



Drought Assessment Report - CARE Morocco

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List of Acronyms

CARE: Cooperative for Assistance and Relief Everywhere

FAO: The Food and Agriculture Organization of the United Nations

FGDs: Focus group discussion

FSL: Food Security and Livelihoods

FWS: Food and Water System team (CARE USA)

GDP: Gross domestic product

HAT: Humanitarian Affairs Team (CARE USA)

HH: Head of household

ICARDA: International Center for Agricultural Research in the Dry Areas

MCM: Million cubic meters

ONEE: Office National de l'Électricité et de l'Eau Potable (National Electricity and Drinking Water Board)

PNE: Plan National de l'Eau (National Water Plan)

RO: Reverse osmosis

UNESCO: The United Nations Educational, Scientific and Cultural Organization

USD: United States Dollar

VSLAs: Village savings and loans associations

I. Executive Summary

In summary, Morocco has taken important positive steps with respect to drought risk management over the past several decades, but there still appears to be room for improvement, as indicated both in the reviewed assessments and the findings of the present study, which has focused specifically in the agricultural (and livestock) sector with gender lenses. The ongoing technical assistance by different actors and by United Nations agencies will undoubtedly help to set the stage for further improvements in this regard.

Ultimately, the effectiveness of the actions proposed will depend on how well they are implemented by the Moroccan Government and other national stakeholders. Because of its arid to semi-arid climate, characterized by limited and fluctuating rainfall, Morocco has made the mobilization of surface water an important component of its economic and social development strategy.

Drought is defined as an extended period of time characterized by a deficiency in a region's water supply that is the result of constantly below-average precipitation. (The World bank)

Significant investment efforts in surface water storage and mobilization of 73 facilities, as well as significant availability of renewable groundwater, are expected to secure water resources that are large enough to meet the needs of its population, harmonious development of the different sectors of the economy and contribute significantly to its food security.

This report will study the overall situation in Morocco and the drought's negative effects on agriculture, the economy, food security, etc., with gender lenses considering how different gender groups are affected differently on household and community levels. Additionally, the report will provide suggestions and information for the way forward at the local level and per gender group.

Rainfall is often the single biggest factor in determining Moroccan economic growth rates and this year, the cereals harvest was two-thirds smaller than in 2021 and milk output down by 30%. "I'm not even sure I will sow wheat this year because the rainfall has been so late," said Zakaria Khatabi, a farmer in Zhiliga, north of Rabat.

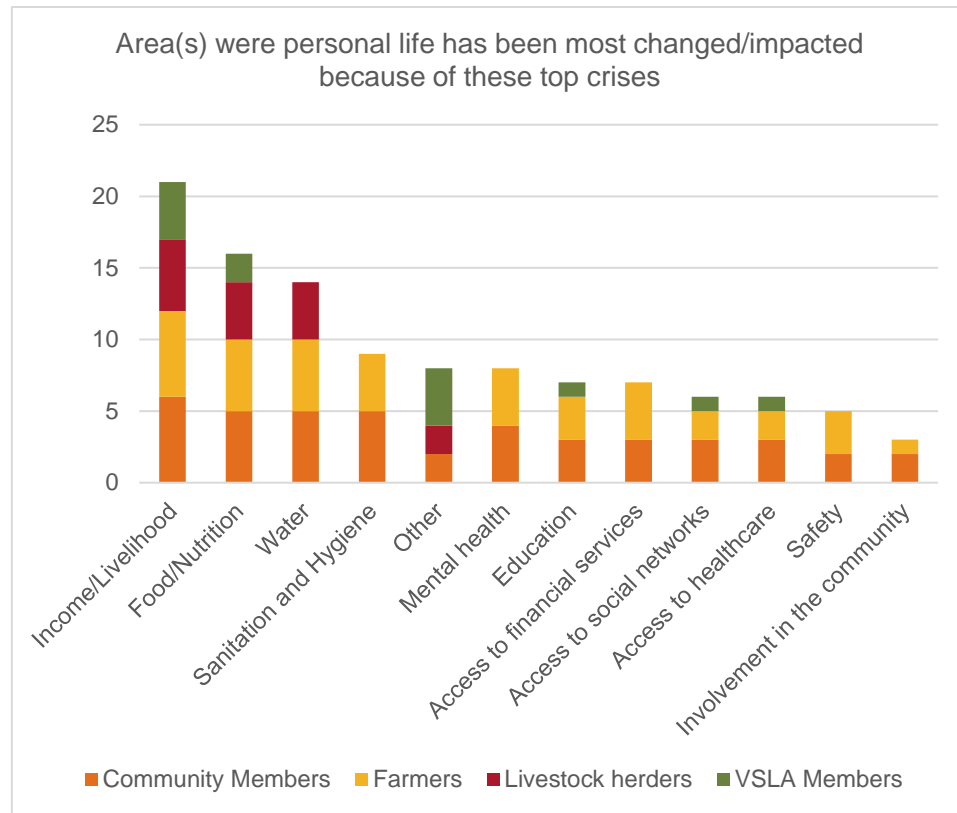
The findings are reliant on primary data and desk review findings with dependency on the existing Villages savings and loans associations network (VSLAs) that CARE Morocco has been supporting over the past few years, and that is mostly made up of female participants.

Although the drought is the primary focus of the study, it is worth mentioning that climate-linked risks don't only affect agricultural losses and challenges but could also lead to flash floods from heavy rain, landlines that are destroying key infrastructure, wildfires, and loss of properties, livestock, and crops.

Key findings:

- Male community members in the rural areas who used to consider agriculture as their main income source decided to migrate to urban communities seeking temporary or permanent jobs.
- Women are the most affected during the drought season for several reasons:
 - **Women are primarily responsible for fetching water and with the drought, access to water is more challenging.**
 - **When the male HHs members migrate to urban areas, female members step forward to take additional responsibilities on top of their existing daily tasks which put them in very overwhelming circumstances.**

- It is observed that over the past few years, farmers have progressively stopped using local seeds/seedlings/crops aiming for a higher yield using foreign inputs that showed low resilience to Moroccan climate and weather. Similarly, few profitable crops were cultivated in areas that suffer from water scarcity such as watermelon, avocado, and few other crops which led the government to intervene and restrict these crops in certain locations.
- It was reported that veterinary service expenses, which were already high, have increased even more due to inputs and fuel costs which pushed herders to reduce the frequency of veterinary checks.
- Drought can have a significant impact on the macro economy, but through this study, it was confirmed that the most affected sector was the agricultural production and yields, and thus people's livelihoods such as small farmers and rural workers with specific challenges women and girls were going through due to water and income shortage.
- Water consumption was reduced despite the implications on the amount of yield they will harvest later but considering that irrigation expenses won't be recovered by selling their crops later considering the high production cost and limited purchasing power.

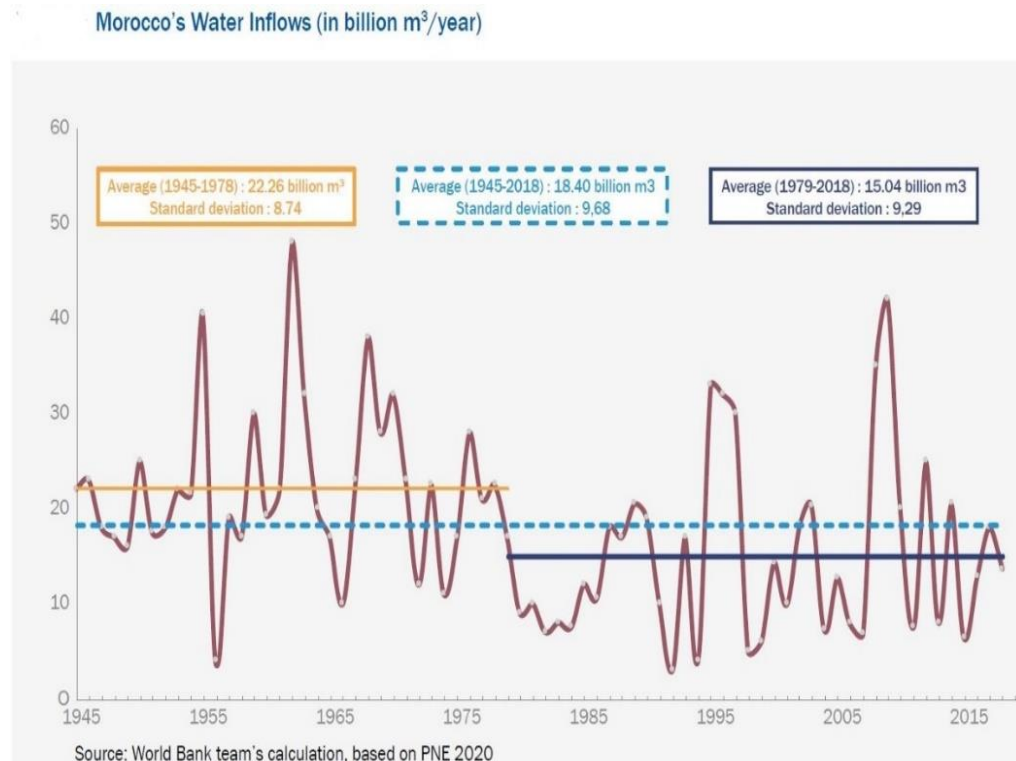


Recommendations for CARE Morocco for the immediate to medium term aiming to meet essential needs, pre-position in terms of preparedness for risk reduction:

- Engage women in the program design phase especially when it comes to preparedness and resilience building. The program design should be customized per location/community considering the different adaptation methods and shocks, consequences per gender group, and the thematic area of the community (rural/urban).
- Deliver awareness-raising sessions to the local communities covering the following aspects:
 - **Water value and water management methods and techniques.**
 - **Target farmers with information related to smart-climate agriculture and food production.**
 - **Access to early warning systems and information from official sources.**
- Engage in the response coordination platforms to identify the gaps and fill them.
- Ensure the coordination with different CARE Members that are going through similar circumstances to exchange learning and experience.
- Maintain active contact with CARE USA Humanitarian Affairs team (HAT) and Food and Water Systems team (FWS) to ensure that both teams are on top of the context and ready to provide support and guidance efficiently.

II. Background

Morocco is a country that consists of mountains, in particular, the Atlas in the center-south and the Rif Mountains in the north. The Atlas Mountain region is the largest and most important mountain range in North Africa, extending from Morocco to Tunisia for about 2,400 kilometers in a series of creased mountain chains. Morocco's portion of the Atlas Mountains includes the Middle Atlas, High Atlas, and Anti-Atlas, as well as deserts such as the Moroccan Sahara. Morocco's arable land extended to an area of some 6.9 million hectares in 2019. As of the same year, permanent crops stretched over 1.7 million hectares of land, while permanent meadows and pastures reached 21 million hectares.



In association with global climate change, the drought periods in Morocco are increasing in frequency and intensity, causing increasingly severe damage to the economy, agriculture, food security, etc., and affecting rural and urban local households differently.

Official drought declarations, triggering government emergency relief, were made in 1992–95, 1998–2001, 2005, 2007, and 2015–2016, the recent one that Morocco is going through has been declared since 2019. The 1994–95 drought was particularly strong, leading to an estimated 7.6 percent GDP loss. [The 1999 drought cost an estimated US\\$900 million and affected more than one million hectares of cropland.](#)

Morocco is among the most water-stressed countries in the world. The country's total water resources are estimated at 22 billion cubic meters (m³) divided into 18 billion m³ of surface water (on average for the available historical series), and 4 billion m³ of groundwater.

Since the late 1970s, Morocco has seen its water inflows (from surface water) decline, from an annual average of 22 billion m³ between 1945 and 1978 (represented by the yellow line on the graph) to an annual average of 15 billion m³ between 1979 and 2018. These declining inflows, combined with a growing demand pushed by demographic growth and economic development, have pushed Morocco into a situation of water stress: between 1960 and 2020 the per capita availability of renewable water resources has decreased from 2,560 m³ to about 620 m³ per person per year, placing Morocco in what is considered a situation of structural water stress ([below 1,000 m³ per person per year](#)), and is quickly approaching the absolute water scarcity threshold of 500 m³ per person per year. As a result, the pressure on groundwater resources has significantly increased to a level of overexploitation. The challenge of water scarcity is compounded by the deterioration of water quality (surface and groundwater). Therefore, the government and the local communities changed their approach, interaction, and

strategy to respond and adapt to the new situation by thinking about preparedness for the coming seasons. This is happening through a more proactive stance concerning drought on both short and longer-term measures that involve hydrological, agricultural, and meteorological monitoring activities.

Several drought management interventions have been implemented over the past decade. This includes a multi-risk insurance program for rainfed crop cultivation since 2011 to reach 1.1 million hectares in 2016.

III. Assessment Methodology and Limitations

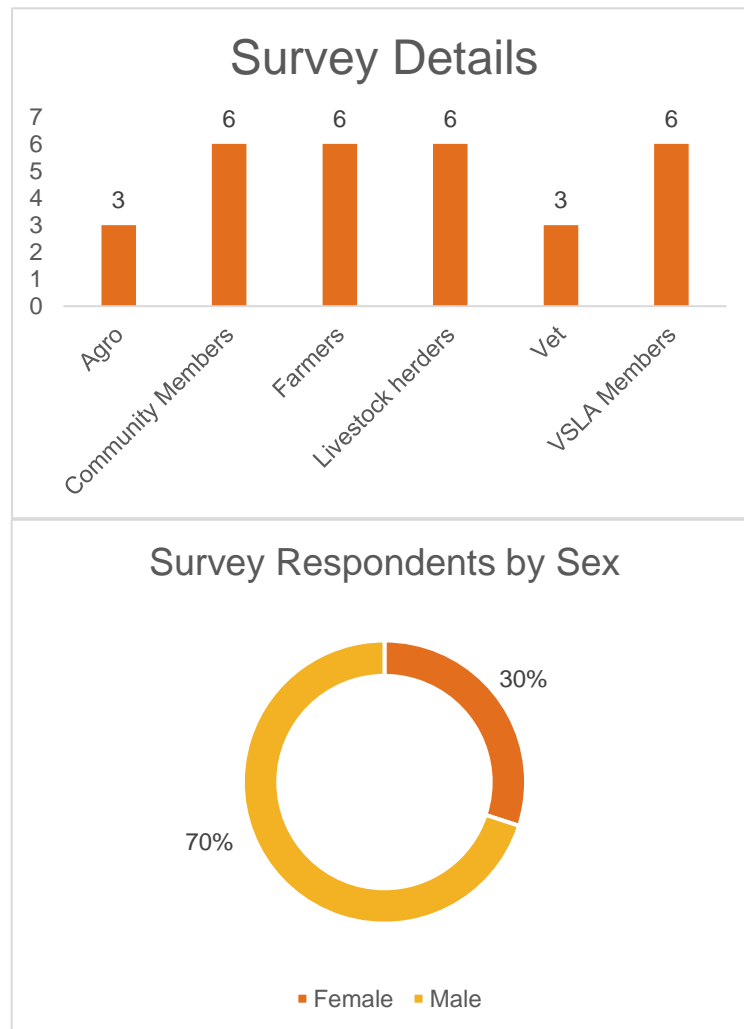
The main objective of this assessment is to inform a larger scale response to the food and economic crisis affecting the most vulnerable rural (farmers and herders) households, and on the role that VSLAs can play in such emergencies.

CARE Morocco conducted the drought need assessment in the provinces of [El-Hajeb](#), [Beni Mellal](#), and Al-Haouz ([Marrakech](#)) in October 2022. The data collection (as per the following charts) happened through interviewing farmers, Agro-business owners, livestock herders, veterinarians, extension service providers, VSLA members, VSLA groups, community members (non-beneficiaries), focus group discussions (FGDs), key informant interviews with international and local organizations, governmental officials, and institutional representatives. Surveys and interviews concentrated on sufficient female representation and inclusive age diversity with targeting above 18 years old.

The interviews focused on access to water, risks, coping strategies, current challenges that local communities are going through, economic and food security situation, agriculture, livestock, water availability and water management (rain, surface water, groundwater), and needs. They prioritized support, access to information, challenges women are facing due to drought, migration, and best practices.

It is worth mentioning that this drought assessment did not focus on technical aspects related to soil fertility and soil analysis, desertification, and salinity. On the other hand, contacting official representatives responsible for water management was not feasible, and data was not available considering the sensitivity of data related to water resources in Morocco. On the operational side, visa and traveling were challenging and caused delays affecting the assessment implementation plan starting from data collection, translation, analysis, and report development.

Finally, all figures which are double-colored in orange/yellow show sex-disaggregated data.



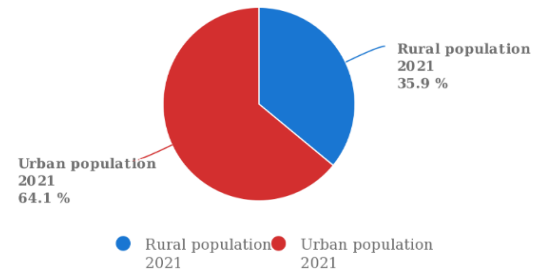
IV. Population with Gender Context Overview

The total population of Morocco is 37.8 million with a growth rate of 1.31% (50.35% Females and 49.65% Males).

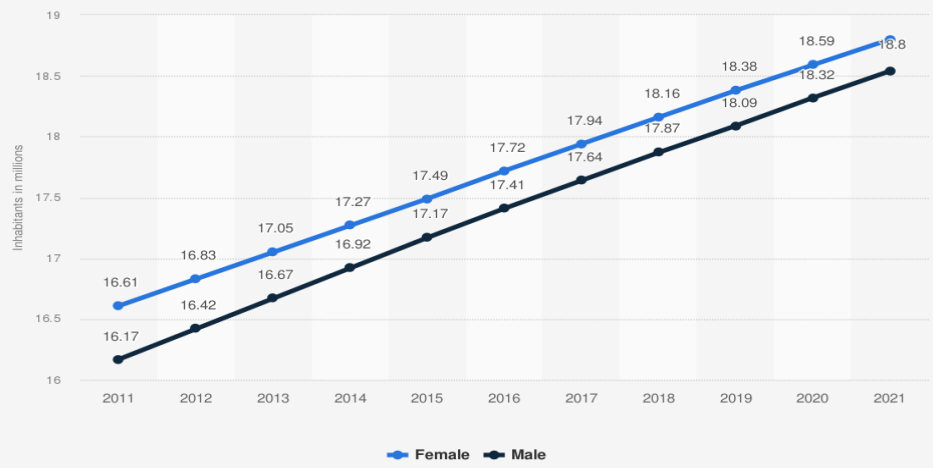
Considering the depletion of essential resources such as water is affecting income and food security, this is forcing men and boys to migrate to urban communities and large cities such as Rabat and Casablanca to seek income opportunities in different sectors such as tourism and services, and this means abandoning agriculture and livestock activities that used to be their primary income source.

On the other hand, this migration is having a negative impact specifically on women and girls as they are left behind with the responsibility of managing the household and the challenging farming sector on top of their regular responsibilities. This also leads to decreasing access to education rates for girls due to high percentages of withdrawal.

Rural and urban population 2021



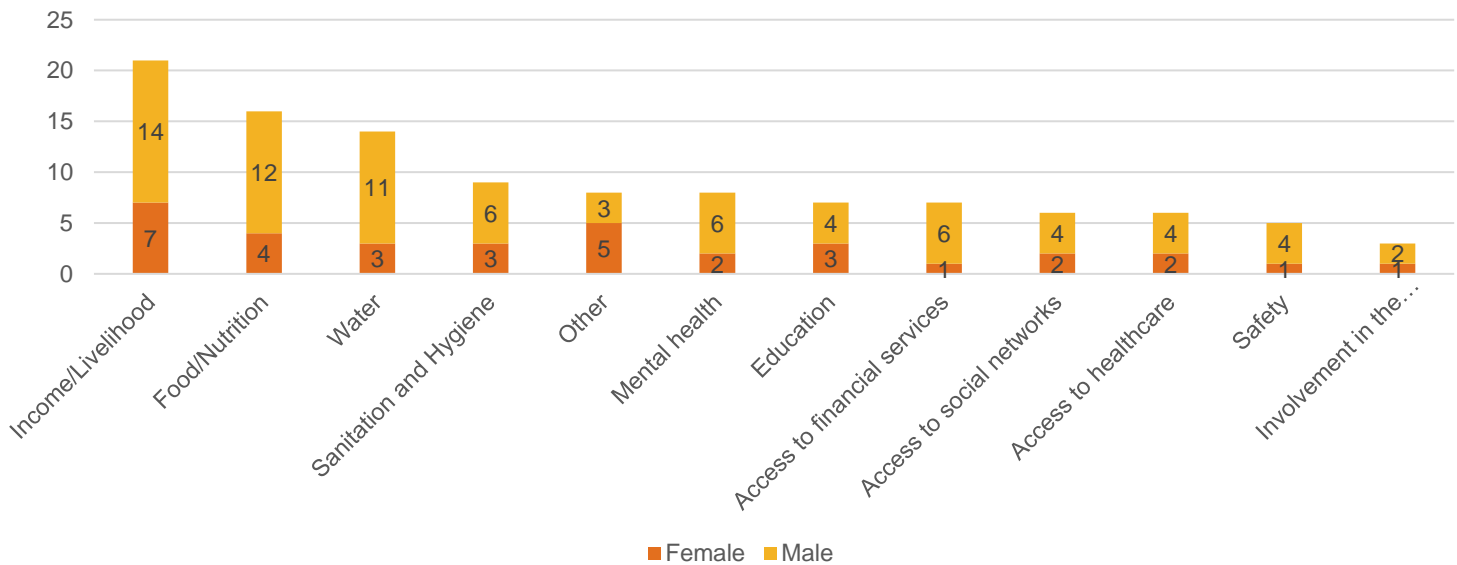
Morocco: Total population from 2011 to 2021, by gender (in millions)



Source: World Bank © Statista 2022

Additional Information:

Area(s) where personal life has been most changed/impacted because of these top crises by sex



“There is a problem with the treatment. The woman, during delivery, travels a distance in order to reach the hospital located in Tahanawt, which is 15 km (4 Km are unpaved), This hospital is just a transit station. When you reach it, they tell you that you have to go to Marrakesh (from Tahanawt to Marrakesh there is more than 36 km). And when you arrive in Marrakesh, you can catch another disease, and there is no one to take care of you, in brief, there is no healthcare and education in Morocco.” Male Community Survey Respondent, Marrakech.

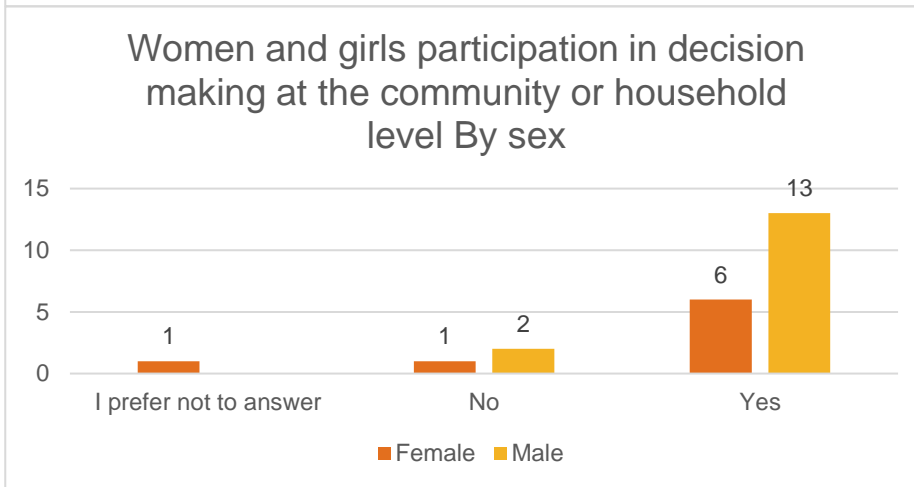
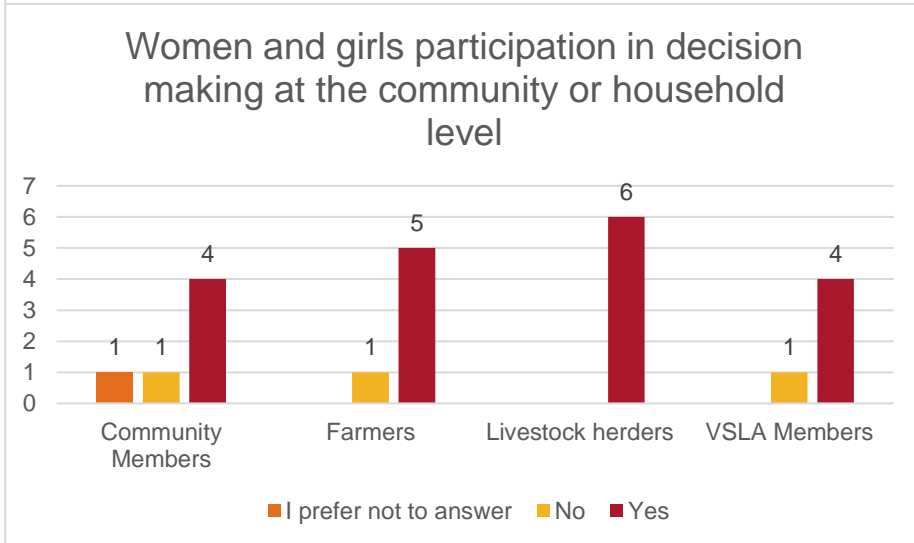
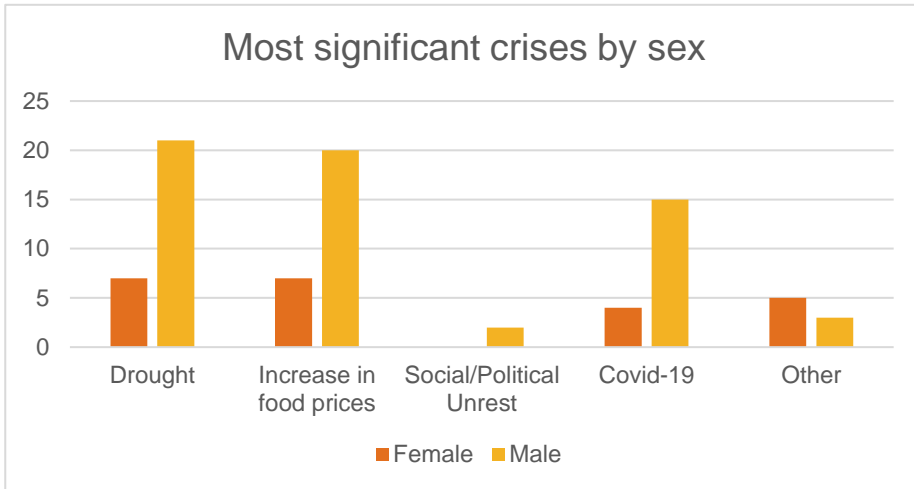
Apart from the above internal migration, it was reported that the young generation is living with the aim of migrating to Europe to seek a better future and less challenging living conditions related to basic aspects such as drinking water.

In the women’s situation, their work on subsistence farms is often unpaid or unrecognized. About 73% of female labor in the primary sector is unpaid, a share that is even higher than the 60% unpaid labor rate for youth.

The communities are affected by the same crises, but different gender groups are affected differently as reported during the interviews; the following chart shows how male and female community members are ranking different changes in their personal lives aspects and what the most significant crises from their perspective had the most negative impact on them.

Additionally, as per the next chart, male and female community members reported following what was the areas of their personal lives that have been most changed/impacted because of the previously ranked crises. The data shows that both males and females are affected in the same way ranking livelihoods and income as most affected, followed by food and nutrition.

Surveys studied to what extent female community members are engaged and involved in decision-making on the household and community levels.



These questions were asked to both male and female interviewees, and the findings as per the following charts were 6 out of 8 interviewed women confirmed their engagement and 13 out of 15 men confirmed that women are engaged in the decision-making process while the other charts show the source of data:

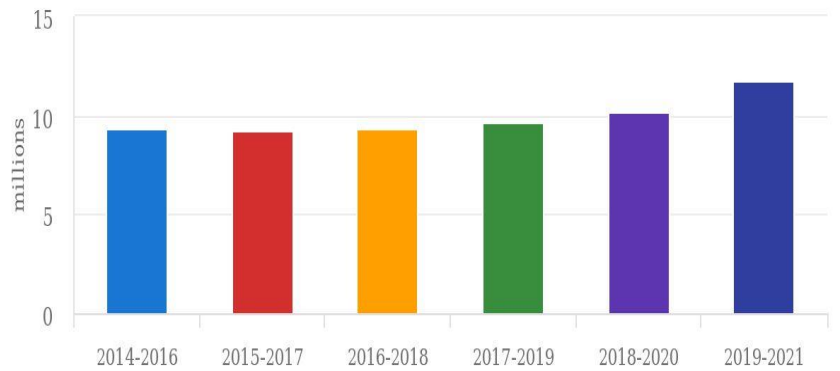
“There is still a difference between women and men, for example traveling, a man can travel but women can not. This has a relation to responsibilities, a woman is responsible for livestock, taking care of the house and children, only then she can do something if she has a free time.” Female Community Survey Respondent, Marrakech.

V. Food Security and Economic Situation Overview

Overall, the food security situation is stable and not significantly affected by the drought so far with observing data on a [number of people undernourished and a number of people living with moderately and severely food insecure](#).

In addition to observing dietary intake for different nutrients such as protein, research was also led on energy supply which does not reflect a red flag yet.

Further information is provided in the following briefs:



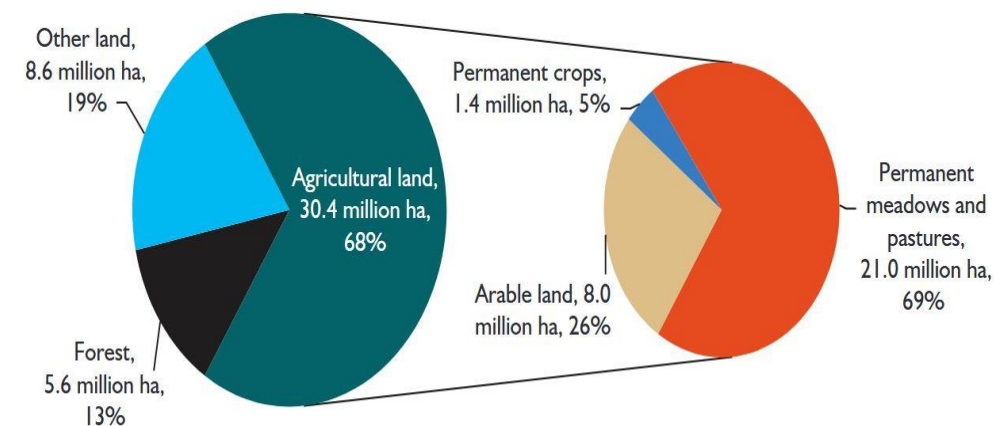
● Morocco
Number of moderately or severely food insecure people (million) (3-year average)
Source: FAOSTAT (Nov 26, 2022)

a. Agriculture & Livestock

Agricultural activities are a key contributor to Morocco's economy. In 2020, the agriculture, forestry, and fishing sector accounted for [12 percent of the GDP](#), the second-highest added value in North Africa behind Algeria. Morocco has around 30 million hectares of [agricultural land area offering 33.3%](#) of the employment rate on the national level ([52.1% of the total female](#) employment and [27.3% of the total male](#) employment). About 21 million hectares are permanent meadows and pastures, while 7 million hectares is arable land.

The land area under the permanent crops extends over the remaining 1.7 million hectares.

In addition to crop production, animal breeding and fishing activities are also widespread in the country. The main crops in Morocco are sugar, wheat, [potatoes](#), and [olives](#). Morocco was ranked among the highest sugar exporters worldwide.



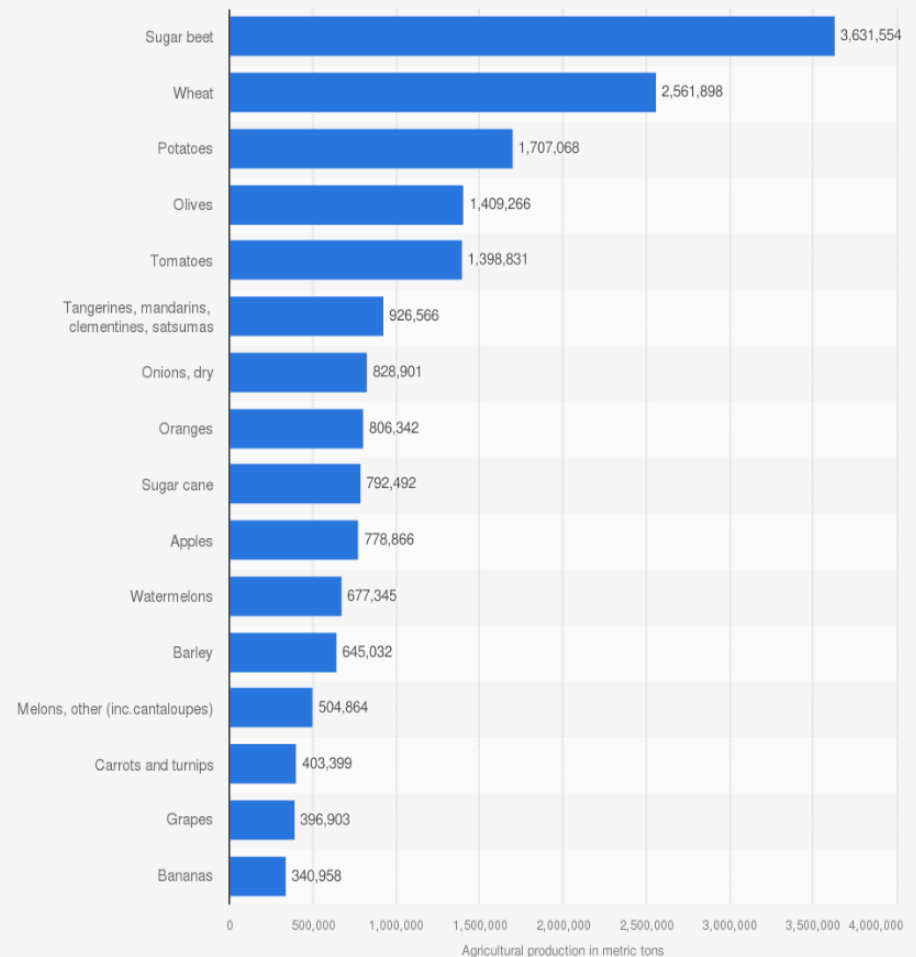
Source: FAOSTAT 2013.

Morocco has four distinct geographic regions. In the north, there is a fertile coastal plain along the Mediterranean Sea, the Atlas Mountains, extending across the country from southwest to northeast and into Algeria, comprise another region. A third area is a wide arc of coastal plains lining the country's western seaboard, bounded by the Er Rif and Atlas Mountain ranges. Finally, the south of Atlas Mountains is semiarid grasslands that merge with the Sahara Desert along the southeastern borders of the country ([map](#)).

In relation to land mapping, most of the arable land in Morocco is devoted to agriculture, with the rest in the forest or other uses.

Agricultural land use statistics reveal that 8 million hectares are arable, while 1.4 million hectares are dedicated to permanent crops and 21 million hectares are permanent meadows and/or pastures. The permanent crop area in the country increased by 46% between 2008 and 2013 in response to government efforts to promote higher value and commercial agriculture, including citrus and olives.

Production of agricultural crops in Morocco in 2020, by product (in metric tons)



Source
FAO
© Statista 2022

Additional Information:
Morocco, 2020

On the other hand, [During 2020 Morocco recorded](#) the highest production of poultry in Africa as chicken is by far the main species produced in Morocco with 630 million heads ,and 12 million turkeys. while for livestock, Morocco recorded 1.3 million cattle, 13 million sheep, 0.2 million camels, and 0.51 million mules. Additionally, Morocco is a substantial producer and exporter of fish and seafood products.

The mentioned animals contributed to 1.35 million metric tons of milk, and 300Ks tons of meat.

In 2020, sea fishing generated one billion USD.

“Yes, we were affected a lot, we can afford only the expenses of the house and the expenses of the livestock, people are decreasing in the number of livestock to decreases its expenses. We thought of other projects like the bread and sweets project, but they do not work well.” Al-Khair VSLA Group, Beni Mellal.

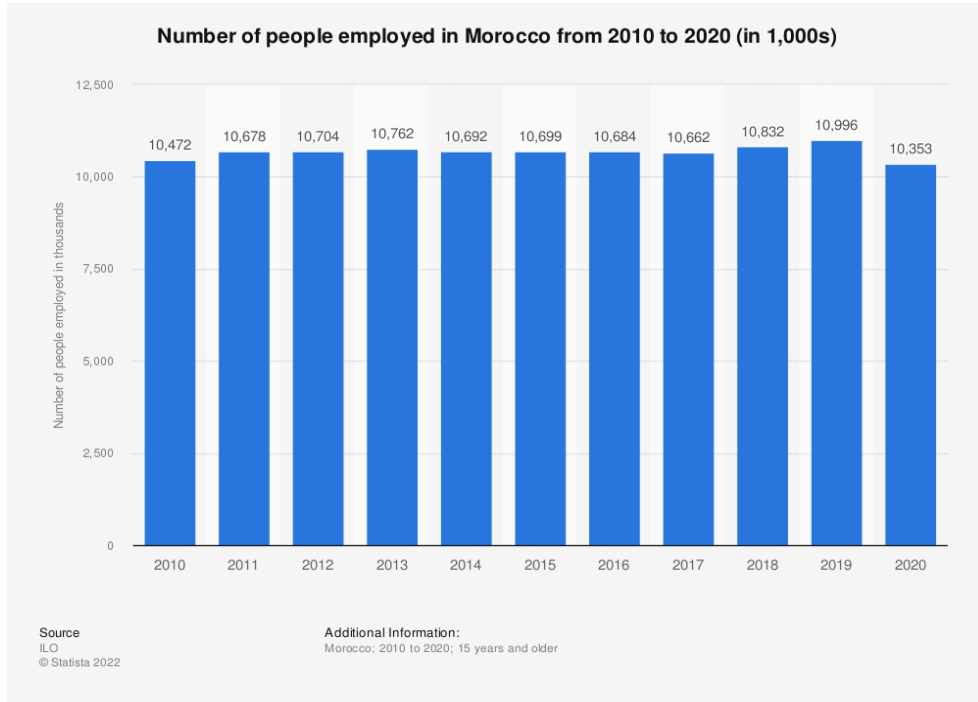
b. Economy

In 2021, Morocco was ranked as the 5th highest GDP in Africa with 131 billion USD. In 2022, the inflation rate was measured at 4.4% increasing significantly compared to 1.4% in the previous year. Food prices increased significantly with a 15% food inflation rate in June 2022 compared to the same month in 2021.

The economy of Morocco mainly relies on services. In 2021, the service sector employed more than 40% of the country's workforce and contributed to around half of the country's GDP.

In contrast, the industrial and agricultural sectors accounted for approximately 27% and 13% of the economy, respectively. Within services, the tourism industry is a key economic contributor in Morocco, as it was forecast to make up eight percent of the GDP in 2022.

Employment in the public and services sectors is considered the primary livelihoods/income-generating activity with estimates of nearly 10.4 million people employed in 2020 with decreased number compared to the previous years, which indicates how the economy functionality was affected by Covid-19, drought, and any other contributing factors. This is also reflected in the [unemployment](#) rate increasing since 2019 from 9% to 11.5% in 2021, especially for [youth \(15 – 24 years\)](#) which registered 27.2% in 2021.

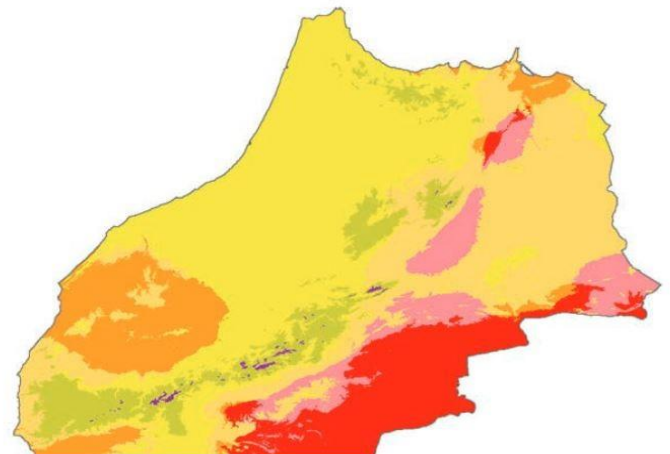


VI. Climate Change and Water Shortage Overview









Over a quarter of the world's population is facing a high level of water stress due to different reasons including industry, irrigated agriculture, irresponsible consumption...etc.

The Middle East is the most affected region where most of the countries are recording high water stress scores. Morocco was ranked among the [highest 25](#) countries globally with a water stress score. The same ranking applied to Morocco on the drought risk score, where Morocco was also included

Morocco Natural Climate Zones according to the Köppen Classification



Köppen climate type

- | | |
|--|---|
|  BWh (Hot desert) |  Csa (Hot-summer mediterranean) |
|  BWk (Cold desert) |  Csb (Warm-summer mediterranean) |
|  BSh (Hot semi-arid) |  Dsb (Warm-summer mediterranean continental) |
|  BSk (Cold semi-arid) |  Dsc (Dry-summer subarctic) |

Source: Wikimedia Commons, https://commons.wikimedia.org/wiki/File:Morocco_koppen.svg.

among the [top 25](#) countries living the drought risk.

Climate projections indicate that [Morocco](#) will continue to experience warming well above the global mean rate. Projections also suggest that winter precipitation will be reduced as warming increases. Even with no change in rainfall, evaporation will increase due to rising temperatures, and surface soil moisture will tend to decrease.

Similarly, the availability of water for irrigation using mountain streams and reservoirs will continue to be stressed at an increasing rate. Taken together, the chances are high that widespread drought conditions will occur more frequently and become more severe in Morocco, challenging local agriculture.

a. Climate Overview

Morocco has three climatic zones: from the Atlantic Ocean to the west, from the Mediterranean sea to the north, and the Sahara desert to the interior south and east.

Temperature variations are relatively small along the Atlantic coast, while the interior is characterized by extreme variations. The north and central areas have a Mediterranean climate, moderate and subtropical, cooled by the Mediterranean sea and Atlantic ocean.

[The north and central areas](#) characteristically have warm, wet winters and hot, dry summers.

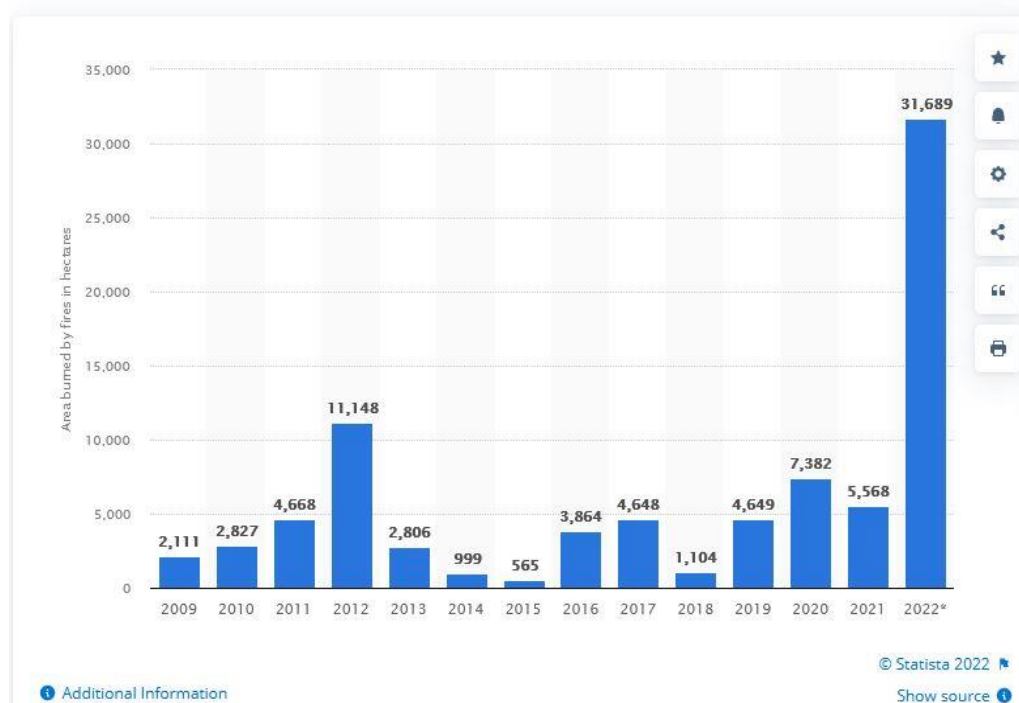
The average temperature hovers around 20°C. In the northern part of the interior, the climate is predominantly semi-arid. Winters can be quite cold, and summers can be very hot. In the mountains, ranges temperatures can drop as low as -18°C. It is worth noting that the climate in Morocco is changing and the country has a large annual mean temperature increase of 0.5°C per decade since about 1970. This is well above the global mean trend of 0.15°C per decade. Recent years have been particularly warm, several temperature records have been broken and a worsening drought, making wildfires even more likely.

Morocco has lost nearly 32,000 hectares of land to wildfires since October 2022. The 2022 fire season has been the country's worst in terms of cumulative area burned and cost the lives of at least seven people.

The western slopes of the Atlas Mountains received a great deal of rain, but at the expense of the interior since the mountains block the central areas of the Atlantic or Mediterranean coasts. The two rainy seasons are April – May, and October - November. Maximum annual rainfall of 75 to 100 centimeters occurs in the northwest, other parts of the country receive much less precipitation. Half of all the arable land gets no more than 35 centimeters of rain per year.

Area burned by wildfires in Morocco from 2009 to 2022

(in hectares)



b. Climate Change Impact

Floods are the most frequent climate-related natural hazards in Morocco, The World Bank estimates that disasters, such as flooding, earthquakes, and drought cost it over US\$575 million each year, with a disproportionate impact on vulnerable households. In addition, given that more than 65% of the population and 90% of the industry is concentrated on the country's coastline, sea-level rise constitutes another long-term stressor, especially for low-lying areas that will contribute to exacerbating the risk of floods.

Also, drought is considered among the primary consequences of climate change in Morocco. Drought often has significant direct and indirect economic, social, and environmental impacts. The effects mainly concern agriculture and food production sectors including livestock, forestry, and fisheries because of their high dependence on surface water supply and rain considering that 83% of agriculture and livestock are dominated by rainfed crops such as:

1) Implications on agriculture will lead to reduced crops, and essential strategic food commodities production rates 2) which forces the government toward filling the gap by importing. 3) This will expose local communities to higher costs. Considering that these consumers are the most vulnerable who will adopt negative coping strategies to survive. 4) Because of drought, plant disease could significantly increase and lead to massive losses. 5) Reduced soil moisture, and vegetation could lead to soil erosion and desertification. 6) On the other hand, reduced income for farmers and Agro-businesses with effects on all rural employment opportunities and rural market systems' functionality.

The drought in Morocco's impact could go into further dimensions such as causing 7) migration from rural to urban areas as well as illegal migration through high-risk routes towards Europe. Also, it could lead to 8) political instability, and increased crime, 9) insecurity and conflict among community members for the limited resources such as water.

10) The drought increases forest and similar locations' vulnerability to fire hazards, 11) damages wildlife and fish habitats and boosts its mortality.

12) Drought has significant implications on livestock. This is starting from basic health issues and it could lead to increased mortality when herders are not able to provide proper animal feed/fodder and enough water.

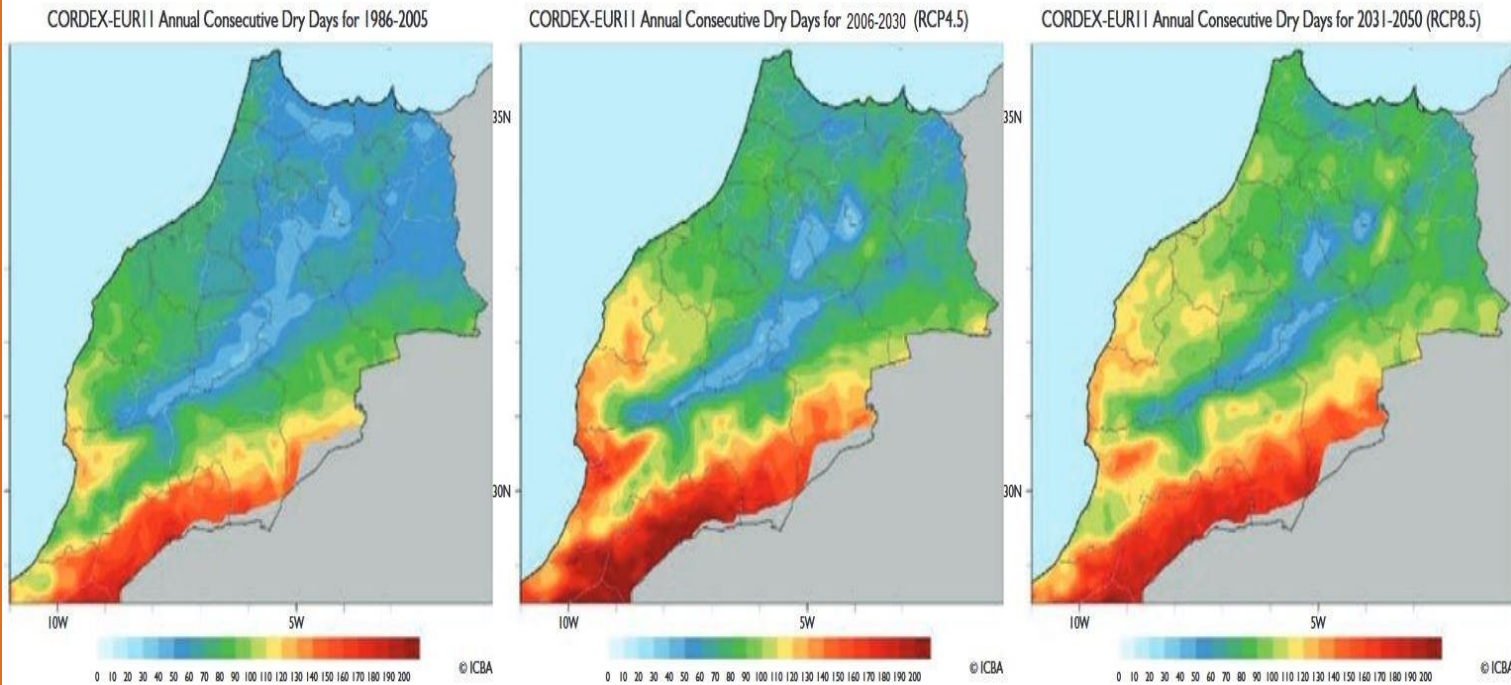
13) Economic Losses from crop production, dairy & livestock, fisheries, and land value depreciation note that agro-businesses contribute more than 30% to Morocco's GDP.

14) In the rainfed areas, consecutive dry years affect both rural areas and urban populations in terms of the availability of drinking water. 15) Forage crops and rangelands are also seriously impacted by the drought. Considering that together with cereals, this sector contributes to two-thirds of the total ag-production in Morocco. Forage prices increase in winter, especially in January which negatively affects the ability of farmers/herders to feed their animals which might lead to a sharp decrease in the number of ruminants.

16) Farmers of essential crops such as citrus and olive reported that harvesting time is not stable due to the instability of rainfall, extreme temperature, and weather events such as hail affecting the timing of blossoming and ripening. This is leading to force farmers to have several harvesting cycles due to the unpredictable time, but it is decided based on the crops' different varieties' status and readiness.

17) Due to the challenging agricultural livelihoods, farmers are selling their lands or offering it for rent to large-size Agro-Investors who aim mostly for profit regardless of soil, water, and other resources exhaustion.

Spatial Distribution of the Annual Consecutive Dry Days in Northern Morocco for the Periods 1976–2005 (left panel), 2006–2030 – RCP4.5 (middle panel) and 2031–2050 – RCP8.5 (right panel)



c. Water

In Morocco, there are more than 135 artificial lakes and 50 natural ones as well as 140 dams with a storage capacity of 17.6 billion cubic meters of water.

“There is water in the underground, but we need solar energy, so that we can reach it. At the present we depend on electricity which consumption is very expensive, the monthly bill of electricity is MAD 4000 for the group (equivalent to Mad 120 per person for one month), and this is just for drawing water from the well to the water tower. This consumed bill is only for the drinkable water. We stopped since Covid-19 started, the sufferances have started since four years, the increase in prices does not need to take about in Morocco, for example peolpe were buying hay for MAD 1,30 PER Kg now it is for MAD 3,5” Male Community Survey Respondent, Marrakech.

The water resources are under increasing pressure from population and industrial growth, irrigated agriculture, urbanization, tourism, climate change, overexploitation of aquifers, and deteriorating water quality. Through the following information, the report will provide an overview of the water and wastewater situation in brief as follows:

I. Potable water:

In June 2020, around 109.1 million cubic meters of potable water were produced in Morocco. For around 95% of the potable water produced in urban areas, 75% were distributed to subscribed consumers.

As of 2020, Morocco had 483 rural clean water supply centers. These were managed by the country's Office National de l'Électricité et de l'Eau Potable (ONEE). In urban communities, the number of potable water operation centers added up to 266.

II. Wastewater:

As of 2020, Morocco disposed of a wastewater treatment capacity of over 450,000 cubic meters per day, increasing from nearly 353 thousand cubic meters per day two years prior. From 2010 onwards, the treatment capacity of the plants steadily increased. Overall, the number of wastewater treatment plants in Morocco has been following an upward trend. [More than 120 wastewater treatment plants](#) have been built, increasing the treatment capacity to 900 MCM/year in 2016. Indicatively, 75% of the total population is connected to the sewer network, with 62% connected to wastewater treatment plants.

The wastewater sector has made significant advances in the last ten years, as the ONEE provided water sanitation services to 142 cities and localities in Morocco as of 2020. This accounted for the 5.8 million inhabitants in the sanitation cities. Despite the high potential, the level of wastewater reuse is low. [It is expected that by 2030, wastewater generation will increase to 900 MCM](#). Of the total wastewater discharge, 60% is discharged directly into the Mediterranean sea and Atlantic ocean, while 40% is discharged into the natural environment. The implementation of the National Sanitation Program and National Water Plan (PNE) was a real trigger for the controlled reuse of wastewater. Eighteen wastewater reuse projects with a total production of 38 MCM are in operation and supplying good-quality water for [the following uses](#):

- **Irrigation of green spaces, parks, and golf courses 69.3%.**
- **Agriculture, which currently accounts for 13%.**
- **Industry, specifically phosphate mining 16.6%.**
- **Groundwater recharges 1.1%.**

Treated wastewater provides an important potential source of water, for closing the widening gap between water demands and supplies. While recently there have been substantial improvements in access to water supply – with near-full access in urban areas (now centralized under ONEE).

III. Groundwater (wells and boreholes):

[Groundwater is a strategic resource](#), representing 20% of total water resources, or a total of some 4.2 billion cubic meters (BCM) per year across 9 major basins. There are 6 major hydrogeological areas that contain 103 aquifers of variable importance, from local to regional size. Of these, 32 are deep or confined aquifers, and 98 are shallow. Groundwater in all aquifers is experiencing stress, with falling water levels related to over-abstraction and low rainfall (and therefore low recharge). [Statistics](#) indicate that there is an annual groundwater deficit of 1000 million m³, and in some aquifers, water levels are falling by up to 2 meters per year.

Climate change models indicate that in the future there will be an intensification of drought occurrence, indicating that groundwater stress is likely to increase. Artificial recharge of aquifers is part of important actions carried out by the Department of Water, aiming to replenish, at least in part, strategic reserves of groundwater resources. This would allow for the restoration of the balance of these aquifers or, at least, the mitigation of the recorded deficits, as well as the slowdown of the progress of saline intrusion in coastal areas. At a national level, 24 aquifers that are experiencing advanced overexploitation may be the subject of artificial recharge to mitigate their deficits. The total volume that can be injected into the whole of these aquifers is estimated at nearly 200 million m³.

Groundwater quality degradation is occurring in many areas, linked to falling groundwater levels, including saline intrusion; pollution by nitrates (fertilizer); and natural (geogenic) salinity. Pollution by nitrates originates from essential agricultural activities, especially in irrigated areas. Aquifers that are significantly affected by nitrate pollution include Tadla, Berrechid, Triffa, Doukkala, R'mel, Tafilalet, and Massa. The aquifers of Martil, Gharb,

Chtouka, Guercif, Charf El Akab, Beni Mathar, Laou, Souss, Kert, Tafilalet, and Haouz have less nitrate pollution overall but have localized pollution. The level of nitrogen in some aquifers, including that of Beni Moussa in the Tadla and Mnasra in the Gharb, exceeds the maximum allowed limit of 50 mg/l.

The problem of salinity of coastal groundwater, because of seawater intrusion, is acute, especially for the aquifers of Nekkour, Kert, Gareb, coastal Chaouia, and Mnasra. Salinity also exceeds the permitted threshold in many groundwaters where the recharge area contains evaporate rocks (Halite and gypsum). About 25% of the total national water supply comes from groundwater. Of this, up to 15% is used for drinking water and industry, and between 85% and 96% for irrigation and livestock watering (data from the Hydraulic Department and UNESCO). About one-third of the water used for irrigation is groundwater as Morocco's groundwater resources are strategic to sustain stable agricultural revenues, including for small-scale farmers. Industrial use includes hydropower and tourism.

The main types of groundwater sources are boreholes with electric pumps, traditional (hand-dug) wells, and major springs (e.g. Bittit, Ribaa, Ain Asserdoune, Bouadel and Abainou).

IV. Surface Water (sea, ocean, springs, rivers, and lakes).

The Mediterranean sea is north of Morocco. It is an almost completely landlocked body of water that lies between Southern Europe, North Africa, and Southwest Asia. Morocco's western coast faces the Atlantic ocean and the Strait of Gibraltar connects the Mediterranean sea with the Atlantic ocean and separates Morocco from Spain. Morocco has the most extensive river system in North Africa. The principal rivers flowing south or westward into the Atlantic Ocean are the :

- **Rebia (555 kilometers/344 miles long)**
- **Sebou (Sebu; 500 kilometers/ 310 miles long)**
- **Bouregreg (250 kilometers/ 155 miles long)**
- **Tensift (270 kilometers/167 miles long)**
- **Drâa (1,200 kilometers/744 miles long) The Drâa is Morocco's longest river, but it is seasonal.**
- **The Ziz and Rheris both flow south out of the Atlas Mountains into the heart of the Sahara.**
- **The Moulouya (Muluya) flows 560 kilometers (347 miles) northeast from the Atlas to the Mediterranean, making it the longest river in the country that consistently reaches the sea.**

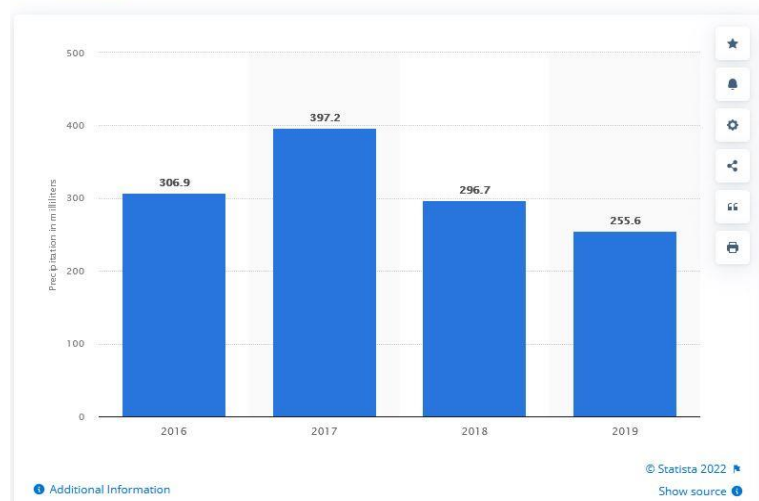
V. Rainfall

The average rainfall is 140 billion cubic meters per year (BCM/year). The most rainfall occurs between October and May.

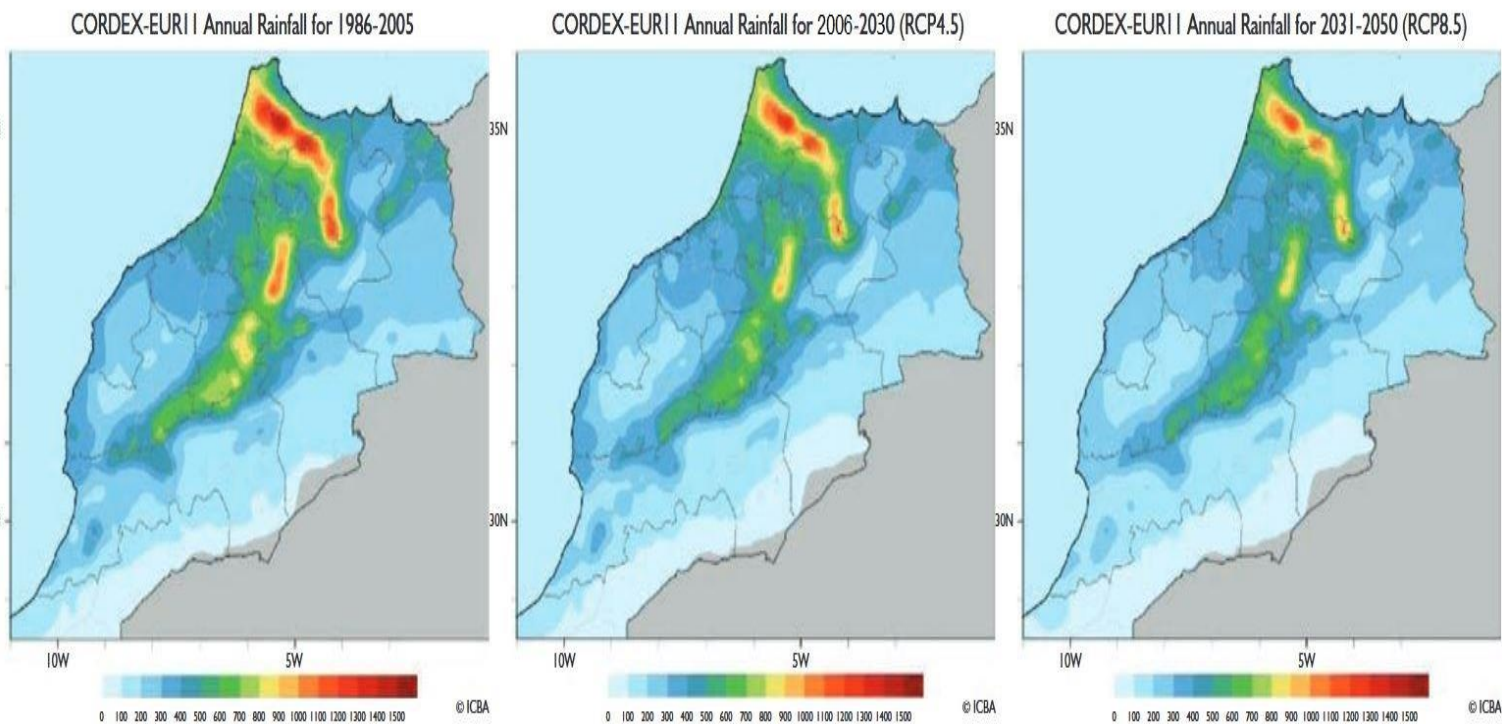
The rainfall variability in northern and central Morocco is illustrated in the next Map.

Higher annual precipitation occurs in the mountainous areas of the north-west, in the Loukkos river basin, Tangier and the Mediterranean coast, at more than 1,000 millimeters per year (mm/year). Conversely, precipitation is less than 300 mm/year in the Moulouya, Tensift, Souss-Massa and South Atlas basins. In the sub-Saharan region, it is even lower, at less than 100 mm/year.

Average annual precipitation in Morocco from 2016 to 2019 (in milliliters)



Total Annual Rainfall for the Periods 1976-2005 (left panel), 2006-2030 – RCP4.5 (middle panel) and 2031-2050 – RCP8.5 (right panel)



VI. Seawater desalination

Seawater desalination is considered a promising non-conventional water source and climate change adaptation measure. In 2009, Morocco launched the PNE for 2020-2030, which outlines several measures to address the gap between water supply and demand, including desalination. The PNE proposes the construction of seawater desalination plants to produce nearly 515 MCM/year in 2030. By 2016, Morocco had 15 desalination installations, with a total desalination capacity of 132 MCM/yr.

As Morocco imports 95% of its energy, reverse osmosis (RO) will likely remain the preferred technology, given that it is the least energy-intensive of the desalination technologies at large and extra-large scale. However, future desalination projects may be combined with renewable energy generation to address the problem of high-energy costs.

The Agadir Desalination Plant is under construction at a cost of about \$112 million, using RO technology to produce 36 MCM/year, to fulfill the drinking water and irrigation needs of 800,000 people (123 liter/capita/day). Two desalination plants at Jorf Lasfar – el-Jadida and Safi, with a capacity of 75 MCM/yr and 25 MCM/yr respectively, are under construction and set to produce 100 MCM/yr of drinking and industrial water by 2025.

Decreasing technological costs, its drought-proof nature, and the production of superior water quality are among the reasons why desalination is becoming the water treatment technology of choice around the world.

The perception that seawater desalination can be a drought-proof alternative to other water supplies has enabled water utilities around the world to effectively incorporate seawater desalination as a promising alternative to dwindling water supplies.

In 2016 the total world-wide desalination capacity of seawater and brackish water stood at about 22 billion m³/year. Desalination is now a well-established technology, particularly in the MENA region, but it is still relatively expensive and energy-intensive, even though declining solar and wind energy cost move the gate posts in its favor.

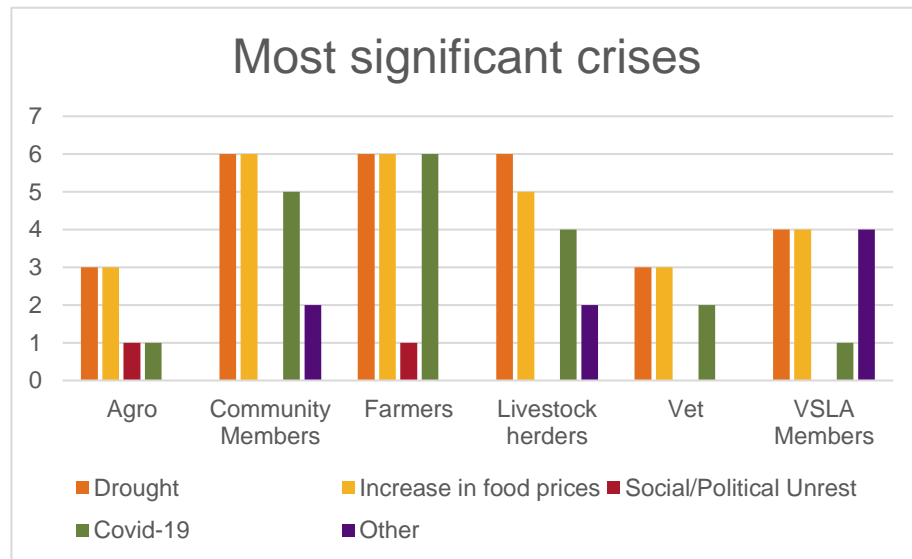
VII. Assessment Key Findings

a. Primary Data Findings

The next chart shows the ranking of the crises that were reported by different key informant surveys/interviews that affected their communities.

The drought/water shortage had a negative impact on all sectors including the tourism due to migration from rural to urban areas, increased prices, and market instability.

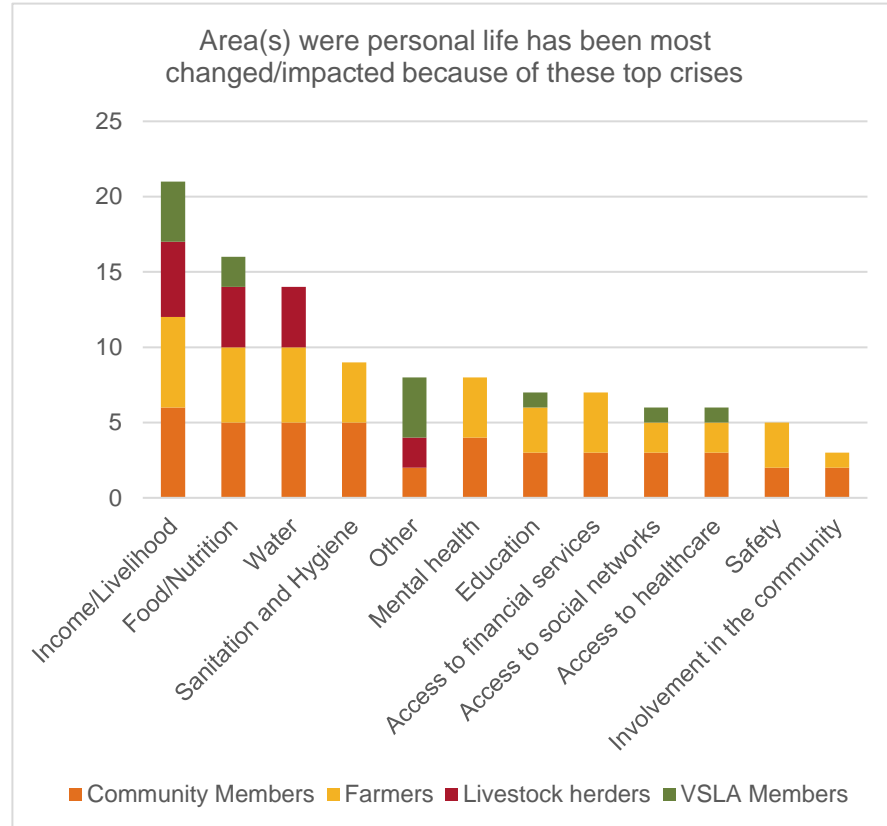
During our surveys with different sectors and community members it was reported as per the following chart how different areas of local individuals personal life have been changed/impacted because of the above mentioned crises.



- Male community members in the rural areas who used to consider agriculture as their main income source decided to migrate to urban communities seeking temporary or permanent jobs.
- Women are the most affected during the drought season for several reasons:
 - **Women are the primarily responsible for fetching water and with the drought, access to water is more challenging.**
 - **When the male head of households (HHs) members migrate to urban areas, female members step forward to take additional responsibilities on top of their existing daily tasks which put them in very overwhelming circumstances.**
- It is observed that over the past few years, farmers have progressively stopped using local seeds/seedlings/crops aiming for a higher yield using foreign inputs that showed low resilience to Moroccan climate and weather. Similarly, few profitable crops were cultivated in areas that suffer from water scarcity such as watermelon, avocado, and few other crops which led the government to intervene and restrict these crops in certain locations.
- Groundwater is significantly affected due to illegal digging for increasing the depth or digging new boreholes. Noting that agricultural technicians reported few occasions of depleted boreholes.
- In relation to **Agriculture**, CARE Morocco team interviewed local farmers and agro-business owners and key findings were as following:
 - **Reported that the most common rainfed crops are olive trees, and grains (in Hajeb and Marrakech).**
 - **All interviewed farmers and Agro-businesses confirmed that they were affected by failing cultivation of certain crops.**
 - **The three studied locations are not affected by salinity and desertification. Extension services and ag-related knowledge is available through local training centers and directorate of agriculture counseling.**
 - **It is reported by farmers and agro-businesses that there is an interest to expand cactus cultivation as it is used currently as animal fodder.**

- CARE Morocco interviewed several **livestock** herders, veterinarians, and livestock value chain actors to capture the following:

- It was observed that livestock herders started to notice the drought in July.
- Herders reported/were observed either in a severe economic situation and forced to sell their animals for a cheap price due to the large offer and limited demand, or thinking to sell but still resisting due to the very low price offered in the market.
- Livestock-related market systems such as meat, dairy, animal feed, etc. were categorized among the most affected market systems by drought.
- It was reported that veterinary service expenses, which were already high, have increased even more due to inputs and fuel costs which pushed herders to reduce the frequency of veterinary checks.
- In the assessed areas, the herders' ownership average is 4 cows, 35 sheep, and 28 goats. This differs between herders in accordance with the goal of herding. The main purposes were ranked as milk/dairy, meat, and raising/ fattening.
- Women are primary actors in the livestock value chain through dairy production, fodder/feed provision, cleaning, and sometimes field grazing. While men do motley grazing, marketing, health follow-up, and purchasing needed inputs.



b. Agriculture

- It is reported that the most affected areas are where agricultural livelihoods are rainfed.
- Economically, farmers and livestock herders residing in the mountains are the most affected, not by drought directly considering the availability of water compared to other places, but by the economic decline and increased prices. This is mostly in the south and southeast.
- Drought can have a significant impact on the macro economy, but through this study, it was confirmed that the most affected sector was the agricultural production and yields, and thus people's livelihoods such as small farmers and rural workers with specific challenges women and girls were going through due to water and income shortage.
- Farmers are giving up on their cultivation due to drought, energy, and input price increase. For the most part they immigrate to coastal cities (eg. to work in tourism, and businesses); some other take local jobs in the third sector (eg. in retail) or sell their land to large-sized investors who use it extensively.

c. Water

- There is a knowledge gap related to water management especially amongst the young generation who have the potential to integrate artificial intelligence and technology with water management.

- Water scarcity forces farmers to pump more groundwater to irrigate their crops with limited understanding of climate change implications and longer-term sustainable solutions and adaptation. Noting that on some occasions it was observed that pumping water happens through renewable energy using solar panels which allow farmers to pump beyond their actual needs and exhaust the groundwater significantly.
- It was reported that there is a weakness limiting efforts efficiency in the government drought management system related to the unclear institutional leadership to implement the response framework.
- Drought and water data is considered highly sensitive from a political perspective, which exacerbates the other barriers.
- One of the most effective instruments in water management is the adjustment of prices to signal to the consumer the true price of the resource for society and to put it in the position to decide the level of use of the resource and therefore to calibrate its application. The idea is to make consumers understand the difference between the price and the value of water (higher than the rather low price they pay on their bill).
- However, the environmental cost is not taken into account in the calculation of the price paid by the end user and both price and value might increase in a near future.

VIII. Adaptation and Best Practices

Through the key informant interviews, it was mentioned several times that Moroccan communities are used to the adaptation lifestyle which influence what type of crops to be cultivated, and what livestock to own, but they lost the techniques regarding water collection and other methodology considering their access to services provided by the authorities.

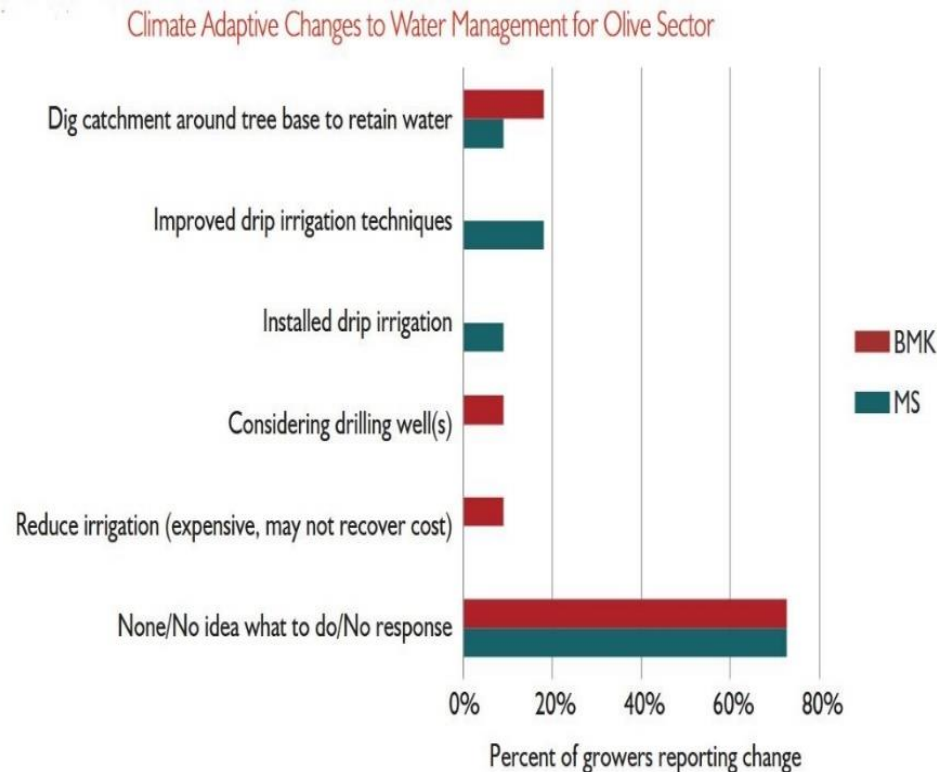
Now, the old generation is passing their knowledge to the younger generations aiming to reduce the effects on the agriculture sector.

Observations and reported information indicated that most of the farmers and livestock herders, especially the ones with small-scale ownership of land or number of heads of animals can not do anything as an adaptation measure to reduce the drought.

Some farmers reported that they took basic approaches such as digging more and deeper.

At the same time, water consumption was reduced despite the implications on the amount of yield they will harvest later but considering that irrigation expenses won't be recovered by selling their crops later considering the high production cost and limited purchasing power.

On a positive note, many farmers improved their irrigation techniques towards by implementing climate smart approaches such as drip irrigation.



Source: World Bank data.

Note: Multiple responses accepted. BMK = Béni Mellal-Khénifra; MS = Marrakech-Safi.

In addition, several stakeholders and active actors such as the International Center for Agricultural Research in the Dry Areas (ICARDA), The Food and Agriculture Organization of the United Nations (FAO), Association des Enseignants des Sciences de la Vie et de la Terre (AESVT) are working in collaboration with the Moroccan government to raise awareness and build local communities' resilience by empowering them with the needed knowledge and equipment to combat water scarcity mainly through irrigation systems, water storage, and transportation, water/rain harvesting, selecting crops in accordance with context and resource, etc.

Morocco is committed to an Integrated Water Resources Management (IWRM) approach, under its national Water Sector Development Strategy (2009) and its new Water Law 36-15 (2016). The entire water sector is governed by Law 36-15, promulgated on the 10th of August 2016, commonly referred to as the "Water Law", which provides the framework for water resource management and has created the necessary tools for its implementation.

- **Management of water demand and efficiency, and valuation of water**
- **Management and development of water supply**
- **Preservation and protection of water resources and natural resources**
- **Reducing vulnerability to natural hazards and adaptation to climate change**
- **Continuation of institutional and regulatory reforms**
- **Upgrading of information systems and capacity**

The government of Morocco is taking actual steps to reduce and limit migration from rural to urban areas. In parallel with speeding up the seawater desalination plans to reduce the drought effect on rural areas and the agriculture sector.

IX. Recommendations

The following listed recommendations are aimed at CARE longer-term focus, donor community, official institutions, and peer organizations.

a. Agriculture & Livestock

- Develop a response plan to intervene directly with the affected agriculture and livestock sectors and different value chains enhancing the supply and the demand sides with primary focus on water resource management. This will assist both rainfed and irrigated crops/lands with positive impact on the livestock herders in the drought affected zones. In rainfed areas, aiming for supporting crops, the government and active actors can provide subsidies, extension services, access to loans/business grants, insurance, animal feed provision/subsidized prices, drinking water for livestock, and vaccination & other veterinary services.
- Observe the non-irrigated crops that showed high resistance to drought, and support these crops' cultivation such as argan, cactus, and many other resilient crops.
- It is crucial to focus on supporting livestock herders in the preparedness process and building their resilience, considering that the drought in 1982-1985 caused losses to cattle and sheep exceeded 25% and 40% respectively. The recovery from these losses took more than 7 years.
- Applying fertilizers with poor understanding during drought will complicate and speed up the destruction of



soil and available water. Therefore, it is important to sensitize farmers on how to use fertilizer with minimum quantities and maximum caution in relation to soil health and fertility.

- The government and agriculture active actors/stakeholders have to ensure the validity of the strategic value chain studies such as corn, wheat, textile...etc. and keep a close observation of its functionality and maintain, support, and intervene immediately when disturbance happens (Eg. Import/export issues, weather conditions, market prices...etc.). Especially given that value chains and market systems are fragile during environmental crises, when they can collapse easily but much harder to restore such as the fields of olive/olive oil, livestock, citrus, etc.
- Ensure the usage of certified and approved seeds and seedlings/trees considering their adaptability to the local context and environmental conditions. Introducing new seeds and crops without governmental clearance might cause harm by overwhelming soil, water, and other resources. This happened in Morocco when introducing non-local, and profitable crops such as watermelon and avocado, which were restricted later by the authorities.
- Increase the supply of grain and animal feed in the local markets which will stabilize the prices and limit large size traders from influencing prices.
- Increase access to drip irrigation and other climate smart agriculture techniques. Water/rain harvest, use of organic fertilizers are among such techniques that were used successfully in other countries with similar conditions.
- To reduce the impact of increased prices, which is happening in parallel with high losses of harvest as a result of the drought, it is recommended to distribute certified seeds and appropriate amounts of fertilizers, in addition to water collection, storage, and transportation of high-quality materials.
- Boost new agricultural methods such as hydroponic, aquaponic, and aeroponic. Also, increase the dependence on organic fertilizers and compost through local production to reduce the need for chemicals.
- In rural areas, local municipalities need to establish water points for livestock.

b. Economic Recovery

- Prioritize the employment/income generation activities of the affected communities with gender focus aiming to protect the functioning businesses, recover/replace the lost ones, and create new opportunities through vocational training, apprenticeship, and access to capital. This could happen through market linkages, access to capital, skills development, infrastructure rehabilitation...etc.
- Increase farmers' sense of responsibility in relation to water management and usage with raised awareness on longer-term solutions and adaptation measures.
- Give local farmers access to loans and business grants supporting agro-business entrepreneurs especially new innovative ideas developed by local community including youth.

c. Water Management & Policies

- It is important for the authorities on the local and national levels to take participatory steps by engaging local community representatives while building drought management policies. This will increase its functionality and practicality especially with implementing a social accountability mechanism.
- Experience indicates that technology has the potential to raise yields, improve soil health, and reduce costs and labor relative to traditional tillage systems. It is important, however, for Morocco to maintain soil health and the soil-plant-water-nutrient system while encouraging crop rotation, for maintaining residue, maximizing soil biomass, and minimizing external input.
- To overcome the high irrigation expenses, it is recommended to scale up the renewable energy utilization where applicable. This should happen in parallel with increasing the sense of responsibility to mitigate the risk of over-use due to the low operating cost. Ownership of provided equipment should be on a local

community level rather than individuals, which increases accountability measures.

- Develop short-term preparedness plans to respond to drought if it happened with clear roles and responsibilities.
- Develop a long-term strategy to reduce vulnerability based on a risk management approach to reduce the vulnerability to drought from different perspectives including policies, and social implications.
- Municipal wastewater is identified as a valuable resource considering the availability of water, organic matter, energy, and nutrients (nitrogen and phosphorus) which can be recovered for many economic, social, and environmental purposes. Therefore, it is recommended that further investment especially for irrigation purposes as it is proved that treated wastewater is very efficient for irrigation while considering the safety testing and measures.
- Invest in stormwater collection and rainwater harvesting, considering the various of techniques and scale that could be used and on the other hand, the harvested water could be used for many purposes including drinking, livestock, gardening, recharging groundwater etc. It is recommended that CARE start piloting this concept in several locations where feasible.
- There is an area for improvement in relation to water and sanitation and increasing wastewater treatment and reuse capacity.

d. Capacity Building

- Conduct massive and inclusive awareness-raising campaigns should target all communities with serving different gender groups. The messaging should convey the actual cost of water and the consequences during the drought. A common understanding of water value should go beyond the bill cost.
- In some south-eastern regions, local communities showed a high capability of adaptation to drought for decades, which proves the possibility to align with available resources with high awareness of how to manage these limited resources.
- Restore best practices old generations used to cover water movement canals (an old technique to create a covered and deep canal).
- Study local communities' adaptation methods to be captured and replicated in other communities especially the old generations considering a wealth of experience exists but is depleted considering the development that happened over the past few decades.
- Provide access to early warning systems for local communities including farmers, and other affected businesses, with a focus on different gender groups. This includes access to remote sensing data/findings/readings.

e. Coordination

- Develop a roadmap to clarify tasks between governmental institutions and non-governmental organizations.
- Collaborate with the active international organizations in Morocco such as FAO, World Bank, World Meteorological Organization, ICARDA, local training centers, directorate of agriculture counseling etc. To establish a collective response working group supporting the Moroccan government's efforts to limit the negative effects on vulnerable communities. This will allow CARE Morocco to determine gaps and respond accordingly.
- Work closely with national and local organizations and research institutions to maintain close and up-to-date information on different communities' situation, which will allow CARE Morocco to be informed and be well-positioned to provide time-efficient support.
- Coordinate with women empowerment associations and organizations to increase CARE's access to local communities' specific gender groups aiming to build resilience and boost preparedness for any anticipated crises/shocks.

- Develop an expert network from different aspects and thematic areas (on water management, women economic justice, economic recovery, livestock, agriculture, etc.) which will help monitor the drought and increase the preparedness process for an efficient response or developing mitigation measures plan.
- One of the issues that were reported during the study is the lack of coordination; it is strongly recommended to relevant stakeholders to establish a task force per sector/value chain in collaboration with the relevant governmental authorities which CARE in Morocco could play an active role.
- Drought is not a Morocco-specific challenge, on the international level there are plenty of experiences that Morocco could benefit from.
- It is important to explore expertise in the region and on the global level from both humanitarian side as well as the technical/scientific side. Then utilize the applicable knowledge in Morocco in terms of responding to affected communities, preparedness for anticipated hazards, and build local communities' resilience.

f. Gender Mainstreaming

- Engage women in the program design phase especially when it comes to preparedness and resilience building. The program design should be customized per location/community considering the different adaptation methods and shocks, consequences per gender group, and the thematic area of the community (rural/urban).
- Women and girls are the most affected by the drought in several shapes such as being responsible for heading the family after men migration, or being a primary responsible for fetching water and hygiene aspects of the family. This is leading to further pressure, reduced access to health, food, education and many other services. Therefore, it is strongly recommended to study women situation on local community level and aim to boost their access to services and reduce the burden they are affording.
- In addition to the previous clause, it is crucial to consider women and girls with a central focus while developing preparedness plan and disaster risk reduction activities.
- It is recommended that policy makers and donors take into account the effect of water scarcity on the vulnerability of women and strengthen their leadership in the management of the latter, both in public policies and their operationalization.
- It is recommended to encourage companies to contribute to projects strengthening access to and management of drinking water in at least their areas of operations / activities, in particular through their corporate social responsibility approach.
- Authorities to instruct assessments, studies and reports with gender-segregated data.
- Decision makers to consider a social accountability mechanism to measure user satisfaction with the quality and sufficiency of water in precarious areas.

X. Acknowledgment

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