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Climate change and livelihoods in the Sahel: revisiting nexus and focusing on endogenous knowledge

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Abstract

Climate change effects will be especially grave in the Sahel zone in the next following decades (UNEP, 2011). Temperatures in the area will increase more than the global average -1,5°C- and sustained droughts and desertification will affect the livelihoods of millions of people, according to IPCC (2019). The logical reasoning is clear: the degradation of the soil aggravates food insecurity, led to instability and violent extremism and drives displacement and human mobility (Myers, 1995). This statement evokes a “threat multiplier” based on climate change-fragility-conflict and migration nexus (Homer-Dixon, 1994). But questions arise: Is this hypothesis accurate? In which way are these phenomena related? Which are the local strategies to cope the environmental degradation?

The EU focuses on the Sahel from this security perspective considering that climate change will intensify the instability of the zone with terrorism expansion, food crises extension and migration flows rising (Barnett & Adger, 2007). Some studies demonstrated, however, that parts of the Sahel have been “re-greening” (Hutchinson et al., 2005). Other predictions indicate that an increase of rainfalls as a consequence of climate change could turn this dry region into a very wet one (Schewe & Levermann, 2017). These countervailing studies are often ignored or undervalued by policymakers and international organizations. This paper deepens in the impact of climate change on livelihoods in Niger and Mali, mostly based on rain-fed agriculture, nomad and transhumance activities, avoiding neo-Malthusian arguments to explain climate risks in the area. From a political ecology approach, the study focuses on local coping strategies to environmental stressors such as mobility, one of the main endemic characteristics of the Western Sahel zone. The article also values the importance of indigenous knowledge and points how to incorporate it in current policies.

Key words: climate-change, food security, conflict, migration, Sahel



Biographical information:

I am a researcher of the Horizon 2020 CASCADES Project at CIDOB (Barcelona Centre for International Affairs) about climate change, food security and conflict in Western Sahel. PhD in Social Anthropology from the University of Barcelona (UB), my thesis about trans-Saharan mobility between Niger and Libya granted the 2017 Extraordinary Doctoral Prize of UB. I am also Associate Professor in the Autonomous University of Barcelona (UAB). My main research lines are: mobilities within Africa, return migration, borders and identities in mobility as well as climate change, food security and conflict in the Sahel.

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Introduction

Niger and Mali belong to the poorest countries of the world and they will suffer intensely climate change effects (IPCC, 2019). Rainfall variability, increasing temperatures and extreme weather events, mainly droughts and flooding, are the most relevant effects of global warming in the area (Souley, 2017). Climate change impact in the Sahel is not a prediction but rather a fact. However, too often policy discourses evoke climate change consequences as main causes of structural food crises, conflicts or migration (Rüttinger et al. 2015). Environmental degradation and climatology are surely drivers of poverty, hunger and instability, but these phenomena are complexly intertwined with several other factors -political, social, economic, cultural,...- (Verhoeven, 2011).

European narratives about the Sahel are completely based on security and migration “threats”, “risks” and “dangers”. In recent decades, climate change has joined these discourses of fear as a “threat multiplier” (CNA, 2007). All the stakeholders contributing to create public opinion -journalists, scholars, international institutions and NGOs- address frequently the topic from top-down approaches. Europe usually tries to provide solutions in terms of adaptation and resilience strategies. Yet, it diminishes that Sahelian populations have faced for centuries all sort of adverse weather conditions. This is a very relevant local knowledge, which deserves to be considered (Nyong et al. 2007). The contrary, it only shows arrogance and shortsighted strategies doomed to failure.

This paper highlights human mobility in the Sahel region as an important local coping strategy not only to climate conditions but also influenced by other political, economic and social factors (De Haas et al., 2020). Sahelian populations have historically incorporated migration as a livelihood for both pastoralist and farmers. So, today it continues being like although increasing sedentary policies could threaten such types of living (Hoffman et al. 2017). The article seeks to value local knowledge in a comprehensive manner from agricultural skills to livestock-keeping and other income-earning activities, which have become sustainable livelihoods in continuous adaptation.

The paper begins by reviewing the climate change, food insecurity, conflict and migration nexus focusing in the Sahel region. The next section tackles the different livelihoods of Sahelian populations with special emphasis on human mobility. The

article continues addressing specific local knowledge strategies to cope climate change impacts. The conclusion supports the need to value local knowledge in policy making in order to achieve sustainable and effective development.

Methods and limitations

This research bases on online semi-structured interviews with key experts and local stakeholders such as pastoralist and farmer organizations; national and regional academic centres, public institutions as well as grey literature. It is part of the EU funded project called CASCADES in the framework of H2020 programme and due to COVID global situation it has several limitations in terms of scope, data and methodology. Pandemic restrictions provoked a reconfiguration of the physical predicted research based on a representative survey, focus-groups and personal interviews. The survey and interviews were maintained but shifted to an online elite survey more exploratory than representative. This article, however, does not include the results of the survey, which is still on-going.

Climate change food insecurity and conflicts: revisiting nexus in the Sahel

Many authors have tackle the nexus between climate change-food security and conflict in recent decades (Scheffran et al. 2012). The main consensus is the complexity and the interrelation of several factors beyond climatology (McMichael, 2014). There are two principal trends: those who find a primary connection between climatic stress and insecurity (Hendrix & Salehyan, 2012) and those who reject it or minimize the incidence of climate drivers in conflict (Sletteback, 2012). The first group exposes the Syria war and the Darfur conflict as primary examples of “climate wars” with a direct and relevant link between climatic stressors and conflict (Mazo, 2010). The second one defend “the extremely weak” link between those phenomena (Selby, Dalhi and Hume, 2017). A great majority of policymakers have assumed the security discourse of “threat multiplier” firstly evoked by military agencies (Hsiang et al. 2011). Verhoeven (2011) associates this link to “naivety and securitization” narratives, which present very simplistic and Neo-malthusian discourses about climate change.

These statements are very frequent addressed to the central Sahel ¹, characterized by high rates of poverty, conflicts, displacement and extreme weather patterns, mainly droughts but increasingly flooding (Tschakert et al. 2020).

According to IPCC (2019), this area is and will be among the most affected by climate change in the world not only because of its climatic dependency but also due to its economic and political vulnerability (Snorek, 2014). Niger and Mali are among the poorest countries of the world, both located in semi-arid zones with annual rainfalls from 250 to 600 in northern parts; and 450 and 800 per year in the south. In recent years, the total volume of rainfall fluctuates more year on year, with a longer dry season and a shorter rainy season, normally lasts from May to October. The lean season -the phase between harvests- seems to aggravate, even if Earth Observation studies show a positive general trend in precipitations and vegetation greenness over the last decades. Droughts and desertification are present, but the popular idea of advancing desert seems not to be confirmed by evidences, at least not in the whole region (Dardel et al. 2014). Future climate predictions are not conclusive and differ depending on climate models, periods and geographical zones (Hulme, 2000; Nicholson, 2013). Academic consensus only arises on rainfall variability, with more droughts and floods and rising temperatures, 1,5° faster than the global average (Fensholt et al. 2017; IPCC, 2019).

Lake Chad shrinking is often presented as one of the main climate change impacts in the zone. Conversely, academic studies show ground water of the lake, which accounts for over 80% of the Basin, truly rising (Vivekananda et al. 2019). The basin contracted significantly due to the drought in the 1970s and 1980s but today the surface water storage is stable. So, “the impact of climate change is far more complicated and uncertain than the evocation of a direct linkage between global warming and surface shrinkage insinuates”, according to Nagarajan et al. (2018). This is an example of simplistic approaches, which ignore socio-economic, historical and political dynamics (Kloos et al., 2013). There are so many conditioning factors in conflict, food security and environmental degradation such as population growth, land use and management, technology access, international dependency, corruption, weak institutions, global food prices, past grievances, climatic conditions... (Benjaminsen et al. 2012; Olivier de Sardan, 2005).

In the Sahel, around 14,4 million people would be at risk of food insecurity in Burkina Faso, Niger and Mali during 2020 (Fewsnet, 2020). Thousands of people are displaced in the Liptako-Gourma region in the eastern part of Burkina Faso, southwestern Niger and southeast central Mali (UNCHR, 2020). Communal intra and inter disputes between farmers and pastoralist populations have increased in the

last decade (Théroux-Bénoni & Assanvo, 2016). Some reports try to explain these situations as direct or indirect consequences of climate change impacts. Indeed, climatology and environmental factors surely have a role, but it is not possible to ignore that hunger and conflict are essentially political (Sen, 1999). Food insecurity, for instance, is related to accessibility, sufficiency, security and sustainability, which mean the importance of resource management (FAO, 2019). In this sense, the well-known discourse about the Sahel refers to population tensions due to the scarcity of natural resources, land pressure and population growth, but diminishes that growing incomes could also drive escalating conflicts (ICG, 2020). Why? Because their redistribution and allocation ultimately matter, and a lot.

Mali and Niger: local livelihoods as adaptation strategies

Living in the Sahel means adapting to climatic harsh weather conditions. Not only now because of climate change impacts but rather due to dryness, sand and warmth of the Sahara Desert and the aridity of the Sudano-Sahelian zone (Hendrix & Salehyan, 2012). Even if one main difficulty is the lack of past and future reliable climatic data, there is a consensus about the hardness of living conditions in this semi-desert area with only two main water sources: the Niger River and the Lake Chad, beyond groundwater reserves that are abundant. Subsistence agriculture, pastoralism and less fishing are the most important livelihoods. Primary sector employs more than 70 percent of the population in Mali and Niger. Agriculture bases on low productivity of agricultural yields, lack of irrigation and mostly rain-fed cereals crops -sorghum, millet, cowpea- but also cotton, corn, sugarcane as well as increasingly rice culture. Livestock is extensive and intensive and fishing develops mainly in inner delta of Niger River, in central Mali and the Lake Chad. Cross-border trade and mining are also relevant incomes. Uranium in Niger and gold in Mali are exploited by multinational enterprises² (Grégoire, 2011).

Water access and management are crucial in these dry lands (Barbier et al. 2009). Wetter areas are located on the south and drier on the north. This entails a visible stratification of livelihood systems with northerly cultures tend towards pastoralism and southerly practice sedentary arable rain-fed farming (Mounkaila & Boyer, 2010). Mobility thus is a primary economic practice and adaptation strategy to climatic factors (McLeman, 2009). In a way, migration could be always considered as a human response to climatic hazards even if this should be qualified (Black et al. 2011). Indeed migration is intertwined by several factors, structural, relational and

individual (Faist, 2018). Sahelian populations characterize by different forms of movement ranging from pastoral nomadism, transhumance, rural-urban mobility and seasonal out-migration, known as *exode* (Boyer, 2019). Mobility is more linked to wealthier households than to poorer families, actually, pastoralists even reduce their movements during droughts (Hampshire, 2002). In that sense, movement is here a diversification of financial capacities rather a survival strategy (van der Geest, 2011).

These mobilities are mostly inter and intra regional and the furthest address to southern countries such as Ivory Coast, Nigeria or Ghana or Maghrebi like Algeria and Libya (Molenaar, 2017)³. They are not all related to pastoralist because indeed farmers also move both to the south and to the north (Puig, 2017). Agricultural expansion and southward movements of pastoral communities visualizes the collisions of interests between communities that lead to open conflicts (HRW, 2018). These mobilities are not only forced displacements caused by conflicts, which leave thousands of people fleeing violence within the country or around the region, mainly in Liptako Gourma area. It does exist other sorts of migration as a way of living that when they are hindered can also lead tensions in a vicious circle of cause-effect. It is the case of non-respect of the established herder corridors or, in many occasions, also the Economic Community of West African States (ECOWAS) free movement protocol (UNOWAS, 2018). Hence, mobility is not an indigenous knowledge but rather a historical coping strategy to environmental conditions and unequal management of natural resources. However, international stakeholders, especially the European Union, prioritize agricultural adaptation practices and sedentary policies (Benjaminsen & Ba, 2018). So, the externalization of borders affects directly the intra regional mobility with more road controls, obstacles and small corruption payments along the route both for migrants in transit to the North and Sahelian populations (Puig, 2020). It is a flagrant incoherence of European policies that, on the one hand, claim to facilitate adaptation strategies to climate change and, on the other, they work hard to hamper them (Venturi, 2017).

Adaptation and resilience: to incorporate the indigenous knowledge

After a long and hard fight in international forums, African countries achieved to prioritize adaptation policies instead of mitigation strategies imposed by Western powers. However, the majority of them combine both plans at the same time, because they contribute much less to global warming with the lowest greenhouse gas emissions of the world. Sahelian countries are a good example of it due to its

low industrialization rates and, therefore, the predominance of traditional practices to deal with droughts and extreme weather patterns (Brooks, 2004). Indigenous, traditional or local knowledge, although there may be nuances in those concepts, have been defined as institutionalized local knowledge that has been built upon and passed on from one generation to the other by word of mouth (Osunade, 1994). In the Sahel, the local knowledge have been applied in different terms from weather forecasting to vulnerability assessment, water storage, agricultural techniques or livestock practices (Nyong et al., 2007). Just as an example, Sahelian farmers have applied several soil conservation systems like *half-moon* and *zai* and systems of gathering, prediction, interpretation and decision-making in relation to weather (Zougmoré et al., 2018). They are the ones who know their land best, and those who suffer or benefit in the first person from the result of crops. So, they are the most interested in making their production more profitable as they have done it throughout last centuries. Local knowledge thus contributes to mitigation with the use of organic fertilizers and promotion of fallow system of cultivation, which encouraged the development of forests (Sendzimir et al. 2011). Although in recent times the practice of fallows have been substantially reduced due to population growth and other conditioning factors such as land grabbing or conflicts, it is part of traditional knowledge. Forests are important for traditional institutions and some practices based on agro-forestry are very expanded with effective results on carbon sequestration (Zougmoré et al. 2018).

Concerning pastoralism, local strategies such as the use of emergency fodder in times of droughts, multi-species composition of herds to survive climate extremes and culling of weak livestock for food during periods of drought are often practiced (Nyong et al. 2007). Depending on drought or wetter periods, pastoral communities tend to breed cattle, sheep or goat husbandry, as the feed needs of goat are less than the others (Oba, 1997). Likewise, pastoralist's nomadic circular mobility tries to avoid overgrazing and manages range resources available. It is thus a local adaptation strategy to environmental conditions (Hummel et al. 2012). At this regard, integrating local knowledge into current policies against climate change is crucial. It does not mean promoting these experiences in isolation but in complementarity to modern globalised scientific knowledge, according to Zougmoré (2020)⁴.

One interesting approach trying to combine both knowledges in the last decade is the **climate-smart agriculture**. This is an innovative and integrated model initially

promoted by FAO (2013), which seeks to introduce a set of agricultural tools and policies embedded in many indigenous practices such as fallow systems, crop rotation and water harvesting practices. This model tries to pool different activities such as agriculture, agroforestry and livestock breeding in the same plot of land with the main purpose of improving food security. The climate-smart agriculture takes the farmer-managed al regeneration as one of main practices, promoting the planting of trees and increasing soil productivity (Weston et al. 2015). With a high adoption in countries like Niger, especially in Maradi region, this method also contributes to tackle at the same time climate change mitigation and adaptation strategies (Weston et al. 2015).

The climate smart-agriculture endorses solar-powered drip irrigation systems, climate information systems and high yielding and drought resistant needs. Equally, it privileges organic fertilizers and highlight the advantages of the whole farming chain. This approach is a good step in order to build synergies between global/modern knowledge and traditional practices. Yet, although its potentialities it still lacks the appropriation of national, regional and sometimes also international organizations, even if it is increasingly expanding in Mali and Niger (Lipper et al. 2014). The climate smart-agriculture is hence a first attempt to integrate this local knowledge, which had been excluded from western solutions and recommendations in last decades, into climate change and agricultural policies.

Conclusions

The aim of this paper was first to review the most common public discourses about climate change impacts in the Sahel. For this reason, it revisits the academic literature about climate change-food security, conflict and migration highlighting the complexity in the interrelation of these phenomena (Scheffran et al. 2012). The only academic consensus is about rainfall variability, rising temperature and extreme weather events such as droughts and floods. Desertification is a fact in some areas but not in all the Sahel, where there is also a “re-greening” (Fensholt et al. 2017). The need to question some official narratives go in parallel to the demand of de-construct the most frequent approaches about adaptation and resilience in the region.

To do so, we emphasize human mobility as a one of the main local coping strategies not only to environmental factors but also as an economic diversification plan. This

is important to highlight the incoherence of European policies, which try to promote adaptation and resilience to climate change impacts and they hamper at the same time human mobility within the region. In this sense, the article seeks to value indigenous knowledge as an effective way to promote sustainable livelihoods.

Local expertise has gained recognition in recent years as an important vector to achieve positive development results, but it is necessary to give it not only formal rather real promotion. Some traditional agricultural techniques such as *zai* or *half-moon* have been already incorporated into current development models. The climate smart-agriculture is the best example of it with the integration of modern innovative systems and local know-hows. However, although this model could be effective in its role of promoting food security from endogenous processes, it is still a minority and little expanded. Most of the experts and institutions interviewed consider local knowledge as a fundamental aspect to promote development. Nevertheless, it is still being relegated as a subordinate element in development strategies.

The most conventional science continues to analyze vulnerability factors in the Sahel as endogenous issues and addresses possible solutions from exogenous approaches. This shows top-down perspectives instead of bottom-up methods. This is tremendously biased, vain and most of all ineffective. This type of outlooks ignore not only the colonial and the neocolonialism footprint but also the counterproductive effects that some of these exogenous policies can have on the ground. We are referring here especially to migration containment policies with negative consequences on internal mobility, but also the imposition of certain products and techniques not very adapted to the climatic and land conditions. For example, the promotion of rice crops irrigation.

It is necessary thus to really trust the efficacy of local knowledge and value the participatory bottom-approaches. It is not only about working for social justice but a way to be more effective and efficient in measures promoted. It is important to note that of course not all indigenous practices are beneficial to the sustainable development or can provide a right solution for a given problem. But they should be scrutinized for their appropriateness just as any other technology, as Nyong et al. (2007) express. To finish, it is equally important to prioritize the expertise of local scientists and institutions, much closer to the problems and populations needs. The lack of certain sovereignty is clearly perceived in the Sahelian academy, also

depending on international funds. Therefore, it is imperative to take into account this vast and rich contributions of local experts and institutions, not only related to traditional knowledge but also to global modern knowledge. We should definitely decolonize our minds from Eurocentric paradigms thinking very well what our added value could be in order to provide knowledge not subtracting already acquired expertise.

References

Barbier, B. ; Hama Maiga, A. ; Mahe, G. ; Paturel, J.E. (2009). Le retour des grands investissements hydrauliques en Afrique de l'Ouest, *Géocarrefour*, 84, 31-41.

Barnett, J. & Adger, N. W. (2007). Climate change, human security and violent conflict, *Political Geography* 26, 639- 655

Benjaminsen, T. A; Alinon, K.; Buhaug, H. & Buseth, J. T. (2012). Does climate change drive land-use conflicts in the Sahel?, *Journal of Peace Research* 40, 1, 97-111

Benjaminsen, T. A. & Ba, B. (2018). Why do pastoralists in Mali join jihadist groups? A political ecological explanation, *The Journal of Peasant Studies*.

Black, R.; Adger, N.; Arnell, N.; Dercon, S.; Geddes, A. & Thomas, David (2011). *Migration and Global Environmental Change: Future Challenges and Opportunities*. Foresight, Government Office of Science, London.

Boyer, Florence (2019). El *exodant* en Níger : ¿una figura frustrada por las políticas migratorias contemporáneas? In: Oriol Puig & Albert Roca: *El Sahel de las gentes: más allá del síndrome de la seguridad*, Cidob monografía

Brooks, Nick (2004), Drought in the African Sahel: long-term perspectives and future prospects, Tyndall Centre for Climate Change Research.

CNA Military Advisory Board (2007), *National security and the threat of climate change*. Alexandria, VA: Center for Naval Analysis Corporation.

Dardel, C., L. Kergoat, E. Mougin, P. Hiernaux, M. Grippa, and Tucker, C. J. (2014). Re-greening Sahel: 30 Years of Remote Sensing Data and Field Observations (Mali, Niger), *Remote Sensing of Environment*, 140, 350–364.

De Haas, Hein; Castles, Stephan & Miller, Mark J. (2020). *The Age of Migration*, Red Globe Press.

FAO (2013). *Climate-smart Agriculture Sourcebook*. Food and Agricultural Organization of the United Nations, Rome, Italy.

FAO (2019) *The state of food insecurity and nutrition in the world. Safeguarding against economic slowdowns and downturns*. Rome: Food and Agriculture Organization of the United Nations

Faist, T. (2018). The Socio-Natural Question: How Climate Change Adds to Social Inequalities. *Journal of Intercultural Studies* 39, 2, 195-206.

Fensholt, R.; Mbow, C.; Brandt, M. & Rasmussen, K. (2017). Desertification and Re-Greening of the Sahel. *Climate Science*

Fewsnet (2020) *Niger: Food insecurity remains in crisis due to the worsening security situation*. Food security outlook, April.

Fewsnet (2020) *Mali: Increase in food insecurity due to damage to livelihoods caused by COVID19*. Food security outlook, April.

Grégoire, Emmanuel (2011). Niger: a state rich in uranium, *Herodote* 142, 3, 206-225

Hampshire, K. (2002). Fulani on the move: seasonal economic migration in the Sahel as a social process. *The Journal of Development Studies* 38, 5, 15-36

Hendrix, C. & Salehyan, I. (2012). Climate change, rainfall, and social conflict in Africa. *Journal of Peace Research* 49, 1, 35-50.

Hoffman, Anette; Meester, Jos & Nabara, Hamidou Manou (2017) *Migration and markets in Agadez. Economic alternative to migration industry*. Clingendael Institute.

Homer-Dixon, T. (1994). Environmental scarcities and violent conflict: Evidence from cases. *International Security* 19, 1, 5-40.

Hsiang, S.; Meng, K. & Cane, M. (2011). Civil conflicts are associated with the global climate. *Letters*, 476, 438-441.

Human Rights Watch (2018). *We used to be brothers. Self-defense groups abuses in Central Mali*, December.

Hulme, Mike (2000). Climate perspective on Sahelian disiccation, 1973-1998. *Global Environmental Change*, 1-11.

Hutchinson, C.F.; Herrmann, S.; Maukonen, T. & Weber, J. (2005). Introduction: The 'greening' of the Sahel. *Journal of Arid Environments*, 63, 535–537.

International Crisis Group (2020). The Central Sahel: scene of New Climate Wars? *Crisis Group Africa Briefing* 154, April.

IPCC, 2019: Summary for Policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Pan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press.

Kloos, J., Gebert, N., Rosenfeld, T., and Renaud, F. (2013). Climate change, water conflicts and *human security: Regional assessment and policy guidelines for the Mediterranean, Middle East and Sahel*, (Report No. 10), United Nations University: Institute for Environment and Human Security.

Lipper, L., Thornton, P. K., Campbell, B., Baedeker, T., Braimoh, A., Bwalya, M.,...Torquebiau, E. F. (2014). Climate-smart agriculture for food security, *Nature Climate Change*, 4, 1068–1072.

Mazo, J. (2010). Climate conflict –How global warming threatens security and what to do about it. Abingdon: Routledge

McLeman, Robert A.; Hunter, Lori M. (2009). *Migration and adaptation to climate change*, IBS

McMichael, C. (2014). Climate Change and Migration: Food Insecurity as a Driver and Outcome of Climate Change-Related Migration. In: Malik A., Grohmann E., Akhtar R. (eds) *Environmental Deterioration and Human Health*. Springer, Dordrecht

Myers, Norman (1995). *Environmental exodus: an emergent crisis in the global arena*, Climate Institute

Molenaar, Fransje (2017). *Turning the tide. The politics of irregular migration in the Sahel and Libya*, The Hague: CRU Report

Mounkaila, H. & Boyer, F. (2010). Partir pour aider ceux qui restent ou la dépendance face aux migrations. L'exemple des paysans sahéliens, *Hommes et Migrations*, 1286, 214-221.

Nagarajan, C.; Pohl, B.; Rüttinger, L. et al. (2018). *Climate-Fragility profile: Lake Chad Basin*, Adelphi

Nicholson, S. (2013). The West African Sahel: A Review of Recent Studies on the Rainfall Regime and Its Interannual Variability, *ISRN Meteorology*

Nyong, A.; Osman-Elasha, B. ; Adesina, F. (2007). The value of indigenous knowledge in climate change mitigation and adaptation strategies in the African Sahel, *Mitigation Adaptation Strategies Global Change*, 12, 787-797.

Oba G (1997). Pastoralists' traditional drought coping strategies in Northern Kenya. A Report for the Government of the Netherlands and the Government of Kenya, Euroconsult BV, Arnheim and Acacia Consultants Ltd, Nairobi

Olivier de Sardan, J.P. (2005). *Anthropology and Development*, London, Zed Books

Osunade, M.A. (1994). Indigenous climate knowledge and agricultural practices in Southwestern Nigeria. *Malays J Trio Geogr*, 1, 21-28

Puig, O. (2017). *Libya Kaman Turai. El Dorado libio: los retornados nigerinos en Niamey*. PhD Thesis. Department of Social Anthropology. University of Barcelona.

Puig, Oriol (2020). *The Sahel : Europe's other border*. CIDOB Nota Internacional.

Rüttinger, L. et al. (2015). *A New Climate for Peace. Taking Action on Climate and Fragility Risks*. Berlin/London/ Washington/Paris: Adelphi, International Alert, The Wilson Center, EUISS

Selby, J.; Dahi, O.; Fröhlich, C. & Hulme, M. (2017). Climate change and the Syrian civil war revisited. *Political Geography*, 60, 232-244.

Sendzimir, J.; Magnuszewski, P.; Reij, C. (2011). Rebuilding resilience in the Sahel: greening in the Maradi and Zinder Regions of Niger. *Ecology and Society*,

Scheffran, M. B. et al. (2012) (eds.) *Climate Change, Human Security and Violent*

- Conflict: Challenges for Societal Stability*, 91–131, Berlin: Springer.
- Schewe, J. & Levermann, A. (2017). Non-linear intensification of Sahel rainfall as a possible dynamic response to future warming, *Copernicus publications* 8, 3, 495-505
- Sen, Amartya (1999) *Development as Freedom*, Oxford University Press, Oxford
- Slettebak, R. T. (2012). Don't blame the weather! Climate-related natural disasters and civil conflict. *Journal of Peace Research* 49, 1, 163-176
- Snorek, J.; Stark, J. & Terasawa, K. (2014) *Climate change and conflict in the Sahel. A policy brief on findings from Niger and Burkina Faso*. USAID
- Souley, K. (2017). Perceptions et strategies d'adaptation à la variabilité et au changement climatique de la population du village de Baoucheri dans la Commune Rurale de Kolleram (Département de Mirriah), *International Journal of Innovation and Scientific Research*, 28, 2, 171-179
- Thérroux-Bénoni, L.A. & Assanvo, W. (2016). *Mali's Young Jihadists: Fuelled by Faith or Circumstance?* Policy Brief, Institute for Strategic Studies (ISS), Dakar.
- Tschakert, P.; Sagoe, R.; Ofori-Darko, G. & Nii Codjoe, S. (2020). Floods in the Sahel: an analysis of anomalies, memory and anticipatory learning. *Climatic Change* 103, 3, 471-502
- UNCHR (2020) *Tillabéri and Tahoua regions –Malian refugees and Internally Displaced People (IDPs)*. Factsheet
- UNEP (2011) *Livelihood security. Climate change, migration and conflict in the Sahel*.
- UNOWAS (2018). *Pastoralism and security in West Africa and the Sahel*. UNOWAS Study. August 2018.
- Venturi, B. (2017). *The security migration-development nexus revised: a perspective from the Sahel*, IAI
- Verhoeven, G. (2011). Climate Change, Conflict and Development in Sudan: Global Neo-Malthusian Narratives and Local Power struggles. *Development and change*, 1-29.

van der Geest, K. (2011) North-south migration in Ghana: What role for the environment? *International Migration*, 9 49(S1): 69-94.

Vivekananda, J.; Wall, M.; Sylvestre, F.; Nagajaran, C. (2019) *Shoring up stability. Addressing climate and fragility risks in the Lake Chad region*. Adelphi.

Weston, P.; Hong, R.; Kaboré, C.; Kull, C.A (2015). Farmer-managed natural regeneration enhances rural livelihoods in dryland west Africa. *Environ Manag*, 55, 14020-1417

Zougmore, R. B. ; Partey, S. T.; Ouédraogo, M.; Campbell, B. M. (2018). Developing climate-smart agriculture to face climate variability in West Africa: challenges and lessons learnt. *Journal of Cleaner Production*, 285-295

¹ Here, we include mainly Mali, Niger and Burkina Faso.

² Niger it is the fourth largest exporter of uranium in the world, mainly exploited by France

² Niger it is the fourth largest exporter of uranium in the world, mainly exploited by France through its international company Areva, now called Orano. However, Niger is completely energetically dependant, especially from Nigeria. Gold is the largest source of Malian exports -the third largest producer in Africa-, after cotton, which was historically the basis of Mali's export industry.

³ Only a small minority of Sahelian communities migrate to Europe.

⁴ It bases on online interviews, although these explanations can be found in some articles of this local expert.