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The Sahel Crises: Diversity of Underdevelopment and Empowerment of Renewable Energy Sources

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Abstract

Based on the results of comprehensive interdisciplinary research on the Sahel crises, this paper aims to outline them within the diversity of underdevelopment and to build for sustainable development by empowerment of renewable sources of energy. The diversity of underdevelopment was explained under the economic dimension, population growth, environmental degradation, and international intervention. The results suggest for their imperative influences on the Sahel crises which could be resolved by the empowerment of renewable sources of energy.

Keywords: crises, the Sahel, underdevelopment, energy empowerment

1. Introduction

The Sahel extends over 5,500 km length and 450 km width south of the Sahara, from the Atlantic Ocean to the Red Sea, with an area of approximately 2.5 million km² (Le Houerou, 2006), and accommodates over 150 million people (Dieng, 2021) living in Mauritania, Senegal, Mali, Upper Volta, Niger, Chad, Nigeria, Eritrea and Sudan (Figure 1). It has a fragile ecosystem characterized by high insolation rates and with 52 agro-ecological zones (Yobom, 2020), easily affected by climatic changes and human activities (Holthuijzen, 2011).

The crisis which is defined as “stage or a sequence of events at which the trend of all future events is determined, or a condition of instability or danger leading to a decisive change” (www.dictionary.com), is experienced by the Sahel. These crises were viewed by this research, within diversity of underdevelopment based on a comprehensive interdisciplinary

research on the Sahel. These crises can be resolved by taking advantage of the potentiality of the Sahel in producing renewable energy, with emphasis to solar energy.



Figure 1: The Sahel location and extension

1. The Sahel crises

The complexity of the Sahel crises have been detailed by reports of the International organizations such as, there are “huge numbers of people in the Sahel face a complex and interlinked crises ([www.unocha.org/publications/report- 6 June 2024](http://www.unocha.org/publications/report-6-June-2024)), that could become “a problem for the world’ ([www.voanews.com-May 29, 2024](http://www.voanews.com-May-29-2024)), and “makes it “a chokepoint, affecting the continent’s security” (www.fpri.org-7/5/2024), with “chronic levels of malnutrition, food insecurity, poverty and inequality “(www.wfp.org); and being “marked by recurring periods of drought, leading to food and nutritional insecurity and the repeated pastoral crises, resulting in a decline in livestock” (www.vsf-suisse.org /2024/05/17/).

In the West and Central Sahel “more than 33 million people need live-saving assistance in 2022, an increase of more than 25% over the last five years” ([www.who.int/emergencies/situations- 10 June 2022](http://www.who.int/emergencies/situations-10-June-2022)); and “nearly 55 million people will have difficulty of feeding themselves during the upcoming lean season from June to August 2024” (www.openglobalrights.org- May 22, 2024); simultaneously with “some 17 million people in Burkina Faso, Mali and Niger need humanitarian assistance” (www.iom.int 12 January 2024; www.wfp.org; www.rescue.org- August 17, 2023), in addition to “an estimated 3.7 million people have been internally displaced” (<https://www.unrefugees.org/emergencies/sahelcrisis>, (www.rescue.org-August 17, 2023, www.unhcr.org/news- 7 June 2024), and “the ongoing conflict in Sudan is impacting food security and migration across West and Central Africa, depleting scarce resources, and exacerbating inter-communal tensions” (<https://news.un.org/en/story/2023/07/11>).

The Sahel also faces “rise in armed conflicts which have led to numerous human rights violations” (www.vsf-suisse.org /2024/05/17/), and “violence against children” (UNICEF report-<https://news- May 2024>), which “has led to a five-fold surge in the number of children forced from their homes over the past five years in three West African countries” (www.savethechildren.net- 21 March 2024).

These reports, on the view of this research, have confirmed the Sahel crises within diversity of underdevelopment that can be explained with emphasis on the four following dimensions.

2. Diversity of Underdevelopment

2.1. The economic dimension

The Sahel has a negative image which is a stranglehold on the great potential for development (Mbow et al. 2021), because its performs Low levels of economic development (Yobom, 2020), with a widening gap between exponential available resources and population growth (May et al. 2017), although the Sahel botanical diversity and capacity can support high concentrations of humans and livestock, (Cooper, 2018) with farmer-managed and agro-environmental transformation that enable for land rehabilitation and agricultural intensification (Gray et al. 2020), accompanied with new potential users of land and vegetation combined with the weight of the market (Raynaut,1996).

The productivity of the Sahel depends upon a single unpredictable annual rainy season (Cooper, 2018), with high vulnerability to recurring drought and the threat of long-term land degradation (Eaquist et al. 2009), with continual degradation of vegetation due to land use temporal dynamics and land saturation which resulted

in farmer-herder conflicts and drop in grazing areas (Yacouba et al. 2016), accompanied with transboundary animal diseases which constantly reduce the region’s capacity to achieve food self-sufficiency and pose impediment on trade in livestock and their products (Kardjadj, 2019), which contributed into food insecurity and prevalence of poverty (Baba, 2014).

Migratory pastoralists have traditionally lived with their cattle in balance with the vegetation, however, the policies and development interventions to control pastoralism have been largely unsuccessful due to “the fundamental misfit between these normative concepts and the reality of dry land ecosystems and pastoral society” (De Bruijn et al. 1998) and preservation of the indigenous peoples of nomadic life and organizational structure (Eric, 2007), which is contradicting the States and development agencies who conceive territory as a resource that must drive the specialization of production (Retaillé et al. 2011). This is besides the isolation of pastoralists from other populations after cattle began to spread, or merge with other populations, and domestication of sorghum and pearl millet and with the subsequent spread of agriculture (Černý et al. 2023), influenced by the human ecology of semi-arid ecosystems (Watts, 1985).

The excessive presence of the Sahel States in densely populated areas, with ignoring of low-density areas, have generated areas conducive to all kinds of trafficking and terrorism (Bassou, 2017), where the Sahel’s communities broadly did not recognize economically motivated trafficking to be criminal acts (Reitano et al. 2014), with the prevalence of informal governance (Bøås, 2015), and bad governance and considerable economic, social and environmental disparities which has “fostered the growth of violent extremism, armed militancy and the proliferation of transnational crimes in the region” (Dentice, 2018).

The Sahel witnesses less equitable current changes in land tenure largely for capitalist farming (Bonte,1999), and modes of land use which show that the type and intensity of exploitation of natural resources varies geographically (Raynaut, 2001), while adaptations have enabled an environmentally sustainable land use within the context of a rising population and growing scarcity of natural resources (Mazzucato et al. 2002). This is in situation of long time clash between the real inhabitants of the land and the newcomers (Besenyó, 2011), accompanied with increasing agro-pastoral activities which caused strong changes led to competition for space between farmers and breeders during rainy seasons (Ouedraogo et al. 2016), simultaneously with disintegration of traditional society (Gila ??) with processes of modernization, introduction of agriculture, sedentarization, urbanization and implementation of new strict political borders. This has fractured the open space societies which used to move within, and modified the previous patterns of climatic periodic migrations (Gila, 2011), threatened domestic security (Elischer, 2019), made significant differences between Sahelian social systems and cultures which influenced their resource exploitation (Raynaut, 2001).

2.2. Population growth

The population grows rapidly, where by 2050 they will more than triple from 100 million to 340 million (Potts et al. 2013). This caused increasing population pressure that has resulted in a breakdown of the fallow system, low crop yields and reduced availability of communal land (Ramaswamy et al. 1991). This is in the presence of a fine-scale population structure and complex patterns of admixture (Triska et al. 2022), influenced by tribalism and ethnic dynamics (Lyammouri, 2019), and the rooted slavery

and abolitionism (Rossi, 2020), and preserve nomadic life and organizational structure (Eric, 2007), which is contradicting the exponentially growing urban populations (Černý et al. 2018), who have much higher Haplotype than in rural settlements (Rocca et al. 2020).

These population characteristics contributed into underdevelopment since it altered States, civil society, production systems, (Cour, 2001), produced a burden by children under 15 years old who outnumber the working age population (Berat, 2020), food insecurity (Kabir et al. 2023), social stratification and social transformations which have disturbed resource exploitation (Raynaud, 1996), enhanced tribalism (Lyammouri, 2019), ethnicity (Jourde, 2017), and created a complexity social, environmental, and economic challenges to the Sahel rural populations (Saqalli, 2008).

2.3. Environmental Degradation

Climatic changes have caused major environmental change in the Sahel (Brandt et al. 2014), which influenced the Sahel agro-ecological zones (Yobom, 2020), exaggerated by mismanagement (Katz et al. 1978), and impacted on the relations between societies and their environment (Raynaud et al. 1997), caused famine and losses of property (Kamrany, 1975), and put millions of pastoralists and agro-pastoral herders in need of urgent help (Ramaswamy et al. 1991), thus worsening the poor living conditions already experienced by people in this region (Adoukpe et al. 2012).

Climate change in the Sahel has also, transformed ecological balance, caused ecosystems degradation and deformed of policies (Yacouba et al. 2016), retarded agricultural productivity (Kabir et al. 2023), caused resource scarcity leading to migration, emergence of new conflicts (Benjaminsen, 2016), have contributed to decreasing of net migration (Alessandrini et al. 2021), when migration has been used as a traditional response to the changing challenges of environmental conditions (Gila??), when agriculturalists are more likely to migrate than pastoralists (Hampshire et al. 1999). Climate change also delayed onset of rains, reduced duration of wintering and higher temperatures which have adversely affected agricultural production systems and food security, health and livelihoods (Faye et al. 2021), increased absolute runoff (Paturel et al. 2017), and reduced the biological productivity (Rishmawi et al. 2016).

Desertification has become increasingly evident in the Sahel as human and livestock populations increase which created ever increasing population pressures for food, fodder, fuel, etc. (Wickens, 1997), increased child mortality and short-term reductions in fertility and increased migration (Pedersen, 1995), changed of land use/cover which undergone continual degradation of vegetation (Yacouba et al. 2016), and led to swallow of 251 000 sq. miles of farming and grazing lands in the past 50 years (Scott, 1984).

2.4. International intervention

International intervention in the Sahel could be considered a contributory factor for underdevelopment because it retards national and local development by enhancing dependency on aids, and opens doors for external interference in a State's sovereignty, particularly when colonial and postcolonial state's hegemony have undermined the full development of competing forms of space production in the Sahel (Rottenburg ?), and initiated different regional projects to reframe the area according to their interests

(Baldaro, 2020), including the nature of land consolidation and the tradeoffs between food sovereignty and export-oriented growth (Kitchell, 2015), and the indigenous forms of agency outside Europe which continued to perform borders by extracting and capturing the economic and cognitive resources that pass through luminal spaces (Raineri, 2023).

The roles of United States and France, with unprecedented military might and economic strength (Djedei et al.????) have militarized the Sahel that caused more instability (Kfir, 2018), simultaneously with the geopolitical interests of EU Member States in the Sahel that have long lead to interventions aimed at the securitization of the region that can be dated back to the early postcolonial period (Daria et al. 2018).

The Nonstate transnational actors have long played a central role in Sahelian economic structures and geopolitical arrangements because of their capacity to constitute sources of authority and sustenance outside and across state structures. (Niang, 2015), as well as other numerous drivers who have created the conditions for the growth of new threats in the region (Dentice, 2018), such and the displacement of the global war on terror in the Sahel (Niang, 2015), particularly against Islamic terrorism (Elischer, 2019), benefitting from state fragility (Rizk, 2021), and influenced by globalization which is radically altering West African systems of production (Cour, 2001), and made extended forms of domestic organization untenable in the face of modern economic and ecological circumstances (West, 2010).

The international influences retarding development in the Sahel is evident in the roots of Sahelian desertification as some refers it to the colonial period (Gangneron et al. 2022), and to the policy discourse of foreign investments and promotion around large-scale leases which has defined productivity solely in terms of agricultural output which have weakened links between rangelands and croplands (Kitchell, 2015), and in the parallel economy of ransoming, aggressive scramble for resources (Niang, 2015), and also, in security interventions such as that by French military action, EU-funded projects to prevent drug trafficking, and both bilateral and multilateral efforts against irregular migration (Frowd et al. 2018), and increasingly asserted centralized power by economically lagging northern regions through military coups and/or electoral victories (Gaiya, 2024).

World assistance by international and non-governmental organizations could be considered also a contribution into underdevelopment since the Sahel problem is exacerbated by piecemeal development aid projects (Sinclair et al. 1985), and that emergency food aid by itself will aggravate the problem (Sinclair et al. 1985), as it was found that the changes are the result of an interaction between the State, rural producers, urban speculators, international development agencies and other actors (Raynaud, 2001).

This world assistance is achieved by international organization where the World Health Organization has "released US\$ 8.3 million for emergencies to assist the 10.6 million people in need of emergency health services in the Sahel region" (www.afro.who.int/news- 29 April 2022), and the "EU allocates €201 million in humanitarian aid for Sahel and Africa's Lake Chad countries....will support food security and assistance for malnutrition, health care and protection, water, sanitation and hygiene, shelter and education activities" (https://civil-protection-humanitarian-aid.ec.europa.eu/news, 28 May 2024). and the

“United Nations World Food Program is calling on governments and partners to safeguard resilience-building programs that help crisis-affected communities withstand shocks and meet their own food and nutrition needs” (www.wfp.org- 20 February 2024), besides “a drastic increase in humanitarian needs in the Central Sahel, reaching 14.7 million people in need of life-saving assistance early 2022.” (https://reliefweb- 27 Jan 2022).

3. Empowerment of Renewable Energy Sources for sustainable development in the Sahel

The Sahel crises, considered here, revolved around diversity of underdevelopment that can be resolved by empowerment of energy, with emphasis on solar energy as has been justified in the following paragraphs.

Africa has 60 percent of the best areas in the world for solar farms due to high solar resource (Figure 2). The Sahel, particularly, has high solar potentiality (DW, 2024), uniquely abundant (Mohamad et al. 1998), with highest solar energy density on average (Didane, 2018), and although not uniform across the region (Niang et al. 2023), it will not be reduced with climate change (Pedro et al. 2019). The capacity of electrical energy in the Sahel is estimated at 6.89 GWe for an installation surface estimated at 275.61 km² (Thiam et al. 2017), and the monthly average solar radiation data is 5.87 kWh/m²/day and wind data is 4.4m/s (Diaw et al. 2019), where, for example, in Chad there are three climatic zones with good solar potential (Soulouknga et al. 2017), as well as in N’Djamena the annual global potential is 4.71 kWh/m²/d (Goni et al. 2019), while PV solar potential is projected to increase to the northwest and southern Africa to about +5% (Pedro et al. 2019).

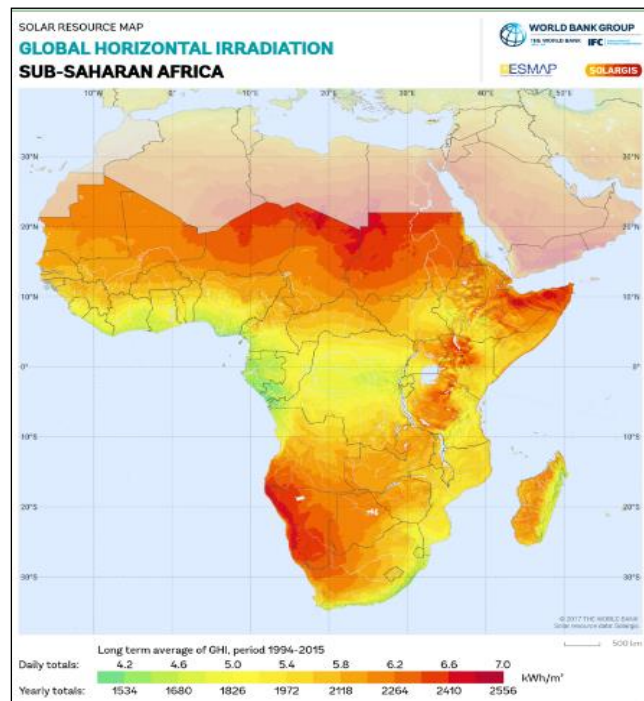


Figure 2: Sub- Saharan Africa potentiality of Solar energy

https://ar.wikipedia.org/wiki:Sub_Saharan_Africa

This potentiality of solar energy in the Sahel has been empowered by many energy projects with intensification on low cost

technology (Diarra et al. 2001) since 90% of energy in the Sahel comes from expensive diesel or heavy fuel, which results in high energy costs, rapid rising of electricity demand, and there are dangers of continuation of energy poverty since the Sahel faces high vulnerability to climate change, fastest population increase, lowest degree of electrification and there is a need for an energy transition towards renewable energies (Bichet et al 2019).

The United Nations, World Bank, and African Development Bank have focused on using solar energy to drive Sahelian nations’ economic development (Mirzabaev et al. 2021). The International Center for Research and Training in solar energy at Dakar University and the Lasquo-ISTIA Laboratory of Angers University have put in place a research project on the photovoltaic (PV) modules characteristics (Ababacar et al. 2013). The Desert to Power G5 Sahel Facility aims to tap into the immense solar energy potential of the Sahel to develop 10 “gigawatts” of solar energy and supply 250 million people with clean electricity by 2025. The African Development Bank, Africa 50 and the Green Climate Fund have agreed to work together on the Desert to Power Program to promote the deployment of competitively-procured Regional Solar Parks in West Africa (Mustafa, 2019). The key technological innovations include expanding irrigation and adopting water use efficient irrigation techniques, crop diversification, expanding agricultural mechanization, investing into restoring and rehabilitating degraded lands through reforestation, afforestation and agroforestry practices (Mirzabaev et al. 2021).

These projects of solar energy in the Sahel implemented technologies that included off-grid power sources (borgenproject), solar power plants (Niang et al. 2024), CSP/hybrid plants (Thiam et al. 2017), large-scale photovoltaic solar farms (Lu et al. 2021), wind-solar hybrid system (Diaw et al. 2019), solar trackers (Niang et al. 2024), parabolic trough technology (Ramd et al. 2013), roof’s thermal insulation capacity (Adounkpe et al. 2012), wind and solar farms (Li et al. 2018, Nikiema et al. 2023) since wind pattern in Sahel is marked by a strong diurnal cycle and strong seasonal cycle (Madougou et al. 2013), movable solar panels (Niang et al. 2024), and decentralized household-based solar energy (Kanwal, 2013).

There are many obstacles that hindered the efficiency of these solar energy projects. They included lack of regional and international collaboration to attract the energy transition financing (iea.org), accumulation of dust on the surface of solar panels results in a decrease in their performance (Aidara et al. 2023), seasonal fluctuation reduces the amount of solar radiation which decreases the plant’s production (Niang et al. 2024), higher uncertainty during June to October of the quantity of incoming solar radiation (Danso et al. 2020, Osinowo et al. 2014), the lack of infrastructure facilitates competition with nonrenewable options (Bruggink, 1984), and rainfall and not insolation is the limiting factor in determining water balance characteristics (Sharon et al. 1990).

4. Discussion

The crises in the Sahel are a diversity of underdevelopment manifested in low economic performance, climate change and environmental degradation (Dieng 2021, Cour, 2001), exceptional political instability (Walther, 2017; Trnovec, 2020) associated with fragile states (Osland et al. 2020), international interventions, urgent need for help by millions of pastoralists and agro-pastoral herders (Ramaswamy et al. 1991). This research comprehended

them into low economic performance, population growth, environmental degradation, and international interventions.

The inclusion of cheap energy in the Sahel could be the basic building block for resolving these crises since the success of sustainable development in Africa lies in addressing the imminent energy crisis in the continent (Bugaje, 2006). This is because the Sahel has a high potentiality for solar energy production and experiences that could prove their success.

Solar energy constitutes a viable option for addressing issues of underdevelopment (Pedro et al. 2019, Burney et al. 2010), where for example, solar-powered drip irrigation significantly augments both household income and nutritional intake and is cost effective compared to alternative technologies (Burney et al. 2010), presents better opportunities for increasing access to electricity and for diversifying sources of energy (Ramd et al. 2013), besides large-scale installations of wind and solar farms lead to more than a twofold precipitation increase through increased surface friction and reduced albedo (Li et al. 2018).

The empowerment of solar energy in the Sahel could contribute into investment in the transformation of the Sahel from desert to greenbelt (Okon et al. 2023), by establishing and leveraging green value chains that reduce poverty and create jobs (UNDP, 2024), and plantation of *Balanites aegyptiaca* (L.) for the restoration of Sahelian ecosystems (Sagna et al. 2014). Also, it makes possible the moving away from being a highly climate-dependent region based on agriculture towards a more open and diversified economy (Lambin et al. 2014), that provides sustainable development for transformation in natural resources management (Mbow et al. 2021), enable for the adoption the sociopolitical elements model of drought concerning nomadism in the Sahel (Bovin, 1990), which facilitates provisioning of social welfare (Weiss, 2002), populations specializing in economic activities (Cooper, 2018), balancing land use change and migration (Olsson et al. 2005), and makes food aid acceptable if tied to long-term care of the people and regeneration of the vegetation (Sinclair et al. 1985).

5. Conclusions

This research dealt with the Sahel crises within diversity of underdevelopment that could be resolved by adoption of renewable sources of energy, particularly solar energy. The research has justified that, solar energy is potentially abundant, accessible and profitable in this region as was confirmed by many implemented prominent projects, and could be introduced in remote and isolated places at household and community levels, and furthermore, it could revenue and income to the Sahel countries via export world widely. The overcoming of the constraints of empowerment of solar energy in the Sahel could be through regional integration between the Sahel countries, appropriate regional development policies, and promotion of scientific research on improvement of the efficiency of solar energy.

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