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Water scarcity, climate change and migration: an assessment of the nexus

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Abstract

Un numero significativo di individui in tutto il mondo affronta sfide nell'ottenere una necessità fondamentale per la vita: l'accesso all'acqua. Sebbene negli ultimi tempi i governi e le organizzazioni umanitarie abbiano compiuto sforzi per assistere coloro che risiedono nelle regioni a rischio idrico, è previsto un peggioramento della situazione a causa degli impatti combinati del riscaldamento globale e della crescita demografica. Allo stesso tempo, l'insufficienza della collaborazione internazionale nell'affrontare le preoccupazioni legate alla sicurezza dell'acqua ha impedito progressi nel trovare soluzioni efficaci.

Il grado di stress idrico varia significativamente da una località all'altra, causando danni estesi e in contesti differenti. Infatti, quest'ultimi si possono estendere alla salute pubblica, al progresso economico e al commercio globale. In questo contesto, lo stress idrico può agire come catalizzatore per le migrazioni, siano esse regionali, nazionali o su larga scala.

Questa tesi è volta a riconoscere il legame tra la scarsità dell'acqua, il cambiamento climatico e le migrazioni seguendo due obiettivi principali.

In primo luogo, lo studio mira ad analizzare la rilevanza della scarsità d'acqua indotta dal cambiamento climatico nel dibattito accademico. Con l'intensificarsi della scarsità dell'acqua a causa del riscaldamento globale, diventa sempre più cruciale cercare di comprendere le sue implicazioni. Attraverso un'analisi delle basi scientifiche e della letteratura esistente che ne consegue, questa tesi è volta a fornire approfondimenti sul dibattito accademico in evoluzione riguardante lo stress idrico indotto dal cambiamento climatico.

In secondo luogo, questo studio cerca di indagare come la scarsità d'acqua e il cambiamento climatico agiscano come fattori trainanti delle migrazioni, in particolare nella regione del Medio Oriente e Nord Africa (MENA). Questa regione è particolarmente suscettibile agli impatti del cambiamento climatico e della scarsità d'acqua, dato il suo clima arido e semi-arido, la popolazione in rapida crescita e le complessità geopolitiche. Attraverso lo studio di casi, dati empirici e quadri teorici, questa tesi mira a far luce sui meccanismi attraverso i quali la scarsità d'acqua e il cambiamento climatico influenzano i modelli di migrazione nella

regione del MENA, vedendo il processo migratorio più come una strategia di adattamento che come una minaccia per la sicurezza.

Per sviluppare questo duplice obiettivo, la tesi è divisa in quattro capitoli principali. L'Introduzione a quest'ultimi si propone di fornire la base scientifica al cambiamento climatico, che funge da contesto principale all'insieme della tesi. A causa della sua natura intricata e complessa, il cambiamento climatico si è sviluppato nel corso dei secoli, portando alla formazione di un crescente consenso scientifico riguardo alle sue origini e alle sue conseguenze. Il riscaldamento globale è stato considerato per troppo tempo come una preoccupazione per le generazioni future, ma le attuali evidenze scientifiche illustrano come il suo impatto sia sempre più intenso e come esso altererà progressivamente l'esistenza umana. Le ripercussioni del cambiamento climatico sono evidenti e scientificamente documentate, influenzando vari aspetti del nostro pianeta, tra cui gli oceani, i livelli del mare, l'atmosfera e la criosfera. Non c'è dubbio che il clima della Terra stia subendo cambiamenti senza precedenti sia nel tempo che nella dinamica e non c'è dubbio che il cambiamento climatico indotto dalle attività umane stia già influenzando vari estremi meteorologici e climatici in tutte le regioni del mondo. Tutti questi cambiamenti vengono perfettamente descritti dall'*Intergovernmental Panel on Climate Change* (IPCC) nell'ultimo e più recente *Sixth Assessement Report* e nel *Working Group II* che ne sussegue. Quest'ultimo presta particolare attenzione all'impatto fisico del cambiamento climatico, sostenendo che esso abbia portato a conseguenze irreversibili, spingendo sia i sistemi naturali che quelli umani oltre la loro capacità di adattamento.

Il primo capitolo ha come scopo andare ad investigare il legame tra la scarsità d'acqua e il cambiamento climatico. È importante sottolineare che le risorse naturali sono finite e si stanno gradualmente esaurendo, principalmente a causa dell'impatto dell'uomo sul consumo e sull'ambiente. Per questo motivo, la disponibilità d'acqua tra le diverse regioni a livello globale sta subendo estreme variazioni. Nonostante l'importanza critica dell'acqua pulita, l'acqua dolce costituisce solo una piccola frazione, rappresentando appena il 3% del totale delle risorse idriche globali. Quasi due terzi di quest'acqua dolce sono destinati a scopi agricoli, come evidenziato nel Rapporto del *World Economic Forum* (2023). Con lo sviluppo sociale ed economico che progredisce in varie parti del mondo, il problema della scarsità

d'acqua è diventato sempre più evidente. Le acque sotterranee e il loro utilizzo per le esigenze agricole, l'inquinamento idrico e l'uso di fertilizzanti hanno portato all'esaurimento delle falde acquifere in varie regioni aride e semi-aride del mondo, riducendo la disponibilità d'acqua e affrontando problemi di sovrasfruttamento.

In secondo luogo, il capitolo si concentra sulla questione del fronteggiare, definire e misurare la scarsità d'acqua mediante un'analisi delle principali evidenze accademiche e scientifiche.

L'ultima parte del capitolo analizza la scarsità d'acqua nella regione MENA affermando il suo status internazionale come una delle regioni più scarsamente dotate d'acqua al mondo, presentando anche alcuni casi, principalmente Giordania ed Egitto.

Il secondo capitolo si concentra sulle migrazioni e la loro relazione con la scarsità d'acqua e il cambiamento climatico. Offrendo una prima comprensione delle migrazioni in generale, questo fenomeno emerge come un elemento definitorio dell'ordine mondiale contemporaneo, poiché lo spostamento delle persone è storicamente stato visto come una soluzione per sfuggire ai conflitti, alla povertà e alle sfide ambientali. Una sezione del capitolo è dedicata alla comprensione dei principali fattori che guidano le migrazioni - principalmente economici, politici, demografici, sociali ed ambientali. In questa analisi, il cambiamento climatico, e di conseguenza i fattori ambientali delle migrazioni, sono descritti come fattori preponderanti nella decisione delle persone a migrare, anche se spesso non vengono riconosciuti principalmente come tali.

Inoltre, un paragrafo è dedicato a chiarire diversi insiemi di concetti riguardanti le migrazioni e gli spostamenti causati dal cambiamento climatico. Viene fornita una definizione di diversi concetti, come come *voluntary e forced migration* - anche in connessione con il concetto di *planned relocations* proposte dall'*International Organisation for Migration* (IOM) -, *sudden-onset e slow-onset events* in relazione al fenomeno della migrazione, così come la pianificazione temporale e il problema delle migrazioni temporanee.

Una sezione importante di questa parte è dedicata all'assenza di consenso sulla definizione nel campo delle migrazioni e degli spostamenti ambientali. Nelle discussioni accademiche e nel dibattito politico, vengono utilizzati vari termini per

descrivere il fenomeno, tra cui *'environmental migration', 'climate change-induced migration', 'ecological o environmental refugees', 'climate change migrants'* e *'environmentally-induced forced migrants'*. Tuttavia, si sottolinea l'assenza di una definizione legale della migrazione indotta dall'ambiente. Raggiungere un consenso sulle definizioni a livello internazionale è reso difficile anche dalla sempre più grande complessità dei modelli migratori contemporanei. Pertanto, questa sezione analizza la questione dei rifugiati ambientali e delle persone sfollate internamente.

Infine, l'attenzione è rivolta alla scarsità d'acqua e al cambiamento climatico come fattori di migrazione. Le sfide legate all'acqua derivanti dal cambiamento climatico, come inondazioni, innalzamento del livello del mare e siccità, possono agire come catalizzatori diretti o indiretti per la migrazione interna e internazionale volontaria o forzata. Gli insediamenti umani dipendono fortemente dall'acqua, svolgendo un ruolo centrale nel benessere sociale e avendo un impatto diretto sulla sicurezza alimentare e sulla qualità della vita complessiva. Quando cambiamenti sostanziali nelle condizioni dell'acqua mettono a repentaglio i mezzi di sussistenza delle persone, diventa imperativo garantire un'adeguata adattabilità per mantenere un equilibrio armonioso tra gli esseri umani e l'acqua. La migrazione emerge come un percorso pratico per gli individui per adattarsi ai sistemi idrici in pericolo, presentando opportunità per diversificare le fonti di reddito e aumentare la resilienza.

Il terzo capitolo offre una panoramica di casi studio per comprendere il nesso tra scarsità d'acqua, cambiamento climatico e migrazione. Come delineato in altre sezioni dei capitoli precedenti, la regione del Medio Oriente e del Nord Africa (MENA) è analizzata come il principale punto critico, concentrando l'analisi principalmente su Libia, Sudan, Nord Africa e Marocco.

Nell'ultimo capitolo seguirà una discussione, che asserirà principalmente l'esistenza di un nesso tra scarsità d'acqua, cambiamento climatico e migrazione. Come spiegato in questa ricerca, varie forme di migrazione ambientale derivano tipicamente da molteplici cause interconnesse, tra cui l'esclusione sociale ed economica, la povertà, la distribuzione diseguale delle risorse, le dispute territoriali, i cambiamenti demografici, le limitazioni istituzionali, le tensioni intergruppo e i

conflitti nei paesi di origine, così come vari fattori nei paesi di destinazione. In questo contesto, l'obiettivo principale di questa tesi è considerare il fenomeno migratorio non come una minaccia alla sicurezza, bensì come una possibile strategia di adattamento, nonostante tutte le incertezze e le domande che tale concetto può sollevare.

In conclusione, è rilevante sottolineare che la comunità internazionale deve agire per limitare le emissioni di gas serra e il loro impatto sull'acqua, poiché ciò è fondamentale per ridurre l'entità della migrazione e dello spostamento causati dal cambiamento climatico. Sebbene la migrazione ambientale sia una realtà diffusa, non dovrebbe essere vista solo in termini negativi. È urgente un'azione coordinata per prevedere, prepararsi agli effetti e per sfruttare il potenziale della migrazione come strategia di adattamento. Tutti gli attori, a livello globale, nazionale e locale, dovrebbero cogliere l'opportunità di investire in conoscenza, mitigazione e adattamento, in quanto l'azione tempestiva può portare benefici a lungo termine per tutti. È cruciale enfatizzare la migrazione come strategia di adattamento valida, specialmente dati i problemi nell'attuare misure di mitigazione efficaci. I governi e le organizzazioni internazionali dovrebbero riconoscere l'importanza di questo approccio, poiché è fondamentale per costruire resilienza e adattarsi ai cambiamenti ambientali.

Per quanto riguarda la metodologia impiegata, questa tesi si è basata ampiamente su una revisione completa delle fonti. Le fonti primarie, tra cui rapporti, studi scientifici, convenzioni, dichiarazioni e accordi internazionali, sono state esaminate attentamente. L'uso di queste fonti primarie ha coinvolto una lettura e un'analisi attenta. Solo le porzioni rilevanti e necessarie per gli scopi di analisi della tesi sono state citate o riferite nel testo. Anche le fonti secondarie, come libri, capitoli di libri, articoli di riviste, glossari, articoli accademici e ricerche scientifiche, sono state ampiamente utilizzate.

Inoltre, per migliorare e integrare l'analisi presentata nella tesi, è stato fatto un uso responsabile e giudizioso di vari siti web e pagine web appartenenti a enti autorevoli o organizzazioni internazionali. Questi includono piattaforme come le Nazioni Unite (ONU), l'Organizzazione Internazionale per le Migrazioni (OIM), il Panel

Intergovernativo sui Cambiamenti Climatici (IPCC), l'Alto Commissariato delle Nazioni Unite per i Rifugiati (UNHCR) e altri.

Introduction

In the contemporary era, there is a near-consensus in affirming that the Earth's climate is undergoing unprecedented changes in both timing and dynamics. The most recent Assessment Report, the Sixth, released by the Intergovernmental Panel on Climate Change (IPCC) in 2013, provides a comprehensive account of the ongoing transformations on our planet. While some natural processes contribute to climate variations, the prevailing view among the majority of scientists is that human activities stand as a principal driver of global warming, encapsulating the practical manifestation of climate change.

Hence, climate change has emerged as a primary challenge facing the global community both presently and in the foreseeable future. A momentous event occurred on April 22, 2016, at the United Nations headquarters, where 175 countries gathered. This gathering, characterized by the presence of Ban Ki-moon, the Secretary-General of the UN, as a historic occurrence in the organization's history, witnessed the signing of a universal agreement by over a hundred world leaders in a single day. This remarkable document is renowned as the Paris Agreement, marking the world's first comprehensive accord on climate change, formulated during the UN Climate Change Conference (COP 21) in December 2015. In the opening ceremony, Ban Ki-moon stated "We are breaking records in this Chamber, and that is good news. But records are also being broken outside," reiterating the significance of the occasion while alluding to alarming statistics and forecasts related to climate change (UN, 2016).

The willingness of numerous nations, including previously skeptical ones like the United States and China, to endorse such an agreement underscores the gravity of the environmental and climate crisis ahead. As reported by the Europeans, the Paris Agreement was conceived as a mechanism to formulate strategies for limiting global warming, with the objective of keeping it below 2°C in the coming decades. This imperative goal aims to prevent irreversible harm to the planet's environment and humanity as a whole (European Commission, 2019).

Furthermore, an emerging concept was emphasized by Ban Ki-moon during the UN Climate Change Conference in Paris. In his address, he stressed that the consequences of climate change are now more severe than ever before,

necessitating immediate action to mitigate climate risks and safeguard communities (European Commission, 2019).

According to information provided by the UNFCCC, the term climate change denotes persistent modifications in the long-term average weather patterns of a specific region or the entire planet. These alterations encompass shifts in temperature, wind behaviors, precipitation, and other climatic elements over extended time frames. Climate change can be instigated by natural processes and, notably in recent periods, by human activities. It represents a intricate and multi-faceted phenomenon that impacts ecosystems, sea levels, weather occurrences, and the overall equilibrium of the Earth's climate system (UNCCC, 2010).

Due to its intricate and multifaceted nature, climate change has unfolded over centuries, leading to the formation of an expanding scientific consensus regarding its origins and repercussions. Global warming has been viewed for too long as a concern for future generations, but current scientific evidence illustrates the intensifying impact of climate change and how it will progressively alter human existence (Mearns and Norton, 2010).

The repercussions of climate change are evident and scientifically substantiated, influencing various facets of our planet, including oceans, sea levels, the atmosphere, and cryosphere. There is no doubt that the Earth's climate is undergoing unparalleled changes in both timing and dynamics and there is no doubt that climate change induced by human activities is already impacting various weather and climate extremes in all regions worldwide.

As sustained in AR6 of the IPCC, human activities, predominantly through the release of greenhouse gases, have undeniably contributed to global warming. The global surface temperature has risen by 1.1°C above the pre-industrial levels of 1850-1900 during the period of 2011-2020. As outlined in AR6, there is no doubt that human activities have indisputably elevated temperatures in the atmosphere, ocean, and on land. Global mean sea level exhibited an increase of 0.20 (0.15 to 0.25) meters from 1901 to 2018. The average rate of sea level rise was 1.3 (0.6 to 2.1) mm yr-1 between 1901 and 1971, which then escalated to 1.9 (0.8 to 2.9) mm yr-1 between 1971 and 2006, and further surged to 3.7 (3.2 to 4.2) mm yr-1 between 2006 and 2018 . Human influence is highly likely to be the predominant factor driving these increases since at least 1971. The evidence of observable shifts in extreme events such as heatwaves, intense precipitation, droughts, and tropical

cyclones, and specifically their association with human influence, has continued to strengthen since the Fifth Assessment Report (AR5). Human influence has probably heightened the likelihood of compound extreme events since the 1950s, including an escalation in the frequency of simultaneous heatwaves and droughts.

Human-induced climate change, characterized by an increased occurrence of more frequent and intense extreme events, has resulted in extensive negative effects, leading to losses and damages affecting both the environment and human populations, surpassing what can be attributed to natural climate variability. The IPCC AR6 Working Group II (2022) provides a particular attention to the physical impact of climate change, arguing that it has resulted in irreversible consequences, pushing both natural and human systems beyond their capacity to adapt.
Following AR6 Working Group II discourse, extensive and pervasive repercussions on ecosystems, human populations, settlements, and infrastructure have arisen from documented rises in the frequency and intensity of climate and weather extremes. This includes heightened extremes in terrestrial and oceanic heat, intense precipitation events, prolonged droughts, and conditions conducive to wildfires. Notably, since the Fifth Assessment Report (AR5), these observed impacts have increasingly been linked to human-induced climate change, particularly through the heightened occurrence and severity of extreme events. Such impacts encompass increased heat-related human mortality, coral bleaching and mortality in warm waters and elevated tree mortality attributed to heightened drought conditions. The escalation in areas affected by wildfires has been attributed to human-induced climate change in certain regions. What is nore, the detrimental effects of tropical cyclones, along with associated losses and damages, have surged due to sea level rise and increased heavy precipitation. Adverse impacts on both natural and human systems resulting from gradual processes, such as ocean acidification, rising sea levels, or regional decreases in precipitation, have also been unmistakably linked to human-induced climate change.

Looking more closely on climate change physical impact on water, experts do assert that climate change has significantly diminished food and water security, impeding and diminishing the achievement of Sustainable Development Goals. While overall agricultural productivity has seen an increase, climate change has exerted a

decelerating effect on this growth globally over the past 50 years. Negative impacts have been predominantly observed in mid- and low-latitude regions, whereas certain high-latitude regions have experienced positive outcomes. The warming and acidification of oceans have adversely affected food production in shellfish aquaculture and fisheries in specific oceanic regions.

Another important point of AR6 WGII concerns the fact that the escalation of weather and climate extremes has exposed millions of people to acute food insecurity and diminished water security, with the most significant impacts observed in numerous locations and communities across Africa, Asia, Central and South America, Small Islands, and the Arctic. Simultaneous losses in food production and restricted access to diverse diets have contributed to an upsurge in malnutrition in various communities, particularly affecting Indigenous Peoples, small-scale food producers, and low-income households. This impact is especially pronounced in vulnerable groups such as children, the elderly, and pregnant women. Approximately half of the global population currently faces severe water scarcity during some periods of the year due to both climatic and non-climatic factors.

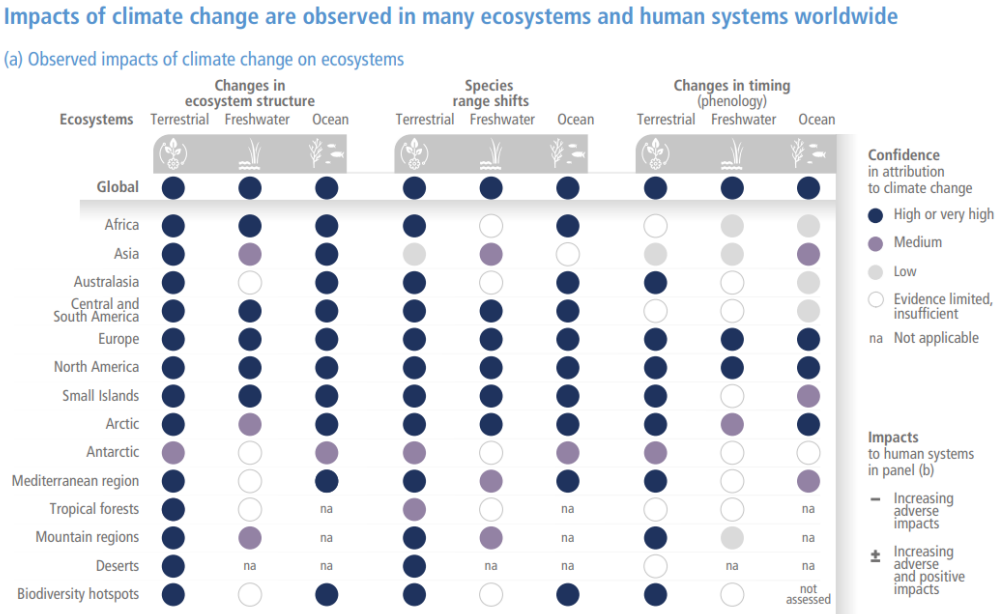


FIGURE 1: Impacts of climate change are observed in many ecosytmes and human systems worldwide. Source: IPCC, 2022: Summary for Policymakers, In: Climate Change 2022: Impacts,

Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.

Considering mid- and long-term risks, AR6 WGII delves into water scarcity and climate-induced displacement.

Firstly, there is high confidence that risks related to physical water availability and water-related hazards will continue to escalate across all evaluated regions, with higher global warming levels posing greater threats. With an approximate 2°C global warming, projections indicate a potential decline of up to 20% in snowmelt water availability for irrigation in certain snowmelt-dependent river basins. Additionally, global glacier mass loss of 18 ± 13% is anticipated to reduce water availability for agriculture, hydropower, and human settlements in the mid- to long-term, a trend expected to double with a 4°C global warming. In Small Islands, there is high confidence that groundwater availability is under threat due to climate change.

Projections also indicate adverse impacts on freshwater ecosystems in numerous watersheds by the mid- to long-term, encompassing changes in streamflow magnitude, timing, and associated extremes. Direct flood damages are projected to be 1.4 to 2 times higher at 2°C and 2.5 to 3.9 times higher at 3°C compared to 1.5°C global warming without adaptation. At a global warming of 4°C, approximately 10% of the global land area is projected to experience simultaneous increases in both extreme high and low river flows in the same location, posing implications for planning across all water use sectors. The challenges for water management are expected to worsen in the near, mid, and long term, contingent upon the magnitude, pace, and regional nuances of future climate change. These challenges will be particularly daunting for regions with limited resources for water managemen

Secondly, a rise in displacement will occur due to the heightened occurrence of heavy precipitation, associated flooding, tropical cyclones, drought, and an escalating trend of sea level rise. As temperatures continue to increase, it is quite probable that involuntary migration will surge from regions characterized by high exposure and limited adaptive capacity. On the other hand, in comparison to other socioeconomic factors, the impact of climate on conflict is determined to be relatively weak. Over extended socioeconomic trajectories that mitigate non-

climatic drivers, it is predicted that the risk of violent conflict would decrease. However, at elevated levels of global warming, the impacts of weather and climate extremes, particularly drought, will enhance vulnerability, progressively influencing the occurrence of violent intrastate conflict.

Global warming is expected to persist in the near term (2021–2040), primarily driven by the continued accumulation of CO2 emissions in nearly all evaluated scenarios and modeled trajectories (AR6, 2022).

The establishment of modern climate models dates back to 1990, with the work of the World Climate Research Programme (WCRP). The development of these models is governed by the Coupled Model Intercomparison Project (CMIP), which establishes standards and experimental protocols. These protocols ensure that contributors to CMIP adhere to common guidelines for coordination, infrastructure, and documentation. All models within CMIP follow standardized rules regarding the utilization of input variables and inclusion of output variables. Over time, since the comprehension of the natural world has advanced, successive editions or phases of climate models have been introduced. The latest and widely used phases are the fifth and sixth phases of CMIP, denoted as CMIP5 and CMIP6, respectively.

Climate models are subjected to various greenhouse gas emissions scenarios, each representing distinct possible futures. CMIP specifies scenarios known as Shared Socioeconomic Pathways (SSPs) in CMIP6. These SSPs portray changes in population, economic growth, education, urbanization, and technological development rates, impacting future greenhouse gas emissions. They offer a narrative depicting how specific levels of warming could be attained. SSPs are closely linked to Representative Concentration Pathways (RCPs) from CMIP5, which are solely based on greenhouse gas concentrations in the atmosphere. While RCPs indicate potential outcomes without detailing the path taken, SSPs and RCPs collectively serve as tools for policymakers to plan for the envisioned future they aim to create. Both SSPs and RCPs are identified by specific numerical designations, which correspond to the anticipated alteration in radiative forcing from the year 1750 to the conclusion of the 21st century, specifically 2100 (USDA Climate Hubs, 2024).

Understanding these scenarios is relevant in the context of climate change mainly because they are applied by scientists and experts to understand the present and the

foreeable future. In the Sixth Assessement Report, it is indicated that in the near term, it is more likely than not that global warming will reach 1.5°C, even under the extremely low greenhouse gas (GHG) emission scenario (SSP1-1.9). It is likely or very likely to surpass 1.5°C under higher emissions scenarios. The considered scenarios and modeled pathways indicate that the best estimates for reaching the 1.5°C global warming threshold fall within the near term. In certain scenarios and modeled pathways, global warming regresses to below 1.5°C by the end of the 21st century.

The evaluated climate response to GHG emission scenarios yields a best estimate of warming for the period 2081–2100, ranging from 1.4°C for the very low GHG emissions scenario (SSP1-1.9) to 2.7°C for an intermediate GHG emissions scenario (SSP2-4.5), and 4.4°C for a very high GHG emissions scenario (SSP5-8.5). It is asserted that these estimates come with narrower uncertainty ranges compared to corresponding scenarios in the Fifth Assessment Report (AR5).

Continued emissions will have pervasive impacts on all major components of the climate system. As global warming persists, the magnitude of changes in extremes continues to amplify. The ongoing trajectory of global warming is anticipated to heighten the global water cycle, encompassing increased variability, augmented global monsoon precipitation, and heightened occurrences of very wet and very dry weather and climate events and seasons. In scenarios marked by escalating CO2 emissions, there is a high level of confidence that natural land and ocean carbon sinks will progressively absorb a declining proportion of these emissions. Anticipated changes also encompass further reductions in the extents and/or volumes of nearly all cryospheric elements, inevitable global mean sea level rise, and elevated occurrences of ocean acidification and deoxygenation.

Given the above-mentioned scientific evidence concerning climate change and its impact, that in this context works as a framework, it is important to oultline that the objectives of this study are twofold.

Firstly, it aims to analyze the significance of climate change-induced water scarcity within academic discourse. As water scarcity intensifies as a result of climate change, understanding its implications becomes increasingly crucial. By examining

existing literature and scholarly debates, this thesis will provide insights into the evolving academic discourse surrounding climate change-induced water scarcity.

Secondly, this study seeks to investigate how water scarcity and climate change serve as drivers of migration, particularly in the MENA region. The MENA region is particularly susceptible to the impacts of climate change and water scarcity, given its arid and semi-arid climate, rapidly growing population, and geopolitical complexities. By examining case studies, empirical data, and theoretical frameworks, this thesis aims to shed light on the mechanisms through which water scarcity and climate change influence migration patterns in the MENA region, ultimately seeing the migrations process more as an adaptation strategy than as a security threat.

In the first chapter, the discourse evolves around water scarcity and its nexus to climate change. Natural resources are finite and gradually depleting, principally due to the human-consumerist impact on the environment. It is imperative to emphasize the considerable variation in water availability across different regions globally. Despite the critical importance of clean water, freshwater comprises only a small fraction, accounting for merely 3% of the total global water supply. Alarmingly, almost two-thirds of this freshwater is allocated for agricultural purposes, as highlighted in the World Economic Forum Report (2023). As social and economic development progresses in various parts of the world, the issue of water scarcity has become increasingly pronounced. Presently, the Earth is confronted with a significant water scarcity challenge, which could potentially be alleviated through judicious water allocation practices. In the chapter, the issue of water scarcity is briefly mentioned in connection with the global power generation, which is 90% water-intensive. As a matter of fact, the energy sector will be highly impacted by the water crisis if progresses in policy will not be made.

Groundwater and its usage for agricultural needs, water pollution and the use of fertilizers has led to the depletion of aquifers in various arid and semiarid regions of the world, diminishing water availability and facing issues of overexploitation.

Furthermore, the chapter focuses on the issue of coping with, defining and measuring water scarcity by an analysis of the main academic and scientific evidence.

The last part of the chapter analyses water scarcity in the MENA Region asserting its international status as one of the most water-scarce regions in the world by presenting some cases – mainly Jordan and Egypt.

The second chapter poses the attention on migrations and its relation to water scarcity and climate change. By offering a first understanding of migrations in general, this phenomenon stands out as a defining feature of the contemporary world order as the movement of people has historically been viewed as a solution to escape conflict, poverty, and environmental challenges. One section of the chapter is dedicated to the understanding of the main drivers of migration – namely economic, political, demographic, social and environmental. In this analysis climate change, and consequently the environmental drivers of migration, are described as preponderant factors in driving people to migrate, even if often they are not primarily recognised as such.

Furthermore, a paragraph is dedicated to elucidating different sets of concepts concerning migration and displacement caused by climate change. A definition is provided to different concepts such as voluntary and forced migration - also in connection the concept of planned relocations proposed by the IOM-, sudden-onset and slow-onset events in relation to the phenomenon of migration, as well as time framing and the issue of temporary migrations.

An important section of this part is dedicated to the absence of consensus on definition in the realm of environmental migration and displacement. Within academic discussions and political discourse, various terms are used to describe the phenomenon, including ‘environmental migration’, ‘climate change-induced migration’, ‘ecological or environmental refugees’, ‘climate change migrants’ and ‘environmentally-induced forced migrants’. However, it is stressed the idea that no legal definition of environmental-induced migration has been coined. Furthermore, achieving consensus on definitions at the international level is also made difficult by the heightened complexity of contemporary migratory patterns. Thus, this section analyses the issue of environmental refugees and internally displaced persons.

Lastly, the focus is pointed to water scarcity and climate change as drivers of migration. Water-related challenges resulting from climate change, such as floods,

rising sea levels, and droughts, can act as direct or indirect catalysts for voluntary or compelled internal and international migration. Human settlements are greatly dependent on water, playing a central role in social well-being and exerting a direct impact on food security and overall quality of life. When substantial changes in water conditions jeopardize people's livelihoods, the need for effective adaptation becomes imperative to maintain a harmonious balance between humans and water. Migration arises as a practical pathway for individuals to adapt to endangered water systems, presenting opportunities to diversify income sources and enhance resilience.

The third chaper offers an overview of case studies to understand the nexus between water scarcity, climate change and migration. As outlined in other sections of the previous chapters, the Middle East and North Africa (MENA) Region is analysed as the main hotspot, focusing principally on: Lybia, Sudan, North Africa and Morocco.

A discussion will follow in the last chapter, concluding principally that there exists a nexus between water scarcity, climate change and migration. As explained many time in this research, various forms of environmental migration typically stem from multiple interconnected causes, including social and economic exclusion, poverty, unequal resource distribution, land disputes, demographic changes, institutional limitations, inter-group tensions, and conflicts in countries of origin, as well as various factors in destination countries. In this context, this thesis aims at considering the migratory phenomenon not as a security threat, but more as a possible adaptation strategy, with all the gaps and questions that may arise from the concept.

Regarding the methodology employed, this thesis relied extensively on a comprehensive review of sources. Primary sources, including reports, scientific studies, conventions, declarations, and international agreements, were meticulously examined. The use of these primary sources involved careful reading and analysis, with only relevant portions necessary for the analysis purposes of the thesis being referenced or cited in the text.

Secondary sources, such as books, book chapters, journal articles, glossaries, academic papers, and scientific research, were also extensively utilized. Deep examination and analysis of these secondary sources were conducted, with relevant portions being referenced or cited in the thesis text as needed.

Additionally, to enhance and supplement the analysis presented in the thesis, responsible and judicious use was made of various websites and web pages belonging to authoritative bodies or international organizations. These included platforms such as the United Nations (UN), International Organization for Migration (IOM), Intergovernmental Panel on Climate Change (IPCC), United Nations High Commissioner for Refugees (UNHCR), among others

Chapter 1. Understanding Water Scarcity

1.1 Water Scarcity and Climate Change

Rising temperatures and extreme events, such as floods or prolonged droughts associated with ongoing climate changes, exert a notable impact on ecosystems and human communities. Despite persistent efforts to address water resource management, numerous regions globally continue to grapple with intricate and challenging situations stemming from water scarcity.

This predicament is undoubtedly linked to inappropriate water usage and climatic factors (Bosco and Ballarin, 2006).

Throughout history, climate has wielded a significant influence on humanity, and the current alterations in climate patterns pose a substantial threat to the accessibility and distribution of natural resources, particularly given the increasing population density observed in various developing nations. Natural resources play a pivotal role in production, serving as vital inputs. Beyond the production process, the extraction, processing, and disposal of these materials significantly contribute to income generation and job creation in numerous countries. However, these activities also yield varying impacts on the environment. Natural resources constitute integral components of ecosystems that facilitate services such as climate regulation, flood control, natural habitats, and cultural services essential for nurturing artificial, human, and social capital. The utilization of materials derived from natural resources in production and consumption processes yields multifaceted environmental, economic, and social repercussions. Importantly, these consequences transcend borders and will influence future generations (OECD, 2013).

Moreover, the majority of human infrastructure, whether urban or agricultural, has been strategically situated near dependable water resources. However, the specter of climate change looms, posing a threat to the reliability of these resources and reshaping the geography of trustworthy water outlets. The Intergovernmental Panel on Climate Change (IPCC) reports a historical increase in global average temperatures, with a rise of approximately 0.13°C per decade since 1950. Forecasts

suggest an accelerated pace, around 0.2°C per decade, in the coming two to three decades.

This warming trend is expected to bring about significant alterations in various aspects of water resources. Anticipated changes encompass shifts in the timing of water availability due to modifications in rainfall patterns, snowpack melting, and the diminishing of glaciers. Additionally, there will be changes in the timing and intensity of water demands due to rising temperatures, heightened evaporation rates, and alterations in both surface water availability and groundwater storage. The consequences extend to an escalation in the number and intensity of extreme climatic events, such as droughts and floods, along with alterations in water quality. Furthermore, rising sea levels are poised to result in inundation and saltwater intrusion in currently irrigated areas.

The impact of increased temperatures extends beyond water resources to agricultural domains. In temperate regions, climate change is likely to extend growing seasons. However, the downside includes prolonged survival of pests in warmer conditions, leading to heightened crop damage. This shift in climate is also expected to influence the geographical landscape of agricultural productivity, determining which areas are most suitable for cultivation and which crops thrive there. Conversely, tropical regions are anticipated to experience a reduction in suitable plant-growing days due to rising temperatures, with the most significant impact felt in countries characterized by poverty and high dependence on plant-related goods and services (FAO, 2015).

While it is certain that precipitation patterns are undergoing changes, the ultimate repercussions of climate change on water availability and variability remain uncertain. There are numerous unknowns, including the locations where impacts will be most pronounced, the extent of alterations in precipitation amounts and intensity, and whether these changes will unfold in the short term or evolve over multiple decades (Bosco and Ballarin, 2006). The interplay of shifting precipitation patterns and rising temperatures has the potential to exacerbate water scarcity in certain regions, while simultaneously creating opportunities for expanded agricultural production in others.

Despite observable enhancements in water resources in specific areas, the global management of water resources is poised to become more intricate due to the pervasive influence of climate change on the entire water cycle. The acceleration

of the hydrological cycle, driven by warming temperatures, is expected to lead to increased precipitation (Pratapand Markonis, 2022). As reported both by a study proposed by the University Corporation for Atmospheric Reaserch (UCAR) as well as by Ertharin Cousin, A.G. Kawamura and Mark W. Rosegrant (2019), this, in turn, may result in flooding and the inundation of croplands in certain regions, causing a reduction in crop yields and a heightened demand for drainage systems. Furthermore, the escalating rate of evaporation is anticipated to contribute to a rise in drought occurrences across various parts of the world by the middle of the 21st century (UCAR, 2024).

Figure 5 – The world will experience both longer dry spells and increasingly erratic rainfall

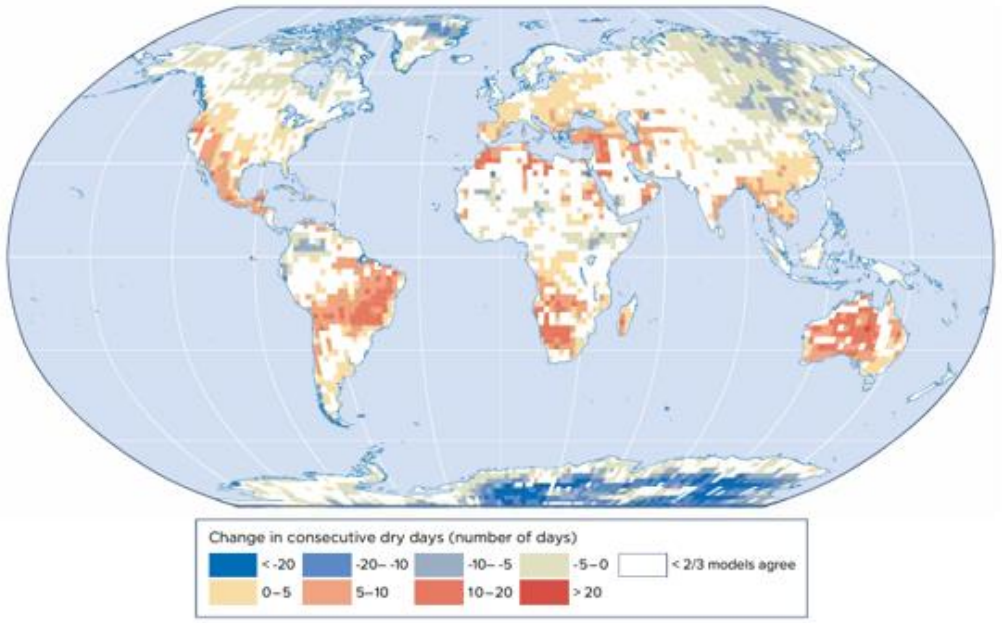
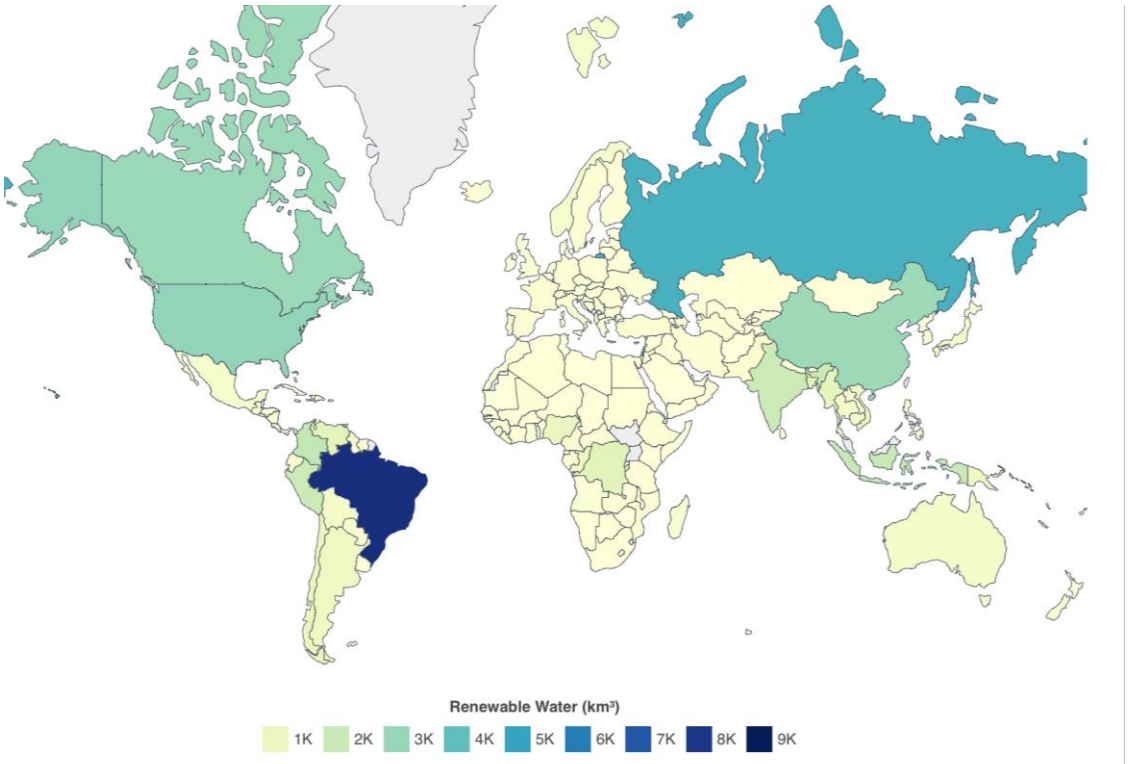


FIGURE 2: The world will experience both longer dry spells and increasingly erratic rainfall. Source: Ertharin Cousin, A.G. Kawamura and Mark W. Rosegrant (2019), The threat of water scarcity, Chicago Council on Global Affairs.

As highlighted in the 2013 OECD report, natural resources are finite and gradually depleting, primarily due to the adverse effects of consumerism on the environment. The 2013 OECD Report projects a quadrupling of the global economy and an increase in the global population from 7 billion to over 9.2 billion by 2050. The OECD Environmental Outlook for 2050 emphasizes the heightened pressure this growth will exert on the Earth's material, energy resources, and environment. With

an increasing population experiencing elevated average income levels, the demand for food, industrial goods, energy, and water intensifies.

It is crucial to underscore that water availability varies significantly across different regions worldwide. Notwithstanding the essential nature of clean water, freshwater constitutes the tiny fraction of 3% of total global water, and almost two-thirds of this amount of freshwater is used for agriculture, based on the World Economic Forum Report (2023). With the improvement of social and economic development in different regions of the world, water shortage has been progressively intensified, and now the Earth is facing an important water scarcity that could be solve with a reasonable water allocation (Haiqian, 2019).

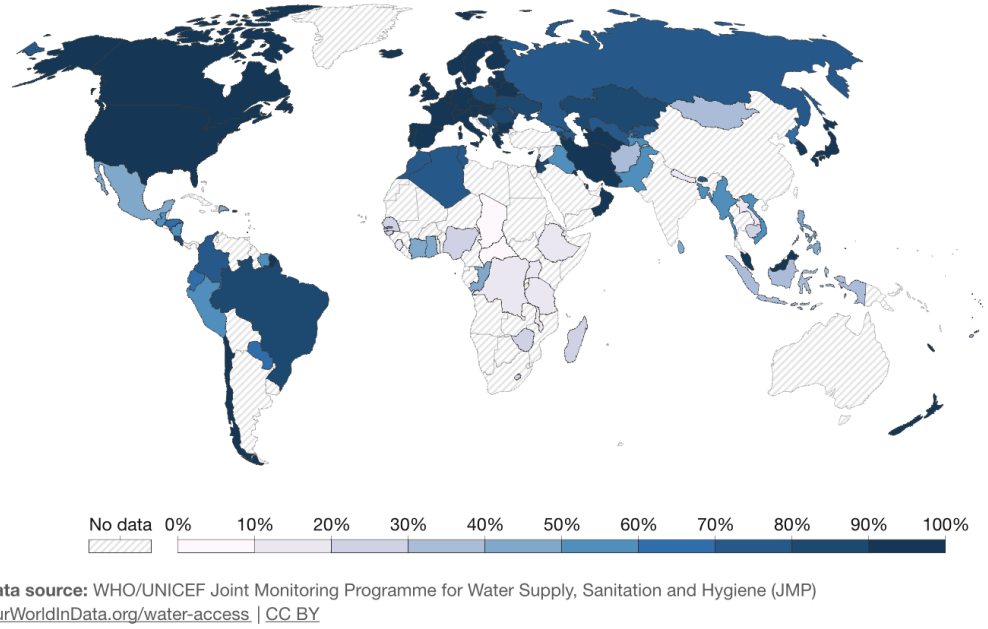


FUGURE 3: World Population Review. Renewable water (km3). Source: World Population Review. Fresh Water by Country 2024.

The overhead table shows that geographical distribution of freshwater by country is unequal and most of the world's clean water is locked in the form of ice in glaciers and arctic regions, and another biggest amount is under the surface like groundwater. While some areas consider water a widely abundant resource, in others, it is perceived as a rare commodity due to both scarcity and source

contamination (Bosco and Ballarin, 2006). In this perspective there are some countries, such as Brazil, Russia, Indonesia, Canada, USA, China and Colombia, where the amount of fresh water is bigger and the result is that almost one - fifth of the global population lives in a condition of water scarcity. USA is the country where the consume of water per capita was the highest with 3304 liters of freshwater per day, and the country with the less consume of clean freshwater per capita is the Democratic Republic of Congo with 34 liters per day. This important lack of water is crucial, and it causes difficulties related to the access to clean, fresh and usable water and consequently it affects people's life.

The map below shed light on the distribution of the population using safely managed drinking water. The result revelas that the access to clean water is not for everyone (Our World in Data, 2022).



FUGURE 4: Share of the population using safely managed drinking water. Source: Our World in Data (2022).

According to the United Nations, approximately 2.1 billion individuals, primarily residing in Africa and Asia, faced a lack of access to freshwater in 2017. Instead, they relied on contaminated water sources, containing pollutants and bacteria. This situation leads to over a million deaths annually, underscoring the severe consequences of inadequate access to safe water (Ritchie et al, 2019). As a matter of fact, the map vividly depict the disparities in freshwater access among various countries

Following the discourse on water scarcity, to understand the significance of emphasizing water conservation, it's essential to consider the available water levels. Despite water covers a significant portion of the Earth's surface, it's crucial to note that not all of it is suitable for various purposes or easily accessible (Baker et al, 2016). As illustrated in the chart below, a mere 2.5 percent of the total global water represents freshwater. Adding to this challenge, nearly 70 percent of this freshwater is confined within glaciers and ice caps, leaving only 30 percent accessible as surface and groundwater.

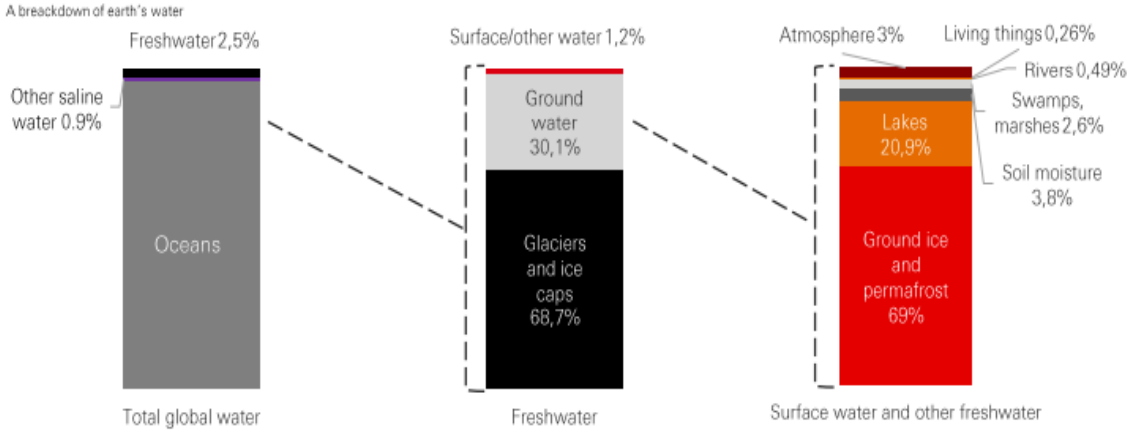


FIGURE 5: A breakdown of earth's water. Source: Baker, B, Aldridge, C and Omer, A (2016). Water: Availability and use. Mississippi State University Extension. 2016. p3011.

Our dependence on water extends beyond agriculture, playing a crucial role in various essential production processes. For instance, as reported by the UN (2014), a staggering 90 percent of global power generation is water-intensive. In an ever-evolving world, both water and energy emerge as finite resources, destined to face escalating pressures and strains (D'Odorico et al, 2018).

According to the Comprehensive Assessment of Water Management in Agriculture (2007), energy plays a crucial role in contemporary water management and is expected to exert an even more significant influence in the future. The escalating costs of energy, including pumping water, manufacturing fertilizers, and transporting products, are contributing to the overall rise in expenses. This situation has implications for both water access and irrigation practices. The growing prominence of hydropower introduces heightened competition for water resources, particularly in the agricultural sector. The nexus between energy and water

management underscores the need for integrated strategies to address the interdependencies between these vital resources. Climate change policy is progressively endorsing a heightened dependence on bioenergy as a substitute for fossil fuel-based energy. However, this shift is not consistently paired with discussions on water considerations. According to the Comprehensive Assessment, an extensive reliance on bioenergy could lead to agricultural evapotranspiration in 2050 supporting increased bioenergy use, reaching levels equivalent to the current overall agricultural water depletion. Relying on bioenergy is poised to amplify competition for both water and land resources. It is crucial to raise awareness about the dual nature of bioenergy, emphasizing both its potential benefits and the associated challenges, particularly in terms of water and land use.

What is more, the energy sector is growingly concerned about the impacts of climate change on the water cycle. According to a report from CDP (2016), over three-quarters of the world's leading energy companies acknowledge that uncertainty in water availability stands out as a significant source of risk for their business operations.

One of the United Nations' Social Development Goals (SDGs) is to ensure universal access to water. However, achieving this goal will demand increased energy for treating wastewater and processing saline or brackish water. Over the next 25 years, it is anticipated to be a transition towards energy-intensive water projects, resulting in a twofold increase in energy consumption for water-related initiatives, as highlighted in a 2016 report by the International Energy Agency (IEA). This surge is primarily attributed to the implementation of desalination projects and large-scale water transfer endeavors.

The escalating demand for water is exacerbated by factors such as the growing global population and the trend towards urbanization, where people shift from rural to urban areas. This leads to increased stress on water sources that serve densely populated areas (Klobucista and Robinson, 2023). Currently, the OECD reported that 40 percent of the world's population resides in water-stressed areas.

The cumulative effect of these factors has led to a substantial increase in global freshwater consumption over the past century, as depicted in the chart below. The strain on this finite resource is expected to intensify. The OECD’s Environmental

Outlook to 2025 (2012) anticipates a 55 percent surge in global water demand from 2000 to 2050, driven primarily by manufacturing, electricity generation, and domestic uses. The projection also foresees a rise in the percentage of people residing in water-stressed areas to 50 percent by 2025, leaving 1.8 billion individuals grappling with absolute water scarcity.

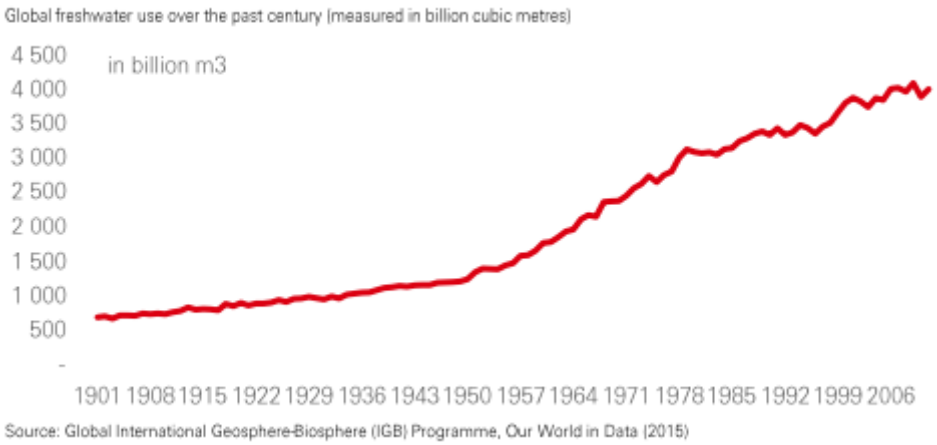


FIGURE 6: Global freshwater use over the past century. Source: Global International Geosphere-Biosphere (IGB) Programme, Our Wolrd in Data (2015).

Moreover it is interesting to note that in 2009, scientists introduced the concept of "Planetary Boundaries" as a framework to ensure the sustainability of the Earth. These are nine critical thresholds within which humanity can maintain a safe operating space, ensuring the survival, well-being, and evolution for future generations (Stockholm Resilience Center, 2024). The nine boundaries include:

1. Climate Change
2. Biodiversity Integrity Loss
3. Altered Biogeochemical Cycles
4. Land System Change
5. Freshwater Use
6. Ocean Acidification
7. Chemical Pollution and Novel Entities
8. Ozone Layer
9. Atmospheric Aerosol Loading

Planetary Boundaries are all interconnected, because negative effects have a waterfall effect on every aspect of natural processes. Specifically addressing the current freshwater use, the Stockholm Resilience Center's 2022 Report, titled *A Planetary Boundary for Green Water*, establishes a limit of 4000 km3/year. This report introduces a crucial distinction between green water and blue water: blue water pertains to freshwater in rivers, lakes, and water tables, while green water represents the larger portion of freshwater available solely to plants. Managed by farmers and pasture, green water plays a role in hydrological activities crucial for safeguarding ecosystems and biodiversity. The report introduces a novel approach, suggesting that the *green water planetary boundary* can be determined by assessing the percentage of ice-free land area where root-zone soil moisture deviates from Holocene variability for any month of the year (Wang-Erlandsson et al, 2022). However, the authors raise concerns, indicating that the freshwater planetary boundary has likely already been surpassed.

Furthermore, the report advocates for differentiating between green water and blue water, proposing two distinct planetary boundaries. This approach allows for a focused examination of each aspect and the formulation of specific regulations. By considering blue water alone, the suggested limit could be set at 1700 km3/year instead of the broader 4000 km3/year threshold (Tautonico, 2022).

In this perspective, the September 2023 update confirm and highlighted that six out of nine planetary boundaries have been crossed: climate change, biodiversity integrity loss, chemical pollution and novel entities, land system change, altered biogeochemical cycles and freshwater use. Regarding the misuse of freshwater, it leads to a decline in biodiversity, compromises the planet's ability to absorb carbon dioxide, and disrupts climate regulation. A recent assessment took into account not only blue water but also green water. The findings indicate that both thresholds were surpassed more than a century ago, with blue water exceeded in 1905 and green water in 1929. This implies that the planetary boundary for freshwater was likely breached by 2009, the year when the Planetary Boundaries were identified (Corbelli, 2023).

The updated framework for planetary boundaries suggests that Earth is currently operating far beyond a safe zone. All nine critical processes are significantly disrupted due to human activities. Despite being in the best interests of humanity to preserve the Earth's system, the current state indicates a pressing need for concerted

efforts to address the impacts of human-induced disruptions on the planet (Richardon et al, 2009).

Considering an economic standpoint, the continual reduction and stress on the global water supply translate into losses for agriculture and other water-dependent industries, impacting overall output. Certain regions face the risk of a decline in growth rates of up to six percent of output by 2050. Despite these alarming forecasts, corporate initiatives addressing water governance remain insufficient. The level of water reporting, even among major companies, is notably low, with less than 40 percent of companies reporting water intensity metrics. In a world where escalating water scarcity is a certainty, closely monitoring and promoting a reduction in companies' water intensity becomes crucial for investors, as neglecting this aspect may pose an unaccounted financial risk (Dupe, 2022).

The groundwater, naturally stored in distinct rock formations known as aquifers, plays a pivotal role in global irrigation and food production. Over one-third of the world's 301 million hectares of irrigated land relies on groundwater, with approximately 38 percent of the 252 million hectares of net irrigated area benefiting from groundwater access (Siebert et al, 2010). Moreover, groundwater constitutes 43 percent of total consumptive irrigation water use. Notably, eleven out of the top 15 countries heavily reliant on groundwater are situated in Asia. India, in particular, annually utilizes over 250 km3 of groundwater, twice the amount of any other country. Of this, a substantial 89 percent (223 km3) is allocated for irrigation. Following India, significant groundwater users include China, the United States, and Pakistan, where irrigation comprises 54 percent and 71 percent of total groundwater use in China and the United States, respectively.

The intensive extraction of groundwater for irrigation has led to the depletion of aquifers in numerous arid and semiarid agricultural regions, resulting in diminishing groundwater tables. Alarmingly, many of these overexploited aquifers coincide with some of the world's most crucial breadbaskets. The persistent overdrafting of groundwater jeopardizes future irrigated food production and gives rise to undesirable environmental repercussions, such as land subsidence and saltwater intrusion. These consequences can have substantial social and environmental impacts, including the contamination of agricultural and drinking water (Rosegrant et al, 2019).

Groundwater, typically considered a common pool resource accessible to users with suitable technologies, faces the challenge of overexploitation. In certain regions, notably parts of India, agricultural electricity, including the pumping of groundwater, is subsidized or provided free of charge. The recent introduction of solar panels for groundwater pumping in South Asia, without improved governance and incentives for water conservation among farmers, has the potential to exacerbate the depletion of water resources.

Water pollution is also a problem that has far-reaching implications for human health, economic progress, and the natural environment. It triggers heightened competition among water users vying for diminishing reservoirs of uncontaminated water. The pollutants responsible for this predicament encompass both human-induced factors, such as microbiological contamination, eutrophication, excess nutrients, acidification, metal pollutants, toxic wastes, saltwater intrusion, thermal pollution, and increases in total suspended solids, as well as natural contributors like salinization, arsenic, and fluoride (Rosegrand et al, 2019; Lin et al, 2022).

The adverse effects of water pollution extend to agricultural productivity, particularly in densely populated regions where water is already scarce, and wastewater treatment is inadequate (FAO, 2017). Additionally, water pollution poses a significant threat to aquatic life. Salinity emerges as a prominent water-quality challenge confronting the agricultural sector. The decline of freshwater biodiversity and fisheries in Low- and Middle-Income Countries (LMICs) limits the availability of essential nutrients for populations already facing nutritional deficiencies.

The 2019(b) reasearch paper proposed by Cousin, Kawamura and Rosegrant underlines the fact that while inorganic fertilizer has played a pivotal role in driving agricultural production growth, its excessive use in certain regions now leads to runoff that pollutes irrigation and drinking water. This runoff can contribute to eutrophication, characterized by excessive algae growth and oxygen depletion in water bodies. The result is a reduction in water productivity, requiring the use of fresh water to leach pollutants, further diminishing the effective water supply. Agricultural water pollution arises when fertilizers and agrochemicals are applied in excess or washed away during storms. Subsidies, particularly for nitrogen fertilizers, contribute to their overapplication. Efficient fertilizer application and

water management are crucial in mitigating losses. Balancing adequate nutrient application for healthy crops without excessive fertilizer use remains a challenge.
In regions like Sub-Saharan Africa, low levels of inorganic fertilizer use have led to soil infertility, as nutrients are lost over time without replenishment. Increasing the use of inorganic fertilizers, in conjunction with organic alternatives, presents an opportunity to enhance nutrient management and boost crop yields. Organic techniques, including incorporating leguminous trees, planting cover crops, and applying manure and compost, can complement higher inorganic fertilizer use for sustainable agricultural practices (Mucheru-Muna et al, 2012).

Coping with

Internationally, the formation of an interagency entity known as United Nations Water (UN-Water) has played a crucial role in addressing water-related issues. Established by the Chief Executives Board in 2003, UN-Water serves as the United Nations' mechanism for enhancing comprehensive and coordinated action across all aspects related to freshwater and sanitation. Comprising 35 members from the UN system, it collaborates with 44 international partners (UN-Water, 2019).
As outlined in the UN-Water 2030 Strategy, three primary pillars underpin its core functions:

- *Informing Policy Processes and Emerging Issues*: UN-Water contributes to shaping policies related to water and sanitation by providing data, insights, and expertise. It aids in identifying emerging challenges and opportunities, offering guidance to decision-makers on effective strategies and policies.

- *Supporting Monitoring and Reporting on Water and Sanitation*: UN-Water plays a central role in coordinating global, regional, and sub-regional efforts within and beyond the United Nations framework. Its main focus includes evaluating and monitoring goals and objectives concerning water and sanitation within the 2030 Agenda for Sustainable Development and other relevant frameworks. This support extends to backing the United Nations

Regional Economic Commissions and other existing inter-agency mechanisms.

- *Building Knowledge and Inspiring Action*: UN-Water utilizes diverse platforms, both digital and traditional, to engage various audiences and garner support with the aim of prioritizing water and sanitation matters. By raising awareness and inspiring action, UN-Water empowers and motivates the public, Member States, civil society, and the private sector to actively participate in its initiatives.

At international level, water plays a fundamental role in issues related to climate change and sustainable development, but UNESCO's Director General Audrey Azoulay pointed out that water rarely appears in climate agreements (We Are Water Foundation, 2020). Water is a *climate connector* because sustainable water management requests efforts and responsibility from worldwide governance, individuals and organizations. There are Conventions, such as the Sustainable Development Goals, the Sendai Framework and the Paris Agreement, that offer the opportunity for collaborations among states in order to hinder our adaptation to climate change and global warming (Hannah, 2023).

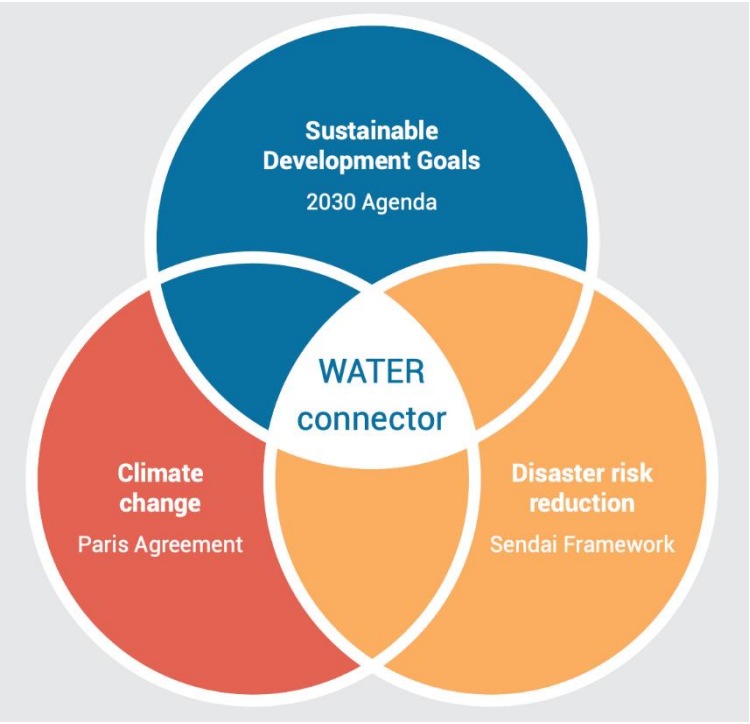


FIGURE 7. Water as a connector. Source: UN-Water (2018)

The overhead map was introduced by the United Nations World Water Development Report in 2020, illustrating water as a common thread among three vital Climate Change Agreements. In the 2030 Agenda, the significance of water is underscored in Goal Number 6, which aims to ensure access to water and sanitation for all. Despite water being recognized as a human right, billions still grapple with water scarcity, leading to detrimental effects on poverty reduction, food security, human rights, ecosystems, and peace.

The 2030 Agenda aims to achieve global and equitable access to clean drinking water, which can be accomplished through civil societies investing in water research and development to foster awareness and action for the protection and restoration of water resources. Although water is not directly addressed in the Paris Climate Agreement, its global implications are profound, especially regarding climate-related events such as flooding, shifts in rainfall patterns, water quality deterioration, and freshwater salinization. Recognizing water as a pivotal dimension in the Paris Agreement is essential for achieving its goal of limiting global warming to below 1.5°C, as adapting to climate change is intricately linked to effective water management (FAO, 2024).

The Sendai Framework for Disaster Risk Reduction, adopted by the UN General Assembly in 2015, complements major 2030 Agreements by urging Member States to take concrete actions to safeguard the environment from disaster risks. Water-related disasters constitute the majority of natural hazards, highlighting the importance of understanding water risks and implementing tailored normative and sustainable water policies to enhance disaster risk reduction and achieve environmental development goals (Imperiale, 2022).

In summary, the Sustainable Development Goals, the Sendai Framework, and the Paris Agreement all underscore the critical role of water as a connector that must be safeguarded to achieve their respective objectives. Additionally, the Conference of the Parties (COP), the supreme decision-making body on sustainable development, plays a crucial role in advancing efforts to address water issues. COP28, held in Dubai, emphasized the urgency of water-related challenges, with a focus on reducing freshwater consumption and forming strategic partnerships to champion water, food, and agriculture. As the climate crisis is intrinsically linked

to water scarcity, initiatives like COP28 are essential for drawing attention to water issues and catalyzing action to address them, particularly considering the staggering number of people currently affected by water scarcity globally (Michel, 2023).

Defining

UN-Water provides a concise definition of water scarcity:

"Water scarcity can mean scarcity in availability due to physical shortage, or scarcity in access due to the failure of institutions to ensure a regular supply or due to a lack of adequate infrastructure" (UN-Water, 2018).

The context of water scarcity is nuanced, exhibiting diverse manifestations depending on geographical locations and temporal factors. Its impact on individuals is not uniform and varies based on exposure. While climatic elements, notably insufficient rainfall, primarily drive water scarcity, it can also be exacerbated by non-climatic stressors (Shivakoti and Casero, 2015).

The Sixth Assessement Report proposed by WGII of the IPCC, scholars do focus in defining water scarcity. It is mainly argued that water scarcity and water insecurity, while related, are distinct concepts with a degree of overlap and various interpretations.

Broadly, water scarcity refers to a discrepancy between the demand for fresh water and its actual availability, measured in physical terms. On the other hand, water security/insecurity is a more comprehensive concept that extends beyond physical water scarcity. It encompasses factors such as access to water services, protection from poor water quality and flooding, and effective water governance ensuring access to safe water. Metrics for evaluating water security include both physical and socioeconomic components, providing a tool for comparing relative levels of water security among different locations and countries in the face of water-related risks.

Furthermore, experts continue stating that some definitions of water scarcity also encompass these broader issues. For instance, “economic water scarcity” is defined as a situation where 'human, institutional, and financial capital limit access to water,

even though water in nature is available locally to meet human demands' (Comprehensive Assessment of Water Management in Agriculture, 2007). Economic water scarcity may occur even in the presence of infrastructure if water distribution is inequitable. While discussions in this context primarily focus on quantifying physical water scarcity as a measurable indicator of water availability compared to demand, the broader societal aspects of economic water scarcity are considered integral to the more encompassing concept of water insecurity.

The European Environment Agency (EEA) states that *water stress* or *scarcity* arises when the demand for safe and usable water in a specific region surpasses the available supply. On the demand side, a substantial portion—approximately 70 percent—of the world's fresh water is utilized for agricultural purposes, with the remaining divided between industrial (19 percent) and domestic uses (11 percent), including consumption. Regarding the supply aspect, sources encompass surface waters such as rivers, lakes, and reservoirs, as well as groundwater drawn from aquifers (Ritchie and Roser, 2015; Gleick, 2014).

In general, the concept of physical water scarcity and economic water scarcity are broadly accepted by the academic community and environmental experts. Alongside with that, other scholars like Xu and Wu (2017) used the terms “water scarcity”, “water availability” and “water stress” interchangeably to describe water resource problems. Taking into account the different literature on the topic, they also argued that the term "water scarcity" can be categorized based on different criteria, one of which involves distinguishing between measurements based on per capita water availability and use-to-availability ratios. Falkenmark (1998) termed the former "demographic water scarcity" and the latter "technical water scarcity".
However, Kounina et al. (2012) argued that per capita water resources reflect socio-economic situations rather than physical water scarcity.
Another classification, proposed by Schyns et al. (2015), introduces the perspective of "absolute scarcity" and "relative scarcity." "Absolute scarcity" pertains to situations where elementary needs cannot be satisfied, while "relative scarcity" denotes scarcity resulting from competing demands across various economic sectors.

From these definitions, it becomes evident that "water scarcity" characterizes the interplay between human activities and natural water supply.

In summary, the main distinction needs te done between:

- *Physical water scarcity*: manifests when the available water is insufficient to fulfill all demands, encompassing environmental needs such as maintaining natural flows.

  While arid regions are commonly linked to physical water scarcity, it can also occur in areas seemingly abundant in water resources. This paradox arises when water resources are overcommitted to various users due to excessive development of hydraulic infrastructure, particularly for irrigation purposes. In such instances, the available water is inadequate to satisfy both human demands and the essential environmental flow requirements. Indications of physical water scarcity include pronounced environmental degradation, diminishing groundwater levels, and water allocations that disproportionately favor specific groups over others (Comprehensive Assessment of Water Management in Agriculture, 2007)

- *Economic water scarcity*: it arises from a deficiency in water-related investment or insufficient human capacity to meet the demand for water. This form of scarcity is largely influenced by institutional functioning, where certain groups receive preferential treatment while others, particularly women, may not have their voices adequately represented. Indications of economic water scarcity include limited infrastructure development, whether on a small or large scale, leading to challenges in accessing sufficient water for agricultural or drinking purposes. Even in cases where infrastructure is in place, the distribution of water may be inequitable. Many regions in Sub-Saharan Africa are marked by economic water scarcity, suggesting that enhanced water development efforts could significantly contribute to poverty reduction (Comprehensive Assessment of Water Management in Agriculture, 2007)

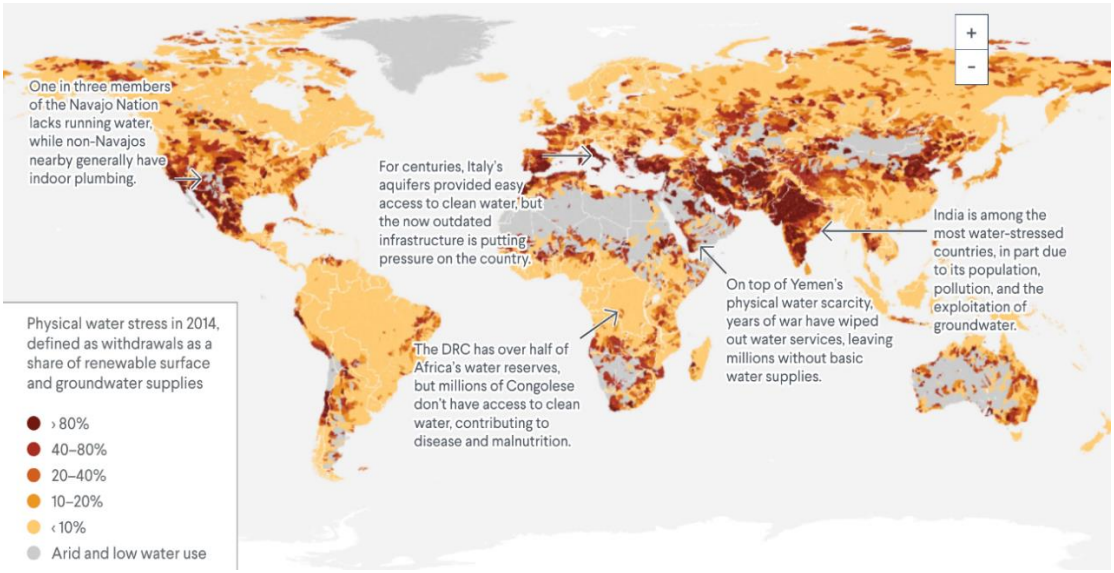


FIGURE 8: Water Stress is a Global Challenge. Source: Klobucista and Robinson (2023), Water Stress: A Global Problem That's Getting Worse. Council on Foreign Relations.

Measuring

In the last decades, growing concerns about the overexploitation of water resources have prompted the development of numerous indicators and indexes aimed at measuring the levels of water scarcity.

The terms *indicator* and *index* need to be clarified with reference to the definitions provided by the Cambridge Dictionary. *Indicators* are essentially tools, instruments, or devices that reveal the current state of a situation or its changing dynamics, offering information about the status of something. Conversely, an *index* is described as a numerical representation or a set of values used to indicate the magnitude of something by comparison, often employed to represent the occurrence of an event.

Both terms serve the purpose of summarizing and analyzing large volumes of data, but it's crucial to recognize that each index has its inherent limitations. Water experts adopt a multifaceted approach, utilizing various indexes to ensure reliable and comprehensive results.

Some indexes adopt a systemic approach, incorporating different dimensions such as socio-economic and environmental factors. Conversely, there are indicators that

focus exclusively on specific aspects, like the Falkenmark Index, which concentrates solely on physical water scarcity.

In the sections below, a brief description of the most relevant indexes of water stress is presented.

Falkenmark Water Stress Indicator

In 1997, the Swedish water expert Falkenmark introduced the Water Stress Indicator, which has since become one of the most widely utilized metrics for assessing water scarcity. It defines water scarcity in terms of the total amount of renewable freshwater resources that is available to the population of a region in a year (Blue Planet Prize, 2018).

Falkenmark established a threshold of 1700 m3 to identify what regions suffer from water stress by proposing a differentiation among different classes of water stress. If the availability falls below 1700 m3 per person per year, the country is deemed to be experiencing water stress or scarcity. Furthermore, if the availability drops below 500 m3, the country is unable to meet the total water demand, indicating severe scarcity that can lead to significant consequences, including famine and widespread mortality (Khan and Khan, 2022).

Index (m3 / capita / year)	Class
> 1700	No Stress
1000 - 1700	Stress
500 - 1000	Scarcity
< 500	Absolute Scarcity

FIGURE 9: Mapping of water stress indicators. Source: Paul Ruess (2015).

While the Falkenmark Indicator has gained widespread use and offers certain advantages, it is not without limitations. Firstly, the reliance on a singular threshold of 1700 fails to consider variations in climate, seasonal fluctuations, regional differences in water availability, and diverse cultural contexts unique to each country. Additionally, a notable drawback is the indicator's failure to address the accessibility of water resources, particularly in cases where pollution may impact

their usability. Another limitation lies in the indicator's exclusion of man-made sources, such as desalination plants, and its inability to differentiate the sources and amounts of water consumption within each country.

Basic Human Needs Index

In 1996, Peter Gleick introduced the Basic Human Needs Index, shifting the focus from physical water availability to water use. This index specifically measures the amount of water essential for fulfilling basic human needs crucial for maintaining hygiene, ensuring minimum drinking water, sanitation, bathing, and food preparation. To establish an absolute "minimum water requirement" for human survival, the National Research Council of the National Academy of Sciences in the USA set it at three liters per day for individuals in typical temperate climates. However, this requirement varies for those residing in tropical or subtropical regions (Gleick, 1996).

The index accounts for various essential needs, specifying that 50 liters per person per day is necessary for bathing, sanitation, and hygiene. Despite these standards, a significant challenge arises as hundreds of millions of people across the world, particularly in certain regions, lack access to the minimum water requirements. Additionally, the index falls short in addressing the quality of water that many individuals receive (Gleick, 1996).

One notable limitation of the Basic Human Needs Index is its exclusive focus on human requirements, neglecting other vital water uses such as in industries, agriculture, and environmental contexts. According to Gleick, the rapid population growth in the last decades has accentuated the problem of water stress, particularly in some regions, such as Africa and Middle East, a region with a long history of water disputes. As a recommendation, the author advocates for the implementation of regulations by national governments, international organizations, and water providers to ensure the fulfillment of basic water requirements for human well-being.

Social Water Stress Index

The Social Water Stress Index was coined by Ohlsson (2000). The author deviated from Falkenmark by introducing the concept of the *society's adaptive capacity*, meaning the ability of the society to act and to resolve conflicts related to the reduction of the likelihood of negative impacts of climate-related hazards, in particularly the problems about water scarcity. Ohlsson's innovative approch combined the hydrological Falkenmark index and the Human Development Index (HDI), which measures the fundamental keys for human development. He stated that society's adaptive capacity depends on political engagement, wellness and level of education.

While emphasizing the pivotal role of water in human freedom and overall well-being, Ohlsson underscored that accessible water is fundamental for human life. The scarcity of freshwater is acknowledged as one of the primary causes of global conflict. The Social Water Stress Index, proposed by Ohlsson, encapsulates two major themes: firstly, water availability as a constraint on development, and secondly, water scarcity as a potential source of international conflict. This nuanced approach acknowledges the multidimensional impact of water-related issues on both societal development and geopolitical dynamics (Metha, 2006).

Water Resource Vulnerability Index

Unlike previous indexes that do not consider variations in water demand among countries, the Water Resource Vulnerability Index, also known as WTA ration, addresses this aspect quantifying water scarcity by establishing a ratio of total annual water intake to the total available water resources.

According to the index, a country is experiencing severe water stress and scarcity if the annual withdrawals exceed the criticality ratio of 40%. It stands out as one of the most commonly used indicators for assessing water stress due to its ability to measure the quantity of water used in relation to the available renewable water. While this index takes into account a country's water demand, it has limitations. Challenges include the difficulty of distinguishing overall data from the amount allocated for basic human needs. Similar to the Falkenmark Index, it cannot be

applied to artificial water resources and does not consider the adoption of new technologies or infrastructure by a country to conserve water and meet human requirements (Liu et al, 2017).

Water Poverty Index

The Water Poverty Index (WPI) was proposed in 2002 by Sullvian as a new approach to examine poverty, encompassing various dimensions of this condition. Sullivan's holistic and multi-dimensional approach incorporates a value to represent ecosystem maintenance, signifying the physical quantity of water available for human needs, including industrial, agricultural, and domestic uses, as well as environmental requirements (Sullivan, 2002). The WPI proves to be useful in illustrating the interconnection between water scarcity and socio-economic aspects, ranking countries based on water provision through five components, as reported by Damkjaer and Richard (2017):

1. Resources: it represents the physical quantity of both internal and external water resources.
2. Access: it measures accessibility to safe water, sanitation, and irrigation.
3. Use: it differentiates the various uses of water, including domestic, industrial, and agricultural water supply.
4. Capacity: it captures socio-economic factors influencing the population's knowledge in managing water sources effectively.
5. Environment: it involves a composite of factors such as water quality, water stress, regulation and management capacity, informational capacity, and biodiversity. These components collectively convey the essential amount of water required to meet environmental needs.

The intricacy of the Water Poverty Index can be viewed both as advantage, considering that it covers comprehensivly issues previously overlooked by other indicators, and as a disadvantage, as it poses challenges in interpretation and necessitates expert involvement (Pedro-Monzonìs et al, 2015).

International Water Management Institute Indicator

The International Water Management Institute (IWMI) developed an index, known as the International Water Management Institute Indicator, that considers the portion of usable water amount for human needs with respect to primary water availability. Globally, the results of the IWMI index show an important evidence of the increasing of water scarcity. For this reason, the Institute divided countries in two categories based on water scarcity they are suffering from :

1. Economic water scarcity: it arises when there is an adequate supply of water, but the resources are unable to meet the overall demand due to significant deficiencies in investment in water infrastructures. According to the Food and Agricultural Organization (FAO), approximately 1.6 billion people are facing a shortage of drinking freshwater in cities like São Paulo, Beijing, Tokyo, Miami, and London (Britannica, 2022). This condition implies limited access to freshwater, unable to meet both human and environmental needs. It is often a consequence of underdeveloped water infrastructures, mismanagement, and unregulated use of water, leading to citizens bearing the brunt of these shortcomings.
2. Physical water scarcity: it occurs when the availability of freshwater and water resources is insufficient to meet the demands of the population. This type of scarcity can be seasonal, particularly in regions affected by extreme weather conditions, but it may also manifest in areas where water appears abundant due to overdevelopment of hydraulic infrastructures and extensive irrigation (World Ecnomic Forum, 2023b). The FAO reports that around 1.2 billion people, primarily in arid or semi-arid regions, currently experience physical water scarcity. This figure is expected to rise with population growth, contributing to progressive deterioration in water quality and a reduction in usable water quantity (FAO, 2017).

In recognition of the vital importance of water quality for human well-being, the 2030 Agenda for Sustainable Development has included a specific water target. This target aims to influence future strategies, ensuring effective control over water, addressing issues of pollution, and mitigating water scarcity as part of the global efforts towards sustainable development (United Nations, 2015).

Agricultural Water Poverty Index

Previous indicators do not take into account water scarcity related to agriculture. Thus it is noteworthy that Karami and Forouzani (2010) developed an indicator based on the WPI that focuses on the agricultural water poverty, known as Agricultural Water Poverty Index (AWPI).

It works as a valuable tool for monitoring and comparing resources available to farmers or local communities. Additionally, it provides crucial insights into water-related issues. The calculation of this index works with five key components, as reported by the authors (2010):

1. Available Water Resource: it is rooted in the physical availability of water for agricolture.
2. Access: it measures the extent of land that is reachable and available for agricultural water use.
3. Use: it reflects the utilization of water, expressed in monetary terms per unit of water.
4. Capacity: it assesses the farmers' ability to effectively manage the supply of agricultural water.
5. Environment: it involves an evaluation of the ecosystem's impact on the quality and quantity of available agricultural water.

By considering these five key points, the Agricultural Water Poverty Index not only serves as a tool for farmers and local communities to monitor and compare their resources but also offers valuable information on broader water-related issues (Karami and Forouzani, 2010).

In summary, the development of indicators and indexes provide a standardized way to quantify and compare the level of water scarcity across different regions or countries, facilitating a clear understanding of the severity of water scarcity in various areas. In turn, policymakers and water resource managers are able to identify priority areas that are most affected by water scarcity, monitoring changes over time.

Water scarcity indexes serve as valuable tools for assessment, decision-making, and resource allocation in the discourse on water scarcity, contributing to more informed and effective water management strategies at local, national, and global levels.

1.2 Water scarcity in the MENA Region

The Middle East and North Africa (MENA) region covers an estimated area of 12.5 million square kilometers (km2), constituting approximately 9.5% of the Earth's landmass (FAO, 2022).

Despite being home to 5.4% of the global population (World Bank, 2022), this region possesses only 1% of the world's renewable freshwater (Kandeel, 2019). Recognized as the most water-scarce region globally, the MENA region exhibits an average water resource of 550 cubic meters (m3) per capita per year (FAO, 2022). This falls below the 1,000 m3/capita threshold for water scarcity and is just above the 500 m3/capita threshold for absolute water scarcity, as indicated by the UN Water Stress Index (Frascari et al. 2018).

As reported by the IPCC (2021), the notable rise in population, rapid urbanization, migration, expansion of irrigation, and intensified agricultural practices have led to an elevated demand for water in the region. Conversely, on the supply side, the diminishing precipitation and runoff, coupled with heightened evapotranspiration due to climate change, contribute to a reduction in available water resources.

A recent study conducted by the World Bank has highlighted the ongoing struggle of governments in the MENA region in addressing their countries' status as water-

scarce and achieving the necessary security for sustainable water usage (World Bank, 2018; Roudi-Fahimi et al, 2000).

The fact that the MENA region is considered the most water-scarce region of the world follows the actions occurred in 2011: the Arab Ministerial Council acknowledged the severity of the challenge through its Water Security Strategy, proposing a comprehensive regional framework to combat water scarcity. Effectively addressing this challenge requires concerted efforts to manage both consumption and supply, aiming for enhanced water security and sustainable usage despite the limitations of available resources (Baconi, 2018).

However, the current scenario indicates that governments in the region have yet to adequately confront the complexities of water scarcity. Alarmingly, two-thirds of the MENA population resides in areas where renewable water resources are insufficient to maintain current consumption levels—an alarming contrast to the global average of 35 percent. This issue is not isolated; regional trends underscore the increasing potential for water scarcity to contribute to conflicts. A significant factor in this dynamic is the rapid population growth and its concentration in urban areas. With an annual growth rate of around 2 percent, the population in MENA countries is rising steeply compared to other parts of the world (Baconi, 2018; Lahham et al, 2022).

The phenomenon of a 'youth bulge' has already presented challenges for governments, notably in the social and economic spheres, as evidenced by the Arab uprisings and their aftermath. Projections indicate that by 2050, almost 400 million people in the MENA region will reside in urban areas, exerting additional stress on water resources. Within cities, the demand for water infrastructure is anticipated to further strain the quality of life, potentially adding to the list of grievances against ruling elites. This escalating urbanization may prompt the younger generation to demand improved governance and higher socioeconomic standards, emphasizing the interconnected nature of water scarcity with broader societal issues (Baconi, 2018).

Additionally, urbanization inevitably reshapes the economic landscape of states, impacting water security. While some countries are more industrialized, agriculture generally remains a fundamental contributor to the regional economy. In the MENA region, as in other parts of the world, agriculture tends to be the primary consumer

of freshwater resources. Unfortunately, water usage in agriculture across the region is suboptimal, with countries often cultivating water-intensive crops that diminish the productivity of limited water supplies. Moreover, irrigation, transportation, and distribution infrastructure often exhibit wasteful practices (Baconi, 2018; Woertz, 2017).

While urbanization may decrease water withdrawal for agriculture, potentially redirecting it to less water-intensive industries, this shift comes at the expense of investing in a sustainable and productive agricultural sector. Such investment remains crucial for regional economies and the support of urban populations. Consequently, the trade-off between urban development and the preservation of vital agricultural sectors poses a complex challenge for policymakers seeking to balance economic growth and water resource management

Jordan

An example of this situation is Jordan, that according to UNICEF and the World Bank (2023) ranks as the second most water-scarce country globally, relying significantly on the Jordan Basin, an aquifer spanning Lebanon, Syria, Jordan, the West Bank, and Israel. This aquifer, originating in the north and flowing through the River Jordan towards the Dead Sea, has witnessed a drastic decline in water availability over the past fifty years. Factors contributing to this decline include upstream diversions, irresponsible waste discharge, and the cultivation of water-intensive crops in the Jordan Valley and other regions.

While the majority of Jordanians have access to basic drinking water services, with 98.9 percent of the urban population and 96.9 percent of the rural population covered, the reliability of these services remains a concern. Leaking pipes and inefficient irrigation practices contribute to significant water wastage. Unpredictable weather patterns, marked by erratic rainfall and periods of drought, coupled with excessive resource depletion and a growing population, further intensify the fragility of the water situation. These factors not only pose heightened threats due to increased demand but also exacerbate the unreliability of water supply (Baconi, 2018).

The influx of Palestinian, Iraqi, and Syrian refugees into Jordan has added to the water demand, placing additional strain on the government's ability to provide

effective infrastructure for refugee populations and amplifying competition over the scarce water resources available to Jordanians. This scenario raises concerns about potential social unrest, with water becoming a catalyst for tensions (Breulmann et al, 2021).

The expansive consumption of water in Jordan is also fueled by a significant disparity between the cost of the country's water supply and the price customers pay. This economic misalignment encourages irresponsible water use. Given Jordan's heavy dependence on foreign aid, unsustainable public expenditure, and diminishing renewable water sources, this situation poses imminent risks. Past attempts to reduce subsidies for various goods have triggered widespread protests, threatening the stability of the regime. Public trust in the ruling elite remains low, driven by concerns about unchecked corruption and the perception that fiscal reforms disproportionately favor the wealthy (Baconi, 2018)

Implementing domestic reforms to curb demand and exploring alternative sources of water supply is crucial. Presently, these reforms are non-negotiable for Jordan, serving as a prerequisite for ongoing foreign aid. For instance, the European Union and its member states have identified the reform of Jordan's water management as a pivotal priority. Unlike its wealthier Gulf counterparts, Jordan lacks the financial means to heavily rely on non-conventional water supply methods like desalination plants. Consequently, Jordan has avoided hasty, short-term solutions and is compelled to explore more sustainable avenues for water preservation. These efforts must be undertaken domestically, complemented by government initiatives to pursue significant infrastructure projects, such as the Red-Dead Canal, which are financially supported by external development partners.

The Jordanian situation underscores the imperative for water-scarce nations to adopt policies that simultaneously enhance both water demand management and supply diversification. Relying solely on large-scale infrastructure projects proves insufficient; prioritizing domestic reforms, including subsidy reductions, remains essential. Without a comprehensive set of policies addressing the multifaceted aspects of water scarcity, the heightened competition for limited resources due to population growth or the arrival of refugees could transform water scarcity into a catalyst for domestic social unrest (Baconi, 2018; Al-Addous et al, 2023).

Egypt

Egypt's water situation has drawn international attention, primarily due to Ethiopia's ongoing construction of the Great Ethiopian Renaissance Dam (GERD). Egypt, historically dominating the region, has relied on a 1929 treaty dictating its allocation of Nile River water, securing a disproportionately large share. However, Ethiopia's pursuit of GERD for economic growth challenges this treaty as it aims to secure a greater water share. The dam's potential to reduce water flow to Egypt by 25 percent over the next seven years poses an unprecedented threat of shortages. Ethiopia commenced dam construction shortly after Egypt's 2011 revolution, catching its northern neighbor off guard. Initially confident in the durability of the water treaty, Egypt's certainty has waned, prompting considerations of military action and later a recognition of the need for renewed diplomacy (Baconi, 2018; Pemunta et al, 2021).

In 2015, Egypt, Ethiopia, and Sudan signed the Khartoum Declaration, addressing some implications of the dam, yet failing to establish a comprehensive multilateral framework for water sharing. Similar to diplomatic efforts in other regions such as Jordan, Israel, and Palestine, addressing water issues necessitates navigating economic, social, and political complexities. Sustainable agreements hinge on functioning states capable of engaging in negotiations for a genuine partnership. Egypt, boasting a strong state apparatus and institutions with centralized decision-making, holds economic weight compared to Ethiopia and Sudan. Adopting a negotiation approach that promotes a multilateral solution benefiting all nations rather than sustaining Egyptian dominance could help mitigate GERD's impact on Egypt's water supply (Johnson, 2018).

Baconi (2018) reports that the next step in Egypt's diplomatic efforts should involve expanding the 2015 tripartite agreement to lead a joint regional approach to managing climate change and water scarcity. However, success on this front remains uncertain, given the influential role the military plays, potentially favoring a strong-handed approach that protects vested interests. A significant drop in water supply would exacerbate Egypt's internal challenges, including a rapidly growing population, subsidized water costs, inefficient infrastructure, wasteful irrigation, and damaging pollution practices in the water sector.

With backing from the European External Action Service, Egypt has finalized a National Water Resources Plan aimed at tackling existing challenges. This comprehensive document outlines a 20-year roadmap spanning 2017 to 2037, detailing measures to reduce domestic consumption and alleviate the impact of water scarcity. Despite these efforts, Egypt encounters substantial hurdles within its borders, including inefficient public bodies often working in opposition. Notably, while the Ministry of Water has attempted to decrease land usage for water-intensive crops like rice, conflicting incentives from the Ministry of Supply and Internal Trade have encouraged rice cultivation (Baconi, 2018).

Public education campaigns emphasizing water preservation and pollution reduction have gained momentum in Egypt. However, these initiatives alone are insufficient. Such campaigns have only recently gained traction, challenged by a prevailing belief among the population in the Nile's perpetual abundance as a seemingly inexhaustible water source. As one expert noted, despite Egypt being 95 percent desert, it has not historically behaved like a desert nation.

These factors underscore the pressing need for substantial changes within Egypt to address mounting challenges. Given the significant levels of wasteful water losses and unrestricted consumption, addressing subsidization emerges as a crucial priority, aligning with global trends. The Sisi regime has initiated domestic reforms, in line with recommendations from international donors such as the International Monetary Fund. The regime's authoritarian capacity to suppress protests and quell unrest may enable effective implementation of water subsidy cuts in the short term. However, these measures do not point towards a future where Egypt develops a more sustainable water sector (Baconi, 2018).

In conclusion, the challenge of water scarcity is worsening across all continents, but especially in the MENA region, particularly affecting impoverished communities. Experts and international organizations (White, 2014[1]; United Nations (UN); Food and Agriculture Organization (FAO)) elucidate that water scarcity should be understood as a relative concept arising from factors such as demand surpassing

[1] White, C. (2014), Understanding Water Scarcity: Definitions and Mesurement, Part 6, Chapter 28, in Global Water: Issues and Insights, ANU Press.http://doi.org/10.22459/GW.05.2014

supply, inadequate water infrastructure, or institutional failures in meeting everyone's requirements.

Chapter 2. Migration and its Relation to Water Scarcity and Climate Change

2.1 Understanding Migrations

Migration stands as a defining feature in the contemporary world order, as individuals have historically sought new horizons to escape conflicts, poverty, or environmental challenges, in pursuit of enhanced opportunities and more favorable living conditions. Nevertheless, the scope and impact of human mobility have taken on a notably universal and pervasive character in recent decades. This transformation is evident primarily in the substantial rise in the number of international migrants.

The International Organisation for Migration (IOM), a key intergovernmental organization within the United Nations System dedicated to promoting humane and orderly migration, gives a definition of the word *migration* describing it as "The movement of persons away from their place of usual residence, either across an international border or within a State" (IOM Glossary, 2019).

According to the IOM, the global estimate indicates that approximately more than 280 million international migrants existed worldwide in 2023. This figure represents 3.6 percent of the global population, underscoring the substantial scale and significance of contemporary international migration trends (IOM, 2021). Among these international migrants, females accounted for 48 percent of the total. The majority of international migrants, specifically nearly three-quarters, fell within the age range of 20 to 64 years. Notably, a substantial demographic of 41 million international migrants were under the age of 20, emphasizing the diverse age distribution within this global migratory population (UN, 2024).

The evolving nature of migration reflects its complex interplay with geopolitical, economic, and environmental factors, shaping a dynamic landscape that influences societies, economies, and global relations.

In comparison to historical migration patterns, contemporary population movements exhibit greater diversity in terms of their nature, direction, and underlying causes. Notably, one factor that has gained increasing prominence in recent decades as a catalyst for migration is environmental change, particularly in the context of climate change. The available evidence on migration patterns, coupled with the manifestations of climate change, its human-induced origins, the rapid pace of changes, and the interconnectedness of various aspects of this phenomenon (such as global warming, rising sea levels, and extreme weather events), underscores the recognition of a tangible link between environmental shifts and migration. While human migration has always been influenced by environmental factors, political awareness of the significance of this factor has emerged relatively recently. Climate change has played a pivotal role in reestablishing the environment as a key driver of migration, presenting itself as a substantial threat to humanity and a potential catalyst for large-scale population displacement (Ionesco, et al., 2017).

The intricate linkages between environmental degradation, climate change, and migration are multi-faceted, impacting human mobility in various ways. Projections for the present century in climate change indicate that an increasing number of people are likely to migrate as extreme weather-related events, including floods, droughts, and storms, become more frequent and intense (IPCC, 2014). Changes in precipitation and temperature patterns are anticipated to influence livelihoods and human security, further contributing to the complex dynamics of climate-induced migration.

Drivers of Migration

The term *migration drivers* lacks a universally accepted definition. According to Van Hear et al. (2018: 927), migration drivers are described as "forces leading to the inception of migration and the perpetuation of movement."

These forces "shape the broader context within which aspirations and desires to migrate are formed and in which people make their migration decisions – whether to move or not" (Van Hear et al., 2018: 930).

Furthermore, the definition of driver of migration provided by the IOM states as follows:

> "Complex set of interlinking factors that influence an individual, family or population group's decisions relating to migration, including displacement. [..] The concept of "drivers of migration" is dynamic, reflecting an interaction of personal, social, structural, environmental and circumstantial factors working in tandem with local, national, regional and global level incentives and constraints. Drivers influence the decisions to migrate, whether the migration is internal or international, regular or irregular, and/or temporary or permanent; and they operate along a spectrum between voluntary and involuntary movement." (IOM Glossary, 2019).

The study of Carling and Telleras (2006), titled "Root causes and drivers of migration. Implications for humanitarian efforts and development cooperation", argues that a distinction needs to be made between "root causes" and "migration determinants". The authors conceptualize "root causes" as the underlying social and political conditions that prompt individuals to leave, with a particular emphasis on factors such as poverty, repression, and violent conflict; on the other hand, the term "determinants of migration" is commonly defined more in terms of methodology rather than a theoretical perspective. The use of "determinants" suggests an approach involving quantitative modeling and the exploration of data to elucidate and predict patterns in migration. According to the authors, the term "drivers of migration" is a more comprehensive concept that not only includes the factors influencing migration decisions but also encompasses the mechanisms that ultimately lead to migration outcomes. For example, social networks and access to information are considered part of the drivers of migration, even though they may not be the root causes themselves.

In general, the presence of multidimensional disparities between locations, whether in terms of current or potential residence, establishes an environment where migration becomes a feasible option for individuals. These "driver complexes" may encompass persistent economic and non-economic inequalities, such as those

between the global North and South, along with cyclic or seasonal fluctuations and spontaneous changes in life circumstances. Furthermore, the discrepancies in drivers between various places and the connectivity among these locations significantly shape the dynamics of migration processes (Migration Data Portal, 2021).

When talkling about drivers of migration, the academic and scientific debate generally distinguishes between five main grups: economic, political, demographic, social and environmental drivers (Black et all, 2012; Czaika and Reinprecht, 2020). Here below a brief description of each is given based on the Black et all's (2012) research:

Economic drivers encompass factors such as employment opportunities and income differentials between different locations. Merely considering income and wage differentials does not sufficiently explain the intricacies of migration. Migration is not a broad phenomenon of individuals moving uniformly from poorer to wealthier places. Instead, it is a highly specific process where people relocate from one relatively impoverished area to another specific, comparatively affluent area. The scale and direction of this movement are intricately tied to the personal circumstances of migrants, including factors such as class, ethnicity, religion, language, education levels, and connections with individuals in planned destinations. These considerations are further influenced by the intervening effects of migration policies.

Political drivers extend beyond conflict, security concerns, discrimination, and persecution to include influences arising from public or corporate policies, such as those related to land ownership or forced relocation. As far as conflicts are concerned, it is interesting to investigate a bit deeper. Various forms of conflict can serve as drivers for migration. While inter-state conflict is a possibility, it is more likely that conflict within states, such as civil war, communal violence, genocide, and politicide, motivates migration. The relationship between conflict and migration is complex, lacking a straightforward correlation or identifiable 'tipping point' in the level or intensity of conflict that triggers migration. Those most affected by conflict may lack the resources to move, remaining exposed to high levels of danger in their home towns and villages. Conflict can also intersect with other drivers, creating conditions where political tensions, poverty, environmental

hazards, and a relatively young population collectively contribute to migration and displacement. Political uncertainty, even in the absence of actual conflict, may act as a push factor for migration. Conversely, perceived political stability can function as a pull factor, attracting immigrants, or at the very least, discouraging people from leaving.

Demographic drivers involve considerations like the size and composition of populations in source areas, along with the prevalence of diseases impacting morbidity and mortality. The impact of demographic factors on migration is likely to manifest through interactions with other drivers, especially economic ones. It's not merely the presence of a large population in a region that triggers outmigration, but rather the presence of a large population without access to employment or livelihood opportunities, for instance. Additionally, the inclination to migrate is generally higher among younger individuals. Therefore, the demographic characteristics of a source region play a role in influencing who moves in response to economic drivers.

Social drivers incorporate familial or cultural expectations, the pursuit of educational opportunities, and cultural practices related to inheritance or marriage.

Environmental drivers of migration include exposure to hazards and the availability of ecosystem services. Ecosystem services refer to the components of the environment and ecosystems that contribute to human well-being. These services operate through provisioning functions (e.g., providing food and water), regulating functions (e.g., erosion protection), and cultural services (e.g., having emotional or spiritual value). Rapid-onset extreme environmental events, such as floods, tsunamis, landslides, earthquakes, wildfires, and volcanic eruptions, are widely recognized as triggers for displacement. These displacements typically involve relatively short distances and often occur within a single state. International displacement resulting from environmental disasters becomes more significant for small states or islands or when events impact border areas involving more than one state. Displacements driven by events are generally short-lived, and individuals often return to their original locations once the immediate impact has diminished, often after a brief period.

These five drivers seldom operate independently, and their interplay determines the specifics of movement. The nature of these interactions influences the scale of

migration, with movements at different scales, such as internal versus international, being shaped by distinct interactions among these drivers (Black et all, 2012).

Understanding Environmental Migrations

Before discussing the water scarcity-climate change nexus working as drivers of migration, it is fundamental to elucidate different sets of concepts concerning migrations and displacement caused by climate change.

One crucial distinction, which holds significant political implications, lies in categorizing migration as either forced or voluntary. Indeed, certain instances of migration entail a conscious decision, while others are driven by coercion, such as when individuals are compelled to leave due to calamities, violence, instability, or a lack of means for sustenance, thereby endangering survival and necessitating departure. Environmental migration often embodies a blend of both dynamics (Ionesco, et al., 2017). Consequently, in practice, differentiating between forced and voluntary migration can be intricate.

The delineation between voluntary and forced migration is particularly complicated when considering the concept of *planned relocation*. Within the realm of natural disasters or environmental degradation, exacerbated by climate change, the International Organization for Migration (IOM) characterizes planned relocation as "a planned process in which persons or groups of persons move or are assisted to move away from their homes or place of temporary residence, are settled in a new location, and provided with the conditions for rebuilding their lives" (IOM, 2019: p.157). Thus, planned relocation aims to protect individuals, families, and communities from the impacts and hazards associated with disasters, environmental degradation, or climate change and should be considered only as a last resort (IOM, 2019). Typically, this term denotes relocations conducted within national borders and under government oversight. However, in exceptional circumstances, communities may be relocated to another country (IOM, 2019).

This scenario commonly arises in island nations facing existential threats from rising sea levels.

Hence, according to the International Organization for Migration, the relocation of populations from areas rendered uninhabitable by climate change, recurrent disasters, or infrastructure projects should be accomplished through a non-coercive approach, prioritizing the well-being of the affected communities. However, Ionesco et al (2017) do assert that the most problematic feature in this context is to understand whether it is reasonable to talk about voluntary migration when people are eventually forced to migrate. What is more, even if circular migration associated with land degradation is typically perceived as "voluntary", it is essential to underline that there is a notable absence of legal or political mechanisms aimed at assisting the most vulnerable groups in making informed decisions regarding their migration (Ionesco et al, 2017).

Another significant aspect within the framework of environmental migration and displacement involves the classification of *sudden-onset* and *slow-onset events*, which correlates with the differentiation between internal and international migration. *Sudden-onset events* typically encompass extreme weather occurrences like storms, floods, or hurricanes. In contrast, *slow-onset events* denote gradual environmental changes such as sea-level rise, soil erosion, or drought (Kraler, et al., 2020). Regarding the internal and international migration distinction, existing evidence suggests that movements triggered by environmental stressors primarily occur within the same country or region. While developed nations in the Northern hemisphere express concerns about potential large-scale influxes of environmental migrants in the future, crossing international borders is rarely seen as the initial reaction or even a feasible option (Ionesco, et al., 2017).

Typically, disasters tend to prompt what is known as proximity displacement, where affected individuals initially evacuate nearby areas with the intention of eventually returning. Consequently, people usually do not move far from their homes; instead, they opt for temporary shelters near to damaged properties or relocate to evacuation camps or nearby communities seeking aid (Ionesco, et al., 2017). While some individuals with extensive social networks may travel further to seek assistance from relatives or friends in different locations, such as towns, regions, or even other countries, relocating to urban centers or abroad may also serve as a risk mitigation strategy or a means to diversify income and accelerate recovery post-disaster.

Nevertheless, despite environmental hazards, most affected communities are reluctant to abandon their homes, land, and way of life, preferring to remain in place (Ionesco, et al., 2017).

Migration within a country or from rural areas to urban centers often emerges as a common response also as far as slow-onset changes are concerned, particularly in the face of gradual environmental changes that threaten local livelihoods, especially among communities reliant on local natural resources and ecosystems (Ionesco, et al., 2017). As agricultural land becomes less viable or fish populations start decreasing, rural communities engaged in farming or fishing may choose to relocate to rural areas offering more favorable environmental conditions and plentiful resources. Alternatively, some communities may opt for a complete lifestyle shift, moving to urban areas to explore alternative employment opportunities. This decision holds significant weight, as migration to major urban centers can sometimes serve as a precursor to international migration (Ionesco, et al., 2017).

In this context, it relevant to point out that the possibility and extent of migration are significantly influenced by various situational factors, including the nature and severity of environmental pressures, as well as other push and pull factors (Ionesco, et al., 2017). These factors encompass characteristics of households, travel distances, connectivity, the attractiveness of both origin and destination areas, alternative options available to families, and policy frameworks, among others. Moreover, migration, particularly international relocation, is often financially burdensome, requiring substantial economic, social, and political resources for transportation and associated expenses, rendering it inaccessible to many (Ionesco, et al., 2017).

The existence of established migration routes and networks, alongside a thriving diaspora abroad, may incentivize individuals to consider relocation to another country; conversely, the absence of such networks and apprehension about the unfamiliar may deter migration. Hence, migration between neighboring countries sharing strong cultural and linguistic ties often appears more appealing than distant continent-to-continent migration. Additionally, migration patterns are shaped by factors such as freedom of movement, the availability of labor migration protection systems or other facilitative mechanisms for both internal and cross-border

migration, as well as constraints on mobility imposed by both origin and destination states (Ionesco, et al., 2017).

The timeframe involved needs to be evaluated as another critical aspect to consider in examining environmental migration and displacement. Depending on their circumstances and capabilities, individuals undertake migration in diverse ways and for varying durations. For instance, some individuals may opt for daily movements, such as farmers residing near cities who work there during non-farming seasons. Moreover, seasonal migration is also prevalent, where people relocate to different cities or regions for a set period each year to secure seasonal employment. Typically, this type of migration lasts no longer than six months (Ionesco, et al., 2017).

Another form of mobility is temporary migration, which entails movements lasting at least six months per year and typically covering greater distances. Such migration is commonly driven by motivations such as education, family reunification, or the pursuit of better economic opportunities. Although temporary migrants usually intend to return to their place of origin, personal or situational factors, particularly economic considerations, may convert this temporary migration into a permanent one (Ionesco, et al., 2017). Indeed, individuals may decide to settle permanently in a new location if it offers more secure and improved means of subsistence, or if returning home is neither practical nor advantageous.

Many cultures globally have historically utilized temporary and cyclical movement to adapt to seasonal changes. For instance, herding communities in Central Asia, Europe, the Arctic, South America, and Africa have traditionally engaged in seasonal transhumance, shifting their livestock between summer and winter grazing areas (Ionesco, et al., 2017). However, the impacts of climate change, particularly changes in rainfall patterns, have significantly disrupted these traditional practices, profoundly affecting transhumance cycles. For instance, droughts are compelling pastoralists to seek alternative migration routes, travel longer distances for extended periods, and in some instances, permanently relocate to regions with more abundant water and grazing resources. In regions where climate change is altering

precipitation patterns, temporary and seasonal migration serves as a crucial strategy for adapting to exceptionally wet or dry periods. For instance, communities in Thailand, Vietnam, or Bangladesh often practice seasonal migration to urban areas or alternate rural locations to diversify their income during the monsoon season (Ionesco, et al., 2017). Similarly, in various parts of the world, more affluent individuals engage in seasonal relocation in search of milder temperatures.

Ionesco et al. (2017) do make a point arguing that when considering disaster displacement, it's crucial to recognize that the paths and duration of displacement vary significantly depending on the type of event triggering it and the resulting harm. Typically, individuals are initially displaced to temporary shelters or evacuation camps after disasters until it's deemed safe to return home once the threat to populations and assets diminishes. However, in certain cases, these temporary arrangements can evolve into prolonged displacement situations. Those trapped in such displacement face increasing vulnerability over time, as resources and assistance often diminish once the initial emergency response phase concludes. Additionally, governments frequently struggle to devise long-term solutions for return or relocation, facing challenges such as limited financial resources, unclear land rights, potentially hazardous living conditions, and more. Consequently, individuals may find themselves living in precarious conditions in makeshift shelters, urban slums, or unsafe houses for months or even years. While prolonged displacement may seem like primarily a humanitarian and development concern in low- and middle-income countries, it also affects high-income nations such as Japan, Italy, or the US, along with their marginalized groups (Ionesco, et al., 2017).

In the realm of environmental migration and displacement, a significant challenge arises from the absence of consensus on definitions. Within academic discussions and political discourse, various terms are used to describe the phenomenon, including ‘environmental migration’, ‘climate change-induced migration’, ‘ecological or environmental refugees’, ‘climate change migrants’ and ‘environmentally-induced forced migrants’. However, it is important to note that no legal definition of environmental-induced migration has been coined. Furthermore, achieving consensus on definitions at the international level is also

made difficult by the heightened complexity of contemporary migratory patterns. Consequently, since the 1970s, discussions on the topic have been marked by a significant divide between two perspectives. On one hand, there are those who foresee substantial numbers of "environmental refugees," emphasizing environmental factors as primary drivers of migration. These individuals are often labeled as "alarmists." On the other hand, there are those who adopt a more skeptical stance, highlighting the intricate nature of the migration process. These individuals are typically classified as "skeptics" (Dun & Gemenne, 2008).

Even if no legal definition concerning environmental migrations is present, different actors are actively investigating the linkages between migration, environmental change, and climate change, and have developed valuable conceptual frameworks for understanding these dynamics. A brief presentation will follow.

The International Organization for Migration (IOM) proposed a working defintion for *environmental migrants* defining them as all those individuals compelled to leave their usual places of residence, either temporarily or permanently, due to adverse changes in the environment affecting their lives or living conditions (2007). This may involve relocating within or outside their country of origin or habitual residence. Program guidelines from the IOM and other human rights-based approaches to environmental migration articulate three commitments aimed at establishing secure and organized migration pathways.

The primary commitment focuses on enhancing the safety and well-being of migrants during their journeys, considering the anticipated impacts of climate change. The second commitment is dedicated to creating sustainable livelihoods to counteract the economic and social disruptions caused by gradual environmental degradation and sudden disasters. Lastly, the third commitment emphasizes recognizing the uneven distribution of immobility as a fundamental aspect of improved migration governance and climate justice.

This definition is intentionally broad and flexible to encompass the diverse range of movements driven by environmental factors. It encompasses individuals displaced by natural disasters as well as those who opt to migrate due to

environmental degradation. Additionally, it acknowledges that such migration or displacement can occur within affected countries or across national borders, and may vary in duration from short-term to long-term. The purpose of this definition, as clarified by the IOM, is not to overlook the economic, political, or social factors that also influence migration, but rather to draw attention to a significant driver of human mobility that has often been overlooked. Furthermore, the IOM aims to provide an alternative to the term "environmental refugees," which lacks legal basis in international refugee law according to the United Nations High Commissioner for Refugees (UNHCR) (IOM, 2007).

In the absence of a universally accepted definition, various proposals have been made to classify movements resulting from environmental factors. These definitions often offer narrower classifications by focusing on specific types of movement, such as displacement, or specific environmental triggers, such as the effects of climate change. One notable example is the definition of climate migration provided by IOM in its *Glossary on Migration* (2019). According to this definition, climate migration refers to "The movement of a person or groups of persons who, predominantly for reasons of sudden or progressive change in the environment due to climate change, are obliged to leave their habitual place of residence, or choose to do so, either temporarily or permanently, within a State or across an international border" (IOM, 2019: p.31).

It's important to note that climate migration is a subset of broader environmental migration, specifically addressing situations where environmental changes stem from climate change. In such cases, migration, particularly if forced, can exacerbate the vulnerabilities of affected populations, but it can also serve as a strategy for adapting to environmental challenges and building resilience (IOM, 2019).
While the IOM's definition of climate migration serves as an analytical and advocacy tool, it holds no legal weight. However, this terminology is referenced in the legally binding Cancun Agreements, adopted at the 2010 Conference of the Parties to the UN Framework Convention on Climate Change (UNFCCC). The Cancun Agreements delineate three types of climate change-induced movement: migration, displacement, and planned relocation (IOM, 2020). Additionally, the

World Bank has adopted this term to forecast population movements anticipated due to the adverse impacts of climate change (IOM, 2020).

Given the profound impact of the Covid-19 pandemic and subsequent lockdown measures on migrant workers and their networks, future studies on migration should delve into the concept of *trapped populations*. These are individuals unable to move due to conditions such as poverty, conflict, and environmental deterioration. This concept will be briefly discussed in the last Chapter of this thesis.

Concerning different terminology and sets of definitions, the following section will report some definitions of environmental and climate refugee and internally displaced persons as intented by the academic debate. Despite widespread recognition within the international community of the link between climate change and migration, a precise definition of *environmental refugee* has yet to be agreed upon.

The term *environmental refugees* was first coined by American environmentalist Lester Brown in 1970 in the scientific journal "Science," but there is no consensus on a single definition. The discussion about the category of environmental refugees began in 1985 when El-Hinnawi published a paper for the United Nations Environment Programme (UNEP). He defined environmental refugees as “those people who have been forced to leave their traditional habitat, temporarily or permanently, because of marked enviromental disruption (natural and/or triggered by people) that jeopardize their existence and/or seriously affects the quality of their life (El-Hinnawy, 1985: 4-5).

In 2005 Myers introduced the term *environmental refugee* to describe those individuals who can no longer secure a stable livelihood in their homelands and are compelled to seek refuge elsewhere. Biermann and Boas (2007) defined *a climate refugee* as individuals who must leave their habitats, either immediately or in the near future, due to sudden or gradual changes in their natural environment associated with at least one of the three impacts of climate change, such as sea level rise, extreme weather events, and drought and water scarcity.

Hodgkinson et. al. (2008) categorize them as «persons displaced by climate change». He argues that Displacement resulting from climate change represents a type of forced migration, where individuals and their land are both impacted by the detrimental and irreversible effects of climate change. Consequently, they are compelled to flee their homeland involuntarily, thereby attaining the designation of climate refugees.

However, it is noteworthy that even if the term environmental and/or climate refugee is frequently used in the academic debate, individuals falling under this classification do not meet the legal criteria and cannot have their rights protected under the 1951 Refugee Convention (Berchin et al, 2017). Indeed, to meet the legal criteria for being classified as a 'refugee,' it is imperative to establish a case of persecution by one's own government. Consequently, a case of persecution cannot be substantiated for climate migrants crossing national borders since environmental factors are indiscriminate, impacting all groups and individuals without regard for specific characteristics possessed by the group or individual.

In the absence of evidence supporting political persecution in their country of origin, climate migrants find themselves excluded from the provisions of asylum law. For instance, in 2012, New Zealand declined to confer refugee status on a Kiribati citizen citing climate change as the basis. Similarly, in 2015, New Zealand deported a Kiribati man who unsuccessfully pursued legal recourse to be the first individual granted refugee status solely based on climate change. While establishing a direct causal link between the disaster itself and the deliberate policy of state authorities attacking their own population using climate tragedy at the occurrence point is challenging, there undoubtedly exists a historical causal link and responsibility between climate-induced disasters and certain affluent countries. Irrespective of the ongoing terminology discourse, it remains undeniable that these individuals urgently require to seek refuge from the repercussions of climate change.

Therefore, both the terms *climate refugee* and *environmental refugee* lack a legal foundation in international refugee law, as stated by the International Organization for Migration (IOM) in 2020. Key agencies, including the International Organization for Migration and the United Nations High Commissioner for

Refugees, increasingly advocate against their use. These terms are considered misleading because they overlook essential aspects of population movements related to environmental degradation and climate change. For instance, environmental migration is predominantly internal and not always involuntary. Their usage could potentially undermine the international legal framework for refugee protection (IOM, 2020). Furthermore, involved organizations stress that international human rights law is designed to safeguard all individuals on the move due to environmental factors. Additionally, they highlight that the Guiding Principles on Internal Displacement address individuals displaced within their own country due to natural or man-made disasters. However, the extent to which a government adopts these principles determines the level of protection provided (IOM, 2020). In addition, Former High Commissioner for Refugees and current UN Secretary-General António Guterres has acknowledged that the refugee definition is not applicable to environmental claims. Guterres emphasized that adopting terms like *climate refugees* or *environmental refugees* would only complicate and confuse the efforts of the UNHCR to protect individuals affected by persecution and armed conflict (Kraler, et al., 2020).

In this context, additional concerns regarding the use of the term "refugee" arise. Indeed, typically, "refugee" refers to an individual who crosses an international border, while those who are displaced within their own country are labeled as *Internally Displaced Persons (IDPs).* However, since the majority of people displaced by climate change tend to remain within their own country's borders, confining the definition solely to those who cross international borders could significantly underestimate the scale of the issue.

Interestingly, all the authoritative definitions mentioned above are framed from a 'cause' driven perspective, carefully avoiding the consequences of migration, particularly its internal and trans-boundary dimensions. Such a 'cause-focused' definition could be interpreted as an intentional, perhaps unintentional, effort to blend climate migrants with *internally displaced persons* (IDPs) as intended by Hodgkinson et. al. (2008). According to the Guiding Principles on Internal Displacement adopted in 1998 by UN Commission for Human Rights, Internally

Displaced Persons are defined as: “persons or group of persons who have been forced or obliged to flee or to leave their home or places of habitual residence, in particular as a result of or in order to avoid the effects armed conflicts, situations of generalized violence, violation of human rights or natural or human-made disasters, and who have not crossed an internationally recognized State border” (OCHA, 2004:1).

The intertwining of climate-induced forced migrants with IDPs, primarily resulting from environmental degradation and development devastation, falls within the mandates of United Nations High Commisioner on Refugees (UNHCR)’ existing voluntary measures, making international communities less responsible for mitigating the crisis. The inclusion of climate-induced forced migrants and IDPs in the same category may compromise the notion of justice for climate-induced migrants, and if the definitions of these two categories are not clearly distinguishable, they may not receive appropriate assistance.

As explained before, the existing mandate of UNHCR exclusively pertains to 'refugees,' encompassing individuals who flee their homeland due to persecution orchestrated by the state based on race, religion, political opinion, or ethnicity.

To sum up, both UNHCR and IMO have advised against employing terms like “Climate Refugees” or “Environmental Refugees”, asserting that they lack a legal foundation in international refugee law and should be avoided to prevent undermining the established international legal framework for refugee protection.

Despite abundant empirical evidence, the connection between human displacement and environmental events remains complex and not always straightforward. In summarizing the literature on this subject, research suggests that patterns of displacement have the potential to be influenced by changing climate conditions. In such instances, movements typically manifest as internal migration, encompassing either temporary or long-term forms, or abrupt displacements (CPRD, 2015).

2.2 Water scarcity and climate change as drivers of migration

With the available evidence, it is now noticeable that changes in environmental conditions have a significant impact on migration dynamics, including displacement. Consequently, there are clear connections between environmental change and migration. However, understanding the precise typology of drivers that triggers movement more than other determinants is challenging. Often, various typologies of migration drivers interact, influencing the decision to migrate. This implies that environmental and climate change work in conjunction with economic, political, social, and cultural drivers to stimulate movement.

The difficulty in isolating the environmental driver from other root causes of migration is at the core of the challenge in establishing a universally accepted definition of environmental migration and providing protection for individuals falling under this category.

The movement of human populations is a intricate social phenomenon encompassing various interpretations. The interplay between environmental transformations and human migration signifies a mutual relationship between the surroundings and individuals. Despite the spatial and temporal variations in human migration patterns, influenced by intricate environmental and social elements, there is a growing acknowledgment that climate warming and diverse environmental changes are emerging as substantial catalysts for global population mobility and human migration. The evolving climate is expediting human migration, particularly in regions highly susceptible to environmental shifts, particularly in low- and middle-income areas. Projections indicate that by 2050, climate-induced changes may prompt the relocation of more than 134 million individuals in Sub-Saharan Africa, South Asia, and Latin America. Migration might be the sole recourse for populations in these regions to cope with climate change; otherwise, they risk becoming trapped communities. However, in certain instances, migration might not be a suitable response to environmental changes. As observed in Ethiopia, migrants in new environments could face heightened vulnerability compared to their original homes due to the potential for migration to accelerate environmental modifications and the overuse of the destination's natural resources. This interactive and

reciprocal dynamic complicates the comprehension of climate migration challenges, underscoring the urgency for in-depth exploration (McLeman, 2022).

The MENA region, as we have seen, stands out as the world's most water-scarce area and is anticipated to be among the regions most profoundly impacted by the global consequences of climate change. Climate change is expected to escalate the scale and frequency of disasters such as floods, droughts, and wildfires, significantly affecting the livelihoods, security, well-being, and resilience of the population. The subsequent displacement, coupled with scarcity of resources and water, has the potential to heighten the risk of disasters in regions where extensive movements strain already limited water supplies. These interacting factors may intensify tensions regarding access to essential resources among different community groups, thereby amplifying overall fragility (IOM, 2023).

In a recent comprehensive review of academic literature on migration drivers conducted by Czaika and Reinprecht (2020), a multitude of quantitative and qualitative studies have explored the role of climate change and environmental conditions as key factors influencing both internal and international migration. It's noteworthy, however, that the majority of these studies have predominantly focused on developing countries. Existing evidence suggests that gradual changes in temperature and precipitation patterns, known as *slow-onset variations*, are linked to outmigration, particularly from countries highly reliant on agriculture and rural areas (Czaika & Reinprecht, 2020).

It's essential to acknowledge that climate change alone does not singularly determine migration motives and behavior. Numerous studies underscore the indirect impact of climate change on migration, manifested through its consequences on conflict potential, health risks, and notably on economic determinants such as such as financial resources, means for sustaining livelihoods, and food security (Czaika & Reinprecht, 2020).

When climate change is considered alongside economic factors, the latter often exerts a more substantial influence. Interestingly, individuals may perceive their decisions to migrate as primarily economic, while the underlying motivations are inherently environmental (Czaika & Reinprecht, 2020). Thus, deteriorating environmental conditions can be understood within migration dynamics by

examining how environmental change intersects with the economy. Furthermore, environmental variables may also play a role in contexts of forced displacement resulting from violence, war, or persecution.

In addition to slow-onset environmental changes, *rapid-onset events*, including natural disasters and environmental shocks like earthquakes, droughts, floods, storms, or human-made accidents, can trigger migration. Once again, research tends to predominantly focus on the Global South in this context. Natural catastrophes lead to an increase in internal migration, particularly from rural to urban areas, and often result in a rise in international migration (Czaika & Reinprecht, 2020). Similar to the dynamics observed with climate change and slow-onset environmental changes, environmental shocks may reinforce economic determinants of migration, such as a lack of employment opportunities (Czaika & Reinprecht, 2020). Thus, even though economic factors like unemployment or limited market access may be stated as migration causes, the underlying and fundamental driving force is typically environmental in nature.

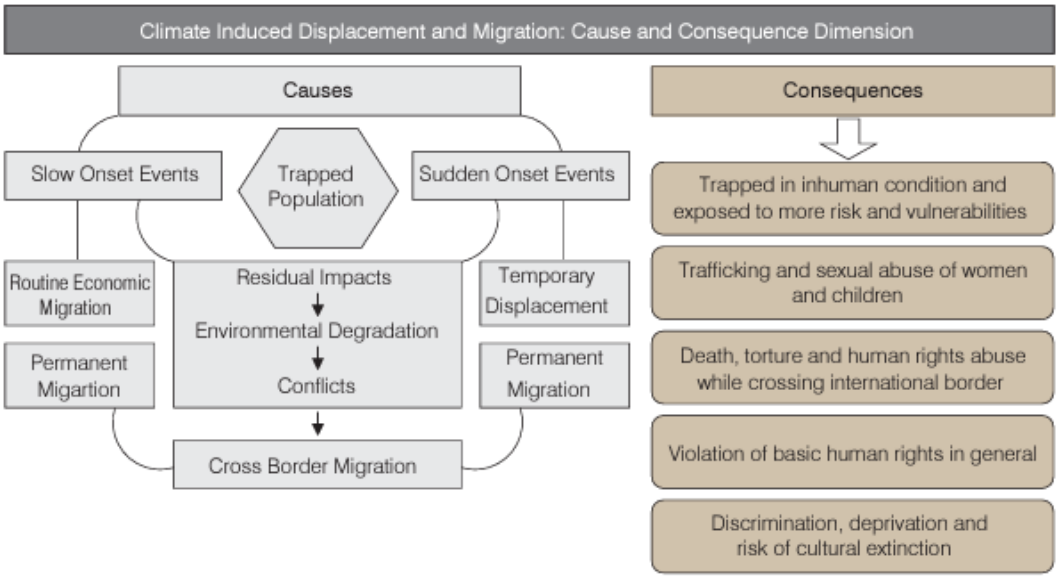


FIGURE 10: Climate Induced Displacement and Migration: Cause and Consequence Dimension. Source: Center for Participatory Research and Development (2015).

Water-related challenges resulting from climate change, such as floods, rising sea levels, and droughts, can act as direct or indirect catalysts for voluntary or compelled internal and international migration.

These challenges directly impact the welfare of individuals residing in areas reliant on agriculture, water resources, and fisheries. Consequently, people are inclined to relocate from these regions in pursuit of improved living conditions and access to essential natural resources (Black et al., 2011; Nagabhatla et al., 2020).

Some theories have been developed as far as the migration is concerned and they need to be briefly clarified. One economically motivated approach is the well-established “Push-Pull" model introduced by Lee (1966). According to this theory, specific factors (demographic, environmental, economic) in the country of origin serve as "push" factors propelling people to migrate, while other factors act as "pull" factors attracting migrants to a destination country[2]. The migration pattern is statistically inclined towards moving from low-income to high-income areas, driven by the anticipation of enhanced employment opportunities and higher wages. However, the static nature of this model presents limitations, depicting migrants as passive individuals lacking agency and offering limited clarity on the role of other influencing factors (Loken, 2021). Moreover, it fails to accommodate evolving circumstances or motivations, presenting migration as a singular action rather than a dynamic process (Haas, 2011; Loken, 2021).

An alternative micro-level explanation for migration is the New Economics of Labor Migration (NELM) approach, considered to be a conceptual improvement on existing theories. NELM proposes that migration decisions are made at the household level, involving the entire family unit rather than just the individual. The goal is to overcome market failures. Over time, as new insights emerge, certain models are no longer as applicable to today's understanding of migration. Criticisms are directed at historical push-pull and neo-classical theories for their failure to consider macro-level structural forces such as power inequality, policies, the labor market, and state dynamics (Loken, 2021).
Consequently, in conjunction with contemporary globalization theories and the transformation in the duration and scope of migration (shifting from temporary, seasonal and circular, to permanent), there has been a paradigm shift in

[2] Lee, E. S. (1966). A theory of migration. Demography, 3(1), 47-57. doi:https://doi.org/10.2307/2060063.

acknowledging connections between various flow types (economic, cultural, and social) (Loken, 2021).

McDowell and De Haan (1997) emphasize that migration encompasses not only physical movement but also intricate linkages between the place of origin and the destination, significantly influenced by familial and social structures, supporting the so-called network-based theories (Loken, 2021).

To sum up, a comprehensive examination of the theories presented indicates a shared foundation for migration: individuals decide to migrate, or not, based on varying degrees of agency influenced by cultural, social, and economic factors. However, not all migrations occur voluntarily, and some individuals feel compelled to move. This is evident in the experiences of Internally Displaced Persons (IDPs) and refugees. As a result, the complex process of migration has paved the way for the consideration of other theories which will not taken into consideration in this discourse.

The intricate connection between water and migration highlights the deep interdependence of these fundamental elements. Human settlements hinge significantly on water, playing a central role in social well-being and exerting a direct impact on food security and overall quality of life. When substantial changes in water conditions jeopardize people's livelihoods, the need for effective adaptation becomes imperative to maintain a harmonious balance between humans and water.

Migration arises as a practical pathway for individuals to adapt to endangered water systems, presenting opportunities to diversify income sources and enhance resilience. However, water-induced migration can frequently be involuntary, particularly when it becomes a last-resort option, posing risks for those unable or unwilling to move to alternative destinations (Irbik, 2022). Consequently, it can both stem from and contribute to the deterioration of hydrological conditions, encompassing aspects related to both quality and quantity, in both the original locations and the chosen destinations.

The role of water in triggering human migration is intricate. (McLeman, 2022; Xu and Famiglietti, 2023).

However, the decision to migrate is usually influenced by various environmental and socioeconomic factors, as explained before The interaction with other environmental elements, such as rising sea levels, and socioeconomic variables, including demographic characteristics and socio-political settings that shape the adaptive capacity of countries or communities, requires further exploration, argues McLeman (2022). For instance, migration prompted by water scarcity is likely to occur in globally arid regions, as observed in countries where individuals are compelled to relocate from vulnerable to more sustainable areas for better living conditions. These areas are often dominated by low- or middle-income countries, where migration decisions are significantly influenced by opportunities at the destination and the associated costs of moving. Besides water scarcity, shifts in human water-use behaviors can also impact migration decisions through a cascading effect (Mach, 2017).

The increasing population and changing patterns of water use are expected to heighten the severity and timing of water-related stresses, affecting agricultural production, worsening water contamination, triggering persistent conflicts over water resources, and compromising human health and economic well-being. The risks linked to water stress will make vulnerable regions and their populations more susceptible to fluctuations in hydrological conditions, further propelling population movements (IPCC, 2022).

For instance, inequities in water usage for industrial and residential purposes can ignite conflicts over water resources among communities and sectors, leading to mass migration, particularly in water-stressed regions like the Middle East, South Asia, and North Africa (McLeman, 2022)

As water stresses intensify due to climate change, an uptick in the number of individuals compelled to migrate because of water-related factors is anticipated in the near future. Extensive literature foresees that climate-induced water stresses will likely prompt a larger segment of the global population to relocate from their original locales, seeking improved opportunities and a better quality of life. Many of these stresses emanate from various water-related elements, including the availability and accessibility of freshwater, water quality for ensuring clean water and sanitation, and exposure to detrimental water hazards (IOM, 2023).

Scholars like McLeman (2022) do underline that it has been estimated that water deficits are associated with a 10% increase in global migration. The livelihoods of over 85% of the population in low- or middle-income countries and a quarter of the world's population will be jeopardised by the escalating water stresses. Despite numerous empirical studies illustrating the connection between water stresses and migration, evidence-based knowledge remains fragmented, benefiting from a synthesis of patterns to identify critical stressors.

According to Xu and Famiglietti (2023), despite the steady growth of research on climate migration over the past few decades, the role of water in migration dynamics has received comparatively less attention. Although these studies acknowledge in their main text that the water/climate nexus acts as a catalyst for migration, they are considered as supplementary data. According to their dataset, studies on water-related human migration began in the 1980s, a decade later than the onset of climate migration in the 1970s (Mach, 2017; Xu and Famiglietti, 2023).

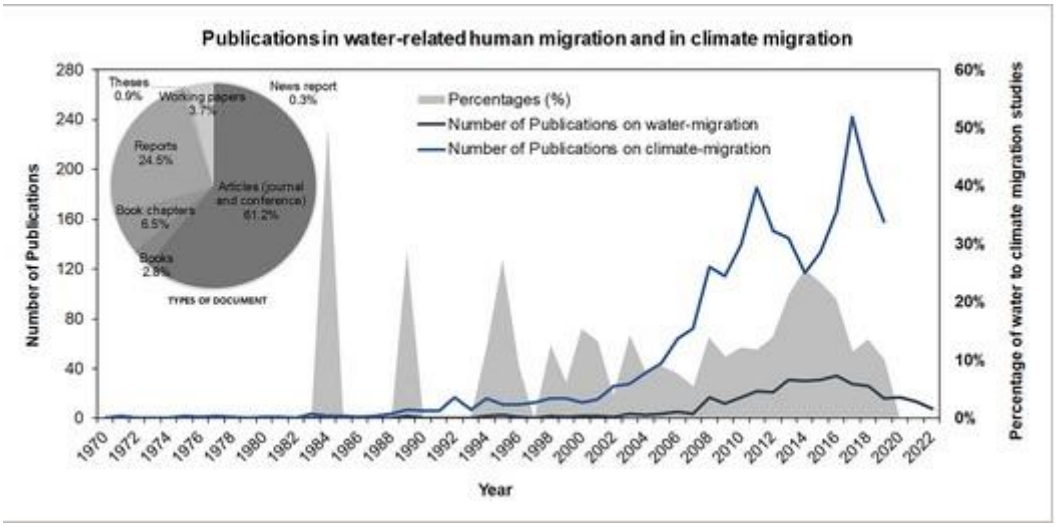


FIGURE 11: Publications in water-water related human migration and in climate migration. Source: Xu, L., & Famiglietti, J. S. (2023). Global patterns of water-driven human migration.

As depicted in the figure, studies on climate migration started increasing in 1990, while research specifically linking water problems to migration gained limited attention until 2007. The annual number of publications on water-related migration has never surpassed 50% of those on climate migration (McLeman, 2022).

As Xu and Famiglietti (2023) said that variations in water quantity, especially water scarcity, act as a catalyst for human migration. This impact extends beyond affecting water availability for crucial life support systems, such as land, soil, and natural habitat, to intensifying the vulnerability of social-ecological systems and jeopardizing people's livelihoods. Sustainable water availability is essential for maintaining the fertility of land and soil, sustaining agricultural production, and ensuring the well-being and food security of farmers and the wider population. Changes in precipitation, influencing soil moisture and land cultivability, further disrupt farming patterns and crop production. The repercussions of water variability on the quality of life and safety of individuals are particularly pronounced in arid regions worldwide, where freshwater resources are significantly depleted. The escalating water variability in these regions has already been identified as a major driving force behind migration, a trend expected to accelerate in the coming decades (Xu and Famiglietti, 2023).

In his paper titled *Global Patterns of Water-Driven Human Migration*, McLeman (2022) evaluates the connection between water scarcity and migration by presenting some cases. In the Sahel and Sahara regions of Africa, groundwater, often found at depths exceeding 500 m, serves as the primary water source for most local needs. Livelihoods in these regions hinge on the availability and storage of freshwater, making them highly susceptible to rainfall variability. The reliability of groundwater sources becomes crucial in mitigating the impact of water shortages, which lead to crop failures and heightened conflicts driven by water scarcity. Continued groundwater depletion exacerbates these challenges. Instances of migration fueled by water scarcity and resulting food insecurity are evident in documented cases in Burkina Faso, Sudan, Mali, Senegal, and Mauritania.

In Morocco, shifts in rainfall patterns have significantly impacted regional agricultural production, with precipitation declining since the mid-1970s and expected to decrease by up to 30% by 2050. This intensifies water scarcity's impact on irrigation for agricultural food production, particularly in the Oum Er-Rbia river basin, housing half of Morocco's irrigated agriculture (McLeman, 2022).

The growing water shortage has prompted a substantial migration of people from agricultural areas along the Oum Er-Rbia river basin to urban areas. South Africa,

with chronic water scarcity in Cape Town and surrounding areas leading to the well-known “day zero” water crisis, has been a critical factor in heightened conflicts and migration. The emerging drying trend in this region is expected to increase vulnerability to water supply variability and expedite environmental migration (McLeman, 2022).As far as environmentally induced displacement is concernd, previous research has primarily concentrated on examining individual natural hazards separately within a context-specific framework. These studies have identified that the migration patterns of individuals vary across different countries, among diverse groups, and in response to various hazards, including temperature increases, storm surges, and droughts.

Furthermore, investigations have suggested that, in the face of slow-onset events like droughts, communities tend to adapt in situ, remaining in their original locations. In contrast, following rapid-onset events, internal displacement often becomes the prevailing outcome. Some studies have also indicated that environmental stress, combined with drought, can lead to prolonged displacement (IOM, 2020.

In order to present a clear idea of the situation, Gray and Mueller (2012) proposed, through a series of studies across the Global South, that drought can both decrease and increase population mobility. Examining the link between environmental factors and migration, they found that migration was significantly higher in places with better soil quality in Uganda, whereas in Kenya, it was lower. Therefore, diminished soil quality compelled people to diversify their sources of income.

Additionally, as national and local migration flows increased in Ecuador alongside a decreasing agricultural harvest, cross-border migration remained constant. Movement in response to slow-onset events typically involves temporary labor migration and serves as a strategy for diversification. A study from the Horn of Africa explored the interconnected impacts of severe drought, revealing that the interplay of civil order breakdown, excessive state oppression, and political conditions collectively hinders populations' ability to adapt to climate change and its effect (Warner et al, 2012).

Similarly, McLeman and Smit (2006) delved into long-term migration as a response to drought, identifying that the inability to adapt was influenced by various

vulnerability factors, such as land tenure, occurrences of crop failure, and the extent of social connections. In this context, it is widely acknowledged that poor or marginalized populations are disproportionately affected by the impact of slow-onset climate change, where factors such as vulnerability levels, socioeconomic class, ethnicity, and race play crucial roles. In pastoralist areas, economic and political marginalization, combined with inadequate development policies, restrict mobility, and limitations in income diversification and low access to basic services contribute to alterations in traditional migration routes.

In regions where pastoralism is prevalent, economic and political marginalization, combined with insufficient development policies, limit the ability to move, and obstacles related to income diversification and limited access to essential services contribute to alterations in established migration routes. Other research indicates that displacement triggered by specific events, such as the aftermath of a cyclone, is typically brief and temporary, as individuals tend to return home when feasible (Foresight, 2011)[3]. Similarly, these events escalate into disasters, particularly when they impact vulnerable populations. For example, in 2005, Hurricane Katrina struck New Orleans and disproportionately affected impoverished Afro-American communities. The lack of social support and the conditions and locations of their residences were crucial factors. This underscores the reality that not everyone can migrate, often due to socio-political factors (McLeman and Smit, 2006).

In a parallel scenario, a study on the consequences of heavy monsoon rains in Bangladesh revealed that the daily displacement rate of 3000 migrants was attributed to the lack of effective aid relief. Conversely, the displacement of Bangladeshis was minimal following a 2004 tornado, as food markets received support, and aid was appropriately distributed. Similarly, mass migration did not occur after the 2004 Indian Ocean tsunami, partially due to substantial mobilization by diaspora groups and a prompt humanitarian response. The effectiveness of

[3] Foresight. (2011). Migration and Global Environmental Change; Final Project Report. Retrieved from London: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/287717/11-1116-migration-and-global-environmental-change.pdf.

government coping strategies significantly influences displacement rates (Loken, 2021).

In conclusion, as previously outlined, population displacement resulting from water scarcity and climate change is a phenomenon that has occurred repeatedly throughout human history. The distinction between past occurrences and the present situation lies in the rapid and intense environmental changes caused by human activity. These changes have become unpredictable, as evidenced by the sudden occurrence of natural disasters. Various forms of environmental migration typically stem from multiple causes rather than a single factor, but in this chapter the aim was to state that water scarcity and climate change do work as drivers of migration. Indeed, their nexus an drive migration in several ways. As explained before, climate change can lead to changes in temperature and precipitation patterns, affecting agricultural productivity and livelihoods dependent on natural resources. Reduced water availability due to droughts can diminish crop yields and livestock productivity, leading to economic losses and forcing people to seek alternative means of survival elsewhere. Moreover, the increase in the frequency and intensity of extreme weather events such as hurricanes, floods, and storms can cause widespread destruction of infrastructure, loss of homes, and disruption of livelihoods, compelling affected populations to flee to safer areas.

Water scarcity, exacerbated by climate change and increasing demand, can lead to competition over limited water resources. In areas where water becomes increasingly scarce, communities may be forced to migrate in search of regions with better access to water for drinking, sanitation, and agricultural purposes. In some cases, the combination of climate change impacts and water scarcity can render certain areas uninhabitable due to extreme heat, desertification, or sea-level rise. This can result in the displacement of entire communities as they are forced to relocate to more hospitable regions.

Overall, climate change and water scarcity contribute to a complex web of factors that drive migration, affecting both rural and urban populations worldwide.

However, it is important to note that new research focusing on climate change and migration has transitioned away from portraying migration as a security menace to both host and destination nation-states. Instead, it now considers migration as an essential strategy for resilience and adaptation in response to the global loss and deterioration of the environment. Approaching migration as adaptation, as opposed to a security threat or crisis, provides a more nuanced comprehension of the lives of migrants and their forms of agency. However, critics argue that this perspective places greater emphasis on individual resilience, potentially overlooking the need for structural changes and institutional accountability concerning climate justice (IOM, 2023).

Chapter 3. The MENA Region - Case Studies

This chapter offers an overview of case studies to understand the nexus between water scarcity, climate change and migration. As outlined in other sections of the previous chapters, the Middle East and North Africa (MENA) Region will be analysed as the main hotspot, focusing principally on: Lybia, Sudan, North Africa and Morocco.

In the Middle East and North Africa (MENA) region, migration represents a significant demographic trend. Approximately 14% of the global international migrant population, including refugees and other migrants, resides in this region, comprising both intra-regional and extra-regional migrants. The migrant population in MENA has notably grown from less than 15 million in 1990 to nearly 35 million by 2015. Additionally, the region hosts the largest population of Internally Displaced Persons (IDPs), accounting for nearly 41% of the global IDP population as of the end of 2016, with over 16 million individuals displaced within their own countries (IOM, 2019b).

Together with these migration patterns, the Middle East and North Africa (MENA) region confronts severe water scarcity issues, with 18 out of 22 Arab states falling below the annual threshold of 1,000 cubic meters per capita for renewable water resources, and 13 states falling below the absolute water scarcity threshold of 500 cubic meters per capita per year. The World Bank has identified Jordan, Iraq, Lebanon, Morocco, and Syria as countries that will face significant increases in water stress due to climate change in the coming years. Furthermore, despite over 56% of the region's population now residing in urban areas, agriculture remains a crucial priority for water usage to ensure food security and sustain rural livelihoods in middle and low-income countries. This emphasis on agriculture is significant, given that the sector continues to consume nearly 80% of the region's freshwater resources, primarily sourced from groundwater. For instance, in Iraq, where 85% of water withdrawal is allocated to agricultural activities, water shortages have significant economic ramifications, impacting the return of Internally Displaced Persons (IDPs) and exacerbating unrest and tensions between communities.

Consequently, experts have warned that the persistent threat of water scarcity poses a greater risk than political instability or unemployment (IOM, 2019b).

Water scarcity in the region is driven by a combination of factors, including the effects of climate change such as droughts and floods, as well as rising sea levels leading to saltwater intrusion into freshwater sources. Additionally, challenges related to low water quality and lack of access are compounded by inadequate infrastructure and management practices. As water becomes scarcer, it also becomes more costly, disproportionately affecting the poorest communities. Residents of slums, for example, often pay 5 to 10 times more per liter of water compared to wealthier individuals in the same city due to their lack of connectivity to main water networks. This disparity means that already marginalized communities may face greater water insecurity despite the physical presence of water resources (IOM, 2019b).

Furthermore, effective water governance at regional, national, and local levels is critical in addressing water scarcity issues. For instance, the management of transboundary water flows is a concern in the context of the Regional Syria Crisis, where projections indicate that Jordan could experience a significant decrease in water availability from the Yarmouk-Jordan River compared to historical levels. This could potentially drive migration as people seek better farming conditions elsewhere. In Iraq, where a large portion of freshwater comes from neighboring countries such as Turkey, Iran, and Syria, the importance of upstream water management at the regional level is evident. Additionally, at the national level in Iraq, water governance plays a crucial role, as evidenced by instances where extremist groups like ISIL utilized control over dams to manipulate water resources, causing shortages and disruptions in supply to certain regions. At the local level, inadequate water governance and scarcity can exacerbate social tensions, leading to displacement or preventing displaced individuals from returning to their homes. For instance, tribal conflicts over water access have emerged in southern Iraq, as well as in areas of Yemen and Sudan. Moreover, in the Maghreb region, water scarcity coupled with insufficient water governance can exacerbate existing inequalities (IOM, 2019b).

From a development standpoint, water is a crucial resource essential for individuals and communities to fulfill their basic needs and achieve sustainable livelihoods.

Within the framework of the 2030 Agenda for Sustainable Development, water management is a specific goal outlined in Sustainable Development Goal (SDG) 6 that aims at ensuring availability and sustainable management of water and sanitation for all, and SDG 11.5 which stress the point of dealing with water-related disasters. SDG 6.4 particularly addresses water scarcity, aiming to enhance water-use efficiency across all sectors of society to ensure sufficient water availability for the population, economy, and environment. The nexus between water scarcity, human mobility, and development underscores the essential role of water in various economic activities, from subsistence agriculture to heavy industry, as goods and services cannot be produced without it. Consequently, migration often emerges as an adaptation strategy for populations impacted by prolonged water scarcity, with working-aged individuals seeking employment opportunities in areas less affected by water shortages and sending remittances to their families back home. However, this can reinforce existing rural-to-urban migration patterns, potentially leading to unmanaged urban growth, particularly through informal settlements, thereby exacerbating water stress in certain areas (IOM, 2019b).

The case studies of Sudan and Libya highlight distinct vulnerabilities to climate change and water scarcity. In this context, the concept of "ecologies of vulnerability" appears to be important. It refers to the combination of political, economic, social, and environmental conditions that influence the risk and adaptive capacity of different groups and regions to climate change impacts, including immobility and migration. This concept integrates human rights-based approaches to migration with ongoing efforts to understand the uneven effects of climate change within specific contexts. It is widely recognized across governmental, policy, and academic sectors that environmental factors contributing to migration are intertwined with various other drivers of displacement and migration, such as economic hardships and conflict (IOM, 2023).

Libya

Libya is positioned at the 15th spot among 33 countries worldwide projected to face severe water scarcity by 2040 (WRI, 2015). The World Resources Institute (WRI) devised a "water risk score" by amalgamating 13 water risk indicators, reflecting the country's water quantity, quality, and regulatory reputation, which pertains to water governance capacity. The majority of Libya is categorized as "extremely high risk," excluding the coastline along the Mediterranean Sea.

Particularly, approximately 87% of Libya's populace resides in or around coastal urban centers, with a significant concentration in Tripoli and Benghazi. The majority of the nation consists of arid landscapes, and cultivated agricultural regions constitute merely 1% of the total land area. Despite the presence of ephemeral rivers, the absence of permanent rivers or lakes necessitates a dependence on groundwater aquifers to meet the demand for potable water (IOM, 2023).

As reported by the FAO (2016), Libya boasts the largest oil reserves in Africa, and petroleum exports make up over 90% of the overall exports. In the 1950s and 60s, while exploring for oil, deep fossil aquifers were discovered in the southern regions. Initially allocated for agricultural endeavors in the desert surrounding the wells, the growing need for drinking water among the coastal population led to a shift in focus towards supplying the North. The Great Man-Made River (GMMR) Project, acknowledged as one of the most expansive civil engineering undertakings globally, transports fresh groundwater from the Southern desert to coastal cities through interconnected pipelines linked to the Nubian Sandstone Aquifer (Brika, 2018; Elhassadi, 2008[4]).

Commencing in the 1980s and financed by the Gaddafi government, the GMMR underwent construction in multiple phases over several decades. Despite facing incompleteness and partial destruction due to NATO bombings in 2011 and subsequent civil unrest, the GMMR largely displaced desalination plants as the primary technology for producing drinking water in arid climates in Libya. With the growing concern over water scarcity, there is consideration of improving the

[4] Elhassadi, A. (2008) Horizons and future of water desalination in Libya, Desalination, 220, 115–122.

desalination plants established by foreign investors in the 1960s as a potential avenue for future development (IOM, 2023).

Although the GMMR continues to supply water to millions, its current state of disrepair renders it unsustainable. Overexploitation of groundwater, especially in coastal cities, has resulted in seawater intrusion into freshwater aquifers, rapidly depleting the water supply (IOM, 2023; Brika, 2019).

Libya serves as a significant departure point for migrants and refugees embarking on the Central Mediterranean Route, aiming to cross the Mediterranean Sea to reach Europe. Itscoastal areas, especially the Mediterranean region, have observed the highest number of disappearances, as reported by the IOMS's Missing Migrant Project (MMP) in 2022. This underscores the inadequacy of relying solely on numerical data to depict the challenges and losses in this particular context. While a substantial portion of those journeying along this route comprises refugees and migrants escaping conflict and climate-induced environmental hardships in sub-Saharan Africa, they are also seeking economic opportunities. Throughout history, Libya has been a favored destination for individuals migrating from neighboring countries, offering the most promising employment prospects and highest salaries in the region, despite the declining standard of living due to the ongoing armed conflict related to oil production and exportation (IOM, 2023) As explained in the previous chapters, this evaluates the idea that the different drivers of migration do usually coexist.

Since the initiation of the uprising against the Gaddafi regime in 2011, almost 400,000 Libyans have faced displacement (Fitzgerald, 2018). As of June 2022, approximately 143,000 internally displaced persons (IDPs) still find themselves unsettled in Libya, according to the IOM. A recent report from the IOM (2022) reveals that the primary motivation for migration for the majority of individuals entering Libya (90%) is the pursuit of improved livelihoods. More than half of the participants in a survey carried out by the IOM (53%) conveyed that insufficient income in their countries of origin played a crucial role in shaping their choice to migrate. Additionally, nine percent of the respondents affirmed that they had experienced internal displacement within their home countries before arriving in Libya.

Despite the existence of armed conflicts, stringent border controls, and exclusionary immigration and refugee policies in Europe, the geographical proximity and

diasporic ties between Libya and neighboring nations like Chad, Egypt, Niger, and Sudan persist in influencing migration patterns in Libya (IOM, 2023) Notably, migrants from Niger constitute the majority (25%) of the migrant population.

As economic migrants and displaced individuals congregate in coastal Libyan cities, the sustainability of the potable water infrastructure becomes a pressing concern. Access to water has evolved into a focal point of political disputes. In different circumstances, these experiences also serve as cautionary examples highlighting the limitations of migration governance frameworks that overlook the underlying structural conditions of livelihood loss, water scarcity, and armed conflict. It becomes essential not only to develop a more comprehensive understanding of conceivable alternatives for migrants entering Libya and Europe but also to empirically grasp the impacts of anti-smuggling laws and international surveillance on migrant routes. Such insights would significantly enhance policy formulation while advancing the legal advocacy for regionally cohesive frameworks (IOM,, 2022; UNHCR, 2017).

In 2017, protests erupted in Tobruk against the closure of a seawater desalination plant, with demonstrators urging the National Oil Corporation to address the water crisis and threatening to disrupt oil exports. Ongoing investigations are scrutinizing the surge in hepatitis A cases among Tobruk residents in 2019, a disease that could potentially be transmitted through drinking water. Armed groups strategically severed water pipes in 2019 as a leverage tactic in their struggle with the state over a captured leader, leading to a temporary but critical water crisis in the capital (IOM, 2023).

The Water Law of Libya, initially established in 1965 and subsequently revised and expanded in 1985, designates water as a public resource that warrants protection from all parties. Additionally, the National Strategy for Integrated Water Resources Management (2000 to 2025), ratified in 2005, outlines directives for sustainable development and emphasizes shared responsibilities in safeguarding water resources. Despite the establishment of these legal frameworks, their effective implementation has been hindered by inconsistency, particularly in the face of ongoing armed conflict (IOM, 2023).

In Libya, the provision of water, sanitation, and hygiene services has deteriorated significantly during periods of armed conflict, with the COVID-19 pandemic exacerbating these challenges. Approximately 19% of migrants report inadequate access to clean drinking water, impacting overall societal health and hygiene standards (IOM, 2023). Additionally, laws implemented in migrants' countries of origin, such as Niger's anti-smuggling law enacted in 2015, have resulted in uncertain outcomes for migrant well-being, leading to shifts in transit routes through less supported and arid regions. Complexities arise also from varying and unreliable criteria for entry and recognition of refugee status among European, African, and international agencies, further complicating the situation. Despite efforts by multiple agencies to facilitate the voluntary return of migrants to their home countries, outcomes have been mixed. It's noteworthy that Libya, although a significant destination for migration in Africa and the Middle East, is not a signatory to the 1951 Convention Relating to the Status of Refugees (IOM, 2023).

Most of the existing literature fails to grasp the intricacies of the migration situation in Libya concerning the escalating water scarcity. If addressed, it is often briefly mentioned in connection with population growth, as sustained by Boretti and Rosa (2019). [5] The authors argue that population growth has conventionally been the default framework for explaining the strains of environmental and resource degradation, yet it inadequately captures pertinent dynamics. Population growth does not explain water scarcity in Libya, where the annual growth rate for the period 2005-2015 declined to 0.8%, in contrast to the 4.2% and 2.8% of the 1980s and 1990s, respectively (FAO, 2016; IOM, 2023).

As noted by the IOM 2023 Report, water scarcity intersects with the vulnerabilities of both urban and rural ecologies, necessitating a dual perspective: 1) as a catalyst for new out-migration flows, particularly from rural agricultural zones to urban centers, and 2) as a problem arising from the overexploitation of resources in destination sites, especially in urban developments and refugee camps. In this context, the IOM has examined environmental degradation and water scarcity as drivers of migration through surveys of migrants transiting Niger and Libya. The majority of survey respondents highlight economic need as the primary reason for

[5] Boretti, A. Rosa, L. (2019). Reassessing the projections of the World Water Development Report. Npj Clean Water 2. No. 15

migration, underscoring the need for further research to comprehend the correlation between reduced rainfall, broader processes of desertification, and escalating water scarcity intertwined with more apparent economic motivations for migrating into Libya (IOM, 2023).

Furthermore, as migrants continue to congregate in coastal cities of Libya, additional strain is imposed on inadequately equipped healthcare systems and potable water infrastructures (FAO, 2016).

In Lybia, desalination stands out as a viable solution for obtaining clean water in countries with coastlines. While desalination plants have been operational since the 1960s, many are currently non-operational or in need of repair. Libyan researchers emphasize the importance of considering local conditions and expertise in future desalination projects, attributing past plant failures to this oversight. The 2017 Tobruk protests highlighted a trend of disinvestment in desalination alongside significant investment in the oil industry. As far as the oil industry is concerned, the petroleum sector is a substantial water consumer, with the production and processing of petroleum requiring large quantities of water. For instance, extracting one barrel-equivalent of oil demands 250 gallons of fresh water and emits over 60 pounds of CO2. Gasoline production ranks as the highest water consumer, utilizing 0.60–0.71 gallons of water per gallon of gasoline, while jet fuel refining requires the least at 0.09 gallons (IOM, 2023).

Although desalination is energy-intensive, countries in the MENA, including Libya, possess abundant sunlight that could be used for thermal processes or solar electrical power to alleviate this issue. Additionally, disposing of the brine leftover from desalination back into the seas or oceans poses concerns about increasing the salinity of these bodies of water. However, if MENA countries collaborate, there could be opportunities to extract various minerals from the brine, including salt (IOM, 2023).

In conclusion, as reported in the IOM Lybia Migrant Report Round 40 (Dec 2012-Jan 2022), when analysing drivers of migration in the country, it appears that The primary driving force behind the decision to migrate for the majority of respondents (90%) was economic factors and the pursuit of a better livelihood. Over half of the respondents (53%) cited insufficient income in their country of origin as the main reason for migrating to Libya, followed by the lack of job opportunities (19%) and

the desire to find employment abroad (17%). Additionally, more than half of the migrants (53%) reported being unemployed at the time they left their country of origin, whereas only 17% were unemployed in Libya. A smaller percentage of respondents (9%) indicated that war, conflict, or targeted violence played a significant role in their decision to leave their home country. Additionally, findings from Round 40 of data collection indicate that nine percent of respondents mentioned experiencing internal displacement (IDP) before migrating to Libya. Furthermore, a small proportion of migrants (2%) identified slow-onset environmental degradation, such as drought, land desertification, water scarcity, and changing rainfall patterns, as one of the primary, secondary, or tertiary factors influencing their decision to leave their home country. However, it's important to note that this figure may underestimate the actual influence of environmental factors, as economic drivers like limited livelihood opportunities and increased rural unemployment often overlap with climate-related hazards and environmental degradation (IOM, 2022).

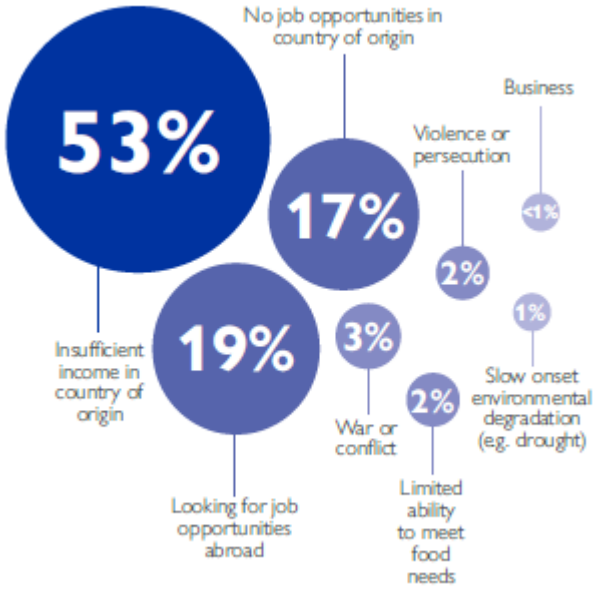


FIGURE 11: Primary reasons to leave a country of origin. Source: IOM (2022) IOM Lybia Migrant Report Round 40.

Sudan

Sudan represents another relevant hotspot for water-related migration in the MENA region. The water crisis in Sudan is influenced by a combination of factors including drought, extreme rainfall patterns exacerbated by climate change, and complex socio-political and economic dynamics such as postcolonial development relations, civil conflict, and the volatility of the oil economy (UNEP, 2016). While Sudan has a history of experiencing cycles of droughts and floods, climate change has notably decreased rainfall over the past four decades, contributing to the advancement of the Sahara Desert by 1.5 kilometers annually, a process known as desertification (IOM, 2023). This phenomenon has led to severe floods during the rainy season, affecting over 700,000 people and causing destruction to more than 60,000 homes, resulting in the displacement of over 100,000 individuals. Approximately 70% of Sudan's population resides in rural areas along the Nile River, with a population growth rate of 2% between 2012 and 2013. Notably, the central states of Sudan heavily rely on the Nile River as their primary water source, which necessitates cooperation and management coordination with 11 other countries, including Egypt to the North and Uganda, Rwanda, and Ethiopia to the South (IOM, 2023).

The establishment of irrigation systems for agriculture has played a significant role in both colonial and postcolonial development initiatives in Sudan. Large-scale gravity irrigation initiatives were initiated during the British colonial era (1898-1956) with a focus on cotton production along the Nile River. One of the prominent projects from this period is the Gezira Scheme, which commenced in 1925 and remains Sudan's oldest and largest gravity irrigation system. Alongside the New Halfa Scheme, these projects were expanded in the postcolonial era as key components of the country's economic development strategy. In the 1970s, oil-rich Gulf nations invested in these irrigation systems, aiming to position Sudan as the "breadbasket" of the Arab World (IOM, 2023).

Oil has historically served as Sudan's most crucial export, constituting 95% of exports since 2008. The division of North and South Sudan in 2011 was significantly influenced by conflicts related to oil. Despite 70% of oil revenues originating from the South, all refining capabilities remained in the North. The

development of oil reserves in the south before the separation in 2011 resulted in significant conflict and mass displacements. The emergence of the Southern Sudan's People's Liberation Army (SPLA) was a response to these tensions, leading to regional autonomy in 2005 and eventual independence as South Sudan in 2011. Subsequently, the civil conflict has resulted in an estimated 400,000 fatalities and forced millions to flee their homes (IOM, 2023). These past conflicts are relevant to better understand the current situation.

Displaced individuals in Sudan, including refugees from South Sudan and those internally displaced, confront challenges such as food insecurity and limited access to clean water resources. Migration driven by armed conflict and flash flooding exacerbates historical tensions among pastoral groups, nomadic tribes, and interests involved in oil production. As people concentrate in smaller areas of higher ground to evade flooding, these longstanding tensions intensify. The Abyei region, contested between North and South Sudan due to oil interests, among other factors, is experiencing heightened temperatures and drier conditions, leading to more frequent and severe droughts and floods. These environmental factors exacerbate political tensions involving transnational oil interests, the Sudanese states, and local seasonal migrants (IOM, 2023).

Droughts and floods stand out as the prevalent natural disasters in the region (UNEP, 2016). The flash floods have resulted in the loss of food and the threat of famine, compelling people to migrate. Subsistence farmers rely on rainfall and small rainfed water reservoirs known as hafirs. Women constitute 57% of rainfed agricultural laborers, engaging in subsistence farming, and 49% of wage laborers in seasonal irrigated agriculture. Currently, there is a limited understanding of the gendered dynamics involving large-scale irrigated farming, livelihood loss, gender, and migration, necessitating more comprehensive and qualitative studies (IOM, 2023).

Indeed, while existing literature primarily delves into conflict dynamics between nomadic and pastoral tribes, along with the exacerbation of conflicts due to climate-induced displacement, less emphasis has been placed on the gendered dimensions of livelihood loss related to water scarcity (IOM, 2023)

In a research study focused on adaptation strategies in the Sudano-Sahelian region, farmers were surveyed about their preferences in the event of worsening drought

conditions. Their inclination leaned towards migration as a means to secure livelihoods less susceptible to climate dependence, aligning with the increased occurrence of drought. Even under alternative future climate scenarios, a notable preference for the continuity of agriculture emerged. The interpretation of these findings is intricate, given the region's prolonged exposure to drought and established seasonal migratory practices. Recognizing the intersections between historical patterns of seasonal migration and shifts induced by gradual and abrupt climate crises becomes imperative (IOM, 2023).

Numerous international initiatives concentrate on bolstering resilience to drought and alleviating conflicts between crop farmers and pastoralists. For instance, a collaborative effort between the UN Environment and the European Union implemented a project distributing seasonal water supplies to enhance agricultural yields in North Darfur (UNEP, 2016).

The objective was to decrease susceptibility to water-related risks, specifically droughts and floods, alleviate tensions between pastoralists and farmers, and promote community livelihoods by implementing sustainable dryland management in the Kilimondo area within the State of North Darfur. The pilot demonstration initiatives encompassed five villages (Eid El Beida, Abudelik, Waa'dha, Wad Kota, and Bahr Omdurman) situated along a 40 km segment of a seasonal water body, known as a *wadi*. As part of this initiative, water channels and reservoirs were established and revitalized under the leadership of community women. Women, specifically as managers of natural resources, demonstrated significant dedication and enthusiasm. Within the project, women assumed the role of local champions, actively engaging in community consultations and decision-making meetings. Women's groups at the village level played a pivotal role in establishing the tree nursery and community forests, and they continue to oversee these initiatives. This assumes an anticipated enhancement of women's involvement in water and natural resource management in the Wadi El Ku catchment (UNEP, 2016).

Another noteworthy project, spearheaded by the International Organization for Migration (IOM), involved a women-led Water Management Committee in the village of Jebel Kheir in South Sudan, effectively maintaining three communal water points and empowering women as community leaders simultaneously. Further in-depth empirical research is imperative to investigate the gendered

aspects of subsistence farming, waged agricultural labor, and how these dynamics are influenced by migration and climate change (IOM, 2023).Sudan's susceptibility to climate variability and change, marked by frequent droughts and erratic rainfall, coupled with its economy heavily reliant on agriculture, renders it one of the most vulnerable nations. Recurrent natural disasters, along with ongoing intercommunal conflicts and armed strife, pose significant threats to both development and the livelihoods of Sudanese citizens. Achieving sustainable and enduring peace is essential to breaking the cycle of vulnerability and fostering long-term stability and prosperity in the country (Eiman, 2024).

During the three-decade reign of the National Congress Party (NCP), Sudan experienced political instability, economic fragility, and civil war, prompting many Sudanese to flee the country. According to the International Organization for Migration (IOM), approximately 4.5 million Sudanese currently reside abroad, with 51% living in neighboring African countries and the remaining 49% in Gulf States, Europe, and North America. The migration rate fluctuates, influenced by factors such as deportations and armed conflicts in host countries. Within Sudan, there are 3.2 million internally displaced persons (IDPs) registered in Darfur, facing insecurity, the challenges of COVID-19, and environmental disasters. Economic crises and food insecurity have exacerbated competition for resources, leading to increased violence and displacement in 2021 (Eiman, 2024).

Sudan's geostrategic location between the Sahel and the Horn of Africa attracts displaced individuals from neighboring countries seeking refuge. However, Sudan lacks the capacity to absorb large numbers of transient migrants, leading many to embark on perilous journeys across the Mediterranean. Efforts by the European Union (EU) to combat this migration have resulted in human rights violations in Africa and Europe.

In conclusion, the Lybian and Sudanese case studies do reflect the interconnectedness between water scarcity and climate change as drivers of migration.

The creation of the Great Man-Made River to transport fresh groundwater from the south to costal cities emerged as one of the greatest civil engineering globally. The project, which involves a vast network of pipelines to transport water from

underground aquifers in the southern Sahara Desert to populated coastal areas in the north, has contributed to agricultural expansion and increased water availability in certain regions. However, despite its importance, the growing problem of water scarcity in the region increased, mainly due to the extreme overexploitation of groundwater. This in turn led to an increase in seawater intrusion into freshwater aquifers, causing a depletion of the water supply. The GMMR project was mainly financed by the Gaddafi government and since the starting of uprising against his regime, a significant number of Libyans have faced displacement. In the period of armed conflict, water provisions, sanitation and hygiene have profoundly deteriorated, forcing people to move in order to find better livelihoods. On the other hand, Lybia offers a refuge to a high number of people, especially from Niger. The development associated with the GMMR project, including infrastructure construction and agricultural expansion, could create employment opportunities in affected areas, thereby influencing internal migration patterns as people move in search of livelihoods. However, it's important to note that the GMMR project alone is unlikely to be a primary driver of large-scale migration in Libya. While it may contribute to localized population movements and demographic changes, other factors such as political instability, conflict, economic conditions, and environmental pressures play more significant roles in shaping migration patterns in the country.

As a matter of fact, water scarcity in Libya, intertwined with other social and political factors, works as a catalyst of migrations and results as one of the outcomes related to the overexploitation of resources. The country, situated in a region characterized by arid and semi-arid climates, faces considerable challenges in water availability due to its limited freshwater resources and high evaporation rates. Climate change exacerbates these issues by intensifying droughts, reducing rainfall, and increasing temperatures, further straining water supplies. As water becomes scarcer, agricultural productivity declines, leading to economic hardships for rural communities dependent on farming. Additionally, water scarcity impacts access to clean drinking water and sanitation, posing health risks and exacerbating living conditions. In response to these challenges, many Libyans are compelled to migrate in search of better livelihood opportunities and access to essential resources.

Moreover, water scarcity contributes to social tensions and conflicts over resource allocation, further driving displacement within the country.

Thus, addressing water scarcity and climate change is crucial not only for environmental sustainability but also for mitigating the drivers of migration in Libya.

Climate change and water scarcity have profound implications for migration in Sudan, exacerbating existing vulnerabilities and prompting population movements for various reasons. As explained in the previous chapter, Sudan is highly susceptible to droughts and erratic rainfall patterns, which are exacerbated by climate change. These events lead to water scarcity, affecting agricultural productivity, livestock, and access to clean water for domestic use. In rural areas heavily reliant on rain-fed agriculture, prolonged droughts can result in crop failures, loss of livelihoods, and food insecurity, prompting rural-to-urban migration as people seek alternative means of sustenance. Together with that, Sudan is highly affected by a long history of conflict, that coupled with the growing issue of climate change results in a dramatic scenario. Indeed, climate change and water scarcity interact with existing social, economic, and political factors to drive migration in Sudan, contributing to internal displacement, rural-urban migration, and cross-border movements. Addressing these challenges requires comprehensive strategies that integrate climate adaptation, disaster risk reduction, and sustainable water management to mitigate the drivers of migration and build resilience in vulnerable communities.

As for Libya, also Sudan works as an attractive hotspot for displaced people from neighbouring countries seeking refuge. Both countries, however, do not have the capacity to absorb large numbers of migrants thus creating a vicious circle.

North Africa and Morocco

The World Bank proposed a relevant case study in the *Groundswell Part II : Internal Climate Migration in the Middle East and North Africa* ‘s Report: North Africa and Morocco (World Bank, 2021).

North Africa is expected to experience a significant proportion of climate migrants compared to its overall population. The population distribution in North Africa is heavily concentrated in certain areas, such as the Nile Valley, Delta, and along the Mediterranean coast, with smaller clusters in Sahara oases and low population densities in arid regions. Urbanization has been steadily increasing in the region over the past five decades, except for Egypt where it has stabilized since the 1970s. Agriculture plays a significant role in employment and livelihoods across North Africa, although there are variations in arable land availability among countries. Water scarcity is a prominent issue, and reduced rainfall could exacerbate droughts and diminish freshwater resources, impacting various economic sectors. Climate change is expected to worsen existing environmental challenges like soil degradation, desertification, and deforestation. Coastal regions are particularly vulnerable to sea-level rise, which could lead to saltwater intrusion in agricultural areas like the Nile Delta, affecting freshwater access for drinking and farming. Additionally, extreme heat and dust storms pose health risks, especially respiratory illnesses, to the population. Climate data for North Africa indicate notable warming trends observed over recent decades, characterized by rises in the frequency of extremely hot days, elevated nighttime temperatures, and prolonged heat wave events (World Bank, 2021).

North Africa has a rich history of both internal and cross-border migration, with internal movements often tied to economic development, advancements in education, expansion of the service sector, and increased economic opportunities in urban areas. Environmental factors such as water scarcity, agricultural challenges, and escalating desertification and land degradation likely contribute to the motivations behind internal migration (World Bank, 2021).

The projected number of climate migrants in North Africa is expected to rise, potentially reaching between 4.5 to 13 million people by the year 2050 (World Bank, 2021).

Spatial development in North Africa is intricately tied to climate conditions, with certain areas becoming hotspots for both climate-induced migration into and out of the region. By 2030, these hotspots are expected to begin emerging, intensifying and spreading by 2050. Climate out-migration hotspots are anticipated in coastal regions like the eastern and western parts of the Nile Delta, the northeast coast of Tunisia, coastal areas in northwest Algeria, and certain areas along the west and southwest coast of Morocco. These areas are likely to experience declining water availability, leading to population displacement. Inland areas, particularly those affected by water scarcity like the central Atlas foothills of Morocco, are also projected to see climate-induced migration. On the other hand, climate in-migration hotspots are forecasted in the Nile Valley, central Delta, the north and south coast of Tunisia, the eastern section of the Algerian coast, and the northern coast of Morocco. These areas are expected to experience increased crop productivity and water availability, attracting migrants and amplifying population growth in urban centers (World Bank, 2021).

By 2050, climate change is expected to play a significant role in driving internal migration in Morocco, further adding to the already established patterns of internal mobility within the country (World Bank, 2021).

Both climate action and development efforts are essential to mitigate the scale of internal climate migration. By reducing global emissions, it's possible to alleviate stressors such as declines in crop productivity, water scarcity, and sea-level rise, thereby lessening climate change's role as a driver of migration. Understanding the trajectory of climate hotspots and their varying vulnerabilities can inform proactive planning in both origin and destination areas. Urban expansion in coastal cities requires resilient and inclusive planning that considers climate risks and their impacts on key sectors and infrastructure. Additionally, adaptation measures are crucial for the agriculture sector to sustain livelihoods and employment. Integrated water resource management is also important to mitigate water scarcity and enhance social and economic resilience (World Bank, 2021).

The Mashreq subregion is already experiencing the impacts of climate change, notably extreme heat and water stress, which are anticipated to worsen in the future. Rising temperatures and diminishing precipitation are expected to exacerbate water

scarcity, placing additional strain on surface and groundwater reserves. This heightened water scarcity could adversely affect urban areas, agriculture, and livestock farming, ultimately impacting key economic sectors, rural livelihoods, and food security. Furthermore, projected increases in temperature and humidity may intensify heat stress, leading to more frequent occurrences of extreme temperatures surpassing human tolerance thresholds. These trends pose significant challenges to the habitability of densely populated urban and coastal regions, particularly for vulnerable populations lacking access to essential services and cooling mechanisms. In this context, climate change has the potential to exacerbate existing drivers of mobility in the subregion. Environmental challenges such as water scarcity, land degradation, and heat stress may further contribute to the push factors for migration. Moreover, climate change and degradation of natural resources could amplify threats, particularly in regions experiencing fragility and conflict (World Bank, 2021).

Considering the above-mentioned cases, this thesis embraces and sustains the idea of the growing consensus among scholars, policymakers, and practitioners that views migration as a dynamic and responsive strategy for reducing environmental risks and adapting to changes (Sobczak-Szelc and Fekih, 2020; Praag, 2023).
The concept of migration as an adaptive strategy will be further discussed in the next chaper.

Chapter 4. Discussion and Conclusions

This thesis aimed at exploring the nexus between water scarcity, climate change and migration, assuming to attain a dual objective: the first purpose was to analyse the relevance of climate change-induced water scarcity in the academic discurse; and the second objective was to understand in which way water scarcity and climate change do act as drivers of migration, with a specific focus on the MENA region.

Climate change in this context emerges as a *threat multiplier*. In recent years, there has been a growing consensus globally that climate change will increasingly impact the political, economic, and social systems that form the foundation of each nation-state. Unlike traditional security threats, which often involve single entities operating in specific ways at precise moments, climate change has the potential to manifest through various conditions and impacts occurring simultaneously worldwide. Projected climate change effects such as drought, water scarcity, sea level rise, flooding, glacier retreat, natural disasters, and the spread of diseases pose significant challenges to our way of life and necessitate adjustments in how we ensure our security. If governments and institutions are unable to effectively manage the shocks of a changing climate or address their consequences, the stability of states and societies will face growing threats. Climate change can thus be described as a potent *threat multiplier*, exacerbating existing vulnerabilities and increasing the likelihood of future societal unrest. The term *threat multiplier* has gained traction, particularly among non-governmental organizations and notably the CNA Corporation, which first introduced it in its 2007 Report titled *National Security and the Threat of Climate Change*. The term acknowledges the connection between climate change and security, suggesting that the former interacts with various factors to heighten security concerns and amplify the root causes of conflict, particularly in developing nations.

Therefore, while climate change may not be the singular cause of conflict, it possesses the capability to exacerbate numerous existing non-climate security risks, particularly in regions most heavily impacted by climate change yet lacking adequate financial resources and mechanisms to mitigate its effects. This role of climate change as a threat multiplier is now widely acknowledged by scientists and policymakers globally, to the extent that it is being considered in international

agreements and national security plans. Consequently, urgent action is imperative to address climate change through both mitigation and adaptation strategies: not only do the consequences of climate change pose a threat to the environment and fundamentally alter our way of life, but they also endanger the safety of populations and nations.

In this context, water scarcity poses a significant threat due to its profound implications for human health, economic stability, food security, and environmental sustainability. Water scarcity and climate change are interconnected phenomena. Climate change exacerbates water scarcity through changes in precipitation patterns, increased evaporation rates, and melting glaciers. Conversely, water scarcity contributes to climate change by limiting the availability of water for ecosystem services and for a safe livelihood, thus reducing the capacity to mitigate and adapt to climate change impacts.

In this analysis, the phenomenon of migration – and in a particular way environmental migration - emerged as one of the possible outcomes of the water scarcity-climate change nexus. As global temperatures rise, there is a growing emphasis within the international community not only on reducing greenhouse gas emissions – the so-called mitigation strategies - but also on developing strategies to cope with and adapt to the severe impacts of climate change – known as adaptation strategies.

Adapting to climate change typically involves implementing measures such as building dams and sea defenses, using drought-resistant crops, or renovating infrastructure to cope with flooding. These actions usually involve individuals staying in place while modifying their surroundings to mitigate the effects of climate change. However, there is growing recognition of *migration as a viable adaptation strategy*. This approach entails people relocating from highly exposed areas to places where they are less vulnerable to the impacts of climate change, with support to facilitate the process.

Assistance for migration as an adaptation strategy could take various forms, such as covering relocation costs, providing training in skills relevant to new locations, or improving infrastructure in areas where communities may relocate. The idea behind migration as adaptation is that, when resources for adapting in their current location are insufficient, moving may offer a more viable solution. Researchers

suggest that migration has long been a traditional coping mechanism and may become more prevalent due to climate change. Rather than being a last resort, migration could be viewed as a way for individuals, especially those reliant on agriculture, to diversify their livelihoods in response to climate change. Migration provides opportunities to increase income, spread risk among households, and send remittances back home, thereby enhancing resilience in the face of climate-related challenges.

This is a possibile scenario, but what if people are unable to move?

Although much attention is given to migration and displacement caused by climate change and other environmental pressures by the media, scholars, and politicians, it's equally important to acknowledge and understand the connection between environmental changes and immobility. The issue of immobility, which disproportionately affects marginalized and impoverished communities and has received little attention thus far, is intended to become increasingly pivotal in policymaking in the future. Environmental shifts can result in significant levels of immobility, not only mobility. Contrary to common assumptions, changes in the environment can hinder rather than facilitate migration, as underlined in the influential 2011 Foresight Report. Migration entails substantial costs and necessitates various forms of capital, yet populations affected by environmental changes may experience a depletion of the very resources required for migration. Consequently, in the coming decades, millions of individuals may find themselves unable to relocate from areas highly susceptible to environmental change, leading to the emergence of *trapped populations*. These trapped populations will undoubtedly present policymakers with challenges equal to those posed by migrants.

In summary, extensive evidence supports the correlation between environmental and climate change and migration. Environmental shifts influence migration by either encouraging the decision to move or fostering conditions that discourage it. Migration typically denotes a voluntary relocation, while displacement suggests a less voluntary movement requiring protection or assistance. However, environmental change can also influence non-migration: some individuals are unable to leave, those termed as *trapped*, while others choose to remain, defined as *immobile* (Foresight, 2011). The distinction between these outcomes is often blurry

in reality, and a strict division between involuntary and voluntary responses to environmental change may be misleading, particularly concerning international protection for those affected by environmental and climate change. However, this issue remains open and necessitates further research. Regardless of whether individuals choose to migrate or stay in the face of environmental changes and whether their decision is voluntary, they should be ensured protection.

As explained in this thesis, various forms of environmental migration typically stem from multiple interconnected causes. Environmental degradation is often intertwined with other factors, including social and economic exclusion, poverty, unequal resource distribution, land disputes, demographic changes, institutional limitations, inter-group tensions, and conflicts in countries of origin, as well as various factors in destination countries.

Migration do represent one of the outcomes of environmental degradation and water scarcity, but it is not the only one. As a matter of fact, as outlined in the chapter of case studies, the overexploitation of resources – and in this case water resources – acts as a catalyst for conflict and consequently causes displacement and mass migrations. Water scarcity can exacerbate tensions and conflicts within and between communities, regions, and even countries. Competition over limited water resources can lead to disputes, violence, and even armed conflicts. In regions where water is a critical resource for livelihoods such as agriculture, pastoralism, or fishing, conflicts over water access and allocation can escalate. In areas experiencing prolonged water scarcity and associated conflicts, people may be compelled to migrate in search of alternative livelihoods, resources, or safety. This migration can take various forms, including internal displacement within countries or cross-border movements. Climate-induced water scarcity, combined with other environmental stressors such as droughts or desertification, can act as push factors driving people to leave their homes. The academic literature has long discussed the potential connection between climate change, migration, and conflict, with policymakers and media increasingly recognizing climate as a security concern. However, despite this heightened awareness, uncertainties persist regarding the specific pathways linking climate change to migration and subsequently to conflict. These uncertainties stem partly from the intricate nature of climate change projections and are compounded by challenges in accurately predicting population

dynamics, identifying conflict triggers, and assessing the relative significance of climate change and migration as drivers of conflict compared to other factors. Despite these obstacles and the inherent uncertainty, the potential repercussions are so severe that further research is crucial to gain a better understanding of the possible linkages between climate change, migration, and conflict (Burrows and Kinney, 2016; De Bruin et al, 2018).

Understanding the intricate relationship between environmental changes and migration necessitates considering also human agency. Access to resources crucial for adapting to environmental shifts varies among populations, leading to differences in vulnerability or adaptive capacity. Migration, therefore, hinges on how communities affected by adverse environmental changes can respond and adapt.

Furthermore, different recent studies evaluate the impact of climate change on different social groups. Migration, being inherently gendered, results in diverse experiences and impacts for women and men. Factors such as the impetus to migrate, perceptions of risk, priorities, strategies, destination choices, employment opportunities, and access to integration or reintegration activities also vary based on gender. Empirical evidence demonstrates that migration can trigger shifts in gender roles, contribute to evolving gender dynamics, and present new prospects for enhancing the lives of both women and men (IOM, 2014).

Several empirical studies examining vulnerabilities to climate change through a gender lens have revealed that women typically face greater exposure to environmental and climatic risks and bear a heavier burden from their consequences. This is often attributed to the specific gender roles and responsibilities historically and socially assigned to women (IOM, 2014).

Women, often viewed as caregivers, may have different responses to environmental degradation and disasters, influencing household decisions such as early evacuation. Global labor demands and cultural norms increasingly lead to women migrating independently, creating additional household burdens. While women's migration may offer economic opportunities and personal autonomy, it doesn't necessarily lead to more equal household divisions or challenge patriarchal norms. It is increasingly recognized that gender plays a crucial role in shaping the migration

experience. Reports from humanitarian aid agencies in the MENA region document heightened vulnerability of women and girls to sexual assault and violence in conflict areas and migrant-refugee settlements where access to water necessitates lengthy walks (IOM, 2023).

While the connections between migration, the environment, and climate change are extensively researched, conversations in policy, and academic spheres about environmental migration often overlook gender considerations. Many studies in this area are gender-neutral, and few explore the interplay between migration, the environment, and gender (IOM, 2014). Thus, it is evident that the gendered dimension of environmental migration does require more space and further analysis.

In conclusion, it noteworthy that recent research on climate change and migration has transitioned from framing migration as a *security threat* to both host and destination nations, to viewing it as a necessary strategy for resilience and adaptation in the context of global environmental degradation.

The notion of viewing migration as a climate change adaptation strategy is widely endorsed as a more favorable approach compared to perceiving climate-related migration solely as a problem. Reframing migration as a potential form of adaptation has helped counter the alarmist predictions of millions of climate refugees, and thus seeing them as a security threat. In this perspective, migration can be seen as beneficial and constructive under appropriate circumstances.

However, the concept of migration as an adaptation strategy is not without debate and controversy. Some countries may view this idea as a means to facilitate new migratory pathways into their territory, leading to opposition due to anti-migrant sentiments among authorities or the general population.

Some may argue that framing migration as a form of adaptation places the burden of adaptation on those who are most impacted by climate change, despite having contributed the least to it. This perspective may suggest that asserting that people can migrate as a means of adaptation might allow major CO2 emitters to evade their responsibility to reduce emissions and instead focus on assisting individuals in adapting to climate change through alternative means.

Despite being a topic of ongoing debate, the integration of migration into the realm of adaptation has not been thoroughly examined. While numerous empirical studies

have been conducted on this subject, significant gaps persist in both theoretical frameworks and empirical understanding.

With the worsening climate crisis, research funding should prioritize exploring solutions that enable a form of migration closer to adaptation strategies, while also addressing non-economic losses, gender and well-being issues that are often overlooked. This requires taking a different approach, involving multiple stakeholders and considering various perspectives.

In the context of this study, giving greater consideration to migration as a potential adaptation strategy appears as essential. Failure to acknowledge migration could result in governments and international development organizations undervaluing a critical approach to adaptation, while also perpetuating power imbalances and denying assistance to the most vulnerable. When managed appropriately and with full respect for the rights of all involved, migration as an adaptation strategy can hold a significant potential.

Over recent decades, there has been a notable decline in the overall availability of water resources across the MENA region, leading to a heightened prevalence of water scarcity. This decline is attributed to rising temperatures, reduced rainfall, and desertification due to climate change, compounded by population growth, which has the potential to worsen migration, existing social tensions, and other vulnerabilities. The impact of water scarcity is particularly severe in rural communities, where agriculture, essential for both survival and livelihoods, is predominantly located. Additionally, despite the critical importance of water in arid environments, human-induced water scarcity persists across the MENA region due to inadequate water management, wasteful practices, and a lack of innovative strategies to mitigate water loss.

The international community must take steps to limit greenhouse gas emissions and their consequent impact on water, as this is essential for mitigating the scale of climate-induced migration and displacement. While environmental migration and displacement are realities worldwide, they do not have to be viewed only in a negative way. Urgent, coordinated action is needed to forecast and prepare for potential outcomes, as well as to capitalize on migration's potential as an adaptation strategy. All stakeholders, at global, national, and local levels, should seize the opportunity to invest in knowledge, mitigation, and adaptation. Taking action now

will yield long-term benefits for all involved. Emphasizing migration as a viable adaptation strategy is crucial, especially given the challenges of implementing effective mitigation measures. Governments, regional, and international organizations should recognize the significance of this approach, as it has proven to be essential for building resilience and adapting to environmental changes.

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