/research-themes/landscapes/ecosystem-services-livelihoods-and-resilience-in-sahel/the-institutional-context-is-of-key-importance-for-improved-management-practices.html (Retrieved 3 June 2019).

6. Climate change and migration

Although a direct causal link between climate change and migration is contentious and difficult to support, there is growing agreement in the environment–migration sphere (as in the climate change-conflict sphere) that intervening factors determine if and how environmental change causes population movements (see Freeman, 2017 for a more in-depth summary of the current environment–migration and climate change-conflict debates). As highlighted in the *Foresight* report (UK Government Office for Science, 2011, p. 9), although environmental change can affect migration through its influence on a variety of economic, social, and political drivers, 'the range and complexity of the interactions between these drivers means that it will rarely be possible to distinguish individuals for whom environmental factors are the sole driver'.

It is also important to remember that the majority of West African migration takes place within West Africa itself, with only a small minority of migration directed towards Europe (see Hochleithner & Exner, 2018[48] for further references). Importantly, there is no single story of Sahelian migration or single explanation. Recent research in the Sahel indicates that environmental factors appear to mainly cause internal migration; outmigration (to Europe) is mostly related to migrants' aspirations and agency shaped by cultural, social, and economic (specifically labour demand) factors (see Hochleithner & Exner, 2018).

Traditional and recent migration patterns

This section provides a review of literature mainly focusing on migration flows of the G5 Sahel within West Africa, such as rural–urban flows and trends in transhumance, and looking at different drivers and indirect links to environmental change. Recent migration trends are also touched on. Factors such as legislation, land reforms and perceptions of climate change are also explored.

The Sahel is a climatically sensitive region in which rainfall exhibits considerable variability on multiple timescales (Brooks, 2004). In the West African Sahel, the rainfall pattern is unimodal, with one short rainy season from June to September/October, a cold dry season from November to February, and a hot dry season from March to May. A large proportion of the population living in Sahelian countries derive their incomes from agricultural activities (subsistence and small-scale farming, herding, and fishing), which are sensitive to potential climate change impacts. However, recurring droughts are inherent to pastoral systems and a number of specific strategies have been developed in response: temporary migrations to southern and more humid areas, loans of animals, seasonal emigration to coastal countries for the purpose of wage-labour and, in some cases, agriculture (Thébaud & Batterbury, 2001). Mobile pastoralism has a long history in the Sahel and represents an effective and innovative livelihood strategy that allows people to respond to scarce, highly variable, and unpredictable rainfall, and to survive in an increasingly marginal environment (Brooks, 2006, cited in Brooks, 2012).

Hence, the Sahel's population movement represents a multitude of migration patterns and trajectories (micle, 2014). In particular, migration through **Niger** into North Africa is a long-

[48] Part of a series of four background papers for the research project 'Political Representation under a Changing Sky', financed by the Swedish International Centre for Local Democracy (ICLD). The project aims to understand the multiple causes for climate-related migration from the Sahel towards Europe and the role of local political representation by local government (see https://icld.se/en/article/climate-or-economic-migration-local-democracy-and-vulnerability-reduction-in-africa:-political-representation-under-a-changing-sky).

standing tradition (Brachet, 2018, cited in Kirwin & Anderson, 2018, p. 8). Furthermore, migratory flows from Africa to Europe have also been taking place for a long time with deep historical roots and rapidly changing patterns (Raineri & Rossi, 2018). It can be seen that movement in the Sahel is complex and multi-faceted in nature, and migration is deeply rooted in history and culture (Hummel & Liehr, 2015). In particular, seasonal and circular migration are enduring and continuing, and most movement is regional, especially rural to urban within the same country.

According to Benattia et al. (2015, cited in Raineri & Rossi, 2018, p. 18), 84% of the migrant population originating from West Africa moves inside the ECOWAS area. Furthermore, Raineri and Rossi (2018, p. 19) highlight that in relation to irregular migration to Europe, it is the 'more developed and more distant countries such as Nigeria, Senegal and Ivory Coast' which account for the largest proportion of migrants, rather than the poorest countries such as **Burkina Faso**, **Chad**, and **Niger** (even though they act as transit hubs). **Niger**, in particular, is a key transit hub for migration throughout the Sahel, used by migrants from West and Central Africa bound for North Africa and Europe (Danda, 2018).

A 2018 study by UNOWAS[49] on pastoralism and security in the Sahel highlights the following changes in transhumance patterns in the G5 Sahel:

- Constraints in **Burkina Faso** (such as population growth, encroachment of transhumance land) are pushing many pastoralists (permanently) southwards into neighbouring countries, particularly to Ivory Coast, Ghana, Togo, and Benin, increasing pressures on natural resources in those countries (UNOWAS, 2018, pp. 24–25).
- Continuous instability has afflicted **Mali** since 2012. The main areas of conflict in northern and central Mali are important pastoral zones with large numbers of livestock. During the rebellion, there was a southwards displacement of pastoralists from the Timbuktu and Gao regions into the Mopti area and the Inner Delta of the River Niger, increasing pressure on natural resources. Cross-border transhumance into northern regions of Mali has been interrupted by the prevailing insecurity, but in southern Mali it still occurs without much interruption (ibid., pp. 40, 43),
- The main pastoral zone in **Mauritania** is in the south. Mauritania's southern border is also its most important transhumance zone, with nomadic groups moving between Mauritania, Senegal, and **Mali**, on a seasonal basis. Until 2016, pastoralists from Mauritania could graze their animals freely in **Mali**; since then, some limits seem to have been placed on their movements (ibid., p. 50).
- There is internal transhumance within **Niger** and cross-border transhumance into neighbouring countries: Benin, **Burkina Faso**, northern Cameroon, **Chad**, **Mali**, and Nigeria. A key difficulty pastoralists report in Niger is insufficient pasture, especially during the long dry season. There has been some movement away from arid areas to other parts of the Sahelian zone, specifically increasing the burden on pastoralist communities in southern Niger (ibid., pp. 60–62).

As highlighted by Hochleithner and Exner (2018, p. 8), only Gambia and Ivory Coast are clearly immigration countries, and Cape Verde and **Mali** are definitely emigration countries within West Africa. This distinction is blurred for other West African countries, which act as origin, transit, and

[49] This report provides a comprehensive account of pastoralism and the different (security) issues faced in six Sahelian countries (Burkina Faso, Guinea, Mali, Mauritania, Niger, and Nigeria). It is recommended for a more in-depth understanding of why conflicts involving pastoralists appear to have escalated in the region in recent years.

destination countries (Charrière & Frésia, 2008 and Neumann & Hermans, 2017, both cited in Hochleithner & Exner, 2018). While the trend of immigration to Europe from West Africa has increased slightly, it still is a marginal phenomenon in quantitative terms. Furthermore, Hochleithner and Exner (2018, p. 9) argue that 'dominant political narratives of emigration from or through the Sahel are flawed insofar as they frequently disregard proportions' and that the majority of migration through the Sahel constitutes a circular and temporary intra-African migration pattern related to livelihood protection.

A recent report by the World Bank estimates that by 2050 there will be 86 million internal migrants in Africa from environmental change alone (Rigaud et al., 2018). It also projects that climate-driven outmigration will occur in areas where livelihood systems are increasingly compromised by climate change impacts. Migration influenced by environmental change in the Sahel can take the form of displacement or more routine migration, and a nuanced view of different kinds of migration is useful (UK Government Office for Science, 2011, p. 71). Distinction can sometimes be made between different types of migration in terms of location and duration. For example, routine economic migration or 'circular migration' that involves household members seeking (often temporary) employment in non-rural contexts, and natural disaster-induced movements such as droughts, which tend to be relatively short term, over short distances, and involve whole families (UK Government Office for Science, 2011, p. 71; Scheffran et al., 2011, p. 4, cited in Freeman, 2017, p. 356). Seasonal labour migration is common, for example, from the arid parts of **Mali**, **Mauritania**, and **Niger** to plantations and mines on the coast of Ivory Coast, Ghana, Nigeria, and Senegal (UNEP, 2011). A higher level of economic development is a strong driver of African migration, especially internationally (Kirwin & Anderson, 2018; Magri, 2017). See Box 2 for more information on migrant movements in Burkina Faso.

In a study from the Migrating out of Poverty research programme,[50] the nature of migration and remittances in three African countries (Ethiopia, Ghana, and Zimbabwe) are compared using household surveys from both migrants and non-migrants (Litchfield, 2018). Although context dependent, the findings provide an interesting insight into drivers and patterns of migration in sub-Saharan Africa. In general, Litchfield finds evidence of 'two overlapping groups of migrants: an older group of both men and women following long-established migration routes, sometimes international, into mining and seasonal agriculture, for example, and a younger, slightly better educated group of men and women, leaving paid employment in rural areas and responding to new opportunities in construction and domestic work' (ibid., p. 4). This highlights that although youth is and will remain a prominent feature of migration in Africa, migration of older generations is also likely to continue for some time to come. Looking at gendered aspects of migration, Litchfield's findings indicate that women are just as likely to migrate as men (although this was only partially true in Ethiopia where women were more likely to migrate internationally to work in domestic jobs) (ibid.).

[50] See http://migratingoutofpoverty.dfid.gov.uk/

Box 2: Migrant movements in Burkina Faso

Snorek et al. (2014, p. 19) find that in Burkina Faso, the combination of the challenges presented by land degradation and increasing climate variability has given further impetus to internal migration over the past decade. Of particular note is 'the migration of people from Mossi areas of the central plateau to (1) more developed areas of the south and southwest, where irrigated agriculture and commercial investments are increasingly found; and (2) less developed areas in the east such as Gourma province, where available land is relatively more abundant' (ibid., p. 19). Burkina Faso also sees seasonal internal migration, with village populations leaving to engage in artisanal gold mining (in some cases up to 60% of a village's population leave) during the dry season, when cultivation becomes unproductive (ibid., p. 20).

Migration vs. population growth

Some authors note that there is a bias in population dynamics research related to climate change in West Africa towards rural emigration. Parnell and Walawege (2011, p. S12) argue that 'natural population growth in cities is a more important dynamic in the evolving system of human settlement in Africa and this significant shift in where people live, both now and in the future is overlooked by the emphasis on the potential impact of environmentally induced migration'. Furthermore,

> The focus of scholarly literature on GEC [Global Environmental Change] impacts on Africa has hitherto been on mobility and displacement, rather than urban growth. Migration and displacement will almost certainly escalate over the next decades in the light of predicted GEC, but these are not necessarily the most critical issues shaping Africa's development. Under-standing [*sic*.] migration and displacement is not sufficient preparation for responding to predicted GEC impacts. In Africa, the burden of settlement change is likely to be in cities, which is not only growing rapidly because of endogenous growth but cities and towns are also potential (neglected) sites of GEC (ibid., p. S19).

Drivers and influences on migration patterns

Complexity and the multi-faceted nature of migration

Of key importance is to consider the full context of migration, not just through a climate lens (however indirect), and that migration can also be seen as a social process not just a reaction to stimuli (Romankiewicz et al., 2016, cited in Hochleithner & Exner, 2018, p. 27). In a study by Little, Mahmoud, Tiki, and Debsu (2012) looking at pastoral decision-making during prolonged drought in northeastern Kenya and Southern Ethiopia, the authors highlight the impact that the timing and sequence of decisions that herders make during these events can have, emphasising the interrelated nature of decision-making that centre on land use, mobility, and market choices. They find that 'early decisions about herd movements and sales during prolonged drought are critical' (ibid., p. 2).

There is a general lack of consensus about what is driving migration in the Sahel. In a literature review by Neumann and Hermans (2017), the single driver most frequently mentioned is the

search for employment. Marriage-related migration was the second most frequent single driver identified, and mainly attributed to women. 'Natural', i.e. environmental, factors were frequently mentioned, with drought being more important than land degradation and desertification.[51] Overall, they found that it is not possible to define one distinct and complete list of migration drivers because of frequent interactions between drivers, and because of regional particularities within the Sahel.

Indirect links to climate change

The diversity in natural resources, landscapes, and people in the Sahel makes generalised statements about interrelations between causes of migration and environmental dimensions difficult. Furthermore, some authors see no empirical evidence, even indirect, between environmental changes and the increase in emigration from sub-Saharan African countries to Europe (see, for example, de Haas, 2008).

However, a recent review by Hochleithner and Exner (2018) of literature on emigration from the West African Sahel, with a selective focus on resource-dependent livelihoods, finds that in general environmental change appears to mainly trigger internal migration. The agency of migrants and their aspirations shaped by culture, structural labour demand, and economic development are most important to understand current emigration trends. The review also finds and emphasises that people's decision to migrate is multidimensional. Furthermore, Hochleithner and Exner (2018, p. 37) highlight that the isolation of migration research from the investigation of broader social realities, changes, and transformations is problematic and limiting, producing a specific social construct of understanding why people migrate.

In her article, Freeman (2017, p. 352) develops 'five causal and exploratory scenarios that show how pathways between environmental change, migration, and conflict can operate'. Freeman (2017, p. 352) recognises that the pathways that lead to migration through environmental change are likely to be complex, and that contextual factors (such as political, social, and economic) are key in explaining *whether* and *how* this may happen. Furthermore, these contextual factors dominate decision-making, and environmental factors, although often catalytic, are secondary in influencing movement.

The project 'micle'[52] – *mi*gration*, cl*imate and *e*nvironment – conducted an interdisciplinary investigation of the socioecological conditions of migration, the role of environmental change in general, and of climate change in particular, focusing on two rural, semi-arid case study regions in Senegal (Linguère) and **Mali** (Bandiagara, near Mopti). Both sites featured indications of land degradation, strong population dynamics, and considerable migration both internal and international. The project results indicate that environmental change does play a role in explaining migration, but that the phenomenon is still multi-causal and complex. The significance

[51] It must be noted that the 'desertification' narrative in the Sahel is also strongly contested by many (see blog by Benjaminsen, 2017 and the *End of desertification?* book by Behnke & Mortimore, 2016). Brooks (2004, p. 11) argues that 'there is little, if any, evidence for regional-scale trends of widespread, systematic and irreversible land degradation and desertification in the Sahel'. Furthermore, climatic variability (including drought) in drylands is the norm, and long time frames are needed to observe and understand dryland processes (Hesse et al., 2013).

[52] The transdisciplinary research project micle, running from 2010 to 2014, was funded by the German Federal Ministry of Education and Research, and conducted by the Institute for Social-Ecological Research in cooperation with the Institute for Geography at Bayreuth University. It investigated the relationship between climate, environmental degradation, and migration in selected areas of the Sahel region. However, the project website is no longer live. See https://www.isoe.de/en/nc/research/projects/project/micle-1/ (Retrieved 5 June 2019).

of climate and environment for migration decisions turned out to be highest for groups depending on agriculture. In both study regions, migration was deeply anchored in culture and did not serve a single purpose. Moreover, motives intersected and changed over time. Overall, the project outcomes indicate that socioeconomic development increases migration in general, and that socioeconomic migration motives are more important than environmental factors (micle, 2014; Hummel & Liehr, 2015). The project also found that motives for migration are highly differentiated across social characteristics such as gender, age, and level of education; although income and employment was the most important motive for both genders.

Different types of environmental changes or perceptions of these may affect migration decision-making (sudden-onset events such as storms or floods vs. long-term, gradual environmental events such as salinity or drought) (see Borderon et al., 2018 for a discussion). It is also important to note that even with environmental changes and stressors, people may not necessarily migrate. A review of several case studies of migration related to drought in the Sahel highlights that environmental stressors such as drought do not necessarily lead to migration (Jónsson, 2010). Another insight was that migration during drought tends to be within the borders of the migrants' country of residence. The case studies also found that population movements under conditions of environmental change appear to be progressive rather than sudden (ibid.).

Migration as a means of risk reduction

Hummel and Liehr (2015) highlight that migration can be a form of adaptation. They emphasise that migration decisions are particularly influenced by climatic changes and land degradation under the following conditions:

- When people are highly dependent on agriculture and thus on local agroecological conditions and rainfall patterns;
- When opportunities for income diversification and non-farm activities are rare; and
- If access to social capital and financial capital (e.g. education or credits) is low (Hummel & Liehr, 2015, p. 4).

However, they also emphasise that migration is only one of several ways to minimise risks and compensate for climate variability, and that people adopt different coping strategies other than migration. Motives behind the decision to migrate are manifold and can change, and that there is no single reason behind the decision of people to migrate (Hummel & Liehr, 2015, p. 4). In their research in **Mali** and Senegal (as part of the micle project mentioned above), Hummel and Liehr (2015) undertook in-depth interviews, participant observation, and a standardised survey with more than 900 individuals. This data confirmed

> the important cultural role of migration: the great majority have personal experience of migration and regard it as something positive. Migration within the countries is prevalent, particularly in larger urban areas, while international migration to Europe is rare. Temporary movements, and circular and seasonal migration are the most dominant temporal migration patterns. Social relations and migrant networks are important factors for decision-making and the choice of destination (ibid., p. 4).

Ayantunde, Turner, and Kalilou (2015) used a participatory approach to explore the vulnerability of three agro-pastoral communities in **Niger** to drought. Participants reported their major coping mechanisms in response to droughts in the last three decades included harvesting of wild plants,

sales of livestock to buy grain, and migration to nearby towns or neighbouring countries. Important to note is that coping strategies change over time as households modify or change their livelihood options. Participants further elaborated that these coping measures were generally seen as ineffective when faced with severe droughts.

The *Foresight* report (UK Government Office for Science, 2011, p. 189) also highlights that in some cases migration can ease people out of situations of vulnerability and help build resilience to environmental change, and therefore a 'lack of ability to migrate is as important a policy issue as migration itself'. In general, people who are most vulnerable to the impact of global environmental change on their livelihoods are also least likely to be able to secure their livelihoods through planned migration (ibid., p. 74).

Motivations for migrating and perceptions of climate change

Hochleithner and Exner (2018) highlight that migrants' aspirations are of crucial importance to understand migration, and are also subject to change. Migration choices are partly based on perceptions of vulnerability and opportunities, which are often based on limited information (Zickgraf et al., 2016). Research conducted in West Africa by Zickgraf et al. (2016) shows that perceptions of environmental changes such as rainfall variability did not match the changes observed on the ground. Populations' migratory responses are made based on their perceptions of environmental changes and their own vulnerability to them; thus, considering these perceptions can improve the understanding of the environment–migration nexus.

Naess et al. (2010) explored local perceptions of changes in climate shocks and stressors for pastoralists and agro-pastoralists in Ethiopia and **Mali**, examining how people respond to these changes, and what constraints they face. Naess et al. (2010) highlight how much of the discourse around climate change and drylands views poor farmers and pastoralists as being incapable of adapting to climate change. Their study contests this position, demonstrating the 'range of adaptation strategies that people employ, while simultaneously recognising the role that social status and other factors play in limiting people's ability to adapt' (ibid., p. 2). They argue that '[e]xamining local perceptions and responses to change is important because these can help to identify more precisely what support people require to strengthen their climate resilience… and also uncover a more holistic understanding of adaptation in relation to particular socioeconomic, political or historical contexts' (ibid., p. iii). These local perceptions can be useful to policymakers, to better inform them of the impacts of climate change as they are felt on the ground, and the challenges and opportunities that people face in adjusting their livelihoods. The work found that respondents in Ethiopia and Mali perceived a trend of declining and more variable rainfall, a change in the type and severity of shocks and stressors, and tell of the emergence of new risks. These are explained as having a negative impact on people's assets such as livestock and farmland, suggesting that people are becoming more vulnerable (ibid., p. iv). Naess et al. (2010) emphasise that climate is only one of many stressors households must deal with on a regular basis.

In a news article in the *Guardian*, Thomas (2013), highlights that '[m]igration has always been a way of life in the Sahel', but 'recent changes in rainfall patterns and rising temperatures have led to… climate displacement'. She visited villages in **Burkina Faso** and **Niger**, where people described changes in rainfall patterns in recent years: 'The rains are no longer predictable'; 'They come too early and then end too soon'; 'There is too much rain, or too little'. She argues that recurrent crises have prevented the most vulnerable Sahelians from being able to recover in time

before the next shock hits, making them 'more vulnerable with each passing season' and that '[e]ventually, many have no choice but to leave their villages'. This migration has become a last resort negative coping mechanism (ibid.).

Kirwin and Anderson (2018), in a paper for the OECD-hosted Sahel and West Africa Club (SWAC), examine international migration motivations at the individual level using nationally representative surveys and focus group data collected in six West African countries[53] (with a focus on Nigeria). Economic factors were cited as the main reason for migrating, and family and love of country were cited as factors for those who wished to stay. Another important factor for Nigerians surveyed was day-to-day concerns about the democratic performance of their state, highlighting the potential importance of good governance interventions in West Africa in relation to migration (ibid., p. 19). Environmental factors did not come up in the study. Aspirations to migrate internationally varied considerably across the countries surveyed, ranging from a low of 11% in **Niger** to a high of 50% in Nigeria, and about one in four in **Burkina Faso**, Ivory Coast, and Senegal (ibid., 2018, p. 9).

Legislation and international support

Land tenure reform

Social structures and local institutions play a key role in determining what options households have to cope and adapt, especially as they influence access to resources as well as access to decision-making power (Naess et al., 2010). For example, in the **Lake Chad basin**, access to resources largely depends on customary systems (Vivekananda et al., 2019). Across the Sahel, rising land values are eroding customary tenure norms. Despite legislation asserting rights of livestock mobility, there is often a gap between law and practice. Common grazing and woodland are particularly vulnerable to large-scale land acquisitions (Hesse et al., 2013). Furthermore, there is often an overlap and competition between formal and informal institutions that manage these natural resources and the customary and state systems that coexist in much of the Sahel (Bagayoko, Ba, Sangaré, & Sidibé, 2017).

Brooks (2012) highlights that in the last 20 years there has been widespread land tenure reform across the Sahel, much of which is intended to increase investment in land and enhance the productivity of land through private ownership. These reforms often recognise customary tenure but emphasise land registration and private ownership, and a shift towards private property rights has profound (and negative) implications for the many areas in the Sahel that are used as common property and is likely to increase the risk of conflict between herders and farmers (Brooks, 2012).

For example, in **Mali**, pastoral lands were considered as state lands under the land tenure reforms of the 1990s, with little consideration of pastoralists. Land reform in **Mauritania** in the 1980s sought to reinforce state control of land, abolished traditional tenure, and encouraged private development of land (Bloch & Foltz, 1999, cited in Brooks, 2012, p. 11). In contrast, **Niger** established a pastoral zone in 1961 reserved entirely for livestock herding; agricultural activities and owning of land for private property were excluded (Larsen & Mamosso, 2014, p. 67). **Niger's** 1993 Rural Code allowed recognition of property rights for pastoralists for pasturelands and water points (Bloch & Foltz, 1999, cited in Brooks, 2012, p. 11). However, the 2004 Pastoral Law

[53] Burkina Faso, Ivory Coast, Mali, Niger, Nigeria, and Senegal.

lacked formal recognition of fundamental rights of pastoralists and herders (Larsen & Mamosso, 2014, p. 67). The 2010 Pastoral Law partly addressed this weakness, as it prohibited appropriation of pastoral land and provided the possibility for herders to register user rights in common property regimes (ibid., p. 67). In **Burkina Faso**, pastoral land is not well protected, and the laws governing the rural space are not widely enforced. Awareness of these laws is also generally low (UNOWAS, 2018, p. 26).

National and regional legislation

Within West Africa, freedom of movement is underpinned by regional treaties, initiatives, and regulations, thereby facilitating regular migration (Raineri & Rossi, 2018). The ECOWAS Common Approach on Migration (similar to that of Europe) is among the most advanced examples of free movement of people. ECOWAS citizens are entitled to enter freely, reside, and settle in member states (Hummel & Liehr, 2015). For example, notwithstanding obstacles to implementation, **Malian** migrants from Bandiagara are formally entitled to move to Ivory Coast for labour purposes (ibid., 2015, p. 5).

Theoretical research into the use of common pool resources in social–ecological systems (such as in transhumance) finds that the key to their sustainable use is self-organisation (i.e. the idea that sustainability emerges from individual resource use within dynamic social–ecological systems that are in non-equilibrium) (Moritz et al., 2018). In the Sahel, the strategic importance of livestock mobility at regional level is now recognised by national and international regulations facilitating livestock mobility within and between nation states (Hesse et al., 2013). However, further work is needed to improve these and reopen transhumance corridors.

International support

According to Hummel and Liehr (2015, p. 5), West African countries such as Senegal and **Mali** seek to embed migration in development strategies, and have intensified their efforts to cooperate internationally, mainly with the EU and several European countries. For example, ‘mobility partnerships’ involve the granting of increased access to the EU labour market in exchange for cooperation on irregular migration. However, European migration policy is contradictory and fragmented.

International support for migration control in the G5 Sahel is particularly focused towards **Niger**. This support is dominated by security-based measures to help manage the migration, mostly aimed at border control/monitoring and preventing illegal migrant trafficking (Danda, 2018, p. 48). Less is invested in preventive approaches related to underlying drivers. Niger is one of the biggest beneficiaries in West Africa of the EU Emergency Trust Fund for Africa. Other support related to combating irregular migration and trafficking and managing migration challenges comes from France, Spain, and Germany.

7. Climate change and conflict

The connections between climate change and security are complex, dependent, and not fully understood. There is an ongoing debate about the links between climate change, conflict, scarcity, and migration. Evidence suggesting that conflict occurs as a direct result of climate-related or climate-sensitive factors is contested (see Adger et al., 2014), and this report does not seek to make a direct connection between climate-related impacts and instability. There is, however, some evidence of indirect links and mediating factors between climate change and social conflict, and this report explores this evidence in relation to the G5 Sahel region and localised conflict. In particular, indirect causal pathways between climate change and social conflict in the academic literature have been related to shocks to food prices or changes in agricultural production, economic growth, environmentally driven migration, disasters, and the role of institutions (Busby, 2018). Therefore, this report explores the particular drivers in the G5 Sahel region; for example, increasing strains on communal resources, and looking at intervening variables (e.g. political issues, institutions, resource management systems) that also determine climate impacts. There was not scope within this report to explore the debates surrounding the climate–security nexus; for a more in-depth understanding of the climate change and security debate, it is recommended that other reviews and analyses be consulted (see, for example, Adger et al., 2014; Busby, 2018; Freeman, 2017; Price, 2019).

Recent conflict dynamics in the Sahel

Conflict dynamics in the G5 Sahel countries are complex and fast moving. A report by Ferdi[54] (2016) argues that in the last decade new forms of conflict have emerged in the Sahel, with the emergence of guerrilla groups and criminal gangs alongside the more traditional inter-state and intra-state conflict. This section gives some brief information and views on current conflict and violence in the G5 Sahel countries.

A 2018 UNOWAS study on pastoralism and security in West Africa highlights the following violence in the Sahel region:

- In **Mali**, insurgency and lawlessness have pushed more pastoralists south of the Niger River, and conflicts in northern Mali and the Inner Delta have increased tensions between farmers and herders. Pastoralists are both affected by and implicated in armed groups, with potential regional outreach. Cross-border attacks and banditry are common from the Gao region, northern Mali, into Tillabéri in **Niger**.
- In the **Lake Chad basin**, farmer–herder conflicts have been aggravated by population displacements due to the Boko Haram insurgency. There are also seasonal conflicts between farmers and pastoralists in different parts of the agro-pastoral zone in **Niger** and cases of disputes between pastoralist groups in dryland areas.
- In **Mauritania**, **Guinea**, and most of **Burkina Faso**, violent conflicts between farmers and herders are less pronounced, but tensions do exist. In these countries, and also in **Niger**, there are local conflict management committees comprised of pastoralists and farmers, traditional leaders, and sometimes state authorities. Niger and Burkina Faso have also drawn up *local conventions*, which stipulate the rights and responsibilities of farmers and pastoralists and establish mutually agreed enforcement procedures that are sanctioned

[54] The Fondation pour les Etudes et Recherches sur le Développement International (Ferdi).

by local state authorities. All this is helping to promote conflict prevention, mediation, and resolution, ensuring that both farmland and pastureland are protected.

- Over the last few years,[55] Nigeria has had more fatalities in farmer–herder conflicts than the rest of the ECOWAS region combined. However, not all states are affected, and there are sharp contrasts even between neighbouring states (e.g. Sokoto and Zamfara, Gombe and Taraba). In the most affected areas, violence often extends beyond clashes between individual herders and crop farmers and engulfs whole settlements and communities. Increased southward movement of pastoralists from northern Nigeria to the southeast and southwest of the country has fuelled new waves of clashes between predominantly Muslim pastoralists and Christian farmers (UNOWAS, 2018, pp. 15–16).

In their assessment of climate-related security risk in the **Lake Chad basin**, Vivekananda and Born (2018) highlight the following ongoing conflict dynamics in Chad and Niger:

- In **Chad**, already host to hundreds of thousands of refugees from conflicts in neighbouring Sudan and the Central African Republic, clashes between settled farmers and nomads over land use rights and access to water occur frequently in the north.
- **Niger**, with its history of conflict between the state and some of its Tuareg communities, has also felt the spillover effects of conflict in **Mali** and Libya, due to its geographical location (ibid., p. 12).

The year 2018 was the most violent year in **Mali** since conflict broke out in 2012, and the conflict, particularly inter-communal violence, is now concentrated more in central Mali than northern parts (Rupesinghe & Bøås, 2019). The *ACLED 2018* report says that between 2017 and 2018, '[w]hat initially began as fighting between armed groups associated with different communities (counter-militancy operations and retaliations) has shifted dramatically toward civilian targeting' (Kishi & Pavlik, 2019, p. 6). It is also likely that the violence could spill over into neighbouring countries, like **Burkina Faso** and **Niger** (Rupesinghe & Bøås, 2019).

Lind and Dowd (2015) argue that the case of northern **Mali** provides an example of the cyclical nature of violence. Violence in the region dates from the process of decolonisation. The growing development gap between the north and south fed into revolts in 1990 and 2006. They highlight the interconnectedness of previous forms of violent opposition, contemporary violence, and wider instability, which continue to characterise the situation in Mali. Lind and Dowd (2015) argue that the greatest threat from militant organisations in Mali lies in how they exploit widely held feelings of disaffection at the margins.

Linking conflict, scarcity, and climate change in the Sahel

Indirect links to climate change

Climate change has been termed by some as a 'threat multiplier' that can interact with and compound existing risks and pressures, thereby increasing the likelihood of instability (Nagarajan et al., 2018, p. v). There is now a general consensus in the climate–security sphere that intermediary social, political, and economic variables need to be analysed to understand if environmental change will lead to political violence (Freeman, 2017, p. 357). There has also

[55] No dates were specified in the report.

been a move to study localised or regional effects of climate and environmental change on conflict, moving away from just national explorations, although local studies are often limited through a lack of reliable data (ibid.).

Heinrigs (2010, p. 6), in a report issued by the OECD's Sahel and West Africa Club Secretariat (SWAC), 'highlights the absence of a generaliseable and direct impact of climate change on security'. Applying a broad notion of security, Heinrigs (2010, p. 6) concludes: 'Environmental variables are of secondary importance at best compared to political, historical and economic variables'. As the IPCC's Fifth Assessment Report concludes, 'it is likely that socioeconomic and technological trends, including changes in institutions and policies, will remain a relatively stronger driver of food security over the next few decades than climate change' (Porter et al., 2014, p. 513).

According to Benjaminsen (2016), 'Two elements underpin the climate change–conflict narrative. First, it assumes global climate change leads to drought and desertification, which in turn leads to resource scarcity. Second, it suggests this resource scarcity causes migration – fuelling new conflicts, or triggering existing unrest bubbling below the surface.' However, although the trajectory and strength of rainfall projections for West Africa and the Sahel contain large uncertainties, he highlights that the majority of climate projections are pointing to more extreme and increased rainfall in most parts of the Sahel in the future, not less.[56] He also highlights that the validity of the second element of the climate change–conflict narrative is brought into question by empirical research. Emphasising that research in the Sahel indicates that 'conflicts have historical and political causes such as government officials seeking rent, as well as policies and legislation that marginalise pastoralists'. For example, he uses the case study of **Mali**, where 'farmer–herder conflicts are linked to the state's pastoral and land tenure policies and legislation', which generally 'favour farmers and tend to lead to pastoralists being squeezed out of access to grazing land'. Benjaminsen (2016) also highlights that the Tuareg rebellion that triggered Mali's civil war in the 1990s and in 2012 were linked to pastoral marginalisation, and that the 'drought of the 1970s and 1980s only played an indirect role in the rebellion'. He argues that changes in rainfall (leading to droughts and floods) may 'potentially escalate tensions but evidence suggests that the root causes of land disputes are historical and political'. Benjaminsen concludes by highlighting three structural factors that are key drivers of these conflicts:

- Agricultural encroachment that has obstructed free movement for herders and livestock;
- Opportunistic behaviour by farmers and herders that moved to fill a political vacuum left by the disintegration and withdrawal of services following the state's decentralisation policy; and
- Corruption and rent seeking among government officials (ibid.).

A USAID report by Stark (2014, p. v) looks at five case studies that consider the intersection of climate change and conflict, aggregated from the seven countries of Uganda, Ethiopia, **Niger**, **Burkina Faso**, Ghana, Nigeria, and Peru. The case studies demonstrate that isolating a single chain of climate change–conflict causality is not useful due to the complex aggravating factors that already affect conflict. However, the report highlights that trying to understand the conflict dynamics in vulnerable countries *without* taking into account the impact of climate change would result in an incomplete and flawed analysis.

[56] See Future Climate for Africa (https://futureclimateafrica.org/) and Diedhiou et al. (2018) for more information on future rainfall projections.

Von Uexkull, Croicu, Fjelde & Buhaug (2016) showed risk of sustained conflict due to the impact of drought was greatest in places that were highly agriculturally dependent, in areas of high political exclusion, and where growing seasonal rainfall declined precipitously, although they recognise the effect is modest in comparison to central drivers of conflict.

In a discussion of the links between climate change, migration, and conflict, Brzoska and Fröhlich (2016, p. 204) conclude that 'the potential of climate migration to lead or contribute to violent conflict is shaped by the causes, extent, goals and consequences of the respective population movement as well as the characteristics of the receiving region, including its economic situation and the societal discourses on the necessity to integrate refugees and migrants'. They also argue that research needs to better distinguish between various types of migration and their differing links with conflicts; for example, climate disaster refugees, permanent climate refugees, and eco-economic migrants.

Analysis of 11 case studies of violent disputes between pastoralists and farmers or pastoralists in the West African Sahel and East Africa by Seter et al. (2018) shows that the nature of these conflicts is complex. Furthermore, '[t]hey cannot be reduced to a stimulus (resource scarcity)–response (violence) relationship' (ibid., p. 169). Although they find variable rainfall as being a contributing factor in five of the conflicts, they conclude that 'resource scarcity is never the most important cause and it does not explain well the differences in conflict intensity' (ibid., p. 169). They also found that different causes are important at different periods of the conflict, highlighting the complexity and dynamic nature of conflict and the interconnectedness of different processes. Seter et al. (2018, p. 186) also caution not to overestimate the propensity of such conflicts to turn violent, as counterfactuals where conflict mitigation has been successful are mostly not reported in the research field.

Buhaug et al. (2015) explore the supposed indirect link between climate variability, food production, and political violence across sub-Saharan Africa. They find a strong link between weather patterns and food production where more rainfall generally is associated with higher yields. However, they found that agricultural output and violent conflict were only weakly and inconsistently connected. They accept that local climate variability and agricultural shocks can be causally linked to instability in some cases, but they suggest that 'the wider socioeconomic and political context is much more important than drought and crop failures in explaining violent conflict in contemporary Africa' (ibid., p. 1).

Busby (2018) argues that more research needs to focus on how climate affects the dynamics of conflict, and whether conflicts are prolonged or shortened under certain kinds of climate change.

Importance of context and the local level

A recent study for USAID on the intersection of global fragility and climate risks seeks to 'identify the locations where fragility and climate risks co-occur around the world' (Moran et al., 2018, p. 1) as these places may be more vulnerable to humanitarian emergencies or instability. One of the study's key findings is that '[c]ompound fragility-climate risks can heighten insecurity, but conflict is context specific' (ibid., p. 3). This emphasises the complexity of these issues and the links between political, economic, and social drivers of conflict, and the importance of context. Different types of conflict, climate change impacts, and fragility can be experienced in different countries in a region and even within a country. For example in the Sahel, '**Chad** hosts "overflow" conflict from neighbouring states; and **Mali** experiences accumulated challenges from Islamist, secessionist, elite, and civil society contentions' (ibid., p. 3). At the same time, **Niger** has

managed to keep the most radical and volatile elements of its politics under control. Another key finding is that '[f]ragility is an important dimension in understanding the indirect pathways between climate risks and potential conflict outcomes' (ibid., p. 4)**.**

The models developed by Freeman (2017, p. 370) suggest that environmental variability and climate change are more likely to be linked to small-scale conflicts such as cattle raiding, agrarian–pastoral clashes, and rural labour competition, thus suggesting that policymakers should similarly focus at the local level. Freeman argues that 'attention needs to be paid to local-level manifestations of conflict and (mal)adaptive forms of migration to understand the potential propensity of environmental change to lead to conflict in Africa' (ibid., p. 351).

The report by Ferdi (2016, p. 21) highlights that '[l]ocal conflicts (e.g. family conflicts over land) resonate with national conflicts (e.g. Tuareg demands). These, in turn, can lead to instability across an entire region (e.g. movements of fighters between Libya and **northern Mali**), as various groups state their own demands.' The Ferdi report argues that over the years, '[h]otbeds of violence [which] were once isolated, driven by unique local and historical contexts… have become increasingly interconnected with trafficking (arms, drugs, contraband and migrants) and a shared interest in destabilising the region' (ibid., p. 32). Therefore, it is important to remember the role of local political, economic, and social conditions in the areas where violence is taking place when considering conflict. Long-term solutions to addressing violence in the Sahel must involve resolving long-standing political and historical grievances, a legacy of past state violence towards minority populations, and intra-regional inequality (Lind & Dowd, 2015).

Role of governance and institutions

Buhaug et al. (2015, p. 2) highlight that '[s]ocial effects of climate variability depend on the adaptive capacity of cultural, economic, and political systems'. The above case studies in Stark (2014, p. vii) demonstrate that 'many of the key aspects of bad governance and institutional failure classically linked to conflict find their most concrete expression in conflicts having to do with rural land use and water management'.

The report by Ferdi (2016, p. 14) emphasises that conflicts in the Sahel region are a result of both external and internal factors (demographic, economic, social, environmental, and institutional), driven by widespread fragmentation of societies across the region and ineffectual institutions. The Ferdi report highlights that in the Sahel, '[f]ormal institutions (prefectures, regional councils and local authorities) exist alongside traditional institutions (chiefdoms and religious communities) in a sort of hybrid system with a varying ability to deal with day-to-day conflicts' (ibid., p. 22). Weak and ineffectual governance at both the local and national levels, compounded by rigid governance systems with little flexibility to shift the power balance or reflect changing lifestyles, have further driven ethnic and religious fragmentation. The report hence argues the need for capacity building of local government but that this is often relegated to a position of secondary importance by donors and international actors, especially as capacity-building programmes only bear fruit in the medium and long terms (ibid., p. 42).

A recent study by Benjaminsen and Ba (2019, p. 1) explores the rise of jihadist groups in the **Mopti region** in central **Mali** since 2015, focusing on the micro-politics of two land use conflicts and how these conflicts are affected by the jihadist expansion, and looking at peasant logics behind joining these armed groups. They conclude that 'a main driving factor behind the land-use conflicts is the power vacuum left behind after state withdrawal, first in the transition to democracy in the early 1990s and more recently with the jihadist expansion' (ibid., p. 16).

Furthermore, they conclude that ‘alliances and conflicts are structured by material interests with deep historical roots in controlling land and resources, rather than by a radical Islamist agenda’ (ibid., p. 16).

Criticisms of drawing links between conflict, scarcity, and climate change

Pastoralists are a common target for ‘crisis’ narratives in the Sahel (Thébaud & Batterbury, 2001). Articles in a special issue of *Geopolitics* present a series of critical mediations on the links between global human-induced climate change, conflict, and security (Selby & Hoffmann, 2014). The articles put emphasis on the centrality of the political within the climate change–conflict discourse. Specifically, Selby and Hoffmann (2014, p. 751) highlight that some key shared themes are raised in the issue: ‘[C]limate security discourse’s simplistic misreadings of human–environment relations; its historical debt to colonial and racialised narratives; its imbrication with power; its troubling political effects; and, not least, the need for forms of analyses that help to historicise and re-politicise our understanding of the conflict and security implications of climate change’.

In a blog post, Hartmann and Selby (2015) highlight how the idea that climate change is a ‘threat-multiplier’ is now conventional wisdom in many international policy circles, especially in the US, but that ‘the idea is based on slim evidence and ethnic stereotypes’. Furthermore, they highlight the lack of consideration in the climate–security discourse of when ‘poor people can and do cooperate and adapt in times of resource stress and natural disaster’, further biasing research.

Farmer–pastoralist conflicts in the Sahel

Importance of pastoralism and competition over resources

Pastoralists rear livestock not only as a main economic activity but also as an intrinsic part of their culture, with lifestyles ranging from nomadic to being settled agro-pastoralists (UNOWAS, 2018). Livestock mobility through the movement of herders and their cattle during the dry season to other pastures and to trade forms a key strand of the resilience of pastoralist communities in the Sahel. Livestock corridors, water-points, and encampment sites are all necessary resources for movements of livestock from one point to the next. Powell and Ly (2017, p. 1) highlight that this practice (transhumance) ‘is well adapted to a variable climate, but it is increasingly under threat from a range of political, social and economic factors, reducing the resilience of the community to climate shocks and stresses’. They highlight that competition for resources (real or perceived) can lead to tension and even violence between pastoralists and the settled communities through which they pass and trade (see also Cooper, 2018 for a discussion of natural resources management in the Sahel, with a section on pastoral and farmer conflicts).

A recent UNOWAS (2018, p. 10) study on pastoralism and security finds that ‘growing competition between herders and farmers over access to water and pasture is a primary driver’ of an increase in violent conflicts involving pastoralists in parts of West Africa and the Sahel in recent years. They find that ‘this tension is often aggravated by a weak enforcement of the rule of law, political manipulation, demographic pressure, climate change, and the prevalence of weapons in the region’ (ibid., p. 10). In most of the countries reviewed in the study (including the G5 Sahel), ‘pastoralists and farmers reported that climatic conditions have become more adverse. Typically, this equates with a longer dry season and a shorter rainy season’ (ibid., p. 14).

Benjaminsen et al. (2012, p. 109) highlight that there are two different and contrasting scenarios for the effect of environmental variability on the onset of conflicts in the Sahel. Drought such as that of the 1970s and 1980s can lead to encroachment on dry season pastureland by farmers and play a role in increasing inter-communal tensions. On the other hand, good rainfall years with generous flooding might also induce more conflicts as the zone of potential contestation is expanded to areas with less established norms of ownership and control. This emphasises the potential importance of land tenure and ownership rules for managing climate-related tensions.

Moritz (2010) stresses that West African herders and farmers have long coexisted in symbiotic relationships, which endure both peace and discord. However, reports of violent clashes between these groups are becoming more frequent and it is important to understand when, how, and why resource-related conflicts escalate into widespread violence between whole communities and when it does not. Less attention has been paid to the latter part of this issue. He argues that herder–farmer conflicts need to be considered as a dynamic process to explain the variable outcomes of them, especially escalation.

Diversity in the types of natural resource conflicts

Michael Griffon (quoted in Ferdi, 2016, p. 28) highlights that the Tuareg and Fulani communities often come into conflict over land. In **Niger**, Nigeria, and **Burkina Faso**, the Hausa are increasingly moving further north to find new farmland to grow millet. Yet in doing so, they come into direct conflict with local livestock farmers, who also grow millet for their own reserves. This, in turn, often leads to violent confrontations along ethnic lines.

Natural resource conflicts can vary in severity from increased tension and the breakdown of community relationships to violent conflict (Vivekananda et al., 2019). Vivekananda et al. (2019) highlight that these disputes take place in the context of a variety of other factors, which can be exacerbated by climate change. In their study of climate-related security risks in the **Lake Chad basin**, Vivekananda et al. (2019, p. 59) found that ‘the frequency and severity of resource conflicts varies across and within countries [in the basin] according to context’. Further demonstrating the multifaceted nature and complexity of conflict dynamics, they elaborate that

> In some cases, violent conflict linked to the fighting between government security forces, armed opposition groups and community militias led to temporary reduction of conflict over natural resources whilst livelihoods were essentially halted, but these conflicts show signs of resurgence as locations become more stable (ibid., p. 59).

Expansion of agriculture, marginalisation, and political vacuums

Benjaminsen and Ba (2009) studied a farmer–herder conflict in the **inland Niger Delta** of **Mali**. Historically, customary pastoral leaders (the *jowros*) have dominated land management in the area, but since independence, they have gradually lost power and wealth to the benefit of previously underprivileged farmers (the *rimaybé*). Benjaminsen and Ba (2009) argue that national policies and laws giving priority to agricultural development at the expense of pastoralism has led to pastoral marginalisation through the large-scale conversions of dry season pastures to rice fields. This pastoral marginalisation has resulted in increased land use conflicts between herders and farmers. Furthermore, land use conflicts in the area are perpetuated by rent seeking by local officials. These land disputes have been further aggravated by the droughts of the 1970s and 1980s, but they argue that these droughts and scarcity alone are insufficient as explanatory

factors for the conflict. They conclude that it is necessary to study both structural and actor-oriented factors in order to understand farmer–herder conflicts better (ibid., 2009, p. 79).

Benjaminsen et al. (2012) also looked at conflict dynamics in the inland delta of the Niger River in the **Mopti region** of **Mali**. Comparing data on land use conflicts from the regional Court of Appeal in Mopti with statistics on concurrent climatic conditions, they found little evidence of climate variability being an important driver of these conflicts. They further explored one of the land use conflicts through qualitative analysis and found that other structural factors dominated as plausible explanations of the violent conflict; namely, agricultural encroachment that obstructed the mobility of herders and livestock, opportunistic behaviour of rural actors because of an increasing political vacuum, and corruption and rent seeking among government officials.

Stark (2014) emphasises the intersection of climate change and erosion of identity and social roles through the case study of the **Tuareg** in **Niger**. Traditional Tuareg life was altered by the droughts of the 1970s and 1980s, and then successive national governments either failed to respond to Tuareg needs or heightened the potential for conflict by favouring other groups. Climate change and government policies combined to destabilise and disempower Tuareg groups across large areas of the country's northern regions (ibid., p. vi). Furthermore, the Tuareg feel squeezed and compromised by climate-driven landscape change and ever-further encroachment by farmers and commercial developments on the traditional grazing zones of the Tuareg (and other herding groups).

Marginalisation and land tenure reform

The role of policy is crucial in the emergence of conflict. Brooks (2012) highlights the key role that agricultural intensification, expansion, and modernisation have played in the Sahel since the 1950s. The drive to commercialisation in the 1950s and 1960s involved the intensification and expansion of agriculture, and the conversion of 'idle' or 'under-utilised' lands to agriculture. However, the 1950s and 1960s were particularly wet in the Sahel (Brooks, 2004). When dry conditions returned in the early 1970s, agriculture in these areas suffered and pastoralists either could no longer access them or came into conflict with settled farmers in areas recently converted to agriculture. Since the 1970s, land tenure reforms have tended to promote private ownership of land at the expense of common property rights, and have favoured agriculture over pastoralism, making pastoralists more vulnerable to drought and undermining reciprocal arrangements that previously allowed different groups access to common resources (Hill, 1989, cited in Brooks, 2012, p. 6). Brooks (2012, p. 7) thus highlights that the likelihood of conflict was increased through not only the droughts of the 1970s and 1980s but also by the implementation of development policies.

Brooks (2012) gives further examples to demonstrate this point by looking at the semi-nomadic **Tuareg** in the northern regions of **Mali** (see also Box 5 below), whose pastoral livelihoods were undermined by the Sahelian droughts of the 1970s and 1980s that led to large numbers of them finding refuge in camps or urban areas. Many Tuareg migrated to neighbouring countries, and some young men become involved in conflicts throughout North Africa and the Middle East, in which they acquired considerable military experience. When they eventually returned to Mali and had to face unemployment and marginalisation, the conditions were created for the 'Second Tuareg Rebellion' in 1990. While drought appears to have been a contributory factor in the conflict, the rebellion was not driven by supply-induced scarcity. Drought and environmental change should be placed in a much wider context of political marginalisation and discontent,

including the return of young Tuareg men combined with a proliferation of firearms, a lack of livelihood opportunities, and political discontent (Keita & Henk, 1998, cited in Brooks, 2012, p. 8; Benjaminsen, 2008).

Brooks (2012, p. 13) sums up that

> The real roots of conflict in the Sahel (at least to date) are not in long-term climatic and environmental change, but in (i) the expansion of agriculture at the expense of herding, placing farmers and herders in closer contact with one another and increasing the risk of competition over land, and (ii) the failure of development planners to appreciate and accommodate the decadal-scale climate variability that is a fundamental characteristic of the region, and a typical feature of semi-arid regions at large.

Snorek et al. (2014), elaborating on the **Burkina Faso** and **Niger** case studies from Stark (2014), found few direct linkages between climate change and large-scale conflict in either country. However, in both countries, there are underlying sources of conflict that could potentially be triggered or exacerbated by future climate stress. Incomplete, unclear, or commonly accepted rules on rural land tenure and management of natural resources have allowed many conflicts over these resources to continue (see Boxes 3 and 4).

Box 3: Marginalisation and land rights in Niger

Legislation that protects the rights of pastoralists has been difficult to implement in **Niger**. Although in principle, cultivation is forbidden in the northern pastoral zone of Niger, there is a strong northward extension of agriculture due to land pressures in the south. Pasture areas and livestock routes are being cultivated, and other activities (such as charcoal production) are encroaching into the land, increasing the incidence of farmer–herder conflicts where this has occurred (Stark, 2014, p. 23). Increasing climate variability and intensity, rapid demographic change, continual extension of agriculture to new lands, environmental degradation, and new forms of commercial activities are configuring new situations of competition over resources that increase the potential for conflict. There are also tensions in relation to differing attitudes toward natural resource management between nomadic indigenous groups (groups who live year-round in the pastoral zone such as the Tuareg, Fulani, Wodaabe, and Arab) and fixed transhumant shepherds from southern communities and neighbouring countries.

Additionally, a new ECOWAS agreement has resulted in neighbouring countries making use of Niger's vast pastoral zone during the rainy season, and indigenous groups have accused these herders of overgrazing (Snorek, 2014, p. 10). The Tuareg, who believe that their concerns have never been satisfactorily dealt with by the state, feel especially marginalised by the effect of these varying forces in northern Niger (Stark, 2014, p. 23). However, Snorek et al. (2014, p. viii) emphasise that there are 'few indications of strong linkages between climate change and large-scale violent conflict' in Niger (see also Land tenure reform in section 5 of this report).

Box 4: Lack of clarity over land use laws in Burkina Faso

Burkina Faso has not faced the ethnic and cultural tensions that have sometimes destabilised other Sahelian countries, but it has recently experienced some political instability and is one of the countries most vulnerable to the impacts of climate change in the world. Internal migration patterns have also been changing, leading to the potential for conflicts. Burkina Faso faces similar confusion to Niger over its rural land use laws. The Régime Foncier Rural (Law on the Use of Rural Lands) of 2009 stated purposes include equitable access to rural lands for all actors in the countryside, the promotion of rural investments, sustainable management of natural resources, and preservation of social peace (Stark, 2014, p. 27). It is a cornerstone in the efforts of the Burkina Faso government to maintain stability in the countryside, but implementation has been difficult, especially as the law is unclear and hard to understand. This has led to some uncertainty and conflict (ibid., p 27).

Box 5: Land tenure in central Mali and conflict

Tensions arising from changing socio-political relations at the local level are often overlooked in the ongoing conflicts in **Mali**, especially in the **Mopti region** (Bagayoko et al., 2017). Here, customary and state institutions clash in an increasingly fragile context. Three main communities dominate in this region: the Fulani, who are mainly pastoralists; the Dogon, who are mainly farmers; and the Bozo, who are mainly fishermen. Despite their generally peaceful coexistence, there are tensions over resources, particularly in relation to the formal and informal institutions that manage these and the overlapping customary and state systems that coexist. There are four historic customary institutions, and different villages and communities developed their own customary systems from these (ibid.). Such customary institutions are still highly relevant and legitimate in central Mali today, and local communities often find it hard to grasp the role of the government in resource management.

The overlap and competition between customary and legal institutions (and laws) for the management of resources often triggers tensions between communities and networks involved in farming, livestock breeding, and fisheries, fuelling century-old conflicts between the different communities in the Mopti region. Furthermore, the priority given by most development programmes to agriculture-oriented policies, at the expense of pastoralism, has triggered intra- and inter-communal tension, resulting in the emergence of new power relations within communities involved in resource exploitation and upsetting historical balances (ibid.). The current conflicts in central Mali are mostly related to the technical and operational conditions for resource exploitation, as well as difficulties in defining and delineating agro-pastoral areas – but are also increasingly due to the expansion of the conflict that erupted in northern Mali in 2012. The complexity of the recurrent and violent crises, as well as the overlapping and competing customary and legal institutions involved in the management of resources, calls for security and development activities to be better grounded on the sociocultural context in central Mali (ibid.).

Climate change-conflict risks in the Lake Chad basin

The **Lake Chad basin** is located in Cameroon, **Chad**, **Niger**, and Nigeria. In recent years, discussion of climate-related security risks in the Lake Chad region has been gaining traction. The Expert Working Group on Climate-Related Security Risks and the Adelphi G7-mandated 'Lake Chad Climate-Fragility Risk Assessment Project' have both made concerted efforts in recent years to address the critical gap in knowledge and action on climate and fragility risks in the Lake Chad region (see Vivekananda & Born, 2018; Vivekananda et al., 2019).

The Lake Chad region is currently facing multiple security risks, and since 2009, the parts of Nigeria, Niger, Chad, and Cameroon bordering Lake Chad have been locked into multiple and overlapping crises (Vivekananda et al., 2019). A recent conflict and climate risk assessment, *Shoring up stability* by Vivekananda et al. (2019), is the product of an intensive two-year period of research across all four countries, drawing on long-term hydrological data from the Lake Chad basin, more than 200 interviews with community members, and an extensive review of literature on Lake Chad. A finding of strong significance is that, contrary to popular belief, Lake Chad is not shrinking. However, the authors find that 'climate change is having profound adverse impacts on the conflict, intensifying existing dynamics and creating new risks' (ibid., p. 10). Communities in this region are vulnerable to both the impacts of climate change and the ongoing conflict.

Even though the current conflict was triggered by violence linked to armed groups such as Jama'atu Ahlis Sunnah Lida'awati Wal Jihad (JAS), known as Boko Haram, the crisis has deep roots in long-standing developmental challenges, with widespread inequality and decades of political marginalisation (Vivekananda & Born, 2018, p. 1; Vivekananda et al., 2019). These challenges are further exacerbated by climate change (Vivekananda & Born, 2018, p. 1). The unpredictability of rainfall in combination with conflict and insecurity dynamics in the region contribute to a number of complex risks to security and stability. Vivekananda et al. (2019, p. 13) highlight that while the situation varies significantly between and within countries, the region as a whole faces four climate change–conflict risks:

1. **The dynamics of ongoing conflict that undermine people's ability to deal with the consequences of an increasingly variable climate.** The adaptive capacity of communities is being undermined by the large-scale displacement of people, restrictions to people's movement because of the conflict, and weaker social cohesion after years of violence.
2. **The challenge of increased competition for natural resources.** The combination of large numbers of displaced people, restricted access to resources, and diminishing land availability and quality has led to competition over natural resources in some locations. The mixture of climate change and conflict challenges has disrupted previous governance and restitution measures, which now either no longer exist or are too weak to defuse conflicts.
3. **The ongoing challenge of recruitment by armed opposition groups.** This takes place in the context of stark social and economic inequality, perceived lack of state legitimacy, increasingly vulnerable livelihoods, and the lure of financial incentives offered to potential recruits. Climate change compounds this risk as it undermines already fragile economies and livelihoods.
4. **Heavy-handed military responses to the violence that undermine communities' resilience and their ability to adapt to climate change.** Military measures taken by the region's governments in response to the crisis have not addressed the root causes of the

crisis. In fact, it has at times had the opposite effect, undermining livelihoods and climate change adaptation potential through blanket restrictions of access to certain areas as well as damaging the social contract through human rights abuses and perceived impunity.

Furthermore, Vivekananda et al. (2019, p. 13) emphasise that close attention needs to be paid to the root causes and drivers of the crisis – namely, increasing inequality, marginalisation, weak governance, social exclusion, dominant gender norms and inequalities, demographic shifts, and human rights violations – but that climate change is also an important factor.

Okpara, Stringer, and Dougill (2017) applied a climate–water conflict vulnerability index to identify and compare the village-level vulnerabilities of farming, fishing, and pastoral livelihoods in the **Lake Chad basin** to climate variability and conflicts over water. They surveyed 240 resource users (farmers, fishermen, and pastoralists) in seven villages on the southeastern shores of Lake Chad in the Republic of Chad to collect data on exposure, sensitivity, and adaptive capacity. Out of the three groups, pastoralists reported feeling most vulnerable to water scarcity, while farmers reported high vulnerability to conflicts and aggression due to the encroachment of pastoralists on farmland. This resource scarcity and disparity underlies approximately three quarters of all conflicts reported in the surveyed villages, according to the authors. Fishermen reported more vulnerability to climate-related losses but were better supported through social and political networks. Their results suggest that pastoralists are more vulnerable to climate variability and water conflict stresses in contrast to farmers and fishermen. However, Okpara et al. (2017, p. 363) caution against interpretation of these findings as indices 'can mask underlying multidimensional realities shaping vulnerability'.

Regional support and gaps

Brooks (2012, p. 13) sums up that development in the Sahel region 'needs to be based on flexible systems that can accommodate climatic oscillations between periods of relative humidity and aridity, perhaps lasting decades. Land tenure systems that lock development into particular patterns of land use are likely to be maladaptive in the medium to long term.' This will require reciprocal arrangements between farmers and herders, and flexible tenure systems that recognise and accommodate the highly dynamic nature of the Sahelian environment.

Krampe, Scassa, and Mitrotta (2018) in a SIPRI Insights on Peace and Security paper analyse how regional intergovernmental organisations are developing their capacities to deal with climate-related security risks. ECOWAS in West Africa has largely recognised environmental and natural resource issues in terms of peace and security within its discourse. However, the authors find that climate change is only marginally visible at ECOWAS and the organisation is facing challenges to the implementation of effective climate security policies; namely, (a) a lack of linking natural resources and environmental change to climate change, (b) capability constraint and donor dependency, and (c) a shortage of commitment from member states to act (ibid., p. 13). They argue: 'In order for ECOWAS to adequately respond, there is a need to increase internal coordination and to strengthen the cross-sectoral exchange of knowledge considering the cross-sectoral dimensions of climate change' (ibid., p. 13).

The recently released UN Support Plan for the Sahel (UN, 2018) is an instrument to foster coherence and coordination for greater efficiency and results delivery under the UN Integrated Strategy for the Sahel (UNISS) framework. It recognises that scaling up the absorptive capacity

of national and regional institutions to deliver on their mandates is crucial in addressing needs in the Sahel, and that coordination of efforts is also key. It identifies the following six priority areas:

1. Promoting cross-border and regional cooperation for stability and development;
2. Preventing and resolving conflicts,violent extremism and crime; and promoting access to justice and human rights;
3. Promoting inclusive and equitable growth and increasing quality access to basic services;
4. Building resilience to climate change, improving management of natural resources, and decreasing malnutrition and food insecurity;
5. Promoting access to renewable energy; and
6. Empowering women and youth for peace and development in the Sahel.

Ferdi (2016) argue for reinvesting in neglected sectors in the Sahel such as education, family agriculture, and mobility of people and goods, to help re-establish stability. The organisation's recommendations include:

- Invest in primary education.
- The share of aid devoted to agriculture, forestry, and fishing in the Sahel is relatively low. However, awareness of the importance of agriculture for the Sahel has been increasing. The agricultural potential of the Sahel is significant, provided obstacles to family agriculture can be addressed. In this respect, agroecology is essential and must adapt to the diverse characteristics of the regions involved.
- Re-establish the circulation of people, goods, and ideas, which drove the wealth of the Sahara in the past. This is especially in relation to towns is **northern Niger** and **Mali**, which need to be designed and organised as connection points between sub-Saharan Africa and the Maghreb (Ferdi, 2016, pp. 58–72).

Hesse et al. (2013) put forward the following suggestions as being key considerations in the support for climate-resilient livelihoods in the Sahel, which partly reflect the recommendations from Ferdi (2016) above:

- Explicitly recognise variability, instability, and unpredictability as inherent features of the environment.
- Strengthen existing production systems that respond to variability by supporting livestock mobility at scale and scaling up sustainable land management practices within dryland farming.
- Build resilience through improved development policy and practice by: securing land rights and tenure security; strengthening local governance through decentralisation; the proactive development of small towns; providing appropriate and accessible basic services; refocusing social protection schemes; and embracing market-based approaches for asset protection (Hesse et al., 2013, p. 5).

Vivekananda et al. (2019, pp. 14–16) suggest 10 positive interventions in the **Lake Chad basin** that should be implemented now to start addressing the myriad security, development, and climatic challenges:

1. Build social cohesion within and among communities.
2. Support resilient livelihoods that go beyond the simple provision of jobs.

3. Broaden people's access to basic services such as education, health, water, sanitation, and energy.
4. Address gender inequality and violations of human rights.
5. Support communities to adapt to climate change and improve natural resource management.
6. Improve information and communication technologies in the region.
7. Provide better climate and hydrological information.
8. Invest in governance and institutional development.
9. Critically review and adapt the tactics used to combat armed opposition groups.
10. Support climate-proof economic growth and development.

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