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Exploring climate change and migration dynamics in Morocco: a multifaceted analysis.

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Lay summary

Morocco represents an important example for understanding the intricate relationship between climate change and migration. This study aims to explore this complex relationship, emphasizing the need to comprehend migration within a broader framework. Social, political, economic, and environmental factors are interconnected and contribute to the dynamics of migration in Morocco. Despite climate change increasingly acting as a significant driver of migration, it is often overlooked in the decision-making processes of the various parties involved in this phenomenon. This study provides an analysis of the diverse dimensions influencing the phenomenon, highlighting the necessity of a comprehensive and integrated approach to fully grasp its complexity.

Abstract

The country of Morocco presents a central example in the assessment of the complex dynamics and relationship between climate change and migration. By recognizing the complexity of migration and the factors influencing it, this study aims to contextualize climate change within a broader framework of political, economic, social, and environmental pressures. Through a comprehensive analysis of the multi-faceted nature of Moroccan migration, this review will highlight how ever-increasing environmental pressures are influencing and impacting migration decisions, despite the limited consideration of these factors in shaping such decisions.

1. Migration and environmental changes

Environmental, socioeconomical, political and cultural reasons have, throughout history, continuously lead and forced people to migrate (Castles et al., 2014). However, environmental changes have put other migration reasons increasingly under pressure (Massey, 1990; Massey, 1999; Bates, 2002; Carling, 2002; Carling et al., 2014; De Haas, 2010). More specifically, the increasing rate of environmental changes adds urgency to the already existing factors such as political, social, demographic and economic (European Parliament, 2020) that are encouraging such migration (IPCC, 2014). In the contemporary global landscape, the intersection of climate change and human migration stands as a critical nexus, demanding academic attention and comprehensive analysis.

With climate change now a reality directly impacting ecosystems and societies, Africa has become a focal point for understanding how environmental changes are affecting migration patterns. Rising temperatures, changing weather patterns, and extreme climatic events have become recurrent features in the last decades. Subsequently disrupting traditional livelihoods, agricultural practices, and amplifying resource scarcity, and thus further forcing migration. The consequence is a confluence of environmental factors that compel communities to adapt, often through migration.

As the Earth experiences sudden and fast environmental transformations, particular regions find themselves at the forefront of climate-induced challenges, influencing the trajectories of human populations. For instance, migration in Africa involves a large number of migrants moving both within and out of the region. In 2020, approximately 21 million Africans were living in another African country, a significant increase from 18 million in 2015 (IOM, 2024). The number of Africans living in different regions also grew during this same period, from 17 million to over 19.5 million (IOM, 2024).

The countries of North Africa encompass both poles of migration: serving as destinations and as places of origin for migrants. The region hosts a large number of young, active workers, with millions working elsewhere in the region or in Europe (IOM, 2024). Recently, migration patterns within Africa have been undergoing a profound transformation, influenced by the semi-arid climate that characterizes the region. This climatic characteristic makes the region highly susceptible to droughts and rising temperatures, exacerbating existing socio-economic disparities. Traditionally characterized by internal factors such as economic disparities and conflicts, migration is now increasingly influenced by environmental factors. Despite the evident pressures resulting from ecosystem transformation, governments in the region often fail to provide adequate support to mitigate its effects, leaving populations vulnerable to environmental pressures and further exacerbating existing socio-economic disparities. The lack of livelihood support is not limited to national governments but also extends to the international community, which, despite numerous discussions on the topic, has shown limited interventions.

2. Objectives

When discussing climate-induced migration, it is of vital importance to recognize that attributing this phenomenon solely to climate change is an oversimplification. Rather, it is therefore crucial to highlight the multifaceted nature of the phenomenon by considering a range of factors that contribute to migration patterns.

This research aims to undertake a comprehensive exploration of Moroccan migration, bridging over historical trends and contemporary dynamics influenced by factors that induce it. Firstly, this study will examine the evolution of migration patterns in Morocco over time, delving into the historical context of political economic development, influenced by climate variations, soil degradation, and water scarcity. An important aspect will involve identifying and analyzing current environmental drivers, particularly the impacts of climate change, agricultural challenges, desertification, and water scarcity on migration. Secondly, this study will focus on the social and economic impacts of migration, assessing consequences on displacement, resettlement dynamics, economic changes, and the shifting social fabric. By doing so, this research will propose future research avenues aimed at evaluating the effectiveness of national policies and strategies in addressing environmental migration issues in Morocco. All the while also investigating the role of international collaborations and agreements in managing the impact of environmental changes on migration.

To conclude, this research intends to clarify the reality of climate-induced migration by posing a crucial question: to what extent do diverse political factors influence this phenomenon, and how significant is the role of climate change in inducing migration?

3. Environmental migration

Moving from challenging environmental conditions to settle in a new place has always been a crucial strategy adopted by humans (McLeman, 2014) in response to environmental changes. According to Hugo (1996), they operate on a continuum ranging from slow-onset stresses to rapid-onset disasters. Except in cases where environmental changes are sudden, such as forced displacements due to earthquakes and floods, the challenge lies in slow and gradual environmental change or degradation processes, such as desertification. These changes affect those who depend directly on the environment for their livelihoods, causing stress on their means of subsistence. The question

arises when environmental degradation is a contributing factor but not the predominant factor, making it debatable whether migration itself can be defined as "environmental" (Dun et al., 2008).

Currently, there is no universally accepted legal definition of environmental migration. The main reason seems to be related to the difficulty of isolating environmental factors from other migration drivers (Dun et al., 2008). However, various factors work on these different connections, developing conceptual frameworks to manage them. Among them is the International Organization for Migration (IOM). In 2007, the IOM proposed an intentionally broad definition of environmental migration to capture the complexity of the issues addressed: "Environmental migrants are persons or groups of persons who, predominantly for sudden or progressive change in the environment that adversely affects their lives or living conditions, are obliged to leave their habitual homes, or choose to do so, either temporarily or permanently, and move either within their country or abroad" (IOM, 2007). Our understanding of environmentally linked mobility is based on this definition, and its deliberately broad and flexible nature aims to consider the wide range and facets of population movements due to various environmental drivers.

There is often an attempt to establish a direct and linear relationship between environmental changes and migration, assuming the total awareness of the individuals involved; however, this is not always obvious (Carling et al., 2018). Human migration linked to environmental factors is not a novelty, but it has gained greater attention and impact as global climate change has triggered increased internal and international migration, characterised by either temporary or permanent migrations.

The unprecedented speed at which climate changes is occurring is severely affecting the lives and livelihoods of millions of people worldwide. These changes impact the material conditions in which people live, but they are not always perceived as a direct consequence of them (Farbotko et al., 2012). These changes have a differential impact among societal groups and are often felt through their entanglement with other factors and trends (Hunter et al., 2015; IOM, 2020). Among the various factors to consider when it comes to the likelihood of migration is the vulnerability of communities to the impacts of climate change, which can be mitigated by various adaptational measures, and the population's access to resources necessary for relocation. The first matter is addressed through actions such as the construction of dams or other defense methods, while the

latter factor significantly influences the choice to migrate. This is because it requires a certain number of resources that, in some cases, may not be accessible to people, such as transportation, social networks, and legal pathways (Zickgraf, 2018)

4. Moroccan migration

The history of Moroccan migration, especially to Europe, is one of unexpected developments and unplanned effects (Ennaji, 2014). This is true of colonial migration, labor migration, and, most recently, undocumented migration (Ennaji, 2014). A narrative that has started almost fifty years ago. The first significant migratory flows date back to the 1960s, and involved Northern European countries with which Morocco signed its initial bilateral agreements for labor recruitment: France (1963), Germany (1963), Belgium (1964) and the Netherlands (1969) (Mounir, 2013). Since then, Morocco has evolved into one of the prime source countries of labor migrants to Europe, experiencing a rural exodus due to socio-economic and environmental stresses, as well as ineffective development policies (Meisenhelter et al., 2014). For the Moroccan authorities, even though these initiatives mostly arose in Europe, they work well as a way of reducing the associated potential for social and political unrest (Collier et al., 2009). This emigration pattern aligned with their strategy of coping with high unemployment and benefiting from migrants' remittances, which were needed to reduce the deficit of the balance of payments (IOM, 2002).

Starting from the 1990s, the migration pattern changed and moved beyond traditional destinations like France and the Benelux area (Belgium, Netherlands, Luxemburg). In fact, low-skilled Moroccan emigrants increasingly sought opportunities in Italy and Spain, while their higher-skilled counterparts opted for the United States and Canada. This shift in migration patterns must be attributed to the tightening of migration policies in France and the Benelux countries during the same period. The stricter regulations in these traditional host countries have limited opportunities for Moroccan migrants to settle or find work there, prompting them to explore alternative destinations such as Italy and Spain (UN-INSTRAW, 2006). Furthermore, after 1995, Morocco evolved into a transit country for migrants and refugees from sub-Saharan Africa. The nation's strategic position between Europe, the Middle East, and sub-Saharan Africa also ensured and solidified its status as a destination country for migrants for centuries. Migrants who fail or decide not to venture into Europe prefer to stay in Morocco as a second-best option rather than to return to their more unstable, unsafe, and substantially poorer home countries (IOM, 2008).

4.1 Global implications of Moroccan migration patterns

The environmental degradation and events related to climate change such as droughts, floods, and desertification can often force populations to migrate internally or across borders (EU Commission, 2022). Climate-induced migration in Morocco could therefore lead to an increase in international and internal migration flows. Regional displacement associated migration put pressure on neighboring countries, potentially contributing to conflicts over territories and resources, while migration directed outside the continent (particularly towards Europe) could lead to an increase in international migration flows.

This could influence migration policies and border security measures in destination countries, potentially causing political tensions and debates on immigration, asylum, and humanitarian assistance.

Moroccan migration patterns have overall significant implications that extend beyond national borders. Understanding and addressing them will require coordinated efforts aimed at ensuring the well-being and prosperity of all stakeholders.

4.2 Importance of investigating Moroccan migration in an environmental context



Figure 1 - Map of Morocco. ©www.osservatorioanalitico.com

Morocco (Figure 1) is one of the countries situated in the Mediterranean region, a biogeographical, environmental, and historical unit located at the border between arid subtropical and temperate mid-latitude zones. It refers to the territories (including all islands) bordering the Mediterranean

Sea with a Mediterranean climate. The climatic dynamics of this region are strongly influenced by the enclosed sea and surrounding mountains, generating mesoscale atmospheric processes with consequences extending beyond the region. This biogeographical unit is warming 20% faster than the global average, with water temperatures expected to increase by 1.8°C to 3.5°C by 2100, with hotspots in Spain and the eastern Mediterranean (Figure 2) (UNEP/WHO, 2024).

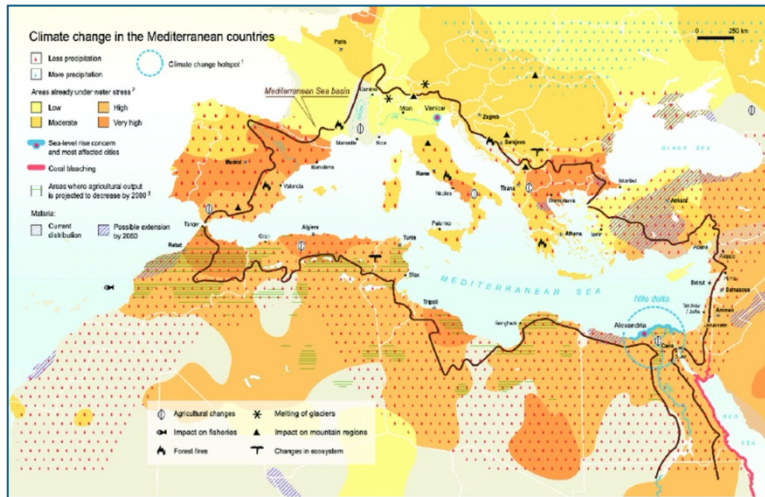


Figure 2 - Climate Change in the Mediterranean Countries (©MED-SEC Report & Zoé Environment Network; Cheterian 2009:11-12)

Furthermore, comprising predominantly of coastal areas, it is more susceptible to increased risk of catastrophes, including floods, erosion, salinization of river deltas and aquifers supporting food security and livelihoods. Characteristically low annual total precipitation and high interannual variability impose a semi-permanent water stress state in much of North Africa and the Middle East. By analyzing regional and local-scale processes significant in shaping Mediterranean climate variability and climate change, we can observe how this area has become particularly sensitive to increasing greenhouse gas concentrations and climate change. In all scenarios, models overwhelmingly project a large reduction in precipitation, more so than in other terrestrial regions in relative terms (Giorgi et al., 2008; Planton et al. 2012; Tuel et al., 2020)

Morocco is geographically located in a region at high risk of global climate change (IPCC, 2014). Since ancient times, the Moroccan population has demonstrated adaptation to abrupt environmental changes. Climatic variability and geological characteristics have always exposed the region to natural events that significantly affect the daily lives of inhabitants. However, these events are increasing in most regions of Morocco, and populations in affected areas are subject to slow-onset climate changes that are likely considered in migration decisions (Driouech et al. 2010).

In this nation, 40% of the population is engaged in agriculture (Ghanem, 2015). Of the total 4.2 million poor (14% of the population), 69% live in rural areas (Ghanem, 2015). Agriculture is the backbone of the economy and well-being of most of the population in rural areas. Therefore, in a migratory decision-making process, this could be a condition that may drive people to choose to migrate in case of critical access to resources necessary for subsistence. This is exacerbated by a decrease in average annual precipitation and a progressively drier climate, which in climate projections indicates that frequent and severe droughts could develop and occur, especially in central and southern Morocco (IEA, 2024).

According to the World Resources Institute (WRI) report, Morocco is classified among countries with high water stress (Mason et al., 2019). Water availability has indeed decreased from 3500m³ per person in 1960 to 730m³ per person in 2005 and 645m³ per person in 2015 (Dahan, 2017). Decreasing precipitation is causing disastrous natural phenomena such as floods and inundations (Nguyen et al., 2014), leading to increased pressure on natural resources, particularly water and soil, needed in agriculture. Since agriculture is a strategically important sector in Morocco, where the majority of the population rely on rain-fed agriculture, further reductions in precipitation will have an impact on both production and consumption (Azzam et al., 2005). This renders the population highly vulnerable to declining precipitation rates and changes in precipitation timing (Tramblay et al. 2012).

Investigating Moroccan migration in the context of environmental change is therefore important for several reasons. The nation's direct dependence on agriculture, its geographic location, climatic vulnerability, and the risk of extreme events make Morocco particularly sensitive to the impacts of climate change. Agricultural production, directly linked to the sustenance and food security of rural communities, is already being jeopardized by the direct impacts caused by decreasing precipitation and other direct phenomena. In this scenario, both external and internal migration processes could be accelerated by climate change, emerging as alternative responses in order to adapt to a continuously changing environment.

Studying the case of Morocco thus provides important insights into the various dynamics linking migration, socioeconomic vulnerability, and climate change, offering perspectives on the development of effective adaptation and mitigation policies on a global scale.

5. The monarchy's political influence and failures of centralization

The Kingdom of Morocco is a constitutional, democratic, and parliamentary monarchy (COR, 2024). As described by Ottaway (2006), Morocco represents an extreme case of top-down reform, where the king, without significantly involving the opposition, implements reforms. However, this system, in 2011, following the events of the Arab Spring, was attempted to be changed. The profound constitutional reform approved through a referendum aimed at strengthening the executive power of the government by limiting the centralization of power, was supposed to be an important turning point and change for the nation. However, still nonetheless remains bureaucratically hierarchical and organized from the top down.

Since the beginning of the reign of King Mohammed VI, which began in 1999, Morocco has pursued a new foreign policy seeking to distance itself from its identity as an Arab and Muslim country. Its goal is to assert itself and be recognized as an African power (Abourabi, 2016). To achieve this, the nation's government has expanded its cooperation tools in various sectors and fields, such as the environment, security, economy, and migration. The latter factor is not new for Morocco, which has heavily relied on migration for its social and economic development. It is noteworthy that after gaining independence from France, budget plans proposed emigration to solve the problem of unemployment. The final objective of this manoeuvre was to finance internal investments, local employment, and the creation of a class of citizens with professional skills and attitudes acquired in Europe, favourable to economic development (Sorensen, 2004). However, it is no longer just a land of emigration, but also of immigration. The country indeed holds growing strategic importance both for the rest of the African continent, as it faces Europe, and regarding migration and security strategy in the Middle East, North Africa, and the Mediterranean region.

The nation is therefore seeking to assert itself as a financial power and a reference point in the African scenario, and these objectives play an important role in determining Morocco's migration policies. After re-joining the African Union (AU) after 33 years of separation (which occurred in 1984 when King Hassan II decided to abandon the seat of the then Organization of African Unity in protest of the admission of the Sahrawi Arab Democratic Republic (SADR) (Al Jazeera, 2017)), the country is trying to demonstrate, through regulation programs and migration reforms, its openness to sub-Saharan migration. However, this move, with the main goal of expanding into African markets, is

often limited both in terms of markets and movements of people. This is due to pressures from the EU to protect borders and keep migrants and refugees away from European coasts (news24, 2018; Asmalal, 2019), thus generating often contradictory immigration policies.

Morocco has made significant efforts to strengthen its foreign policy by diversifying regional and international alliances. Re-joining the AU, signing bilateral agreements with the Gulf Cooperation Council (GCC), and improving its relations with the European Union (EU) to obtain an advanced status are clear examples of this.

Moreover, Moroccan immigration policies are mainly driven by the monarchy's foreign policy and internal regime legitimization objectives, giving the appearance of the state as a liberal monarchy. However, the governability of integration and inclusivity, like other Moroccan public policies, shows structural weaknesses (Lowe et al., 2020). These also manifest in the reluctance of part of the public opinion, which sometimes negatively stigmatizes migration through the media (Bahmad, 2015; El Miri, 2018).

The dynamics of implementing reforms following the riots have not endangered the king's position of power but have strengthened it (Natter, 2022). The constitutional reforms that were supposed to extend the powers of parliament and guarantee the independence of the judiciary have not yielded the hoped-for and promised results. The Justice and Development Party (PJD), which came to power in 2011 after the Arab Spring riots, failed to form a coalition government in 2016 due to what is believed to be a pattern of the Makhzen, or inner power circle around the monarch. After months of deadlock, it was the king himself who ousted the then prime minister to replace him with the PJD's deputy leader.

From this scenario emerges the persistence of socioeconomic inequalities, given the unchanged power structure and ongoing corruption, leading to new protests such as the Hirak in October 2016 by marginalized farmers in the north-eastern Rif region. These protests have contributed to raising the political awareness of the population, making it increasingly difficult for the elite to ignore socioeconomic issues (Debackere, 2021).

6. Urbanization trends in Morocco

Morocco can be primarily divided into three environmental zones: the coastal plains and plateaus, the highland areas of the Rif and Atlas Mountains, and the desert east and south of the Atlas (Figure 1)(Britannica, 2024). Most of the population resides in the coastal plains and plateaus region, leaving the desert and mountainous regions less populated. Climate change is acting as a significant factor driving massive migration in Morocco, leading to internal displacement not only from rural to urban areas but also from more affected rural areas to less affected ones. This phenomenon is known as urbanization, defined as the process by which large numbers of people become permanently concentrated in relatively small areas, forming cities (Britannica, 2024).

Like many other countries, Morocco is experiencing growing urbanization. In 2022, Morocco's urban population accounted for approximately 64.6% of the total Moroccan population, marking a significant increase from 55.13% in 2005 and 60.2% in 2015 (Statista, 2024).

This trend can be explained and motivated by the lack of government support provided to rural areas and their populations. Morocco is comprised of 14 regions, which still exhibit extreme inequality stemming from the French colonial administration. The French protectorate in Morocco from 1912 to 1956 resulted in significant patterns of uneven development across the country that persist to this day. The concentration of power in Casablanca, the nation's capital, led to the marginalization of the rest of the country and the creation of a colonial dichotomy categorizing Morocco into "useful" and "useless" regions, with all mountainous territories identified as "useless" as they were not considered productive land (Atia, 2021).

6.1 Centralization, regional inequality, and migration dynamics

The urban development plan adopted to make the coastal urban region of Casablanca-Rabat-Kentira a centre of political, administrative, financial, and commercial power has come at the expense of small to medium-sized cities inland. The pace of industrial decentralization towards coastal cities and the emergence of new regional centres have further exacerbated the development gap between rural and urban areas, as well as decentralized development. According to data from the High Commission for Planning (HCP), the coastal urban region including the capital Casablanca

represents 58% of the GDP, while the poorest region, Draa-Tafilatet, represents less than 1% (Choukri, 2019).

These manoeuvres are thus impacting both small to medium-sized cities, marginalized by projects focusing on larger cities, and rural areas that, in addition to economic marginalization, must also face spatial marginalization (Bogaert, 2021). According to data from the HCP, poverty rates across Morocco are three times higher in rural areas than in urban areas, with four-fifths of Morocco's most vulnerable population living and relying on rainfed agriculture as a source of food and income (World Bank, 2023). In 2014, 85.4% of multidimensionally poor people lived in rural areas, including 1.3 million citizens labelled as poor from a monetary perspective (CESE, 2021).

The inequality between regions has been recognized by the Moroccan state as a serious problem. For this reason, the country's government initiated a process called "advanced regionalization," which, with declared objectives, aims to decentralize power, governance structures, and shift development from state power centres to regional councils (Atia, 2021). However, this regionalization plan has failed to achieve its intended goals. Instead of transferring power and financial resources to local authorities, there has been an increase in bureaucracy and confusion regarding responsibility. Although power appears to have been given to the regions, it remains primarily centralized and controlled by the Ministry of the Interior, which oversees the budget and limits the autonomy of regional councils. It uses guardianship as a mechanism to keep peripheral and historically hostile territories under control of the Moroccan state (Venema, 2002).

Despite the regions being called upon to be responsible for their own development, they are hindered in making significant changes as they lack effective resources to do so. The state has implemented an ineffective decentralization that still relies on central control, limiting regional autonomy (Atia, 2021). This exemplifies the Moroccan problem within the reform context, where there is a desire to modernize, all while maintaining a centralized unitary structure by adopting a vertical power structure over its regions. In this way, state resources remain firmly in the hands of the central government, implying limited participation by the regions, thus hindering efforts to democratize the country and develop a new social contract.

The approach adopted ignores the cultural, economic, and historical homogeneity of the regions, using these factors to create a regional division based on the centralization of territorial control and the monopolization of resources, rather than using them as a starting point for a revision of the state's unitary character. The effect of the geopolitics of desert areas has led to the integration of

elites from desert regions into the central structure of the state, an act that has not necessarily led or is leading to greater decentralization of power. On the contrary, it strengthens central state control, maintaining the vertical organization of power (Hikama, 2021).

The shift from rural to less affected areas or urban zones (Figure 3) is greatly propelled by climate change, causing mass migration (Najjar, 2023). Both younger and older generations are key players in this internal migration, but they approach the issue from two different perspectives. The younger generations tend to view it as an opportunity for a better life, while the older generations see it as an abandonment of their lives, routines, social networks, and communities (Van Praag, 2021).

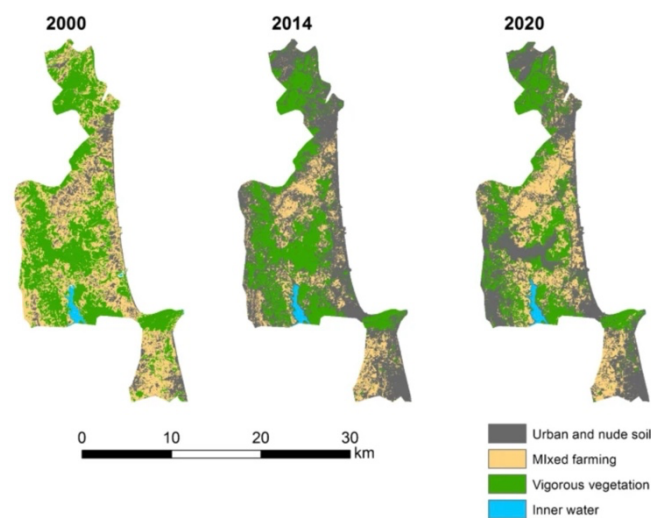


Figure 3 – Land use classification in the M'diq-Fnideq region in North Morocco (Rural exodus and land use change in northern Morocco: 2000–2020, Navarro et al., 2022)

Urbanization and the abandonment of rural areas in this scenario are not predicted to stop; on the contrary, this trend pattern is expected to continue and intensify in the face of challenges brought about by climate change. This trend has led the government to emphasize the use of urban resilience strategies and disaster risk management as cities expand (World Bank, 2023).

The consequences of centralization of power thus have an impact on the current trend of internal migration. Often, this type of governance leads to an unequal distribution of resources and job opportunities between rural and urban areas. Investments and policies will increasingly be oriented towards favouring the continuous development of urban and industrialized areas at the expense of rural areas. Limited services, opportunities, and infrastructure do not represent a worthwhile investment, and residents of these areas are therefore forced to migrate to urban areas for better economic and living opportunities.

7. Vulnerability of ecosystems

7.1 Climate change and water stress

As stated by the World Bank (2023), the effects of climate change are increasingly prevalent in Morocco, where disruptions to the water cycle are increasingly impacting the country. Destructive events such as frequent and intense floods, such as the one of August 28th, 2019, in the province of Taroudant, or sudden flash floods like that of February 8th, 2021, in Tangier (Floodlist (ECMWF), 2021) represent a threat to both the country's economic prospects and efforts for equality and social sustainability.

Although the nation is no stranger to prolonged periods of drought, water inflows are decreasing significantly, putting the state in a situation of structural water stress. This is evident by a growing precipitation deficit recorded in recent years (Driouech, 2010), which according to the World Resources Institute will reach an extremely high-water stress level by 2040 (Maddocks, 2015). The availability of renewable water resources has indeed decreased from 2,560m³ per capita per year in 1960 to about 620m³ per capita per year in 2020. This trend is rapidly approaching the absolute water scarcity threshold of 500m³per person per year (World Bank, 2023), reaching its peak in 2022, when the country experienced the worst drought in the last 40 years (Rachidi, 2024).

The increase in drought events caused by climate change (Anderegg et al., 2013) is a factor in the degradation of natural resources, thus accentuating the desertification process (Wonkka et al., 2016). These two phenomena are indeed closely interrelated and dependent on each other.

7.2 Desertification

Desertification and land degradation pose serious challenges in the global environmental context, particularly in Morocco. Desertification refers to soil degradation in arid, semi-arid, and dry sub-humid areas resulting from various factors, including climate variations and human activities (UNCCD, 2017). This definition includes the concept of soil degradation, which refers to the reduction or loss of the biological or economic productivity of land due to processes caused directly or indirectly by humans (UNCCD, 1993). Although there are various causes of desertification,

anthropogenic contribution is certainly significant and finds its main cause in the unsustainable use of land. Environmental factors leading to desertification and subsequent soil deterioration, such as recurring droughts and soil erosion, are indeed considered natural causes of this phenomenon, but they are exacerbated by climate change.

Desertification has already affected 93% of the land in Morocco (Hammouzaki, 2013), impacting vast areas of the state, where the arid climate makes soils more vulnerable to erosion, which combined with the precariousness of rural life, leads to excessive exploitation of natural resources to meet basic needs. This, however, generates a chain effect that further deteriorates the surrounding environment (Hammouzaki, 2013).

7.3 A study case: decline of oasis habitats

An alarming sign of this is the disruption of the already delicate natural balance of oases. These areas, irrigated by natural springs or other sources of groundwater, are made fertile by a source of freshwater in an otherwise dry and arid region (National Geographic, 2024). These ecosystems are specific ecological landscapes, complex and fragile agro-systems that not only support agriculture in drastic climatic conditions (El Khoumsi et al., 2014) but also serve as more effective barriers against desertification (Fagotto, 2023).

These traditional systems have proven efficient for centuries thanks to effective management of soil and water plants (Pegna et al., 2017), which, combined with continuous human labour and know-how (a culture and social technique), have always made these ecological systems fragile and functional (Battesti, 2012). They are based on an agricultural system focused on date palms, which, by shading the soil from the sun's rays, retain the moisture needed to create orchards, vegetables, and crops. This makes oases extremely resistant and adaptable to climate change (Fagotto, 2023). Their location has historically played a fundamental role in trade and transportation routes in desert areas, implying that control of one of them also meant control of trade on a particular route (Lawton, 2015).

Many components of oasis ecosystems are nonetheless influenced by climate change, especially water availability and soil quality, which are closely linked to oasis agricultural production (Karmaoui

et al., 2014; Ait Houssa et al., 2017). As stated in a United Nations report, oases are increasingly subject to pressures related to climate change, with main consequences being the decrease in groundwater levels (FAO, 2024), and the advancement of the desert (Rayne, 2023). Drought, although always part of oasis life, is directly affecting the subsistence of the population who must face a barren landscape making sustenance based on production difficult. The main change lies in the disruption of previous cyclical patterns that allowed the community to be autonomous and to sustain itself, storing food and carefully managing water resources. Current climate change is disrupting this natural model, increasing temperatures and extended droughts affecting Morocco.

The water systems underlying oasis environments that developed over thousands of years are at extreme risk of desertification, a complex situation characterized by climate change, intensified agriculture and excessive water withdrawal (Rayne et al., 2023).

The country has lost two-thirds of its oasis habitats in recent years due to drought, water scarcity, and heat (Bryce, 2016). They no longer offer viable economic opportunities for families and communities living in these areas, who are forced to migrate to large cities to find alternative means of subsistence, contributing to the loss of historical memory related to traditional water management techniques (Contributor, 2022).

7.4 Water scarcity and agricultural challenges

Water scarcity, however, is a reality across the country. The main reasons, which are extremely interconnected, can be found in environmental change and excessive extraction of groundwater for agricultural purposes (Rachidi, 2024). This is a reality that has consequences on various sectors of the national economy and aspects of life, particularly the agricultural sector (AfricaNews, 2024). This is the largest consumer of water within the kingdom, consuming on average 85% of the available water resources to irrigate 1.4 million hectares of crops, compared to 12% used for public water supply and 3% for industry (Areikat, 2024).

Due to drought, farmers' ability to rely on agriculture as a source of income is decreasing, resulting in a male exodus from rural areas to urban areas in search of temporary or permanent jobs. The social impact of this is significant. The role of women becomes more central, no longer limited to

being responsible for water collection, which in an extremely drought-prone climate like this already poses challenges. With the migration of men to urban areas, women are taking on greater responsibilities beyond existing daily activities, increasing the existing oppression (Taha, 2022).

These situations are exacerbated by weak coordination among various ministries and organizations. In every ministry related to drought management, there is no specialized unit responsible for drought-related issues, and there is a division of responsibilities that leads to inconclusive results. The lack of standard approaches, inadequacy in sharing drought information, coupled with the lack of constantly updated stable mitigation plans, leads to ineffective management of the problem (Areikat, 2024).

8. Strategies, initiatives and adaptation

To address the situation, efforts are being made to work on medium-term projects, supported by the will of King Mohammed IV. The main points include national programs for desalination of seawater, reuse of treated wastewater, and water savings in the supply and distribution of drinking water and irrigation networks. The creation and implementation of dams for water storage is an important point of this plan, but interrupting watercourses can contribute to the exacerbation of water scarcity in the most vulnerable regions (Karmaoui, 2019).

However, a strategy for drought prevention and management could strengthen the population's ability to adapt to climate change. A good example is made by the International Fund for Agricultural Development (IFAD) and the United Nations Industrial Development Organization (UNIDO). These two agencies are working alongside local communities in the uplands of eastern Morocco to combat desertification and reduce poverty. Key focuses include the introduction of technologies aimed at increasing levels of organic matter in the soil and helping improve carbon storage and soil water retention. This, combined with sustainable pasture management and the adoption of resilient methods to ensure and assist soil regeneration, can be a step towards strengthening the capacity to adapt to climate change (Zhong, 2023).

The intensive practices adopted by the nation, despite the ecological limitations of the generally arid climate, are leading to a further lowering of the groundwater level and an increase in sea level,

with repercussions on the environment and agriculture. Climate change is further aggravating the already stressed water deficit situation, as evidenced by the increasing variability in precipitation and the high frequency of droughts, which are further reducing water availability (Abdelmajid et al., 2021).

Despite the ecological limitations of Morocco's generally arid climate, the intensive practices adopted are leading to the decline of groundwater level and an increase in sea level. This has repercussions on the environment and agriculture.

Climate change is cumulative, and current actions and choices directly affect future prospects. Creating short- to medium-term projects (within) medium- to long-term projects could be a way to create continuity that tends towards a sustainable and enduring approach. An approach aiming to integrate the needs of communities by listening to, understanding, and learning from the population of rural areas about traditional cultivation methods and land management. This could be part of the solution for sustainable and inclusive growth.

8.1 Preserving indigenous ecological knowledge for sustainable rural development

Sometimes, to solve the problems of the future, we must look at the past. The current models applied to rural realities are leading to rapid degradation of environments and natural resources, resulting in the marginalization of local communities. There is a need to find alternatives that are locally centered, enabling communities to thrive autonomously, and most importantly, informed about the practices and daily struggles of agricultural workers. However, this requires a bottom-up approach rather than top-down, based on active participation, conservation, and renewal of resources (Saker, 2021).

In recent decades, North Africa has witnessed a sharp increase in rural poverty, malnutrition, and social inequalities (Ayeb, 2019), with Morocco being one of the main protagonists. Indigenous ecological knowledge, developed within communities over generations, offers alternative strategies and perspectives on the management and use of resources (Melash et al., 2023). This encompasses a complex process of dynamic learning embedded in cultural forms and social institutions (Montanari, 2013). An understanding vital for maintaining land and biological resources, and

influencing decision-making chains in various stages of production, management, distribution, and consumption (Grenier, 1998). This knowledge is often transmitted both horizontally, among members of the same generation, and vertically, between members of different generations, contributing to the reproduction of traditional knowledge in both cases (Guglielmino et al., 1995).

The approach employed is always based on unity and cohabitation with the surrounding landscape, developing flexible mechanisms that have allowed populations to survive extreme climatic conditions using the resources at their disposal. Shaping the landscape according to needs has made survival under difficult conditions possible through practices such as terracing, irrigation, pasture management, transhumance, and crop selection.

8.1.1 Agdal

An example of this balanced approach is the agdal. Agdal (Figure 4) is a communal governance system through which shepherds manage communal land and regulate livestock grazing according to specific norms and rules (Walker, 2023). Over the years, they have ensured that resources are not depleted, and that communities of wild animals and plants remain intact in the area. The basis of this system lies in the principle of rotational grazing and the timing of its opening (Domínguez, 2013). To allow vegetation cover to complete its entire reproductive cycle, grazing is prohibited during spring, ensuring the growth of plants, their biomass, flowering, pollination, and subsequent seed production. In this way, the landscape has the opportunity to come back to life during this season, making grazing possible and sustainable (Tekguç, 2024).



Figure 4 - "Little agdal" (Tagdalt), where ecological results such as a pool of biodiversity and points of seed diffusion can be observed (photo credit: P. Dominguez, 2004).

Unfortunately, this system, which has survived centuries of social, political, and environmental changes, is at risk of disappearing as nomadism gives way to sedentarization. Grazing gives way to agriculture, and land changes its purpose of use, resulting in a negative effect on the natural resources of the area.

Although the Moroccan government is aware of the importance of agdals for both sustainability and the economy, it does not provide the recognition and support that the populations living in this reality need. The difficulty for nomadic shepherds to access education, the uncertainty resulting from the type of livelihood, and the consequences of climate change are among the factors pushing a shift towards sedentarization and the abandonment of these practices (Sarahneh, 2021).

As supported by Lahcen Oukanno (AgdalExpert for AFMI), agdal is the best solution to revive biodiversity in Morocco, as the resilience demonstrated by these systems can truly help the population that face the challenges of the future.

The progressive desertification occurring in the country, exacerbated by intensive grazing and cultivation that deprive the land of its vegetation cover, could be countered through the use of these ancient traditions (Walker, 2023). The application of this centuries-old system would help maintain the right balance between environmental and socioeconomic aspects, helping to conserve Morocco's rangelands, vital for both the country's fauna and population.

8.1.2 Agricultural terraces

Terrace agriculture (Figure 5) has been an integral part of the Moroccan agriculture for centuries, playing an important role not only in cultivation. The arid slopes of the Anti-Atlas, Middle Atlas, and



Figure 5 - A typical landscape of wheat terraces in the Agoundis valley. Source Montanari© 2007

High Atlas are managed in this way through the use of this practice, which has been shown to improve ecosystem services and the livelihoods of the associated population (Meliho et al., 2021). Agricultural terraces have a significant positive impact in mitigating phenomena such as runoff, soil erosion, and flood risks. They promote processes such as initial extraction and infiltration, which not only help reduce soil erosion and surface runoff on agricultural land but also promote water storage in these systems, thus improving the agricultural potential of the area. However, it is important to emphasize that agricultural terraces are not only useful for their value in ecosystem conservation but also for their potential to improve the livelihoods of the local population (Sabir, 2021).

The abandonment of these practices is a current and alarming reality, with 56.2% of developed slopes currently consisting of terraces abandoned for at least 20 years (Sabir, 2021). The abandonment of terraces is leading to a dual loss; on one hand, there is degradation with relatively intense erosion forms, while on the other hand, there is a loss of the cultural heritage they represent. The degradation and subsequent abandonment of terraces can amplify issues already affecting the region. Their maintenance is of fundamental importance to improve the limited agricultural potential of the region provided to the population, which, with the current climate change scenario, is increasingly problematic (Meliho et al., 2021).

8.2 Integrating tradition for climate and migration

Strengthening and promoting intergenerational ties, local know-how, researching varieties and crops that are more resistant and suitable for climate change could help reverse the current trend characterized by part of the population having to move to urban centers to financially sustain themselves. This not only results in environmental loss due to the interruption of traditional agricultural practices but also in a loss of the cultural heritage of these populations.

The use of traditional practices resulting from centuries of knowledge, research, and coexistence with the territory, can be a strength in addressing the current climate emergency situation. They are the result of traditions and teachings derived from failures and successes, from which populations have learned. It is necessary to consider these as strengths, to view them with an integration and learning perspective, trying to find a point of union between them and modern agricultural methods. Thus, finding efficient ways that allow the integration of the strengths of both

is essential. These populations deeply understand their territory thanks to the history that has always united them, recognizing and valuing traditional practices is not only an act of respect for the past, but an essential strategy for building a sustainable future for all.

9. Conclusion

Even though environmental changes are having visible and significant impacts on daily life, there is a lack of evidence linking environmental factors to migration patterns, as evident in the case of Morocco. This does not necessarily mean that environmental factors have been largely absent in the decision to migrate, but rather that they are probably not perceived as the primary driving force behind migration. Climate change is negatively affecting the lives of the population, particularly those in poor, rural areas. Nonetheless, the lack of support and concrete interventions from the government is a significant factor exacerbating the living conditions of already struggling communities. Thus, pushing many individuals to seek opportunities elsewhere. This contributes to the ongoing phenomenon of migration in Morocco.

Traditional agricultural practices, as highlighted in this study, are based on a sustainable coexistence with the surrounding environment, rooted in an understanding of and respect as a source of livelihood. Integrating these practices into modern agriculture could facilitate a shift in resource utilization. However, this requires research and economic support for rural areas that retain the knowledge of these practices, which are disappearing precisely due to the lack of such support. In this way, environmental factors will continue to exacerbate inequalities and force more and more people towards increasingly desperate migration.

Bibliography:

Abdelmajid, S., Mukhtar, A., Baig, M.B., Reed, M.R. (2021). Climate Change, Agricultural Policy and Food Security in Morocco. In: Behnassi, M., Barjees Baig, M., El Haiba, M., Reed, M.R. (eds) Emerging Challenges to Food Production and Security in Asia, Middle East, and Africa. Springer, Cham. https://doi.org/10.1007/978-3-030-72987-5_7

Abourabi, Y. (2016) Diplomatie et politique de puissance du Maroc en Afrique sous le règne de Mohammedvi, PhD Dissertation (Lyon: Université Jean Moulin Lyon 3), <http://www.theses.fr/2016LYSE3082>

Aït Houssa Abdelhadi, Drissi Saad, Bamouh Ahmed, Benbella, Mohamed. (2017) Response of corn silage (*Zea mays* L.) to zinc fertilization on a sandy soil under field and outdoor container conditions, Journal of the Saudi Society of Agricultural Sciences, Volume 16, Issue 2, Pages 145-153, ISSN 1658-077X, <https://doi.org/10.1016/j.jssas.2015.05.002>.

AfricaNews. (2024). Morocco: emergency plan to counter the water crisis. Africanews. [https://www.africanews.com/2024/01/18/morocco-emergency-plan-to-counter-the-water-crisis/#:~:text=The%20World%20Resources%20Institute%20\(WRI,70%25%20compared%20to%20the%20average.](https://www.africanews.com/2024/01/18/morocco-emergency-plan-to-counter-the-water-crisis/#:~:text=The%20World%20Resources%20Institute%20(WRI,70%25%20compared%20to%20the%20average.)

Al Jazeera. (2017). Morocco rejoins the African Union after 33 years. Al Jazeera. <https://www.aljazeera.com/news/2017/1/31/morocco-rejoins-the-african-union-after-33-years>

Anteneh Agezew Melash, Amare Assefa Bogale, Abeje Tafere Migbaru, Gashaw Gismu Chakilu, Attila Percze, Éva Babett Ábrahám, Dejene K. Mengistu (2023), Indigenous agricultural knowledge: A neglected human based resource for sustainable crop protection and production, Heliyon, Volume 9, Issue 1, 2023, e12978, ISSN 2405-8440,

Ayeb, H. and Bush, R. (2019) Food Insecurity and Revolution in the Middle East and North Africa: Agrarian questions in Egypt and Tunisia. Anthem Press.

Ayham Taha(2023) Morocco: Drought Assessment Report Brief (January 2023) - Morocco. (2023, February 13). ReliefWeb. <https://reliefweb.int/report/morocco/morocco-drought-assessment-report-brief-january-2023#:~:text=Due%20to%20drought%2C%20farmers'%20ability,of%20temporary%20or%20permanent%20jobs.>

Azzeddine Azzam, Khalid Sekkat (2005) Measuring total-factor agricultural productivity under drought conditions: The case of Morocco, *The Journal of North African Studies*, 10:1, 19-31, DOI: [10.1080/13629380500063011](https://doi.org/10.1080/13629380500063011)

Bates, D.C. (2002) Environmental Refugees? Classifying Human Migrations Caused by Environmental Change. *Population and Environment* 23, 465–477
<https://doi.org/10.1023/A:1015186001919>

Bernhard Venema, (2002). "The Vitality of Local Political Institutions in the Middle Atlas, Morocco," *Ethnology*, 41/2

Britannica encyclopedia (2024).Morocco | History, Map, flag, capital, people, & Facts.
<https://www.britannica.com/place/Morocco/Relief>

Bryce, Emma (2016-12-12). "A Drive to Save Saharan Oases As Climate Change Takes a Toll". *Yale Environment* 360.

Cambridge University Press; (2022). 2022:79-108.Regime Continuity and Immigration Policy Change in Morocco. In: *The Politics of Immigration Beyond Liberal States: Morocco and Tunisia in Comparative Perspective*.

Carling, J. and Erdal, M.B. (2014), Return Migration and Transnationalism: How Are the Two Connected?. *Int Migr*, 52: 2-12. <https://doi.org/10.1111/imig.12180>

Castles, Stephen & de Haas, Hein & Miller, Mark. (2014). Theories of Migration. 10.1007/978-0-230-36639-8_2.

Collyer Michael , Cherti Myriam , Thomas Lacroix & Anja van Heelsum (2009) Migration and Development: The Euro–Moroccan Experience, Journal of Ethnic and Migration Studies, 35:10, 1555-1570, DOI: 10.1080/13691830903165790

COR - Morocco Introduction. (2024).
<https://portal.cor.europa.eu/divisionpowers/Pages/Morocco-Introduction.aspx>

De Haas, H. (2010), Migration and Development: A Theoretical Perspective. International Migration Review, 44: 227-264. <https://doi.org/10.1111/j.1747-7379.2009.00804.x>

Debackere, Ellen (2021). "Five Years of Riffian Protests: We See No Difference". Carnegie Endowment for International Peace.

Dun, O. & Gemenne, F. (2008). Defining 'environmental migration'. Forced Migration Review, 31 (October), 10-11.

Ennaji, M. (2014). Moroccan Migration History: Origins and Causes. In: Muslim Moroccan Migrants in Europe. Palgrave Macmillan, New York. https://doi.org/10.1057/9781137476494_2

European commission (2022). Addressing displacement and migration related to disasters, climate change and environmental degradation doi: 10.2795/302703

European Parliament. (2020). Exploring migration causes: why people migrate |Topics <https://www.europarl.europa.eu/topics/en/article/20200624STO81906/exploring-migration-causes-why-people-migrate>

Fagotto, M. (2023). The disappearing oases in Morocco | WIRED Middle East. WIRED Middle East. <https://wired.me/science/the-disappearing-oases-in->

[morocco/#:~:text=Morocco%20alone%20has%20lost%20two,in%20Morocco%2C%20by%20IGI%20Global.](#)

Farbotko, C. & Lazrus, H. (2012). The first climate refugees? Contesting global narratives of climate change in Tuvalu. *Global Environmental Change*, 22 (2), 382-390.

FloodList (2021), Morocco. European Centre for Medium-Range Weather Forecasts Morocco. <https://floodlist.com/tag/morocco>

Gemenne, F. and Blocher, J. (2017) How can migration serve adaptation to climate change? Challenges to fleshing out a policy ideal. *Geogr J*, 183: 336-347. <https://doi.org/10.1111/geoj.12205>

Ghanem, H. (2015). Agriculture And Rural Development For Inclusive Growth And Food Security In Morocco. <https://www.semanticscholar.org/paper/Agriculture-And-Rural-Development-For-Inclusive-And-Ghanem/D5d21cdf811a8cb489b48d9aa721cae8e484d565>

Giorgi, F., & Lionello, P. (2008). Climate change projections for the Mediterranean region. *Global And Planetary Change*, 63(2–3), 90–104. <https://doi.org/10.1016/j.gloplacha.2007.09.005>

Guglielmino CR, Viganotti C, Hewlett B, Cavalli-Sforzas LL (1995) Cultural variation in Africa: role of mechanisms of transmission and adaptation. *Proc Natl Acad Sci U S A* 92:7585–7589

Grenier L (1998) Working with indigenous knowledge: a guide for researchers. International Development Research Centre, Ottawa

Hadagha, Fatma Zohra; Farhi, Bourhane Eddine; Farhi, Abdallah; Petrisor, Alexandru Ionut (29-12-2018). "Multifunzionalità dell'ecosistema dell'oasi. Caso studio: Oasi di Biskra, Algeria" . *Giornale degli affari urbani contemporanei* . 2 (3): 31–39. doi : 10.25034/ijcua.2018.4716 . ISSN 2475-6156 . S2CID165113883 . _ "Oases Ecosystems" (PDF). FAO.org.

Hammouzaki, Y. (2013). Desertification and its control in Morocco. In Springer eBooks (pp. 91–111). https://doi.org/10.1007/978-94-007-6652-5_5

Hikama (2021) (Governance) bi-annual peer-reviewed academic journal published by the Arab Center for Research and Policy Studies and Doha Institute for Graduate Studies (p-ISSN: 2708-5805), (e-ISSN: 2708-5813).

Hugo, G. (1996). Environmental Concerns and International Migration. *The International Migration Review*, 30(1), 105–131. <https://doi.org/10.2307/2547462>

IEA. (2024). Climate resilience for energy transition in Morocco – analysis. IEA. <https://www.iea.org/reports/climate-resilience-for-energy-transition-in-morocco#>

Inac Tekguç (2024). Community – based grazing. IUCN

International Migration Institute. (2024). Morocco. Haiku. <https://www.migrationinstitute.org/completed-projects/aphm/case-studies/morocco>

IOM (International Organization for Migration) (2024) – Africa and the Middle East. <https://www.iom.int/africa-and-middle-east>

IOM (International Organization for Migration) (2008) - Irregular Migration from West Africa to the Maghreb and the European Union: An Overview of Recent Trends

IOM (International Organization for Migration) (2002) – Moroccan Migration Dynamics: Prospects for the Future

IPCC (2014). *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, R.K. Pachauri and L.A. Meyer (2017)]. IPCC, Geneva, Switzerland, 151 pp

JØrgen Carling (2002) Migration in the age of involuntary immobility: Theoretical reflections and Cape Verdean experiences, *Journal of Ethnic and Migration Studies*, 28:1, 5-42, DOI: 10.1080/13691830120103912

Karmaoui,A.and Messouli,M.and Khebiza,M. Y.and Ifaadassan,I., 20143417035, USA, 5, (Special Issue), Los Angeles, *Journal of Earth Science & Climatic Change*, (S11-2), OMICS Publishing Group, Environmental vulnerability to climate change and anthropogenic impacts in dryland, (pilot study: Middle Draa Valley, South Morocco).

Karmaoui, A (2019). Drought and desertification in Moroccan Pre-Sahara, Draa valleys: exploring from the perspective of young people. *Geoenviron Disasters* 6, <https://doi.org/10.1186/s40677-019-0118-8>

Koenraad Bogaert (2018), "Globalized Authoritarianism and the New Moroccan City," *Middle East Report* 287

Lore Van Praag, Loubna Ou-Salah, Elodie Hut, Caroline Zickgraf (2022) Migration and Environmental Change in Morocco. <https://doi.org/10.1007/978-3-030-61390-7>

Management. 31: 100274. Bibcode:2021CliRM..3100274V. doi:10.1016/j.crm.2021.100274. hdl:10067/1747030151162165141. ISSN 2212-0963. S2CID 234193735.

MASSEY, D. S. (1990). The Social and Economic Origins of Immigration. *The ANNALS of the American Academy of Political and Social Science*, 510(1), 60-72. <https://doi.org/10.1177/0002716290510001005>

Massey, D. S. (1999). International Migration at the Dawn of the Twenty-First Century: The Role of the State. *Population and Development Review*, 25(2), 303–322. <http://www.jstor.org/stable/172427>

Maddocks, A. (2015). Ranking the world's most Water-Stressed Countries in 2040. World Resources Institute. <https://www.wri.org/insights/ranking-worlds-most-water-stressed-countries-2040>

Meisenhelter, Jesse (2014). "Mitigating climate-induced migration in rural Morocco: Improving sustainable development to address socioeconomic and environmental causes of migration". Independent Study Project (ISP) Collection. 1934. https://digitalcollections.sit.edu/isp_collection/1934

Meliho, Modeste, Abdellatif Khattabi, Asmae Nouira, and Collins Ashianga Orlando. (2021). "Role of Agricultural Terraces in Flood and Soil Erosion Risks Control in the High Atlas Mountains of Morocco" *Earth2*, no. 4: 746-763. <https://doi.org/10.3390/earth2040044>

Mona Atia, Said Samlali (2021). "Government Efforts to Reduce Inequality in Morocco Are Only Making Matters Worse," *Middle East Report* 298.

Montanari, B. (2013). The Future of Agriculture in the High Atlas Mountains of Morocco: The Need to Integrate Traditional Ecological Knowledge. In: Mann, S. (eds) *The Future of Mountain Agriculture*. Springer Geography. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-33584-6_5

MPI. (2024). Middle East & North Africa. [migrationpolicy.org](https://www.migrationpolicy.org). <https://www.migrationpolicy.org/regions/middle-east-north-africa>

National Geographic (2024). Oasis. <https://education.nationalgeographic.org/resource/oasis/>

Natter K. (2022) Regime Continuity and Immigration Policy Change in Morocco. In: *The Politics of Immigration Beyond Liberal States: Morocco and Tunisia in Comparative Perspective*. Cambridge University Press; 2022:79-108.

News24. (2018). Morocco-Polisario Western Sahara talks an “ice-breaker”. News24. <https://www.news24.com/News24/morocco-polisario-western-sahara-talks-an-ice-breaker-20181203>

Ninna Nyberg (2004) Migrant Remittances as a Development Tool: The Case of Morocco. Sorensen Danish Institute for Development Studies (DIIS) Denmark

Nguyen and Wodon (2014) Weather Shocks, Impact on Households, and Ability to Recover in Morocco. (z.d.). CORE Reader. <https://core.ac.uk/reader/213960540>

Ou-Salah, L., Van Praag, L. & Verschraegen, G. (2022). The role of environmental factors and other migration drivers from the perspective of Moroccan and Congolese migrants in Belgium. CMS 10, 36 <https://doi.org/10.1186/s40878-022-00307-y>

Planton L., Abrantes, F., Congedi, L., Dulac, F., Gacic, M., Gomis, D., Goodess, C., Hoff, H., Kutiel, H., Luterbacher, J., Planton, S., Reale, M., Schröder, K., Struglia, M. V., Toreti, A., Tsimplis, M., Ulbrich, U., & Xoplaki, E. (2012). Introduction: Mediterranean Climate: Background information. <https://ricerca.univfg.it/entities/publication/bccfa640-627d-4faa-bb60-08a98d15a8fb/details>

Potsdam Institute for Climate Impact Research. (2024) “Regional impacts of climate change on economic sectors in the low-lying coastal zone of Mediterranean East Morocco”.

Rayne, L., Brandolini, F., Makovics, J. L., Hayes-Rich, E., Levy, J., Irvine, H., Assi, L., & Bokbot, Y. (2023). Detecting desertification in the ancient oases of southern Morocco. Scientific Reports, 13(1). <https://doi.org/10.1038/s41598-023-46319-1>

Rachidi, D. C. (2024). EIB invests millions in Morocco to help end water scarcity problem. European Investment Bank. <https://www.eib.org>

Saker El Nour (2021) Towards a just agricultural transition in North Africa, | Transnational Institute

Sarahneh Enas (2021), Back to the Future: Sustainable Management of Heritage Resources and Traditional Landscapes in Morocco. BirdLife International.
<https://www.birdlife.org/news/2021/11/02/back-to-the-future-sustainable-management-of-heritage-resources-and-traditional-landscapes-in-morocco/>

Tramblay Yves, Badi Wafae, Driouech Fatima, El Adlouni Salaheddine, Neppel Luc, Servat Eric, (2012) Climate change impacts on extreme precipitation in Morocco, Global and Planetary, Change, Volumes 82–83, Pages 104-114, ISSN 0921-8181, <https://doi.org/10.1016/j.gloplacha.2011.12.002>.

Tuel Alexandre, Kang Suchul, Elfatih A. B. Eltahir. (2020) Understanding climate change over the southwestern Mediterranean using high-resolution simulations. Climate Dynamics <https://doi.org/10.1007/s00382-020-05516-8>

UN-INSTRAW(2006), Moroccan Migration to Spain.
<https://trainingcentre.unwomen.org/instraw-library/2006-I-MIG-MAR>

UNCCD, (2017). UNCCD Terminology: Desertification. United Nations Convention to Combat Desertification (UNCCD).

UNEPMAP. (2024). Climate change in the Mediterranean | <https://www.unep.org/unepmap/resources/factsheets/climate-change>

Vincent Battesti. The Power of a Disappearance: Water in the Jerid region of Tunisia. B.R. Johnston, L. Hiwasaki, I.J. Klaver, A. Ramos Castillo, V. Strang (2012). Water, Cultural Diversity,

and Global Environmental Change: Emerging Trends, Sustainable Futures?, UNESCO/Springer, pp.77-96, 2012, (10.1007/978-94-007-1774-9_6). (hal-00569337v2)

Walker, K. (2023, 15 November). A Model for Land Management, Morocco's Agdals Are at Risk of Disappearing. New Lines Magazine. <https://newlinesmag.com/reportage/a-model-for-land-management-moroccos-agdals-are-at-risk-of-disappearing/>

WIRED Middle East. <https://wired.me/science/the-disappearing-oases-in-morocco/#:~:text=Morocco%20alone%20has%20lost%20two,in%20Morocco%2C%20by%20IGI%20Global.>

World Bank Group. (2023). Morocco Country Climate Development Report: An example in parliamentary engagement. World Bank. <https://www.worldbank.org/en/news/feature/2023/03/10/morocco-country-climate-development-report-an-example-in-parliamentary-engagement#:~:text=The%20effects%20of%20climate%20change,well%20as%20growing%20water%20scarcity.>