«*There is no life without water. Water is a precious resource, indispensable for all human activities*» (European Water Charter, 1968)

Water conflicts. Geopolitical and socio-environmental aspects

Nicoletta Varani, Kristina Mamayusupova

DISFOR – Department of Education Sciences – University of Genoa, Italy
email: varani@unige.it; kristina.mamayusupova@edu.unige.it

Doi: 10.2478/gssfj-2025-0013

Abstract
This topic belongs to the field of 'water politics, an interdisciplinary area spanning political geography, international relations and environmental studies. It is not merely about "water wars" in the strict sense, but above all about conflicts, competition and negotiation between states and communities. This study is situated within this context and views water as a strategic, limited, unevenly distributed, disputed and essential resource for all human activities and, ultimately, one that is severely affected by climate change and population growth. After presenting an initial framework and references to key international documents, partnerships and organisations for water cooperation, the study aims to analyse conflicts through various reports, databases and open-access tools. In particular, the geopolitical and socio-environmental implications are studied and interpreted through case studies of specific geographical areas, such as: sub-Saharan Africa, the Sahel, as well as specific cross-border lake basins such as: Lake Chad and the Aral Sea.

Keywords: conflicts, frontiers, climate and/or environmental migration, sub-Saharan Africa, Lake Chad, Aral Sea

1. Introduction

Water is a natural element and, together with oxygen, is essential for life on Earth. It covers most of the Earth's surface and accounts for 65% of our body weight. Access to drinking water is a human right, but for billions of people it remains a privilege, as this precious resource has always been the subject of disputes, conflicts and depletion. Indeed, there is increasing reference to 'water grabbing'[8], that is, the hoarding of water resources to the detriment of the most vulnerable populations (Bompan & Iannelli, 2018).
Water is a key factor in numerous global challenges, including climate change, forced migration, conflicts and wars. In recent years, an increasing number of experts have

[8] Water grabbing is a phenomenon which, as highlighted by ASVIS (Italian Alliance for Sustainable Development), sees governments or large corporations taking control of or diverting a region's precious water resources for their own benefit, depriving local communities of the water they need; a phenomenon that has already sparked numerous conflicts in the Middle East, Latin America, Africa and Asia (Squarcia, 2023).

discussed the link between climate change, migration and armed conflict (Balsari et al., 2020; Sitati et al., 2021; Thalheimer et al., 2021; Savelli et al., 2023).

Water scarcity represents one of the greatest global emergencies. And many experts, as will be discussed later in this article, argue that future conflicts could erupt precisely over control of water sources. Although it remains the most abundant primary resource, it is clear that it is becoming increasingly scarce due to unsustainable production systems and lifestyles, as well as climate change (Dionet-Grivet, 2015; Mauceri, 2016; Bompan et al., 2019; Congiu, 2023), in addition to the causes mentioned above.

SDG 6 of the 17 Sustainable Development Goals of the 2030 Agenda is entitled 'Clean Water and Sanitation'. The goal aims to ensure the availability and sustainable management of water and sanitation services for all through the construction and sustainable management of water infrastructure, the reduction of pollution, increased water efficiency, community participation and international cooperation (OXFAM-Italia, 2025). In fact, according to the UNESCO Report (2024), none of the targets of SDG 6 appear to be far from being achieved, although shortcomings in monitoring and reporting demonstrate how difficult it is to conduct an analysis of most of the other indicators relating to the targets of SDG 6[9].

Solving the world's water problem without climate justice, coherent cooperation and adequate investment seems impossible, and we must continue to focus on concrete actions that can lead to measurable progress, valuing the role of everyone on this Earth in bringing the entire planet closer to having access to this vitally important common good.

1.1. Water: an (in)accessible resource, an economic asset or a source of conflict?

Water should be a resource accessible to everyone, but today 2.2 billion people do not have access to safe drinking water in their homes (OXFAM-Italia, 2025). The scarcity of sanitation facilities[10], the improper disposal of wastewater and climate change are increasingly exacerbating this problem. In many parts of the world, water is contaminated, difficult to access or managed unfairly.

[9] For further details on progress towards the targets of SDG 6 based on available data, see *Blueprint for Acceleration: Sustainable Development Goal 6 Synthesis Report on Water and Sanitation 2023* (United Nations, 2023).

[10] To mark World Water Day, UNICEF reminds us that every day, over 1,000 children under the age of five die from diseases linked to inadequate water and sanitation, factors that kill a total of 1.4 million people a year (UNICEF, 2025).

To date, 4 billion people – almost half the world's population – experience serious water shortages for at least one month a year. Around 436 million children live in areas of high or very high-water vulnerability, i.e. areas subject to water scarcity and poor access to safe drinking water. OXFAM-Italia (2025) reports that over 800 children under the age of five die every day from diseases linked to unsafe water. Furthermore, as water stress worsens, by 2040, around one in four children worldwide will live in areas with extremely high-water stress (OXFAM-Italia, 2025). To date, around half of the world's population faces severe water scarcity for at least part of the year (IPCC, 2023). Indeed, some areas suffer from water scarcity for a limited number of months each year, whilst others face water shortages throughout the year. Water scarcity has also been linked to a 10% increase in global migration flows (Zaveri et al., 2021).

Water is also essential for agriculture-based economies. According to estimates, in low-income countries around 80% of jobs depend on water, mainly because agriculture is the main sector of employment. This figure is significantly higher than the estimated 50% of jobs in high-income countries, where the labour market appears more diversified and less dependent on water resources (Connor & Chaves Pacheco, 2024). In lower-income countries, poor environmental water quality is mainly due to low levels of wastewater treatment, whilst in higher-income countries the most serious problem is agricultural and industrial runoff. However, data on water quality remain very limited (United Nations, 2023a).

It is not only water scarcity that can cause disasters, but also an excess of water. According to the CRED report '2022 Disasters in Numbers' (2023), between 2002 and 2021 floods caused around 100,000 deaths (and a further 8,000 in 2022), affected around 1.6 billion people (and a further 57 million in 2022) and resulted in economic losses of $832 billion ($45 billion in 2022). During the same period, drought affected over 1.4 billion people and caused the deaths of over 21,000 individuals, with economic losses amounting to $170 billion (CRED, 2023). According to forecasts, ongoing global warming will intensify the global water cycle, further increasing the frequency and severity of droughts and floods, with climatic events and seasons that are either very dry or very wet.

Water is also a central element in conflicts related to the management of wells, rivers or dams, as in the African case of the Nile between Ethiopia, Egypt and Sudan, or in the case of the large Chinese dams on the Brahmaputra affecting India and Bangladesh, or those forming part of the Mekong river system which crosses South-East Asia and which in the future will have an impact on Laos, Myanmar, Vietnam, Cambodia and Thailand[11].

[11] China, as the dominant player upstream of the Mekong river system, plans to build 11 dams by 2030 to generate hydroelectric power, thereby increasing the sustainability of its energy supply. These

Another example among many is the Tigris and Euphrates river system, which dominates water policy in the Mashreq – that is, the eastern part of the Arab world and a critical, high-risk area. The area is affected by Turkey's massive 'Southeastern Anatolia Project (GAP)', which includes 22 dams and 19 hydroelectric power stations to be built along the Tigris and Euphrates – the two largest rivers in Western Asia – near the Turkish borders with Syria and Iraq. It should be borne in mind, however, that the various projects linked to the construction of dams and hydroelectric power stations in Turkey have reduced Iraq's water supply by 80% (Russo, 2025).

The inequality in water resource management also generates tensions in areas where water is privatised or contested by large extractive industries. In these areas, local communities often have no voice because 'water wars' are sometimes fought indirectly.

A significant proportion of the world's freshwater resources is concentrated in transboundary aquifers (UNESCO, 2024). Transboundary water resources are undoubtedly the most prone to serious tensions and conflicts, partly because in most cases they form the border between two or more countries. The most critical cases occur in international river basins and involve watercourses that are often of considerable length and flow, crossing multiple countries. In such cases, the geographical position within the basin plays a important role, as upstream countries are able to influence the quantity and quality of the water flow reaching downstream countries. The intense and unilateral exploitation of a shared resource can create latent conflicts or lead to a significant deterioration in diplomatic relations, but it can also cause irreversible degradation of the disputed water source (Ferragina, 2015).

It is necessary to highlight that an analysis of conflicts over control of water resources requires a multi-scale analysis capable of taking into account the full range of tensions occurring at both local and global levels.

This paper will therefore present conflicts that are emblematic of both large regions such as Africa[12] and more limited areas such as Lake Chad or the Aral Sea (see Sections 4.1 and 4.2), covering both cross-border cases and those concerning areas within the same state.

---

dams would generate a large amount of electricity and would benefit neighbouring countries, but they could also threaten the food security of millions of people living in the lower reaches of the river (Russo, 2025).

[12] Africa has the highest proportion of transboundary basins compared to other continents, with coverage estimated at 64% of total area (UNECA, 2021).

1.2. Main international documents, partnerships and cooperation for water

Water conflicts continue to rage across the globe, despite the significant efforts being made to raise awareness and foster cooperation in order to promote the importance of water as a resource for the entire world population and to find peaceful solutions that benefit everyone. This section discusses the importance, from a documentary perspective, of continuing to raise awareness by highlighting the central role of water for all forms of life. Below, we present the main international documents and events concerning this resource and its management.

Main international documents

The primary international document is the Convention on the Law Relating to the Use of International Watercourses for Purposes Other Than Navigation, together with its annex, signed in New York on 21 May 1997. The United Nations is the sole global legal framework governing the management, use and protection of the world's 276 transboundary watercourses (Gallia, 2009). The Convention also governs relations between states traversed by major rivers; the agreement stems from the parties' desire to preserve major watercourses, including underground rivers and aquifers, through measures aimed at controlling and preventing pollution and which can avert significant damage to countries sharing the same watercourse. Among other documents, the most significant are undoubtedly the 'Resolutions of the United Nations General Assembly', such as: the Mar del Plata Action Plan, the Rio Declaration on Environment and Sustainable Development (1992)[13] and others[14]. In 1998 in Lisbon, non-governmental organisations and others launched the 'Water Declaration', arguing that water is not an economic commodity but a vital common good of the world's heritage, and that a global water treaty must be concluded, with two main objectives: 1) to guarantee access for every human being, for every human community; access must be recognised as a fundamental political

[13] In 1992, at the Earth Summit held in Rio de Janeiro, the UN established World Water Day. The event, which takes place every year on 22 March, provides an opportunity for the global community to reaffirm its focus on and commitment to water issues.

[14] The following documents are also important: United Nations General Assembly Resolution A/RES/58/217, UN Draft Resolution A/64/L.63/Rev.1, UN Resolution A/RES/64/292, UN Resolution A/RES/68/157, UN Resolution A/RES/70/1 and UN Resolution A/RES/70/169. Other important international documents include the 'Resolutions of the Human Rights Council', notably: General Comment No. 15 (2002) of the Committee on Economic, Social and Cultural Rights on the right to water (Articles 11 and 12 of the International Covenant on Economic, Social and Cultural Rights), Council Resolutions No. 7/22, No. 12/L19, No. 15/9, Council Resolution No. 27/7, Council Resolution No. 33/10.

right, an inalienable individual and collective right, and an economic and social right; 2) to ensure integrated, sustainable and solidarity-based water resource management (Petrella, 2001).

Partnerships and cooperation for water

The United Nations World Report (2023) on Water Development, Partnerships and Cooperation for Water highlights how building partnerships and strengthening cooperation in all dimensions of sustainable development are essential to accelerate progress towards achieving all the SDG 6 targets of the 2030 Agenda and ensuring the right to water and sanitation for all.

In an effort to bring us closer to achieving SDG 6, the World Water Council (WWC) is also involved; this is a kind of international think tank with 260 members from 52 countries, including governments and public institutions, universities, international organisations and agencies, public and private sector companies, and even the World Bank. The World Water Council's mission is to bring the international community together to convince policymakers that water is and will remain a political priority for the sustainable and equitable development of the planet. To reinforce this idea, every three years since 1997 (Table 1) the World Water Council has organised the World Water Forum: the most important international event in the water sector, bringing together the scientific community, businesses and civil society to discuss global water challenges, raise awareness among the entire world population about water issues, ensure access to water supply and sanitation for all, and promote cooperation through new international partnerships.

N.	Year	Title	City/Country	Documents
1	1997	"Vision for water, Life and the Environment"	Marrakech/Morocco	Marrakech declaration
2	2000	"From vision to action"	The Hague/Netherlands	Ministerial Declaration of The Hague on Water Security in the 21st Century
3	2003	"A Forum with a Difference"	Kyoto, Osaka, Shiga/Japan	Ministerial Declaration
4	2006	"Local Actions for a Global Challenge"	Mexico City/Mexico	Ministerial Declaration
5	2009	"Bridging Divides for Water"	Istanbul/Turkey	Global Water Framework
6	2012	"Solutions for Water"	Marseille/France	Political process: Parliamentarians 'Manifesto
7	2015	"Water for our Future"	Daegu-Gyeongbuk/South Korea	Ministerial Declaration
8	2018	"Sharing water"	Brasìlia/Brazil	Ministerial Declaration An Urgent Call for Decisive Action on Water
9	2022	"Water Security for Peace and Development"	Dakar/Senegal	Dakar Declaration A "Blue deal" for Water Security and Sanitation for Peace and Development
10	2024	"Water for Shared Prosperity"	Bali/Indonesia	Ministerial Declaration on "Water for Shared Prosperity"

Tab 1. World Water Forum 1997 to date. Source: Elaborated by the Authors

To date, ten World Water Forums have been held. At the end of each Forum, a final document summarising the Forum's outcomes has been produced. The 11th Forum, entitled 'Action for a Better Future', is scheduled to take place in 2027 in Riyadh, Saudi Arabia.

Among the United Nations agencies, UNESCO, through the International Hydrological Programme (IHP), promotes scientific research, the prevention of water-related conflicts and integrated basin management, contributing above all to multi-level cooperation on the issue of water resources.

UN-Water, established in 2003, is a 'mechanism' comprising UN agencies (as members) and various international organisations (as partners) active in the water and sanitation sector. UN-Water's role is to ensure that Member States and partners receive support in addressing water-related challenges. UN-Water coordinates over 30 UN agencies and 40 international partners working on water and SDG 6, and produces the World Water Development Report.

The European Water Association (EWA) is an independent, non-governmental, non-profit organisation dedicated to the management and improvement of the water environment at European and international level. Founded in 1981, it is one of the leading professional associations in Europe, whose aim is to discuss key technical and policy issues relating to water through conferences, workshops, meetings and publications. The EWA's primary objective is to contribute to the sustainable management of water resources, safe water supply and the protection of the water environment and soil.

The United Nations Economic Commission for Europe (UNECE), established in 1947, is one of the five regional commissions of the United Nations. Among the numerous environmental agreements negotiated under the auspices of the UNECE, the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes, known as The Convention on the Protection and Use of Transboundary Watercourses and International Lakes (the so-called Helsinki Convention, adopted in 1992 and entered into force in 1996). In this context, it is important to briefly mention cooperation activities in sub-Saharan Africa. In many studies, Africa is considered one of the main areas where international water cooperation is being tested. Cooperation activities focus primarily on issues such as desertification, climate change, population growth, water scarcity and the associated agricultural-pastoral conflicts.

Major organisations in the field of transboundary water cooperation include Lake Chad Basin Commission, Niger Basin Authority, Nile Basin Initiative e Lake Chad Basin Commission (see Section 4.1).

Therefore, international agreements, partnerships and collaborative initiatives on water demonstrate the commitment made at an institutional level by various socio-political actors to promote the value of water as a resource; however, these initiatives still lack the practical and operational aspects of sustainable management, particularly at a local level, which could serve as a means of preventing both existing and emerging conflicts.

2. Methodology

This contribution is based on a set of accredited sources deriving from international Conventions on the topic, Reports and/or international documents signed by: FAO, IOM, United Nations, OXFAM, UNECE, UNEP, UNESCO, UN-Water, World Bank and, in particular, from the Global Early Warning Tool developed by Water, Peace and Security (WPS) and the Report Water Conflict Chronology developed by the Pacific Institute (see Section 3). The data obtained from accredited sources are combined with emblematic case studies, which illustrate how issues related to water conflicts, climate change, and climate and/or environmental migration can originate in the same territory and have repercussions on the same territory and neighbouring territories over a long period of time.

Water conflicts are also intertwined with climate change and migration, but they are neither the direct consequence of them; other socioeconomic and political factors contribute to their emergence. Lake Chad and the Aral Sea, known internationally as lakes 'dried up by governments', are the result of such 'a combination of causes' that they were led to natural catastrophe. As case studies, we considered the Caspian Sea, Lake Urmia, the Aral Sea, and Lake Chad as endorheic basins fed by two or more rivers. We subsequently found that transboundary water conflicts were strictly related to the Aral Sea and Lake Chad. That's why we chose to explore them. Both lakes are also affected by climate change and desertification, both have suffered a reduction in their surface area of almost 90% over the years, both have recorded continuous exploitation of water resources, the loss of biodiversity and the degradation of ecosystems. These are the reasons for including such lakes in 'judgment sampling' (Subedi, 2023; Ahmed, 2024), according to which the researcher, based on his own judgment (Maxwell, 1996; Taherdoost, 2016) and his own knowledge, selects the case studies and forms, with them, the research sample. This type of sampling lacks representativeness, but it helps the researcher reflect in depth, as much as possible, on specific aspects of such a complex topic as water conflicts and other concepts correlated with them. Generalizability and transferability of data in the case of 'judgment sampling' are not possible, but for us, it was essential to seek answers to the main research questions. Indeed, the research questions that gave rise to this work were: 'What are the transboundary basins that are now disputed territories for water? How do they address issues related to water conflicts, climate change, and migration today? What are the mutual influences between these elements and the repercussions on the territories and populations that inhabit them?'. Through the case study, carried out with the aid of scientific literature, we attempted to answer these questions, but at the same time new ones arose, indicating further avenues of research.

3. Conflicts over the water resource

In a broad sense, conflict can be understood as a process of antagonistic interaction, of short or long duration, in which multiple actors compete for access to and control over strategic resources, using both violent and non-violent means (Gleick, 1993; Wolf, 1998). Water conflicts can be defined as conflicts arising from the inequitable, inefficient, or contested management of water resources among different actors, such as states, local communities, or ethnic groups. In this framework, competition for water represents one of the most significant dimensions, especially in contexts characterized by scarcity and environmental vulnerability.

However, the relationship between water and conflict must be interpreted from a systemic perspective, taking into account that resource scarcity, loss of livelihoods, and the increasing incidence of extreme climatic events may act as 'risk multipliers', amplifying pre-existing socio-political tensions (Homer-Dixon, 1999; Barnett & Adger, 2007). In this context, phenomena such as water grabbing and land grabbing play a crucial role in generating or intensifying conflicts related to water resources[15].

The interaction between these two phenomena – water grabbing and land grabbing – can produce particularly destabilising effects. In several African contexts, including Nigeria and Mali, an increase in conflicts among ethnic groups and local communities over access to water has been observed, exacerbated by the construction of hydraulic infrastructure (such as dams and irrigation canals), which has already altered the hydrological balances of crucial river systems, including the Niger River and the Lake Chad Basin (Okpara et al., 2015; Magrin, 2016). These transformations have also undermined traditional livelihoods such as agriculture and pastoralism, while fuelling socio-political tensions. Furthermore, the expansion of intensive agricultural projects and the industrial exploitation of resources contribute to processes of territorial dispossession, groundwater pollution, and forced migration.

Water thus emerges as one of the primary environmental factors influencing human mobility and is particularly sensitive to the impacts of climate change. Currently, approximately 1.5 billion people live in contexts characterised by water scarcity, and projections indicate a possible doubling of this figure over the coming decades (UN-Water, 2020).

---

[15] The term water grabbing, as already mentioned in the Introduction, refers to the appropriation or control of water resources by dominant actors – states, multinational corporations, or local elites – at the expense of communities that depend on these resources for their survival. Similarly, land grabbing refers to the large-scale acquisition of fertile land, often in developing countries, for agricultural, energy, or speculative purposes, resulting in intensified use of water resources and the marginalization of local populations (Borras et al., 2011; Cotula, 2013).

For this reason, the scientific community has developed analytical and forecasting tools, such as the Water Conflict Chronology report produced by the Pacific Institute and the Global Early Warning Tool developed by Water, Peace and Security (WPS)[16]. These instruments are designed both to catalogue conflicts and to identify potential conflict hotspots in advance, with the aim of promoting strategies for prevention and the sustainable management of resources (De Stefano et al., 2017).

The first tool, the *Water Conflict Chronology Report*, is the most comprehensive and exhaustive open-source database at the global level on water-related violence and violent conflicts associated with water resources and water systems. In the report, the Pacific Institute argues that the increase in violent incidents[17] linked to water resources reflects ongoing controversies and disputes over the control of and access to scarce water resources.

The second tool, the *Global Early Warning Tool*, was conceived as an interactive cartographic platform based on a Random Forest machine learning model, designed to integrate and jointly analyse environmental and socio-economic variables. The aim of this tool is to identify, in a predictive manner, the areas of the world most exposed to the risk of water conflicts, achieving an estimated accuracy level of around 86% (Rasi, 2021). Accordingly, the model continuously processes a series of key indicators. These include water stress, measured as the ratio between water withdrawals and overall resource availability; hydropolitical tension, which identifies river basins characterised by a high probability of conflict over resource control; and fluvial flood risk, expressed as the proportion of the population exposed to flood events within a given time frame.

The integration of these parameters enables the construction of a dynamic mapping of potential conflict hotspots. The results indicate that countries such as Nigeria and Mali are among the most vulnerable contexts, thereby confirming the critical role of environmental pressures and socio-political fragilities in the emergence of water-related conflicts.

[16] In 2018, the Water, Peace and Security (WPS) partnership was established, introducing innovative services and tools to identify and address risks associated with water scarcity, the most prominent of which is the *Global Early Warning Tool.*

[17] The term 'violent cases' refers to three categories of conflict: a) water as a trigger; b) water as a victim/target; c) water as a means of violence.

3.1 Water conflicts in Sub-Saharan Africa: selected Cases and most affected Countries

According to projections produced by the IPCC, sub-Saharan Africa will become increasingly exposed, over the coming decades, to extreme climatic events, particularly more frequent and intense periods of drought (IPCC, 2021; Suman, 2022). In this context, the progression of desertification processes is expected to render the control of and access to water resources ever more central to regional geopolitical dynamics. In shared river basins, water withdrawals carried out upstream directly affect the quantitative and qualitative availability of water in downstream territories. Moreover, the use of fertilisers or pollutants may further compromise water quality, generating tensions among riparian states and, in some cases, contributing to the outbreak of conflicts (Gleick, 1993; Wolf et al., 2003). In Nigeria, the desertification affecting Lake Chad (see Section 4.1) has led to tensions between farmers and semi-nomadic Fulani pastoralists over the control of water resources.

The risk of hydro-conflicts is particularly high on the African continent, where almost all states share at least one international river basin, and many share several[18]. This condition generates an intrinsically interdependent geopolitical system in which the mismatch between political borders and the natural boundaries of river basins fosters competition and fragmentation in resource management (UN-Water, 2020). This is further compounded by the absence, in many contexts, of integrated and coordinated basin-scale policies, as well as by significant economic and political power asymmetries among the states involved. Such imbalances tend to translate into unequal relations, whereby stronger countries impose patterns of resource exploitation and water governance frameworks aligned with their own interests (Zeitoun & Warner, 2006; Ciervo, 2010).

In this context, the role of the international community is crucial in fostering mechanisms of cooperation and conflict prevention, while supporting processes of shared governance of water resources. Geopolitical analytical tools, such as the annual *Military Balance* Report[19] published by the International Institute for Strategic Studies, can further contribute to assessing the balance of power between states and

[18] Africa is characterised by more than 60 international river basins. Among the most significant are the Nile, the Niger, the Zambezi, and Lake Chad. These systems cross colonial borders that are often artificial, rendering hydrological boundaries fluid, contested, and difficult to govern.

[19] Provides an authoritative, annual open-source assessment of military capabilities, personnel, and defense economics for over 170 countries. Published by the International Institute for Strategic Studies, it highlights key trends such as rising global defense spending.

to a better understanding of the strategic implications of water-related disputes (IISS, 2021).

The OXFAM report, *Water-driven hunger: how the climate crisis fuels Africa's food emergency* (2025), provides a significant empirical contribution to the debate on the nexus between water crises and food insecurity in sub-Saharan Africa, highlighting how climatic shocks are progressively eroding the resilience of agro-pastoral systems. In line with recent literature, the report shows that the increasing frequency of extreme events – prolonged droughts, irregular rainfall patterns, and floods – simultaneously undermines the availability and quality of water resources, with direct impacts on agriculture, fisheries, and livestock farming (IPCC, 2021; FAO, 2023; OXFAM, 2025).The analysis conducted across eight countries (Ethiopia, Kenya, Malawi, Mozambique, Somalia, South Sudan, Zambia, and Zimbabwe) documents an 80% increase in acute malnutrition cases between 2019 and 2024, rising from approximately 31 to over 55 million individuals, confirming the role of climate variability as a structural driver of food insecurity (OXFAM, 2025; UN-Water, 2020).

In Ethiopia, food insecurity has increased by 175% over the past five years, while in Kenya the expansion of arid areas between 1980 and 2020 has had a significant impact on agricultural productivity; in Somalia, finally, the seasonal rainfall deficit has led approximately 4.4 million people to severe food insecurity conditions (OXFAM, 2025).

Beyond these macro-structural impacts, relevant socio-spatial and gendered effects also emerge: access to water increasingly requires longer travel distances, particularly for women and girls, with direct consequences for personal safety, education, and economic participation (UNICEF, 2021). Overall, these findings confirm that the water crisis, interacting with climatic and socio-economic variables, acts as a risk multiplier, contributing to the reconfiguration of geographies of vulnerability and food insecurity in the region (Adger et al., 2014; FAO, 2023).

In this study on sub-Saharan Africa, the analysis of types of water conflicts, the geographical areas involved, and the countries most exposed has been based on the use of the Water Conflict Chronology.

Data for 2023 – considered the most comprehensive year in terms of data availability and systematisation – show that such conflicts are widespread across all major regions of the world, with a particularly significant concentration in the Middle East, South Asia, Latin America, and, above all, sub-Saharan Africa (Pacific Institute, 2024). With regard to the latter region, empirical evidence points to a clear upward trend in the number of water-related conflict events over the past decade. Recorded forms of conflict include deliberate attacks on water infrastructure, social unrest, and disputes over the control of and access to water, as well as the use of water as a

strategic instrument or weapon in contexts of war (Gleick, 2014; Pacific Institute, 2024). In particular, 2023 saw an increase of approximately 150% in water conflict incidents compared with the previous year: rising from 231 events in 2022 to 347 in 2023, confirming a significant acceleration in water-related conflict dynamics at the global scale (Greenreport redazione, 2024; Pacific Institute, 2024). The coverage of the data proposed here has its limitations precisely in incompleteness. This was not our goal, however, as we were intent on showing the largest number of water conflicts on the African continent by country. For this reason, we have selected only a few countries for the Table. The collection criteria were the 10-year time frame and recorded and terminated water conflicts.

Year	Somalia	South Africa	Kenya	Burkina Faso	Mali	South Sudan
2011	1	0	0	0	0	1
2012	4	1	2	0	0	1
2013	2	0	2	0	1	0
2014	1	1	0	0	1	1
2015	1	0	0	0	1	0
2016	1	2	0	0	1	0
2017	6	7	2	0	1	3
2018	1	1	2	0	1	2
2019	5	3	4	1	3	2
2020	2	0	2	1	0	2
2021	6	0	4	1	0	2
2022	10	4	5	11	5	1
2023	5	16	8	8	4	0
Total	45	35	31	22	15	15

Tab. 2. Countries where water conflicts have been most frequent (2011–2023). Source: Elaborated by the Authors from Water Conflict Chronology 2023

Table 2 and Figure 1 were developed using data from the Water Conflict Chronology database, covering a time span of just over a decade (2011-2023) and analysing the different types of conflicts recorded across 50 countries in sub-Saharan Africa, including those belonging to the Sahel region (see Section 5.1).

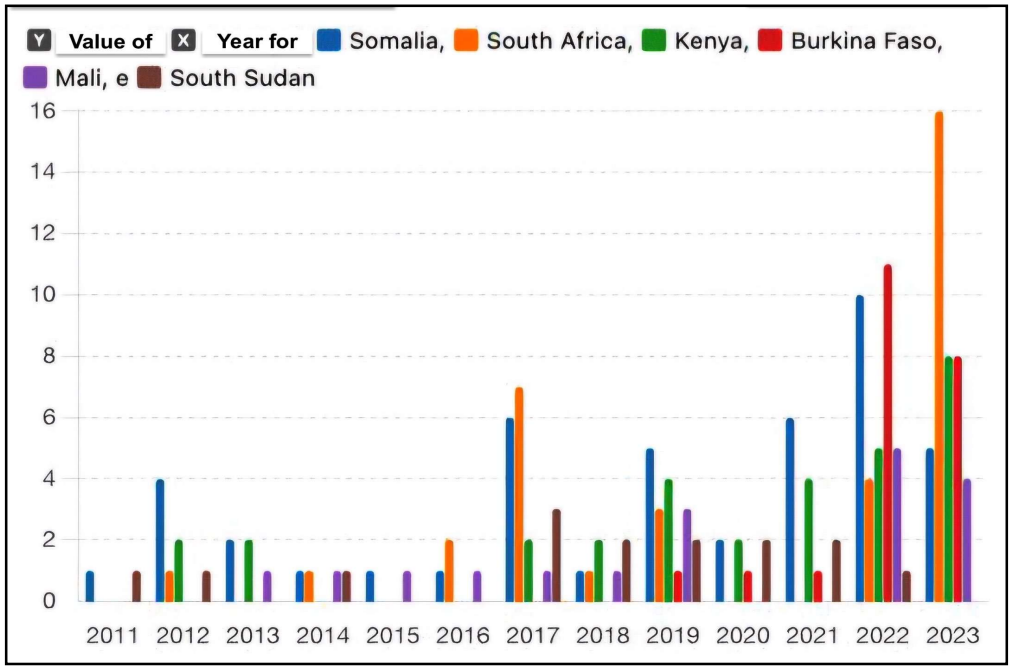

Fig. 1. Countries where water conflicts have been most frequent (2011–2023). Source: Elaborated by the Authors from Water Conflict Chronology 2023

The analysis clearly shows that six countries – Somalia, South Africa, Kenya, Burkina Faso, Mali, and South Sudan – exhibit a particularly high frequency of water conflicts. Among these, three (Burkina Faso, Mali, and Somalia) are located entirely within the Sahel region; two (Kenya and South Sudan) include significant portions of Sahelian territory; while South Africa is not part of this region. In detail, Somalia records the highest number of water-related conflicts (n=45). This finding is consistent with the broader framework identifying the country as one of the global contexts most severely affected by water crises and related tensions, effectively constituting a hotspot in which resource scarcity, climate change, and armed conflict are deeply intertwined. According to the *Global Humanitarian Overview* 2025, traditional grazing areas frequently become spaces of conflict, also due to the presence of armed groups such as Al-Shabaab, which exert control over routes and water resources, making access to water a strategic component of the conflict.

In the case of South Africa, water conflicts amount to 35 (see Table 2) and are primarily configured as socio-political and distributive phenomena rather than armed conflicts, emerging from the intersection of physical water scarcity, structural inequalities, and governance challenges. The literature highlights that the country, characterised by semi-arid climatic conditions, is particularly exposed to intensified

drought cycles driven by climate change, with direct implications for water availability and socio-economic stability (Turton, 2024).

A notable case is the 'Day Zero' crisis in the city of Cape Town (2015–2018), during which the urban water supply system came close to collapse (Rodina, 2019). This event demonstrated that water scarcity is not solely a natural phenomenon, but the outcome of a complex interaction between environmental factors, infrastructural arrangements, and political-institutional dynamics.

A further key dimension concerns inequality. During the crisis, adaptive responses were highly uneven: wealthier groups were able to reduce their dependence on the public system by accessing alternative sources (such as groundwater), while more vulnerable populations remained exposed to restrictions and tariff increases. This process contributed to shifting part of the crisis burden onto the most disadvantaged social groups, intensifying distributive tensions and giving rise to forms of "latent conflict" linked to unequal access to water resources.

The water crisis and water-related conflicts in Burkina Faso (n=22) and Mali (n=15) are embedded within the broader framework of socio-environmental vulnerability in the Sahel region (see Section 5.1), which is characterised by a combination of structural factors: extreme climatic variability, population growth, institutional weakness, and political-military instability.

In the case of Burkina Faso, the water crisis is closely intertwined with the security crisis. The expansion of armed groups and the rise in internally displaced persons have placed increasing pressure on already limited resources. According to relatively recent data, approximately 1.9 million people are in urgent need of access to water, while water infrastructure is either overstretched or destroyed (OXFAM, 2021). In several regions, access to safe drinking water has declined drastically, forcing entire communities to travel long distances or rely on unsafe water sources (Médecins Sans Frontières, 2021).

In Mali as well, the water crisis is exacerbated by the context of armed conflict and the weak presence of the state, particularly in the northern and central regions (Gao, Timbuktu, and Mopti). Here, water resource management is deeply intertwined with dynamics of violence and territorial control: access to wells, rivers, and grazing areas becomes a site of competition between local communities (farmers and pastoralists) and armed groups. The reduction in available resources, combined with widespread insecurity, also limits the intervention capacity of humanitarian organisations, further aggravating the crisis (OCHA, 2024).

In Kenya (n=31), the water crisis represents a structural factor of vulnerability that intersects with socio-economic, environmental, and political-institutional dynamics, contributing to the emergence of local conflicts over access to and control of the resource. The country is characterised by marked climatic heterogeneity: while the

central and western regions benefit from relatively higher levels of rainfall, the arid and semi-arid lands (ASAL), which cover approximately 80% of the national territory, are subject to recurrent drought cycles and high rainfall variability (FAO, 2020).

Water conflicts in Kenya occur predominantly at the local scale and, according to the World Bank (2022), take on recurring forms:

a) Agro-pastoral conflicts: in counties such as Turkana, Marsabit, and Samburu, competition between nomadic pastoralists and sedentary farmers over access to water points and grazing land leads to often violent clashes. The reduction in available resources exacerbates pre-existing ethnic and territorial tensions;

b) Intercommunal conflicts: rival pastoral groups compete for control over wells, seasonal rivers, and transhumance corridors, resulting in episodes of armed violence and cattle raiding;

c) Resource management conflicts: the construction of dams and water infrastructure can generate tensions between local communities and state authorities, particularly when benefits are unevenly distributed.

A paradigmatic case concerns the Tana River Basin, the longest in the country, where hydropower and irrigation projects have intensified competition between downstream farmers and upstream communities. Similarly, in the Lake Turkana area, declining water levels and ecosystem transformations have exacerbated tensions between fishing communities and pastoralists. In the Kenyan case, water conflicts can be interpreted as conflicts of access and adaptation: they do not arise solely from absolute resource scarcity, but rather from its unequal distribution and the differential capacity of actors to adapt to environmental stressors. Water thus becomes a catalyst for pre-existing tensions, rather than a single and direct cause of violence.

Finally, in the case of South Sudan, the water crisis exhibits distinctive characteristics compared with other African contexts: it does not take the form of absolute water scarcity, but rather a crisis of access, governance, and security, deeply intertwined with state fragility and the protracted armed conflict following the country's independence in 2011. The country in fact possesses significant surface water resources, particularly within the White Nile Basin.

Water-related conflicts in South Sudan (n=15) are predominantly articulated at the local and intercommunal scale but are deeply shaped by the context of civil war that has persisted for fifteen years. The typology of water conflicts can be divided into four main categories:

a) Agro-pastoral conflicts: competition between pastoral and farming communities over access to seasonal grazing areas and water points represents one of the main drivers of local violence. During the dry season,

the concentration of livestock around rivers and wells increases the risk of clashes;

b) Inter-ethnic conflicts: access to water resources overlaps with ethnic and political lines of division, amplifying tensions between rival groups;

c) Resource militarisation: in certain areas, control over rivers, wells, and water infrastructure acquires strategic value for armed groups and local militias;

d) Displacement-related conflicts: millions of internally displaced persons concentrate in relatively safer or more water-rich areas, placing significant pressure on local resources and generating tensions with host communities (FAO, 2022).

Finally, it should be emphasised that the civil war has destroyed infrastructure, hindered humanitarian access, and rendered water a strategic element in local power relations, while both seasonal and forced movements further increase competition for scarce resources in specific areas.

Therefore, a comparative analysis of the countries, their conflict typologies, and the associated characteristics/conditions highlights four distinct models of the relationship between water and conflict:

1. 'Critical-extreme' model (Somalia): water scarcity + armed conflict → water becomes a directly contested strategic resource.
2. 'Competitive-local' model (Kenya): relative scarcity + inequalities → widespread but low-intensity conflicts, predominantly agro-pastoral in nature.
3. 'Paradoxical' model (South Sudan): high water availability but limited access → conflicts driven by governance failures and armed violence.
4. 'Sahelian systemic' model (Mali, Burkina Faso): climate crisis + state fragility → water acts as a multiplier of instability and violence.

4. Water crisis: the case of transboundary lake basins: Lake Chad and the Aral Sea

Transboundary waters continue to be a source of tension, not armed. Over three billion people depend on it, but only a third of transboundary basins enjoy real cooperation agreements between the affected states (UN-Water, 2021). Among the areas of tension, the most emblematic concerns the Euphrates and Tigris basin, which has already been briefly mentioned (see Section 1.1). At the same time it is important to remember that the intensive, or at any rate markedly unilateral, exploitation of the shared water resource within transboundary basins is not only a possible origin or further catalyst of political and diplomatic tensions which may then result in situations of direct conflict, but may result in irreversible degradation

of the water resource and of the system which ensures its renewal, by then also hitting the underground aquifer deposits. The progressive retreat of the Aral Sea, on the border between Kazakhstan and Uzbekistan, following the diversion of the rivers that fed it is clear evidence of this. Other signs of the progressive retreat of the lake are: the lowering of the underlying aquifers, the contamination of the lands and, finally, the triggering of desertification phenomena. The cases of the two lakes are directly linked to four of the Agenda 2030 objectives. Specifically: SDG 6 (clean water and sustainable access), SDG 13 (climate action), SDG 15 (life on earth), SDG 16 (peace, justice and strong institutions).

4.1 Lake Chad

The Lake Chad water crisis (see Figure 2) is a prime example of a cross-border environmental disaster, characterised by a drastic reduction in the lake's surface area and serious socio-economic and security repercussions in the Sahel region. The issue of water geopolitics is of particular importance in the Sahel: water resource exploitation, climate change, governance, access to essential services, population growth and conflict situations are, in fact, critical and closely interlinked issues in the region.

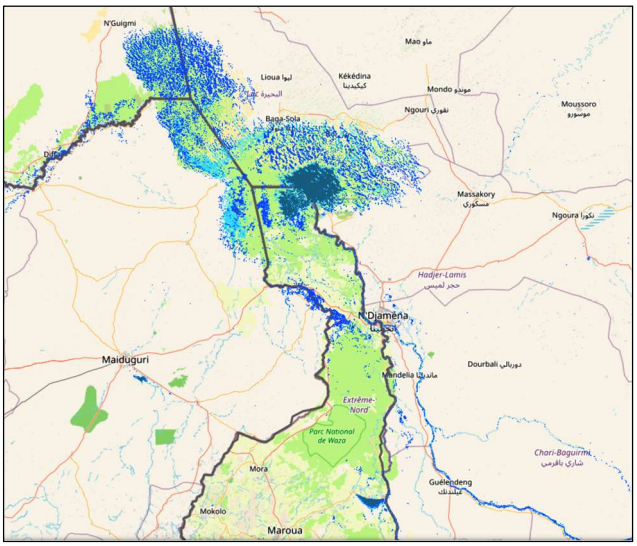

Fig. 2. Recent image of Lake Chad. Note its location as a border area between four countries (Chad, Nigeria, Niger and Cameroon). Source: Elaborated by the Authors from https://atlasahel.it/atlasahel/#/viewer/openlayers/512

Lake Chad represents one of the most complex cases of environmental crisis intertwined with social and geopolitical dynamics in sub-Saharan Africa, located between four states, it is an endorheic basin fed by two rivers: the Chari River, which accounts for 80–90% of the water supply, and the Logone River. It is a very flat basin with variable banks and marshy areas and is a highly dynamic lake as its extent varies seasonally and with strong annual oscillations. Subsequently, the environmental and social problems intertwined with the geopolitical dimension will be recalled and related in a schematic way (see Table 3). These problems have multiple causes, both local and global, especially if we refer to environmental problems, first and foremost the drastic reduction in surface area (in the last 50-60 years, the lake has lost up to 90% of its extension). This phenomenon turns out to be a classic example of desertification and a crisis linked to climate change.
Social problems clearly demonstrate how local communities (farmers, fishermen, herders) depended and depend on the lake, which confirm how a community's vulnerability is often linked to resource scarcity.

Environmental Problems	Social Problems	Geopolitical Dimension
Drastic reduction in surface area: climate change (rainfall variability in the Sahel); rising temperatures (evaporation); intensive water use for irrigation.	Crisis and loss of livelihoods: decline in fisheries; reduction in cultivable land; food insecurity.	Coordination for lake management: sustainable resource management; transboundary cooperation; lake restoration projects.
Ecosystem degradation: loss of biodiversity (fish, migratory birds); disappearance of wetlands; salinisation and soil degradation.	Resource conflicts: conflicts between pastoralists and farmers; competition among neighbouring states; local tensions over access to land and water.	Persistence of: weak governance; lack of adequate funding; divergent national interests.
Anthropogenic pressure: very high population growth; unsustainable agriculture and fishing practices; overexploitation of water resources.	Instability and terrorism: exploit socio-economic fragility; recruit from impoverished populations; further destabilise the region.	—
—	Forced migration: millions of internally displaced persons and refugees; climate migration; pressure on urban areas and neighbouring regions.	—

Tab. 3. Lake Chad: Concerns and Areas of Focus. Source: Elaboration by the Authors

Lake Chad's surface area is not stable and varies greatly depending on rainfall and the seasons; it currently ranges between 1,500 and 2,500 km², but in particularly dry years it can fall below 1,000 km². Since the 1960s (approximately 25,000 km²), the lake's surface area has shrunk drastically (by up to 90%) due to climate variability in

the Sahel, rising temperatures and increasing water extraction for irrigation, resulting in an advanced process of desertification and environmental degradation (Coe & Foley, 2001; FAO, 2016). Its catchment area covers over 967,000 km² and represents the main water source for more than 20 million people. In the past, it was one of the richest sources of water on the African continent. According to UNEP (2018), the main cause of this shrinkage has been the inappropriate use of the lake's resources through the construction of massive irrigation projects by Niger, Nigeria, Cameroon and Chad, which have diverted water from both the lake and the Char and Logone rivers[20].

The average depth is approximately 1.5-4 m, whilst the maximum depth is around 10-11 metres. Lake Chad is therefore extremely shallow, a characteristic that makes it highly susceptible to evaporation, accelerates the processes of surface reduction and promotes fragmentation into separate basins (North and South) (see Figure 4).

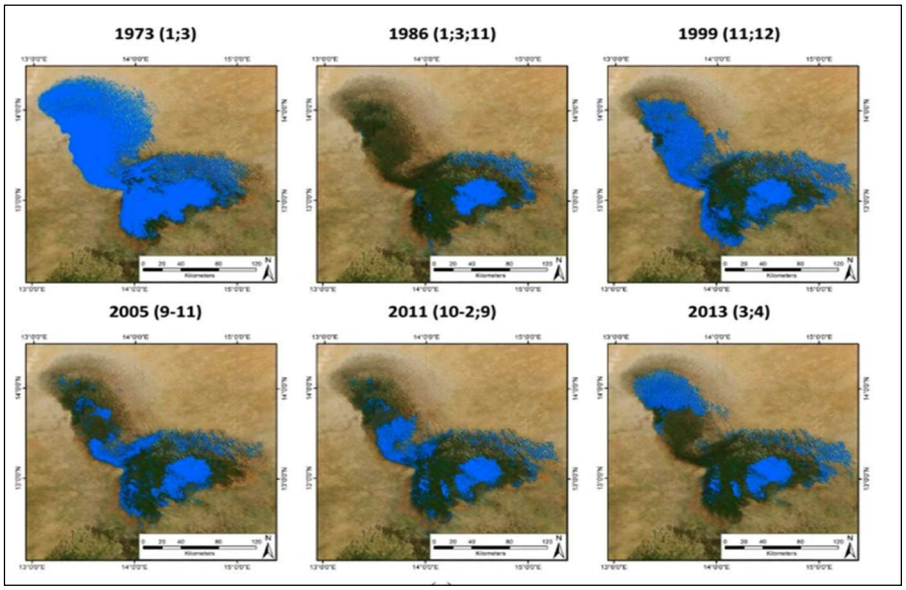

Fig. 4. Chad Lake Downsizing (1973-2013). Source: https://www.blueplanetheart.it/2017/04/il-lago-ciad-ormai-non-esiste-quasi-piu-rimangono-guerra-e-fame-fao-crisi-ecologica-e-umanitaria/

[20] Underlying these water development programs was the desire of local governments to meet the food needs of the basin's population by boosting the agricultural sector. The steadily rising demand for water that has affected the region over the years has been driven by exponential population growth in the Lake Chad region. The most critical situation is that of Nigeria, which, with over 230 million inhabitants, is Africa's most populous nation and has a particularly high population density in the area around the lake (CIA, 2024). The situation is similar in the other countries of the basin, which are also under significant demographic pressure and therefore have an urgent need for water resources.

This decrease has led to a significant loss of biodiversity and the degradation of ecosystem services, with direct impacts on the subsistence economies of riverside communities, which are traditionally based on fishing, agriculture and pastoralism (UNEP, 2018). In this context, the scarcity of water and land resources has intensified local conflicts between social groups and cross-border communities, forming part of a broader framework of competition for limited resources, consistent with political ecology approaches (Béné et al., 2008). Furthermore, the environmental crisis has contributed to exacerbating socio-economic vulnerabilities that foster instability and insecurity, including in relation to the presence of armed groups such as Boko Haram[21], which exploit conditions of marginalisation and deprivation to consolidate their territorial foothold (World Bank, 2016). At the same time, there has been an increase in forced migration and internal displacement, attributable to both environmental factors and conflict dynamics, highlighting the link between climate change, human security and mobility (IOM, 2020). Overall, the case of Lake Chad demonstrates how the crisis of natural resources, in the absence of effective and cooperative governance – despite the efforts of the Lake Chad Basin Commission – can evolve into a multidimensional systemic crisis, in which environmental, economic and geopolitical dimensions are deeply interconnected.

The case of Lake Chad can be interpreted through what is referred to as Political Ecology – that is, the study of the interaction between power, environment and resources – or through scarcity theory, which emphasises competition over limited resources. In the specific context of Lake Chad, the conflict dimension takes on particularly acute characteristics due to the overlap between environmental crisis, institutional fragility and insecurity, including the presence of armed actors such as Boko Haram, who exploit resource scarcity as a destabilising factor (World Bank, 2016).

The drastic reduction of water resources in the basin has triggered competitive dynamics among competing uses (agricultural, pastoral and fishing), effectively transforming water from a common good into a contested strategic resource. This aligns with interpretations within Political Ecology, which understand access to resources as the outcome of power relations and structural inequalities (Swyngedouw, 2009).

[21] The earliest attempts to address the problem of the lake's desiccation date back as far as 1964, when the four heads of state of the countries sharing its waters – Cameroon, Niger, Nigeria and Chad – established the Lake Chad Basin Commission. The aim was to initiate a process of regulation and coordinated planning for the use of the lake's water resources. However, the lake's condition continued to deteriorate for more than 30 years, as most initiatives lacked both a long-term perspective on water-related challenges and the capacity to implement a comprehensive, integrated approach.

Factors contributing to the sharp increase in poverty among the populations of the Lake Chad Basin have been multiple and interrelated. The principal consequence of the worsening situation, with regard to the lake and its population, has ultimately been the emergence of a series of conflicts, both within individual countries and between the different states of the basin, which have found themselves competing for an increasingly scarce water resource. A notable dispute arose on Cameroon's territory between Cameroon and Nigeria in the southern part of the basin from the mid-1990s onwards. As a result of the progressive retreat of the lake's waters, fishermen of Nigerian origin migrated and established – subsequently transitioning into agriculturalists – more than 30 villages in the more fertile Cameroonian section of the Lake Chad Basin.

Tensions between Cameroon and Nigeria escalated as these villages were, in effect, incorporated into Nigeria's decentralised administrative system, becoming part of the Nigerian district of Wulgo[22]. Following a series of armed clashes during the 1980s and 1990s, the two countries attempted to resolve the dispute within the framework of the Lake Chad Basin Commission, of which they are both members, but without reaching a solution.

In 1994, the dispute was brought before the International Court of Justice, which, only 8 years later, delivered its ruling in favour of Cameroon. In this sense, Lake Chad represents a paradigmatic case of 'hydro politics from below', where conflicts are not solely inter-state but primarily local and transboundary, involving marginalised communities and weak or fragmented governance systems.

At the regional scale, these dynamics are linked to similar processes observable in other parts of sub-Saharan Africa – from the Niger River Basin to tensions along the Nile River – where increasing demographic pressure and the effects of climate change intensify competition over limited water resources (UN-Water, 2021).

In summary, the case should be analysed through what is commonly defined as a territorial systemic approach: environmental crisis → economic crisis → social instability → conflict → migration. It is therefore evident that Lake Chad is not merely an environmental issue, but a multidimensional critical nexus in which climate change, demographic pressure and weak governance interact to produce ecological degradation, conflict and migration.

[22] The Nigerian authorities, following the movements of their citizens, established state control within the villages they had occupied in Cameroon, along with the provision of public services and the deployment of military and police structures. See IUCN-West Africa Regional Office (IUCN-BRAO), *Climate-Induced Water Conflict Risks in West Africa: Recognizing and Coping with Increasing Climate Impacts on Shared Watercourses Card information system – 04/2013*.

The study is situated within the debate on climate security in the Lake Chad Basin, an area that has experienced a disproportionate impact of climate change, with the lake's surface area having declined by more than 90% over the past 50 years. The literature highlights that the region represents a critical 'testing ground', where tensions over water resources and fertile land (fishing, agriculture and livestock farming) overlap with poverty, poor governance and political instability. Finally, the case of Lake Chad is a territory with armed water conflict (at the local, transboundary, and state scales) closely related to climate security and competition for resources, which can be analyzed through the lens of Political Ecology and must be studied through a territorial systemic approach.

4.2. The Aral Sea

The Aral Sea, considered one of the worst ecological disasters (Luongo, 2023) caused by human activity, is located in Central Asia, in the center of the Turanian Lowland, on the southern border of Kazakhstan and in northern Uzbekistan (Piastra, 2009; Mazza, 2024) (see Figure 5).

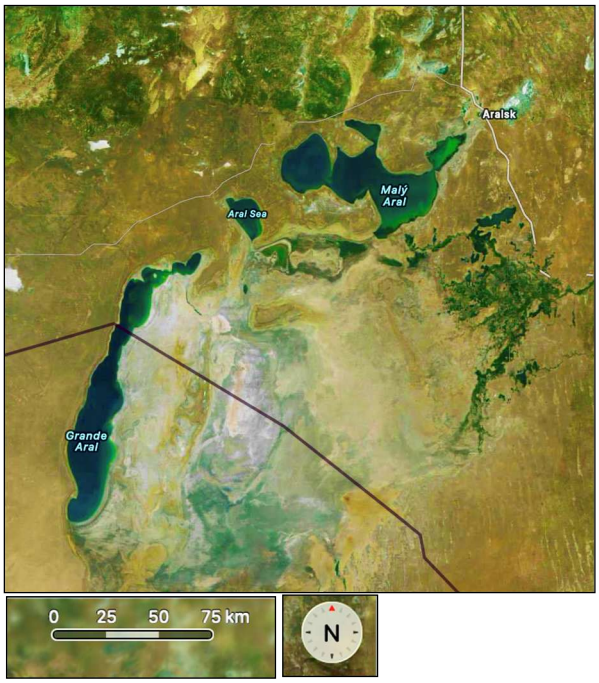

Fig. 5. The current State of the Aral Sea. Source: Elaborated by the Authors from Google Map

Before 1960, this lake was the fourth largest salt lake in the world (Menga, 2016) after the Caspian Sea, Lake Superior and Lake Victoria (Meini, 1994) and a source

of fishing and port activities for local communities (Mazza, 2024)[23]. However, since the 1960s of the 20th century it has lost over 90% of its water volume (Piastra, 2009a), transforming itself into a salt desert (Cervantes & Valls Martínez, 2023; Mazza, 2024), with unprecedented repercussions on the environment, health and the local economy (Gaybullaev et. al., 2012), reducing from 68,000 km² «to less than a tenth of its original size» (Menga, 2016, p. 169) (see Figure 6).

Since the 19th century, the waters of the transboundary rivers Amu Dar'ja and Syr Dar'ja, the lake's main tributaries, have been diverted to provide irrigation for cotton and rice plantations (Menga, 2016; Mazza, 2024). During the Soviet era, Central Asia was transformed into one of the world's largest cotton production hubs – called the 'White Gold' (Piastra, 2009a) – and unsustainable agricultural practices led to massive water withdrawal, progressively reducing the flow of water towards the Aral basin (Wheeler, 2018; Mazza, 2024).

In the 20th century, with even some years in the period 1970-80 when the deltas of the 2 tributaries remained completely dry (Meini, 1994), a strong contraction of the lake's waters was observed which in 1989 reduced it to 2 separate basins (Meini, 1994; Mazza, 2024): the North Aral Sea (the Little Aral), located in Kazakhstan and fed by Syr Darya, and the Southern Aral Sea (the Great Aral), located in Uzbek territory and fed by Amu Darya, symbolically marking the beginning of the collapse of an ecosystem indispensable for local life (Mazza, 2024).

On the lake floor today, there are toxic chemicals – mainly pesticides and fertilizers – used extensively in the Soviet era (Mazza, 2024). In fact, starting from the '50 the use of fertilizers used for the intensive growth of rice and cotton grew from 3.5 to 6 times per hectare of area worked (Meini, 1994).

[23] In the documentary *Be Water, My Friend* (2009), directed by Antonio Martino, Prof. Stefano Piastra confirmed that in the mid-20th century almost everyone in the Aral Sea was a fisherman and that Moynaq was a centre of seaside tourism (Source: https://www.youtube.com/watch?v=1mEtaU6rR1U). Today, in 2025, tourists visit *The Regional History and Aral Sea Museum* a Moynaq (Jarosz, 2025). Sometimes they can even turn to an agency to be taken by jeep to the shores of the Aral Sea to be photographed in the heart of the ecological catastrophe.

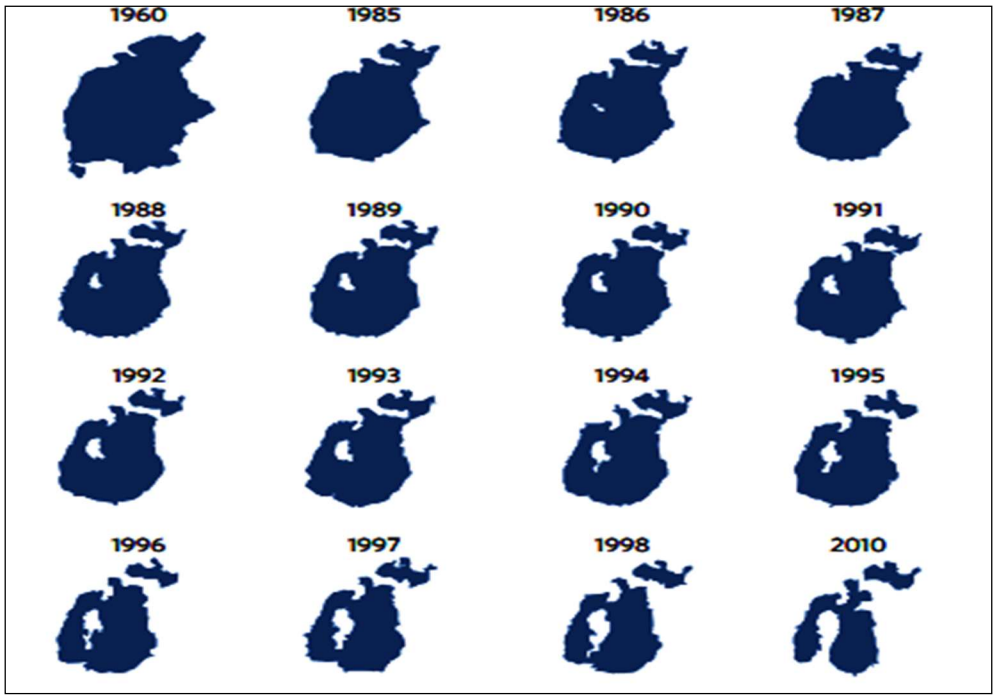

Fig. 6. The Aral Sea resizing process (1960-2010). Source: UNEP, in Ferragina, 2015

Severe sandstorms, enriched by contaminated dust, toxic and radioactive substances, have rendered much of the area uninhabitable, compromising agricultural land and water reserves and impacting crops, health and food security of local communities (Micklin, 1991; Piastra, 2009; de Lauri, 2024; Mazza, 2024). Respiratory problems, allergies and chronic diseases among the populations living near the lake are common (Mazza, 2024), life expectancy in the Republic of Karakalpakstan is lower than in other Uzbek regions (de Lauri, 2024): in 2024, the average life expectancy in Uzbekistan was 75.1 years. Regional disparities were evident, with the highest life expectancy recorded in the Bukhara region (76.3 years) and the lowest in the Syrdarya region (72.2 years). The Republic of Karakalpakstan reported a life expectancy of 73.0 years, ranking just above Syrdarya.[24].

The town of Moynaq, once a fishing port on the shores of the lake, is now the symbolic city of an environmental disaster expressed in images immortalizing the rusty carcasses of abandoned boats (Mazza, 2024) on a land with an arid climate. In 2024, the largest numbers of international visitors to Uzbekistan originated from neighbouring Central Asian countries, particularly Kyrgyzstan (2,331,300 arrivals),

[24] Source: Life expectancy at birth (total), from a https://stat.uz/ru/ofitsialnaya-statistika/demography, lastly accessed on 29 December 2025.

Tajikistan (2,325,379), and Kazakhstan (1,483,586). Other major source countries included Russia (788,574), Turkmenistan (197,772), China (74,304), Afghanistan (73,250), India (70,593), South Korea (41,229), Italy (38,684), and Germany (37,526).25.

Over time, this site has also become an international tourist destination, one of the destinations of dark tourism (Mukashev & Ussenova, 2013; Patterson et al., 2024). Moynaq is now considered a kind of open-air museum (Mazza, 2024), which attracts journalists, researchers and tourists from all over the world26. To help the region's depressed economy, UAE investors have even proposed building a casino resort on the dried-up shores of the Aral Sea (Eurasianet, 2019; Lloyd et al., 2023). In the Aral Sea region, they are even trying to develop ecotourism (Saidmamatov et al., 2020), considered a path to sustainability: environmental, economic, and social.

The Aral Sea disaster has caused the disappearance of the entire fishing sector and migration to other regions or cities in search of work and stability. A small core of people who remained is called 'resistant residents' (Mazza, 2024), as they managed to stay in Moynaq by diversifying their income. Some dedicate themselves to raising brine shrimp in the waters of the few remaining basins of the Aral Sea (Mazza, 2024), some dedicate themselves to commercial activities and tourism.

To combat desertification and reduce the dispersion of toxic dust, some reforestation projects have been launched, such as the planting of saxaul trees. This initiative was seen as an attempt to at least partially reverse the environmental damage caused by the disappearance of the lake (Mazza, 2024). However, climate change in Central Asia has further exacerbated desertification in the region.

In 2005, with the support of the World Bank, the Kazakh government implemented the Kok-Aral Dam project as a means of mitigating the ecological catastrophe of the lake (Mazza, 2024). This infrastructure was aimed at stabilizing the level of the North Aral Sea, containing the waters of the Syr Darya River. Thanks to the dam, the salinity of the water was reduced and it was possible to return some fish species to the lake, such as mullet and catfish; therefore, there was a partial resumption of fishing (Mazza, 2024).

However, the dam could not solve the environmental problem of the Aral Sea in its entirety, as no dam was built in the southern part of the lake located in northern

[25] Source: Distribution by country of the number of foreign citizens arriving in Uzbekistan for tourist purposes, from https://share.google/n18HfeQOGMDpYzNFL, lastly accessed on 29 December 2025.

[26] Today's Aral Sea post-apocalyptic landscape attracts tourists of all kinds; today, numerous companies take tourists by jeep from Nukus to the dry shores of the lake on rusty boats. Tourists sometimes stay overnight in tents just to see the current state of the Aral Sea with their own eyes.

Uzbekistan (Mazza, 2024). The basin has therefore continued to disappear, increasingly worsening the water, environmental, economic and social crisis that is severely affecting Karakalpakstan, an autonomous region located in western Uzbekistan (Mazza, 2024)[27]. The only source of water for Karakalpakstan is the Darya River, which has been highly exploited over time and is now insufficient to meet the basic needs of local communities (Mazza, 2024).

The restoration of the Aral Sea is hampered not only by ecological problems but also by complex political and management factors (Mazza, 2024) which have a history of more than 10 years[28].

The agricultural sector is still dominated by cotton cultivation, absorbing 90% of the country's water resources, although the government encourages the use of new irrigation techniques accompanied by more equitable management of water resources among neighbouring nations (Mazza, 2024). In particular, the Uzbek and Kazakh governments discuss partial water recovery to revitalize the local economy (de Lauri, 2024). Furthermore, since 2006, the land emerging from the lowering of the lake level and rich in natural gas deposits has been exploited thanks to an agreement signed «between the government of Uzbekistan, the Russian company LUKoil, Petronas, Uzbekneftegaz and the China National Petroleum Corporation» (de Lauri, p. 44).

Today, the Aral is a living testimony to the global water crisis, a reminder of how economic policy choices can have devastating environmental consequences (de Lauri, 2024; Mazza, 2024). A partial solution to the environmental disaster is not enough (as in the case of Kok-Aral Dam alone), a program of targeted actions and solid cooperation is needed to be able to carry out such actions by mitigating environmental damage and saving the last 'resistant residents' from humanitarian catastrophe. Furthermore, the construction of a new dam is being considered to bring the Little Aral back to a level that will allow the reactivation of the port of Aral'sk» (de Lauri, 2024, p. 44).

---

[27] Traveling at night by train from Bukhara to Khiva across the Kyzyl-Kum Desert evokes a certain anguish in the traveler, due to the knowledge that they have arrived in a land wounded and exploited for decades, where water scarcity is more than tangible.

[28] Regional relations in Central Asia have been characterized by the coexistence of conflict and cooperation (Menga, 2016). Indeed Menga (2016) identifies three phases in particular: the period 1991-1996, when numerous multilateral agreements on shared water management were signed; the period 1997-2006, when there were several negotiations of the bi- and trilateral annual operational agreements but an individualistic trend in the management of common water resources was still observed; the period 2007-2016, when a revitalization of the projects of large hydroelectric works was observed, becoming the cause of several tensions in the region. We add that today we are in a period in search of the sustainability of reforestation, catering and innovation.

Among the solutions proposed in 1990 to revitalize the lake, the *Sibaral project* stood out «a canal 2500 km long and almost 200 m wide which» was supposed to «connect the Ob' to the Aral through the Turgai Gate» and the «proposal to pump water from the Caspian Sea or directly convey that of the Volga into the Aral Sea» (Meini, 1994, p. 306). However, concrete applications of such ideas have never occurred.

After several decades, attempts have been made to address the lake's environmental problem again. Russian researcher Marina Koziava proposed restoring the lake to its previous levels by growing a water-efficient cotton variety, and researchers Richard Cathcart and Viorel Badescu discussed river diversions or an aqueduct from the Caspian Sea (de Lauri, 2024). Although there is a clear urgency in mitigating the ecological problem of the lake – «to date the only case of almost total human-caused desiccation of a reservoir» (de Lauri, 2024, p. 44)[29] – it seems that the proposals continue to be neutralized by political silence on the path to their realization.

«The crisis of the Aral Sea and its region invites two concluding reflections. The first is that the conception according to which irrigation in arid and semi-arid areas amounts to valorisation – and therefore greater profitability compared to other land uses – is illusory, because it does not take into account the costs of managing and conserving the environment. The second, a sort of generalization of the first, is that economy and ecology must always go hand in hand, especially in an arid ecosystem, where human interventions must be particularly respectful of the environmental delicacy that characterizes it» (Meini, 1994, p. 309).

The drama of the relict lake (Giussani & de Bernardi, 2003) has such far-reaching implications that it can be defined as «a global management problem» (Meini, 1994, p. 309). That problem is in fact being sought to be resolved today through global efforts as well.

Today in Uzbekistan, taking into account the visions of the Aral Sea at the beginning of the 21st century (UNESCO, 2000), several initiatives are taking place for the restoration of the Aral Sea Region, especially because on May 18, 2021, the UN General Assembly unanimously adopted a special resolution declaring the Aral Sea region a zone of environmental innovation and technology. Today, the improvement of more than 1 million hectares of Uzbek degraded land in the same region by 2030 continues (Land Degradation Neutrality (LDN), National Biodiversity Strategy and Action Plan (NBSAP) and Global Biodiversity Framework

[29] In fact, the causes of the ecological crisis in the Aral basin are: the «erroneous choice of development strategy for a dry ecosystem; errors of evaluation in agrarian management and the agricultural techniques used (rice and cotton monoculture; excessive development of irrigation; abuse of fertilizers, herbicides and pesticides; choice of land to cultivate that is unfavorable and difficult to improve; irrational exploitation and inefficient management of irrigation systems» (Meini, 1994, pp. 304-305).

(GBF), Nationally determined contribution (NDC) and Bonn challenge processes). Sustainable agricultural practices, irrigation modernization, crop diversification using drought-tolerant crops, and reforestation of the dried Aral Sea bed and biodiversity conservation activities are promoted. Furthermore, the aim is to achieve land degradation neutrality and restore 30% of degraded ecosystems by 2030: «Large-scale afforestation projects in the desiccated Aral Sea bed would be important to stabilize soils, reduce dust storms, and restore ecosystem functions. Planting drought-resistant tree species and shrubs can improve microclimatic conditions and promote biodiversity» (Mirzabaev & Akramkhanov, 2025, p. 29).

Green coverings on the Aral Sea floor have been taking place since 2019-2020, when another Resolution of the Council of Ministers of the Republic of Uzbekistan No. 745 of 25 November 2020 has already been issued *On additional measures to create forests in the regions of the Republic, 'green cover' in the regions of the Aral Sea and the Aral Sea region*[30].

The restoration efforts of the Aral Sea Region are promoted by several cooperations: «the United Nations Economic Commission for Europe (UNECE) supports international cooperation on sustainable development through data collection and analysis of transboundary issues. International Fund for Saving the Aral Sea (IFAS) coordinates regional efforts to save the Aral Sea and manages water and environmental projects. Regional Environmental Centre for Central Asia (CAREC) also promotes regional cooperation on environmental issues, conducts capacity-building programs. Together, these organizations provide funding, build local capacities through training, and offer technical advice, thereby playing an important role in advancing Uzbekistan's integrative agenda for land, climate, and biodiversity» (Mirzabaev & Akramkhanov, 2025, p. 53).

In this scenario, Kazakhstan continues to hold fast to cross-border cooperation (Haidar & Bland, 2025) with Uzbekistan, believing in restoring prosperous life in the Aral Sea Region, which is also affected by climate change, only through united forces. In fact, the OASIS open project is full confirmation of this.

It appears that Italy is also particularly interested in co-operation with Kazakhstan, Uzbekistan, Kyrgyzstan, Tajikistan and Turkmenistan in order to restore the water resources of the Aral Sea, contribute to its reforestation, the restoration of its soils, the promotion of climate-resilient agriculture and the strengthening of food and health security for local communities, through the project *Environmental and socio-economic regeneration of the Aral Sea transboundary river basin*, promoted by the Ministry

[30] Other projects to rehabilitate the Aral Sea region and invest in its environmental sustainability are the United States Agency for International Development (USAID) ERAS-I (Environmental Restoration of the Aral Sea-Phase I) and ERAS-II (Environmental Restoration of the Aral Sea-Phase II) projects executed in cooperation with the Uzbek and Kazakh Governments.

of Foreign Affairs and International Cooperation (MAECI) through the Italian Agency for Development Cooperation (AICS) and implemented with the technical support of SOGESID, which was recently awarded a special recognition as part of the 2025 Green Drop Award. It is hoped that the sustainable path taken by the Aral Sea region (with the Aral Sea at its centre) in recent years, with the help of international cooperation and the positive vision of the inhabitants for a more peaceful environmental future (Lloyd et al., 2023), will be increasingly consolidated and will contribute to the continuous restoration of the environment and water resources as accessible and sufficient resources for all (Loodin, 2020; Abidova et al., 2021; Ahn et al., 2024; Azizkulov, 2025). Finally, it must be said that the case of the Aral Sea is an example of the unarmed water conflict; of the restoration, reforestation and innovation of degraded land, of attempts to achieve effective cross-border and worldwide cooperation.

5. Climate change and water scarcity in vulnerable areas: socio-environmental impacts

This part of the paper aims to reiterate that climate change today represents one of the main factors transforming global socio-ecological systems, with particularly evident effects in areas characterized by high environmental and institutional vulnerability. And furthermore, the aim is to relate the change with water scarcity to migration, with a specific reference to the Sahel region regarding vulnerable areas in this area.

Scientific literature highlights how the relationship between climate change, water scarcity, and human mobility is not linear, but rather the result of complex interactions between environmental, economic, social, and political factors (Burrows & Kinney, 2016; Huber et al., 2023). From this perspective, climate does not act as a direct cause of migration, but rather as a threat multiplier, capable of amplifying pre-existing vulnerabilities in contexts already marked by poverty, institutional instability and conflict (Balsari et al., 2020; Chigudu, 2024a; Vigil et al., 2025a).

5.1 Areas of sub-Saharan Africa: the Sahel

The term 'Sahel' derives from the Arabic sāḥil (ساحل), meaning 'shore', 'coast', 'edge' or 'margin'; therefore, in a figurative sense, it refers to the 'edge of the desert' (Agnew & Chappell, 1999), that is, the transitional belt between the desert and the more humid areas. It is recognised as a distinct geographical region, namely a semi-arid belt of Africa extending in an east-west direction (from the Atlantic Ocean to the Red Sea), immediately south of the Sahara Desert (see Figure 7).

Fig. 7. The Sahel region. Source: Elaborated by the Authors from: https://aspeniaonline.it/lascesa-continua-del-jihadismo-in-sahel/#

In this context, it is also useful to briefly consider the climatic characteristics of this geographical area, which is marked by a semi-arid climate with irregular seasonal rainfall. The vegetation is characterised by sparse savannah and steppe landscapes, forming a transitional zone between the arid climate of the Sahara Desert and the more humid sub-Saharan region (Nicholson, 2013).

According to the reports of the United Nations Environment Programme (2021), the Sahel is an ecological frontier zone, highly vulnerable to drought, desertification and climate change. It also represents a key space for understanding resource-based conflicts (water and land), environmental and/or climate migration, and crises such as that of Lake Chad (see Section 4.1).

In summary, this area constitutes both an ecological and geopolitical transition zone, central to the study of environmental dynamics and conflicts in sub-Saharan Africa (Amselle, 2023).

It is also worth briefly noting that the term 'Sahel' as a geopolitical identifier was scarcely used until the post-colonial period. Its significance increased following the severe droughts that affected the region during the 1970s and 1980s, as well as the emergence of the first regional organisations grouping Sahelian countries, such as the Sahel Group within the Organisation for Economic Co-operation and Development (OECD), the Community of Sahel–Saharan States (CEN-SAD), the Permanent Inter-State Committee for Drought Control in the Sahel (CILSS), and the Liptako-Gourma Authority (Liptako-Gourma Authority). These organisations have emphasised in their documents the environmental fragility of the region as a defining characteristic.

Building on this perspective, the contemporary concept of the Sahel is understood as a transitional eco-region characterised by scarcity – but not absence – of rainfall. There is now a substantial body of literature on the Sahel, including extensive research – ongoing, emerging and completed – on the major issue of water resources in this region. From the analysed studies, the following main thematic areas emerge:

a) Conflicts and clashes between pastoralists and farmers:

The reduction of water resources and the shrinking of grazing land due to desertification lead to violent clashes between pastoral and agricultural communities over access to water sources (Afifi et al., 2012; Peters, 2013; Tor & Boubacar, 2021; Schilling & Werland, 2023; Ayeb-Karlsson, 2025).

b) Impact of climate change:

Desertification and extreme droughts in the Sahel (including Senegal, Niger, Mali, Chad and Burkina Faso) are making water an increasingly scarce and valuable resource (Adams & Goudie, 2006; Nicholson, 2013; ICG, 2020; Raineri, 2020; Hegazi et al., 2021; UNEP, 2021; Pase & Gianoli, 2022; Raineri, 2022).

c) Health and economic crisis:

The lack of safe drinking water increases the risk of diseases such as cholera, with devastating consequences for public health, as reported in 2022 with thousands of cases across the central Sahel. In the same region, nearly 7.5 million children are in urgent need of humanitarian assistance (UNICEF, 2022). Following the series of coups d'état between 2020 and 2023 in Burkina Faso, Mali and Niger, violence and forced displacement have affected over 3.6 million people (LVIA, 2013; Brando, 2022).

d) Humanitarian responses:

Organisations such as UNICEF are working to improve access to climate-resilient water services and provide humanitarian assistance, although political instability often limits the effectiveness of these interventions. In particular, since 2018 UNICEF has been delivering life-saving assistance and multisectoral services to children and families in severe need in the Horn of Africa and the Sahel, including improving access to climate-resilient water, sanitation and hygiene services, drilling reliable groundwater sources, promoting solar-powered systems, identifying and treating malnourished children, and strengthening preventive services (UNICEF, 2022a).

e) Water as a weapon of war:

In Burkina Faso and other parts of the Sahel, jihadist groups (such as those affiliated with al-Qaeda) destroy or sabotage wells and water infrastructure in order to control local populations (Cochi, 2022). In Mali and Niger, the lives of millions depend on the River Niger. Forced to coexist with the threat of jihadist attacks and military reprisals, and under the pressure of an increasingly harsh climate, the populations of

these Sahelian countries rely on the river as an inexhaustible source of life (Belgrano, 2022; Hauchard & Yambuya, 2024).

Water conflicts in the Sahel constitute a critical and highly complex issue, often described as a 'hidden war' or a 'humanitarian crisis' driven by climate change and geopolitical instability. Over the past twenty years, water scarcity has increased by more than 40% and has now become a conflict multiplier, involving jihadist groups that use control over water resources as a weapon of war in order to seize territory and force local populations to flee (Brando, 2022; Cochi, 2022; Varani & De Andreis, 2015).In the Sahel context, a link between climate change and armed conflict appears plausible: rising violence is intertwined with environmental degradation and the progressive reduction of available natural resources. However, despite this apparent evidence, empirical literature has not yet demonstrated a clear and systematic direct correlation between climatic variables and the outbreak of conflict (Burke et al., 2009; Buhaug, 2010).

More recent approaches suggest instead the need to consider the long-term effects of drought and desertification processes in the Sahel, analysing different theoretical mechanisms linking environment and conflict: the Malthusian paradigm (resource scarcity), the 'greed' model (opportunistic competition), the 'sons of the soil' dynamic (identity-based conflicts over land access), and the political ecology approach (Homer-Dixon, 1999; Raleigh & Urdal, 2007).

This latter approach highlights how climate change acts as a risk multiplier, destabilising fragile socio-economic systems and affecting local mechanisms for conflict regulation. Consistent with this perspective, a substantial body of literature emphasises the crucial role of governance: effective and inclusive institutions can mitigate tensions, whereas contexts characterised by state fragility or social exclusion tend to facilitate the escalation of violence (Adger et al., 2014; Ide, 2023).

It is important to note, however, that climatic factors are neither necessary nor sufficient conditions for the emergence of armed conflict. Exogenous variables such as the proliferation of small arms, the presence of armed groups, and the spread of ideologies that legitimise the use of violence play a decisive role, particularly in the Sahelian context (Collier & Hoeffler, 2004; Kaldor, 2013). Interventions targeting these factors may therefore prove more immediately effective in containing the risk of escalation.

In parallel, an excessively Malthusian narrative centred on demographic pressure and environmental scarcity risks oversimplifying the complexity of conflict dynamics, obscuring their structural causes and limiting the effectiveness of policy responses (Selby & Hoffmann, 2014). Within this framework, some Sahelian governments have at times emphasised the link between climate change and conflict in order to attract international financial resources, strategically drawing on priority

issues for donors. Similarly, a number of Western donors, including the European Union, occasionally adopt a reductionist interpretation, attributing complex and often interlinked phenomena – such as resource conflicts, terrorism and migration – to a single underlying cause, namely climate change (Hartmann, 2010; Bettini, 2013).

This reductionist framing also extends to the relationship between climate change and migration. In the Sahel, human mobility should not be understood solely as an expression of vulnerability, but also as an adaptive strategy and a form of resilience in response to environmental shocks (Black et al., 2011; Scheffran et al., 2012). From this perspective, supporting – rather than restricting – regional and trans-Saharan mobility systems may help reduce socio-economic pressures that contribute to conflict and processes of radicalisation (McLeman & Gemenne, 2018; International Organization for Migration, 2021; 2022).

Similarly, historical experience shows that large-scale interventions – such as 'Green Revolution' programmes, reforestation initiatives like the "Great Green Wall"[31], or broader territorial development projects – may produce unintended or even negative outcomes when designed and implemented through top-down logics, without adequate involvement of local communities in decision-making processes (Mortimore, 2010; Benjaminsen et al., 2012).

In contexts characterised by institutional fragility, centralised governance by political or technocratic elites tends to overlook customary practices and local resource governance systems, thereby exacerbating pre-existing tensions and generating new forms of conflict (Turner, 2004; Peters, 2013).

In light of this evidence, it clearly emerges how environmental policies must be conceived according to a 'conflict-sensitive' approach, capable of integrating the ecological dimension with the socio-political one. Only through inclusive, participatory and contextually rooted strategies can it be avoided that sustainability-oriented interventions end up fuelling, rather than mitigating, conflictual dynamics (Adger et al., 2014; Ide, 2023).

The most interesting research is undoubtedly that of Raineri (2020) and suggests that, in the Sahel, climate change is more dependent on macro factors, while

[31] Since 2007, the African Union has launched an ambitious environmental project The Great Green Wall: to date over 20 countries (Algeria, Burkina Faso, Benin, Chad, Cape Verde, Djibouti, Egypt, Ethiopia, Libya, Mali, Mauritania, Niger, Nigeria, Senegal, Somalia, Sudan, Gambia, Tunisia and Ivory Coast) want to stop the advance of the desert by creating an 8 thousand km long barrier of trees from Senegal to Djibouti across the entire Sahel region. This idea was proposed by British scientist Richard St. Barbe Baker in 1952 at the Summit in Chad on the occasion of World Day to Combat Desertification and Drought (Varani & Mazza, 2023). For further information, see the Green Great Wall Website: https://greatgreenwall.us.com/about-great-green-wall/

conflicts are more often the result of micro dynamics. The articulation of these two levels is not linear and leads to complex and difficult to predict outcomes. This highlights the need for a holistic understanding of the climate-conflict nexus, which excludes simple cause-effect correlations and analyses in more depth the socio-political struggles endemic to the Sahel region.

5.2 Climate migrants and the water shortage

In some regions of the world, natural disasters are commonly classified as 'rapid-onset disasters' and 'slow-onset disasters' (Lauriola et al., 2019) and linked to climate change (Bagliani et al., 2019), whether naturally occurring or induced by human activities, and compounded by economic, social and/or political factors (Nespor, 2007; Piquet, 2017; Talamo, 2021), act as push factors for migration.

In some cases, it is precisely the climatic disaster that triggers forced or voluntary migration, transforming individuals into so-called environmental refugees (Myers, 2002), or climate refugees and climate migrants (Biermann & Boas, 2007; Piquet, 2017)[32].

Although this category of migrants has long been studied at the international level, it still lacks a solid and universally recognised scientific terminology. Moreover, the category of 'environmental refugee' has not yet been supported by any formal legal framework aimed at addressing the needs of those who migrate for climate-related reasons and providing them with secure protection[33]. In this study we adopt a term of Cattaneo (2016) and Chigudu (2024) "climate migrant", because it seems more suitable for our study.

At a conceptual level, climate migration continues to be understood as «a form of adaptation to environmental uncertainty» (Piguet, 2017, p. 16), as well as a strategy for coping with multiple climate-related challenges (Cattaneo & Bosetti, 2017; Wilkinson et al., 2017).

---

[32] In the scientific literature, climate refugees are also referred to by a range of terms, including climate migrants (Cattaneo, 2016), environmental migrants, eco-migrants, eco-refugees (Talamo, 2021), environmental refugees (Louvin, 2020; Talamo, 2021), climate-displaced persons (Galli, 2022), ecological refugees (Vogt, 1948; Talamo, 2021) or, according to Alexander Betts, «*survival migrants*» (Alferi & Favazzo, 2017, p. 129). These are individuals who predominantly migrate within the borders of their country of origin, only rarely moving beyond them (Piguet, 2017).

[33] Even today, migrants who move for environmental and/or climatic reasons are often compelled to seek international protection by invoking grounds recognised under the 1951 Geneva Convention, rather than the actual environmental factors that prompted their migration. Chigudu (2024) also emphasizes the need to legally recognize the category of «climate migrants» in order to mitigate conflicts induced by climate change and other social, economic and/or political factors.

However, this phenomenon is driven by a multiplicity of causes of differing nature, just as environmental migration – distinct from climate migration – also stems from diverse underlying factors. «While the study of environmental migration considers the relationship between post-disaster mobility and the environment, research on climate migration seeks to analyse the impact of climate change on migration processes» (Talamo, 2021, p. 170; Hoffmann et al., 2023; Twinomuhangi et al., 2023).

Indeed, «phenomena such as air and water pollution may contribute to migration driven by environmental causes, whereas rising temperatures, sea-level rise and desertification may, in turn, contribute to migration driven by climatic causes» (Talamo, 2021, p. 170). In Somalia, for example, pastoralists have long used migration as a defence mechanism in times of water scarcity or prolonged heat (Kassahun et al., 2008; Leal Filho et al., 2020, Thalheimer et a., 2021).

Climate and environmental migration tend to occur predominantly in more fragile regions of the world, including Africa, Middle East, South Asia, Latin America and the Pacific region (Elliott, 2012; de Sherbinin et al., 2022; Amadi & Vundamina, 2023; Sim-Sarka, 2025). In 2015, the members of the Climate Vulnerability Forum identified the countries most affected by the impacts of global warming under the designation "V20": Afghanistan, Bangladesh, Barbados, Bhutan, Costa Rica, Ethiopia, Philippines, Ghana, Kenya, Kiribati, Madagascar, Maldives, Nepal, Rwanda, Saint Lucia, Tanzania, Timor-Leste, Tuvalu, Vanuatu and Vietnam (Wilkinson et al., 2017, p. 150). These territories continue, to this day, to be characterised by marked environmental vulnerability, not solely because they are more exposed to global warming, but also due to underlying structural, socio-economic and institutional fragilities.

Also, the Aral Sea case study (see Section 4.2) demonstrates how environmental fragility can produce migration, an almost natural effect of water scarcity on the territory and all the resulting impacts. Many Uzbeks have emigrated from Uzbekistan in recent decades in search of the best living conditions. In 1990 the country had recorded 1,449,406 emigrants, as of 1° July 2024 there were already 2,114,480, the number of emigrants in more than thirty years has increased 1.46 times[34]

The contemporary «global water crisis» is also driven by the «unsustainable management of water resources» (Chiocchini & Di Vito, 2024, p. 4), particularly in territories characterised by rapid urbanisation coupled with ongoing demographic growth. In such contexts – also affected by climate change – it is essential to promote the «resilience of water supply and sanitation services» (Chiocchini & Di

[34] Source: https://share.google/eCdTQqdRqik8Tvii2, last accessed on 29 December 2025.

Vito, 2024, p. 4), while strengthening the resilience and adaptive capacity of populations (Wilkinson et al., 2017).

The cause-effect relationship between climate change, conflict and migration is far more complex. Burrows & Kinney (2016) were among the first to explore the nexus between climate change, migration and conflict, demonstrating the density of interconnections linking these phenomena. Where conflicts already exist, or where there is a high risk of their emergence, climate change tends to act as a threat multiplier rather than as the primary driver of migration (Balsari et al., 2020; Talamo, 2021; Huber et al., 2023; Chigudu, 2024; Vigil et al., 2025).

In armed conflicts, water may constitute not only the object of contention but also an active agent: it can assume the role of a victim, yet it may also be deployed as a weapon. The Pacific Institute systematically records such events worldwide, documenting instances in which water resources take on one or the other role (see Section 3). Water – conceived as victim, weapon, object of dispute and as one of the push factors of migration – underpins analytical mappings that illustrate the degree of water scarcity across different countries. The global hydrological cycle, significantly affected by conflict, climate change and the intensive extraction of water for human activities, is today represented through tools such as the Water Gap map[35].

In light of this centrality of water in both peaceful and conflictual contexts, it is essential to complement international climate and environmental policies by translating them into concrete and effective practices to be implemented at the local level in areas affected by, or at risk of, crisis. Such an approach is necessary both to prevent forced migration and to avoid the irreversible collapse of water systems. Governments, the international community, and both public and private actors should therefore strengthen collective investment in water infrastructure in vulnerable regions, in order to ensure access to basic water services, mitigate water scarcity and support the preservation of social stability and peace.

Addressing water scarcity in these regions would be supported by measures such as wastewater recycling and rainwater harvesting. Alongside human-built infrastructure, it is essential to promote «green infrastructure, such as river basins and forests, which are capable of storing, filtering and distributing both surface and groundwater, thereby enhancing resilience and improving the quality of water supply» (Tautonico, 2021).

In light of these considerations, it becomes necessary to adopt a cumulative policy approach that integrates, on a broad scale, strategies for addressing water-related

[35] This form of scarcity, as it pertains to a given territory, can be visualised through the *World Water Gap* produced by National Geographic.

challenges. This includes policies aimed at mitigating climate and environmental migration, alongside those ensuring secure water provision – an essential prerequisite, particularly in territories affected by food insecurity. Such cumulative policies should be implemented in conjunction with international cooperation efforts, with the objective of progressively reducing conflicts over water resources.

6. Concluding remarks

The data and information analysed in this contribution are situated within a broader framework in which increasing pressure on water resources, combined with climatic, demographic and political-institutional factors, contributes to transforming water into an increasingly contested resource. In the case of sub-Saharan Africa, the fragility of governance systems and dependence on natural resources further amplify the risk of conflict escalation, making the systematic monitoring of these dynamics a fundamental tool for conflict prevention and management (Wolf et al., 2003; De Stefano et al., 2017).

The research contributions and reports analysed, in particular that of UNECE, UNESCO & UN-Water (2024), highlight the lack of international cooperation in the management of shared rivers, lakes and aquifers, calling for more effective collaboration between countries. The limited and slow progress achieved to date is likely to result in delays in the joint strategies required to address the growing impacts of droughts and floods in the context of climate change.

It can therefore be summarised that the availability of freshwater resources is limited and increasingly threatened by climate change, demographic growth and unsustainable patterns of use.

At times, water functions as a boundary; at other times, it transcends it, generating asymmetries, inequalities and/or conflicts at different scales (local, regional, national and/or global). The path towards shared water governance through cooperative agreements is already underway[36]; however, greater political commitment at the local scale is required, along with concrete bottom-up actions involving local populations.

References

Abidova, D. I., Bakhromov, A. A. O., & Dekhkonov B. R. (2021). The Aral Sea Cannot Be Saved, But IT is Possible to Develop a New Tourist Region. *European Journal of Research Development and Sustainability*, 2, 3, 74-78.

[36] In sub-Saharan Africa, the number of countries engaged in cooperation with a very high level of collaboration has increased fivefold, rising from 3 in 2017 to 16 in 2023. Although no successful cases of cooperation are observed at the local scale, sub-Saharan Africa has a long-standing tradition of transboundary cooperation through basin organisations. Recent projects in the region have led to sustainable cooperation systems that integrate local authorities, scientists and indigenous communities (UNECE, UNESCO & UN-Water, 2024).

Adams, W. M., & Goudie, A. S. (2006). The Sahel: Development and desertification. In The Physical Geography of Africa. Oxford: Oxford University Press.

Afifi, T., Govil, R., Sakdapolrak, P. et al. (2012). Climate change, vulnerability and human mobility: Perspectives of refugees from the East and Horn of Africa, Report 1, 1-60, United Nations University Institute for Environment and Human Security (UNU-EHS). https://www.unhcr.org/sites/default/files/legacy-pdf/4fe8538d9.pdf

Agnew C.T., & Chappell, A. (1999). Drought in the Sahel. *GeoJournal*, 48, 299-311. https://doi.org/10.1023/A:1007059403077

Ahmed, S. K. (2024). How to Choose a Sampling Technique and Determine Sample Size for Research: A Simplified Guide for Researchers. *Oral Oncology Reports*. 12, 100662. https://doi.org/10.1016/j.oor.2024.100662

Ahn, Y. J., Kamalov, B., & Juraev, Z. (2024). Revisiting the Aral Sea crisis: a geographical perspective. *International Journal of Environmental Studies*, 81(6), 2381–2398. https://doi.org/10.1080/00207233.2024.2422695

Adger, W. N., Pulhin, J. M., Barnett, J. et al. (2014). Human Security. In C. B. Field, V. R. Barros, D. J. Dokken et al. (Eds.), Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (pp. 755-791). Cambridge-New York: Cambridge University Press.

Alferi, P., & Favazzo, A. (2017). Dentro il cambiamento climatico, popolazioni in movimento. *Equilibri*, 1, 123-136.

Amadi, V. T., & Vundamina, M. N. (2023). Migration and climate change in Africa: A differentiated approach through legal frameworks on the free movement of people. *International Journal of Social Science Studies*, 7(4), 57-58.

Amselle, J.-L. (2023). L'invenzione del Sahel. Narrazione dominante e costruzione dell'Altro. Sesto San Giovanni (MI): Meltemi.

Ayeb-Karlsson, S., Hayward, G., & Kniveton, D. (2025). 'We Herders Are Often Chased About by Drought': A Systems Analysis of Natural Resource Degradation Within the Climate-(Im)mobility-Violence-Health Nexus in Sahel. *Earth*, 6, 11, 1-21. https://doi.org/10.3390/earth6010011

Azizkulov A. A. (2025). Lessons From the Aral Sea Disaster AND Rational Solutions for Future Generations. *Journal of Multidisciplinary Academic and Practice Studies*, 3, 4, 355-367. doi: 10.35912/jomaps.v3i4.3453.

Bagliani, M., Pietta, A., & Bonati, S. (2019). Il cambiamento climatico in prospettiva geografica. Aspetti fisici, impatti, politiche. Bologna: Il Mulino.

Balsari, S., Dresser, C., & Leaning, J. (2020). Climate Change, Migration, and Civil Strife. *Current Environmental Health Reports*, 7, 404-414.

Barnett, J., & Adger, W. N. (2007). Climate change, human security and violent conflict. *Political Geography*, 26(6), 639-655. https://doi.org/10.1016/j.polgeo.2007.03.003

Béné, C. et al. (2008). Power struggle, dispute and alliance over local resources: Analyzing "democratic" decentralization of natural resources through the lenses of Africa inland fisheries. *World Development*, 36(11), 1935–1950.

Benjaminsen, T. A., Alinon, K., Buhaug, H. et al. (2012). Does climate change drive land-use conflicts in the Sahel? *Journal of Peace Research*, 49(1), 97–111.

Bettini, G. (2013). Climate barbarians at the gate? A critique of apocalyptic narratives on 'climate refugees'. *Geoforum*, 45, 63-72.

Biermann, F., & Boas, I. (2007). Preparing for a warmer world. Towards a global governance system to protect climate refugees. Amsterdam: Global Governance Project.

Black, R., Bennett, S.R., Thomas, S.M. et al. (2011). Climate change: Migration as adaptation. *Nature*,

478(7370), 447-449. doi: https://doi.org/10.1038/478477a
Bompan, E., Fragapane, F., Iannelli, M. et al. (2019). Atlante geopolitico dell'acqua. Water grabbing, diritti, sicurezza alimentare ed energia. Milano: HOEPLI.
Bompan, E., & Iannelli, M. (2018). Water grabbing. Guerre nascoste per l'acqua nel XXI secolo. Bologna: Edizioni EMI.
Borras, S. M., Hall, R., Scoones, I. et al. (2011). Towards a better understanding of global land grabbing:: an editorial introduction. *Journal of Peasant Studies*, 38(2), 209-216. https://doi.org/10.1080/03066150.2011.559005
Buhaug, H. (2010). Climate not to blame for African civil wars. Proceedings of the National Academy of Sciences (PNAS), 107(38), 16477-16482. https://doi.org/10.1073/pnas.1005739107
Burke, M. B., Miguel, E., Satyanath, S. et al. (2009). Warming increases the risk of civil war in Africa. *Proceedings of the national Academy of sciences*, 106(49), 20670-20674. https://doi.org/10.1073/pnas.0907998106
Burrows, K., & Kinney, P. (2016). Exploring the climate change, migration and conflict nexus. *International Journal of Environmental Research and Public Health*, 13(4), 443. https://doi.org/10.3390ijerph1304044
Cattaneo, C., & Bosetti, V. (2017). Cambiamento climatico e conflitti civili. *Equilibri*, 1, 79-86.
Cattaneo, C. (2016). Cambiamento climatico e migrazione. *Equilibri*, 1, 101-109.
CIA (Central Intelligence Agency) (2024). The CIA World Factbook 2024-2025 New York City: Skyhorse Publishing.
Cervantes, P.A.M., & Valls Martínez, M.d.C. (2023). Aral Sea Disaster, The. In: Idowu, S.O., Schmidpeter, R., Capaldi, N., Zu, L., Del Baldo, M., Abreu, R. (eds) Encyclopedia of Sustainable Management. Springer. https://doi.org/10.1007/978-3-031-25984-5_1106
Ciervo, M. (a cura di) (2010). Geopolitica dell'acqua. Roma: Carrocci.
Chigudu, S. (2024a). Water, power and politics in the climate crisis. *World Development*, 178, 106-117.
Chigudu, D. (2024). Human security and mobility in the context of climate change in Africa. *Watershed Ecology and the Environment*, 6, 242-251.
Chiocchini, G., & Di Vito, S. (eds.) (2024). Acqua, conflitti, migrazioni forzate. La corretta gestione delle risorse idriche come strumento di stabilità e pace. Dossier di Legambiente, con il contributo di UNHCR.https://mail.google.com/mail/u/0/#inbox/FMfcgzQZTgNtnmKhpPNmXxLCXbvdVLCV?projector=1&messagePartId=0.1
Coe, M. T., & Foley, J. A. (2001). Human and natural impacts on the water resources of the Lake Chad basin. *Journal of Geophysical Research*, 106(D4), 3349–3356.
Collier, P., & Hoeffler, A. (2004). Greed and grievance in civil war. *Oxford Economic Papers*, 56, 4, 563-595, https://doi.org/10.1093/oep/gpf064
Congiu, P. (2023). Oro Blu. Storia dell'acqua. Cosa sta succedendo alla Terra. Il fenomeno della siccità. Le guerre per l'acqua. Finirà l'acqua? Roma: Edizioni & 100.
Cotula, L. (2013). The Great African Land Grab? Agricultural Investments and the Global Food System. London: Zed Books.
CRED (2023). 2022 Disasters in numbers. Brussels: CRED. https://cred.be/sites/default/files/2022_EMDAT_report.pdf
de Lauri, M. (2024). Il disastro pianificato del Lago D'Aral: scelte di politica economica che hanno dato il via al disastro ambientale. *Studi internazionali*, 2(2), 41-45.
de Sherbinin, A., Grace, K., McDermid, S. et al. (2022). Migration Theory in Climate Mobility Research. *Frontiers in Climate*, 4: 882343, 1-16. doi: 10.3389/fclim.2022.882343
De Stefano, L., Duncan, J., Dinar, S., et al. (2017). Climate change and transboundary water conflict. *Global Environmental Change*, 45, 36-46.

Dionet-Grivet, S. (ed.) (2015). La guerra dell'acqua. Come il bene primario per eccellenza sta modificando la geopolitica del mondo. Roma: Fuoco Edizioni.
Elliott, L. (2012). Climate change and migration in Southeast Asia: Responding to a new human security challenge, *Asia Security Initiative Policy Series*, 20, 1-16. Singapore: RSIS Centre for Non-Traditional Security (NTS) Studies.
FAO (2023). The State of Food Security and Nutrition in the World.
FAO (2022). Water resources and pastoral systems in South Sudan.
FAO (2020). Water scarcity in Kenya: Current status and future challenges.
FAO (2017). The state of food security and nutrition in the world.
FAO (2016). Lake Chad Basin crisis: FAO response strategy (2017-2019). Rome: FAO.
Galli, L. (2022). La protezione dei migranti climatici in Italia: luci e ombre nelle prime pronunce dopo l'ordinanza n. 5022/2021 della Cassazione. *Rivista Giuridica Ambiente*, 79-120.
Gallia, A. (2009). Le convenzioni internazionali in materia di risorse idriche. *Rivista giuridica del Mezzogiorno. Trimestrale della Svimez*, 2, 321-346. doi: 10.1444/30542
Gaybullaev, B. Chen, S.-C., & Kuo, Y.-M. (2012). Large-Scale Desiccation of the Aral Sea due to OverExploitation after 1960. *Journal of Mountain Science*, 9, 538–546. doi: 10.1007/s11629-012-2273-1
Gleick, P. H. (2014). Water, drought, climate change, and conflict. *Weather, Climate, and Society*, 6(3), 331-340.
Gleick, P. H. (1993). Water and conflict. *International Security*, 18(1), 79-112.
Global Humanitarian Overview (2025).
Hartmann, B. (2010). Rethinking climate refugees and climate conflict: Rhetoric, reality and the politics of policy discourse. *Journal of International Development*, 22(2), 233-246. https://doi.org/10.1002/jid.1676
Hegazi, F., Krampe, F., & Seymour Smith, E. S. (2021). ClimateRelated Security Risks and Peacebuilding in Mali, *SIPRI Policy Papers,* 60, 1-70. https://www.sipri.org/sites/default/files/2021-04/sipripp60.pdf
Hodbod, J. et al. (2019). Social-ecological change in the Omo-Turkana basin: A synthesis of current developments. *Ambio*, 48, 1-17. https://doi.org/10.1007/s13280-018-1139-3
Hoffmann, R., Vinke, K., & Šedová, B. (2023). Strengthening the science–policy interface in the climate migration field. *International Migration*, 61, 75-97. https://doi.org/10.1111/imig.13125
Homer-Dixon, T. F. (1999). Environment, Scarcity, and Violence. Princeton: Princeton University Press. https://doi.org/10.1515/9781400822997
Huber, D., et al. (2023a). Climate change as a risk multiplier for conflict and migration. *Climate Risk Management*, 39, 100-112.
Huber, J., Madurga-Lopez, I., Murray, U. et al. (2023). Climate-related migration and the climate-security-migration nexus in the Central American Dry Corridor. *Climatic Change*, 176, 79, 1-22. https://doi.org/10.1007/s10584-023-03549-6
ICG (International Crisis Group) (2020). 'The Central Sahel: Scene of New Climate Wars?'. *Crisis Group Africa Briefings*, 154, 1-7. https://www.crisisgroup.org/sites/default/files/b154-sahel-new-climate-wars.pdf
Ide, T. (2023). Rise or Recede? How Climate Disasters Affect Armed Conflict Intensity Open Access in International Security, 47(4), 50-78. https://doi.org/10.1162/isec_a_00459
IISS (2021). The Military Balance. International Institute for Strategic Studies.
IOM (2024). World Migration Report. Geneva: International Organization for Migration.
IOM (2022). Annual Report 2021. Geneva: International Organization for Migration.
IOM (2021). Global Migration Indicators. Geneva: International Organization for Migration.

IPCC (2023). *2023: Summary for Policymakers*. H. Lee e J. Romero (eds.). Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Ginevra: IPCC, 1-34.

Jarosz, K. (2025). The Aral Sea Disaster. In Museums in Central Asia and the Construction of National Narratives. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-031-97047-4_8

Kaldor, M. (2013). *New and old wars: Organised violence in a global era*. Hoboken (USA): John Wiley & Sons.

Kassahun, A., Snyman, H. A., & Smit, G. N. (2008). Impact of rangeland degradation on the pastoral production systems, livelihoods and perceptions of the Somali pastoralists in Eastern Ethiopia. Journal of Arid Environments, 72, 1265-1281. doi: 10.1016/j.jaridenv.2008.01.002

Lauriola, P., Parrish, R., Leonardi, G. et al. (2019). I determinanti dei movimenti migratori in conseguenza di cambiamenti climatici: brevi spunti introduttivi. *Sistema Salute*, 63, 2, 196-210.

Leal Filho, W., Taddese, H., Balehegn, M. et al. (2020). Introducing experiences from African pastoralist communities to cope with climate change risks, hazards and extremes: fostering poverty reduction. *International Journal of Disaster Risk Reduction*, 50:101738. doi: 10.1016/j.ijdrr.2020.101738

Lloyd, S., Nakamura, T., Masuda, S. (2023). Public Perceptions of the Aral Sea Disaster in Uzbekistan, Journal of Disaster Research, 18(7), 783-795. https://doi.org/10.20965/jdr.2023.p0783

Loodin, N. (2020). Aral Sea: an environmental disaster in twentieth century in Central Asia. *Modeling Earth Systems and Environment*, 6, 2495–2503. https://doi.org/10.1007/s40808-020-00837-3

Louvin, R. (2020). Rifugiati climatici, 395-397, in Latini, G., Bagliani, M. & Orusa, T. (eds). Nuovo lessico e nuvole: le parole del cambiamento climatico. UniToGo: Università degli Studi di Torino.

LVIA (Lay Volunteers International Association) (2013). Carestia Sahel, Africa Occidentale. DoSSIER. https://lvia.it/wp-content/uploads/2018/12/Carestia-Sahel_dossier_LVIA-1.pdf

Luongo, G. (2023). From Water to Desert: Evolution of Transportation Systems in The Aral Sea Area. *Bollettino della Società Geografica Italiana*, 14, 6(2): 91-96. doi: 10.36253/ bsgi-7513

Magrin, G. (2016). The disappearance of Lake Chad: History of a myth. *Journal of Political Ecology*, *23*(1), 204-222.

Mauceri, C.A. (ed.) (2016). Guerra all'acqua. La riduzione delle risorse idriche per mano dell'uomo. Torino: Rosemberg & Sellier.

Maxwell J. A. (1996). Qualitative Research Design: An Interactive Approach. Sage: Thousand Oaks, CA, USA.

McLeman, R., & Gemenne, F. (Eds.) (2018). Routledge handbook of environmental displacement and migration, vol. 1. London: Routledge.

Meini, M. (1994). Il lago d'Aral: disastro ecologico e tentativi di conservazione. *Bollettino della Società Geografica Italiana*, XI(XI), 297-310.

Menga, F. (2016). Lo sfruttamento delle risorse idriche in Asia centrale. In: S. A. Bellezza (a cura di), Atlante dello spazio post-sovietico: Confini e conflitti (pp. 169-174). Brescia: Editrice La Scuola.

Micklin, P. (1991). Touring the Aral: visit to an ecologic disaster zone. *Soviet Geography*, *32*(2), 90-105. https://doi.org/10.1080/00385417.1991.10640856

Mirzabaev, A., & Akramkhanov, A. (2025). Integrative land-biodiversity-climate action: Leveraging synergies through ecosystem restoration in Uzbekistan. A case for the Economics of Land Degradation Initiative. https://www.eld-initiative.org/fileadmin/ELD_Filter_Tool/Case_Study_Central_Asia_2024/Case_study_Uzbekistan_Rio_Synergies_en.pdf

Mortimore, M. (2010). Adapting to drought in the Sahel: lessons for climate change. *Wiley interdisciplinary reviews: climate change*, 1(1), 134-143. https://doi.org/10.1002/wcc.25

Myers, N. (2002). Environmental Refugees: A Growing Phenomenon of the 21st Century. *Philosophical Transactions: Biological Sciences*, 357, 609- 613.

Mukashev, A. S., & Ussenova, D. M. (2013). Opportunities of "Dark Tourism" Development in the Republic of Kazakhstan. *Education and Science without Borders, 4*(7), 38-41.

Nagarajan, C., Vivekananda, J., Pham-Duc, B. et al. (2024). Pace in un clima estremo: come i rischi per la sicurezza legati al clima influenzano le prospettive di stabilità nel lago Ciad. *PLOS Climate*, 3(10): e0000314. https://doi.org/10.1371/journal.pclm.0000314

Nespor, S. (2007). I rifugiati ambientali. *federalismi.it*, 4, 1-10.

Nicholson, S. E. (2013). The West African Sahel: A Review of Recent Studies on the Rainfall Regime and Its Interannual Variability. *ISRN Meteorology*, 13, 1, 1-32. https://doi.org/10.1155/2013/453521

Okpara, U. T., Stringer, L. C., & Dougill, A. J. (2015). Conflicts about water in Lake Chad. *Ambio*, 44(5), 448-459.

Patterson, I., Vafokulova M., Oblakulov, B. (2024). Dark tourism: The effect of visiting a mausoleum on a tourist's psychological mood state in the central Asian city of Samarkand, Uzbekistan. *Journal of Tourism Management Research*, 11(1), 49-60. DOI: 10.18488/31.v11i1.3703

Pase, A., Gianoli, F., de Felice, L. et al. (2022). Il respiro del Sahel. Rappresentazioni di uno spazio in movimento. *Rivista Geografica Italiana*, CXXIX, 1, 32-59.

Peters, P. E. (2013). Land appropriation, surplus people and a battle over visions of agrarian futures in Africa. *Journal of Peasant Studies*, 40(3), 537-562. https://doi.org/10.1080/03066150.2013.803070

Petrella, R. (2001). Il Manifesto dell'acqua. Il diritto alla vita per tutti. Torino: Edizioni Gruppo Abele.

Piastra, S. (2009a). *EQA – Environmental quality / Qualité de l'Environnement / Qualità ambientale*, 1, 25-36.

Piastra, S. (2009). La crisi ambientale del lago d'Aral tra realtà e percezione. *Rivista di Antropologia*, XIV, 53-57.

Piquet, É. (2017a). Climate migration as adaptation to environmental uncertainty. *Revue Européenne des Migrations Internationales*, 33(2), 11-29.

Piquet, E. (2017). Migrazione, ambiente, cambiamento climatico: una visione complessiva. *Equilibri*, 1, 11-18. doi: 10.1406/86825

Raineri, L. (2022). Drought, desertification and displacement: Re-politicising the Climate-Conflict Nexus in the Sahel. *Istituto Affari Internazionali (IAI)*, 1-25.

Raineri, L. (2020). Sahel Climate Conflicts? When (Fighting) Climate Change Fuels Terrorism. *ISS EU, Institute for Security Studies, Brief*, 20, 1-8. https://www.iss.europa.eu/sites/default/files/EUISSFiles/Brief%2020%20%20Sahel.pdf

Raleigh, C., & Urdal, H. (2007). Climate change, environmental degradation and armed conflict. *Political Geography*, 26, 6, 674-694. https://doi.org/10.1016/j.polgeo.2007.06.005

Rodina, L. (2019). Planning for water resilience: Competing agendas among Cape Town's planners and water managers. *Environmental Science & Policy*, 99, 10-16.

Saidmamatov, O., Matyakubov, U., Rudenko, I., Filimonau, V., Day, J., & Luthe, T. (2020). Employing Ecotourism Opportunities for Sustainability in the Aral Sea Region: Prospects and Challenges. *Sustainability*, 12(21), 9249, 1-19. https://doi.org/10.3390/su12219249

Savelli, A., Schapendonk, F., Dutta Gupta, T. et al. (2023). Cambiamento climatico, mobilità e conflitto violento: una tipologia di percorsi interconnessi. *International Development Planning Review*, 45, 403-436. doi: 10.3828/idpr.2023.2

Scheffran, J., Marmer, E., & Sow, P. (2012). Migration as a contribution to resilience and innovation in climate adaptation: Social networks and co-development in Northwest Africa. *Applied Geography*, 33, 119-127. https://doi.org/10.1016/j.apgeog.2011.10.002

Schilling, J., & Werland, L. (2023). Facing old and new risks in arid environments: The case of pastoral communities in Northern Kenya. *PLOS Climate*, 2(7): e0000251, 1-16. https://doi.org/10.1371/journal.pclm.0000251

Sim-Sarka, K. (2025). Contesting crisis narratives amidst climatic breakdown: Climate change, mobility, and state-centric approaches to migration. *Frontiers in Sociology,* 9:1411683, 1-11. doi: 10.3389/fsoc.2024.1411683

Sitati, A., Joe, E., Pentz, B. et al. (2021). Climate change adaptation in conflict-affected countries: A systematic assessment of evidence. *Discover Sustainability*, 2-42. https://doi.org/10.1007/s43621-021-00052-9

Subedi, M. (2023). Sampling and Trustworthiness Issues in Qualitative Research. *Dhaulagiri Journal of Sociology and Anthropology*. 61-64. https://doi.org/10.3126/dsaj.v17i01.61146

Swyngedouw, E. (2009). The political economy and political ecology of the hydro-social cycle. *The Journal of Contemporary Water Research & Education*, 142(1), 56-60.

Taherdoost, H. (2016). Sampling Methods in Research Methodology; How to Choose a Sampling Technique for Research. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3205035

Talamo, G. (2021). Migrazioni forzate per cause ambientali e cambiamenti climatici: un'analisi socio-economica. *Mondi Migranti*, 2, 169-185.

Thalheimer, L., Otto, F., & Abele, S. (2021). Deciphering Impacts and Human Responses to a Changing Climate in East Africa. *Frontiers in Climate,* 3: 692114, 1-11. doi: 10.3389/fclim.2021.692114

Tor A.B. & Boubacar, Ba (2021). Fulani-Dogon Killings in Mali: Farmer-Herder Conflicts as Insurgency and Counterinsurgency. *African Security*, 14, 1, 4-26. https://doi.org/10.1080/19392206.2021.1925035

Turton, A. R. (2024). Is Water a National Security Risk in South Africa in 2024, Nongqai, 15, 10, 1-6.

UNECA (2023). Progress on Transboundary Water Cooperation in Africa: Accelerating. Progress on Transboundary Water Co-Operation to Achieve SDG Indicator 6.5.2. Addis Ababa: Economic Commission for Africa.

Twinomuhangi, R., Sseviiri, H., & Kato A.M. (2023). Contextualising environmental and climate change migration in Uganda. *Local Environment*, 28:5, 580-601. Doi: 10.1080/13549839.2023.2165641

UNECE, UNESCO & UN-Water (2024). Progress on Transboundary Water Cooperation: Mid-term status of SDG Indicator 6.5.2, with a special focus on Climate Change – 2024. Paris: Unesco.

UNEP (2021). Sahel Atlas of changing landscapes: Tracing trends and variations in vegetation cover and soil condition. Nairobi: UNEP.

UNEP (2018). Lake Chad Basin: Environmental and socio-economic assessment. Nairobi: UNEP.

Varani, N., & Mazza, G. (2023). Il mosaico dell'Africa sub-sahariana Sostenibilità e geopolitica. Roma: Carocci.

UNESCO (2024). Rapporto mondiale delle Nazioni Unite sullo sviluppo delle risorse idriche 2024: l'acqua per la prosperità e la pace. Parigi: UNESCO, Roma: Fondazione UniVerde.

UNESCO (2023). Rapporto mondiale delle Nazioni Unite sullo sviluppo delle risorse idriche. Partenariati e cooperazione per l'acqua. Parigi: UNESCO, Roma: Fondazione UniVerde.

UNESCO (2000). Water-related vision for the Aral sea basin for the year 2025. Paris. https://www.cawater-info.net/bk/water_land_resources_use/english/english_ver/pdf/unesco2000.pdf

United Nations (2023). *Blueprint for Acceleration: Sustainable Development Goal 6 Synthesis Report on Water and Sanitation 2023*. Geneva: United Nations Publications.

UN-Water (2021). Summary Progress Update 2021 – SDG 6 – water and sanitation for all. Geneva: United Nations Publications.

UN-Water (2020). World Water Development Report. Water and Climate Change. United Nations Publications.

Varani N., & De Andreis S. (2015). The Lake Chad Basin: from the water crisis to geopolitic emergency in Conference: *Third International Conference on Advances in Management, Economics and Social Science* - MES 2015 (pp. 165-170). Institute of Research Engineers and Doctors (USA). doi: 10.15224/978-1-63248-081-1-125

Vigil, J., et al. (2025a). Climate stress, conflict and human displacement: Emerging evidence. *Nature Climate Change*, 15(1), 22-34.

Vigil, S., Steiner, C., Kim, D. et al. (2025). Report "Climate change, migration and justice. SEI's research and pathways for overcoming challenges". Stockholm: Stockholm Environment Institute. doi: https://doi.org/10.51414/sei2025.008

Vogt, W. (1948). Road to survival. New York: Willian Sloane Associates, Inc.

Washington, Banca Mondiale. http://hdl.handle.net/10986/36089

Wheeler, W. (2018). Mitigating Disaster: The Aral Sea and (Post-)Soviet Property. *Global Environment*, 11, 346-376(2018). doi: 10.3197/ge.2018.110207

Wilkinson, E., Schipper, L., Simonet, C. et al. (2017). Cambiamento climatico, migrazioni e Agenda 2030 per lo sviluppo sostenibile. *Equilibri*, 1, 148-174. doi: 10.1406/86839.

Wolf, A. T., Yoffe, S. B., & Giordano, M. (2003). International waters: Identifying basins at risk. *Water Policy*, 5(1), 29-60.

Wolf, A. T. (1998). Conflict and cooperation along international waterways. *Water Policy*, 1, 251-265.

World Bank (2016). Lake Chad Basin: Recovery and development project. Washington, DC: World Bank.

Zaveri, E., Russ, J., Khan, A. et al. (2021). *Ebb and Flow*, Volume 1: Water, Migration, and Development.

Zeitoun, M., & Warner, J. (2006). Hydro-hegemony. *Water Policy*, 8(5), 435-460.

Web resources

Belgrano, G. (2022). No alle guerre dell'acqua, sì alla pace dei fiumi. [Online] Available: https://www.aics.gov.it/oltremare/articoli/persone/no-alle-guerre-dellacqua-si-alla-pace-dei-fiumi/ (29 December, 2025)

Brando, E. (2022). La situazione securitaria nella regione del Sahel: i movimenti indipendentisti, i gruppi jihadisti e le organizzazioni criminali. [Online] Available: https://www.mediterraneaninsecurity.it/la-situazione-securitaria-nella-regione-del-sahel-i-movimenti-indipendentisti-i-gruppi-jihadisti-e-le-organizzazioni-criminali-elio-brando/ (29 December, 2025)

Cochi, M. (2022) La nuova guerra dell'acqua in Burkina Faso. Nel Sahel al-Qaeda ora avvelena i pozzi. [Online] Available: https://www.startinsight.eu/la-nuova-guerra-dellacqua-in-burkina-faso-nel-sahel-al-qaeda-ora-avvelena-i-pozzi/ (29 December, 2025)

Connor, R. & Chaves Pacheco, S. M. (2024). Global Employment Trends and the Water Dependency of Jobs. [Online] Available: https://unesdoc.unesco.org/ark:/48223/pf0000388410 (29 December, 2025)

Eurasianet, (2019). "Is Uzbekistan to get its own Las Vegas?". [Online] Available: https://eurasianet.org/is-uzbekistan-to-get-its-own-las-vegas (29 December 2025)

Ferragina, E. (2015). Geopolitica dell'acqua: nuovi conflitti tra dighe e confini. [Online] Available: https://www.treccani.it/enciclopedia/geopolitica-dell-acqua-nuovi-conflitti-tra-dighe-e-confini_(Atlante-Geopolitico)/ (29 December, 2025)

Greenreport redazione (2024). Guerre per l'acqua: il 2023 è stato un anno record. [Online] Available https://www.greenreport.it/news/acqua/2243-guerre-per-lacqua-il-2023-e-stato-un-anno-record (29 December, 2025)

Haidar,A., & Bland, S. M. (2025). Kazakhstan Urges Regional Cooperation to Save the Aral Sea. [Online] Available: https://timesca.com/kazakhstan-urges-regional-cooperation-to-save-the-aral-sea/ (29 December, 2025)

Hauchard, A., & Yambuya, P. (2024). Le acque che portano speranza nel Sahel. [Online] Available: https://www.africarivista.it/le-acque-che-portano-speranza-nel-sahel/232844/?srsltid=AfmBOopIm7P7iNyaPUzpvFGtfiXMF0TQ2Z-62vIqAMe0zC5GyGgJeKMy (29 December, 2025)

IOM (2020). Assessing the climate change, environmental degradation and migration nexus in the Lake Chad Basin [Online] Available: https://environmentalmigration.iom.int/assessing-migration-climate-change-and-conflict-dimension-lake-chad-region (29 December, 2025)

IPCC (2021). Sixth Assessment Report, Climate Change 2021: The Physical Science Basis. [Online] Available https://www.ipcc.ch/assessment-report/ar6/ (29 December, 2025)

Mazza, S. (2024). Lago d'Aral: declino tra deserto e speranza. [Online] Available: https://ilgiornaledellambiente.it/lago-daral-la-bomba-a-orologeria-dellasia-centrale/ (29 December, 2025)

Médecins Sans Frontières (2021). Conflict in Burkina Faso: when the whole day is devoted to fetching water. [Online] Available: https://www.msf.org/lack-water-growing-crisis-burkina-faso (29 December, 2025)

OCHA (2025). Somalia: 2025 Drought Emergency - Situation Report No. 2 (As of 21 December 2025) [Online] Available: https://reliefweb.int/report/somalia/somalia-2025-drought-emergency-situation-report-no-2-21-december-2025 (29 December, 2025)

OCHA (2024). Sahel Humanitarian Overview, 2024 [Online] Available: https://www.unocha.org/publications/report/nigeria/sahel-dashboard-humanitarian-overview-30-december-2024 (29 December, 2025)

OXFAM-Italia (2025). Acqua potabile nel mondo: accesso e disparità. [Online] Available: https://www.oxfamitalia.org/acqua-potabile-nel-mondo/ (29 December, 2025)

Pacific Institute (2024). Water Conflict Chronology. [Online] Available: https://pacinst.org/water-conflict-chronology/ (29 December, 2025)

Russo, N. (2025). Tutte le guerre nel mondo per l'acqua. [Online] Available: https://www.startmag.it/energia/atlante-guerre-acqua/ (29 December, 2025)

Squarcia, E. (2023), Agenda 2030 Goal 6: Acqua pulita e servizi igienico-sanitari. [Online] Available: https://leyton.com/it/insights/articles/agenda-2030-goal-6-pillole-di-un-percorso-condiviso/ (29 December, 2025)

Tautonico, T. (2021). Banca mondiale: la mancanza d'acqua contribuisce all'aumento delle migrazioni. [Online] Available: https://asvis.it/goal1/notizie/1293-10348/banca-mondiale-la-mancanza-dacqua-contribuisce-allaumento-delle-migrazioni (29 December, 2025)

Trentin, R. (2020). La mappa globale che indica i conflitti per l'acqua. [Online] Available: https://ilbolive.unipd.it/it/news/mappa-globale-che-indica-conflitti-lacqua (29 December, 2025)

UNICEF (2025). Oltre 1.000 bambini al di sotto dei 5 anni muoiono ogni giorno a causa di malattie legate ad acqua e servizi igienici inadeguati. [Online] Available: https://www.unicef.it/media/oltre-1000-bambini-al-di-sotto-dei-5-anni-muoiono-ogni-giorno-a-causa-di-malattie-legate-ad-acqua-e-servizi-igienici-inadeguati/ (29 December, 2025)

UNICEF (2022). A causa di siccità e malnutrizione, nel Corno d'Africa e nel Sahel sono milioni i bambini a rischio. [Online] Available: https://www.unicef.it/media/a-causa-di-siccita-e-

malnutrizione-nel-corno-d-africa-e-nel-sahel-sono-milioni-i-bambini-a-rischio/ (29 December, 2025)
UNICEF (2022a). Central Sahel: Burkina Faso, Mali and Niger Child Rights and Humanitarian Dashboard-December 2022. [Online] Available: https://www.unicef.org/media/139761/file/WCAR-Central-Sahel-Child-Rights-and-Humanitarian-Dashboard-31-December-2022.pdf (29 December, 2025)
World Bank (2022). Kenya Economic Update: Climate risk and water resources. [Online] Available: https://www.worldbank.org/en/country/kenya/publication/kenya-economic-update-keu