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Short of Water and Under Increasing Pressure to Deliver Food Security: Key Policy Considerations
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The Case of the Kingdom of Morocco

By Isabelle Tsakok

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For over six decades, Morocco has largely equated the achievement of food self-sufficiency (FSS) in 'strategic' food commodities to achieving food security. Successive governments have succeeded in guaranteeing the availability of and access to these commodities for the poor and vulnerable. In so doing, they have maintained social stability by fulfilling a basic social contract with the people. This is a major achievement, but the financial, economic, and environmental costs of this FSS approach are enormous.

Morocco is now under increasing pressure to revisit these costs under the existential threat of climate change. Water scarcity, is of course, not a new problem for Morocco, a semi-arid country, but climate change threatens to turn water scarcity into a water crisis. Although governments have invested heavily in dams, irrigation infrastructure, and micro-irrigation technologies, and have succeeded in building a significant irrigated agriculture sector; recurrent droughts still have major adverse impacts on GDP growth and the livelihoods of the smallholder majority, most of the poor and vulnerable in rural areas. Despite the substantial achievements of the *Plan Maroc* Vert with irrigated agriculture, Moroccan agriculture is still dualistic. Rainfed agriculture still occupies 80% of the cultivated area, employs most of the agricultural workforce, and is relied on by the majority of smallholders most of whom are still involved in low-productivity farming.

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Short of Water and Under Increasing Pressure to Deliver Food Security: Key Policy Considerations – The Case of the Kingdom of Morocco

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More irrigation investments are planned but they will not by themselves solve the water scarcity problem since rains are projected to be less, and more volatile, and non-agricultural demand for water is expected to increase with population growth, urbanization, and industrialization. Morocco plans to resort to non-conventional sources of water, through desalination, reuse of waste water, and rainwater harvesting. But exploiting these sources is energy intensive. Since Morocco is committed to decarbonizing its economy by using its plentiful wind and solar resources, its use of non-conventional sources of water will require a major overhaul of the energy sector as well.

How Morocco shapes its agricultural and food security policy to deal with this looming water crisis will have a determining impact on its development path and prospects in the decades ahead. Instead of allowing increasing water scarcity to threaten Morocco's agriculture and food security, it can seize it as an opportunity to embrace a climate-resilient and low-carbon pathway to food security, anchored in the principles of the New Development Model, under the leadership of H.M. Mohammed VI. The daunting challenge is to find a financially stable, economically sound, and socially just transition to transform Moroccan agriculture and food.

INTRODUCTION

Morocco is a semi-arid country with erratic rainfall. It is one of the world's most water-stressed countries (defined as water *per capita* below 1,000 m3/per year), and with climate change, is expected to be even more water-stressed in the decades ahead. From 1960 to 2020, the per-capita availability of renewable water resources decreased from 2,560 m3 to about 620 m3 per year, fast approaching the absolute water scarcity threshold of 500 m3 per person per year (World Bank, 2022).

Being keenly aware that water is a scarce and volatile resource, Morocco has developed structures to store and guide water flows, including *khetarras* and *seguias* introduced in ancient times, the construction of large-scale public schemes under the French Protectorate (1912-56, e.g.` the El-Kansara Dam in 1933), and '*La Politique des Barrages*' launched by H.M. King Hassan II in 1967. Since the mid 1960s, irrigation infrastructure has received most of the public investment in agriculture (World Bank, 1980).

A top priority since independence from France (March 2, 1956) has been achieving food self-sufficiency (FSS) which is largely equated to food security. More specifically, it is food self-sufficiency (FSS) in the 'strategic' food commodities of wheat, sugar, vegetable oils, meat, and milk, all import substitutes. Although the government of Morocco (GoM) now refers to food sovereignty instead of FSS as its policy goal, there is no policy difference in substance as it maintains the same FSS approach. Indeed, key interventions protecting the strategic commodities are still in place.

The GoM intervenes extensively at different points in the long chain from production to consumption, to ensure producers are protected and consumers have access to these strategic foods. Ensuring their availability and access to them are key components of a social contract between the government and its people, an essential cornerstone for social stability.

How can this cornerstone be maintained in a financially, economically, and environmentally sustainable way? Given increasing non-agricultural water demand arising from population growth and urbanization, climate change threatens to make even less water available for agriculture. In other words, continuing an FSS approach to food security, even with periodic adjustments made necessary by financial constraints, threatens to become unaffordable for the entire country.

What are key policy considerations if Morocco wants to achieve food security without undermining its water security, its fiscal strength, and social stability? This Policy Paper identifies key policy questions for the GoM to address, in its transition to a more developmentally sound and inclusive approach to food security.

As in a previous policy paper, covering the Arab Republic of Egypt[1], this paper adopts the holistic FAO concept according to which "*food security exists when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life*" (1996 World Food Summit). Food security thus requires the four pillars of availability, access, utilization, and stability to exist simultaneously—a tall order indeed.

This policy paper is also similarly structured since Morocco and Egypt, though very different countries, share many structural characteristics, policy issues, and challenges. Section I sets out the country and global context with a focus on macro factors with a significant bearing on the state of food security in Morocco, and the GoM's approach to ensuring it. Section II identifies inter-related sector-level factors, namely in Morocco's agriculture and food (also referred to as agri-food), in its water supply and availability, and its foreign trade, which strengthen and/or weaken its food and water security. Section III presents key policy questions that should be addressed to achieve food security (as opposed to FSS Moroccan-style), in a world threatened by climate change.

SECTION I: COUNTRY AND GLOBAL CONTEXT

Morocco's macro-economic performance pre- and post-COVID-19, in the shadow of a darkening global context: From 2000 to 2017, Morocco achieved the highest *per-capita* growth in the Middle East and North Africa region. Its real *per-capita* GDP nearly doubled from US$ 1,727 (2000) to US$ 2,948 (2017) (World Bank, 2019). Unfortunately, there has been a downward trend in average annual GDP growth rate since 1996: thus, the average annual growth of 4.8% between 1996 and 2006, declined to 4.6% between 2007 and 2011, and to 3.4% from 2012 to 2017. In the first quarter of 2018, it was down to 2.8%. This declining trend in annual growth shows the slow rate of transformation of the Moroccan economy, raising fears that Morocco may fall into the middle-income trap (World Bank, 2019).

Morocco was hard hit by the pandemic, suffering a 14.2% fall in its GDP in the second quarter of 2020 when the first harsh impacts of COVID-19 were being felt. Thanks to the $3.6 billion Pandemic Fund created by H.M. Mohammed VI in 2020, and to the authorities' vigorous vaccination campaigns, Morocco vaccinated 31% of its population by late summer[2] 2020 (Barna, 2021). Over the entire pandemic year of 2020, GDP suffered a major contraction but recovered with 7.9% GDP growth in 2021, aided by the excellent performance of agriculture which grew by 17.8%, which in turn was mainly due to an exceptional cereals harvest of 103 million quintals (m Q) after two years of drought (2018-19, 2019-20) (World Bank, 2022).

Unfortunately, the strong recovery was short lived because Morocco was hit by another drought in 2021-22. Thus, in the first half of 2022, Morocco's economy decelerated sharply due to drought,

1. The previous policy paper on Egypt PP -01/23, titled "Short of water and under increasing pressure to deliver food security—The case of the Arab Republic of Egypt" can be accessed at: https://www.policycenter.ma/sites/default/files/2023-01/PP_01-23_Tsakok.pdf

2. Morocco's response stands in sharp contrast to most African nations, where vaccination rates are barely 2% of the population. Although there was little equity in the way vaccines were available worldwide, as wealthy countries purchased 80% of vaccines when they became available in 2020, Morocco placed orders early in the marketplace alongside wealthy nations. It also diversified its purchases, bought multiple vaccine formulas, and launched large-scale communication campaigns to inform and reassure the public (Barna, 2021).

rising energy prices and the food import bill exacerbated by the Russian invasion of Ukraine in February, and a growth slowdown in Morocco's major export market, the European Union. The drought inflicted a 17.3% fall in agricultural output, as GDP growth of 2022 is projected to slow to 1.1% (Morocco's Economic Update, 2022). In November 2022, inflation reached over 8%, the highest since the 1990s (World Bank, 2023). Morocco's ability to recover and to rebuild better is being further tested as forecast global growth has been lowered to 1.7% for 2023, down from 3% projected in summer 2022, as the world economy is battered by a series of crises including:

- The Russia-Ukraine war entering its twelth month, while geopolitical tensions intensify between the United States and China over Taiwan, and between North Korea and U.S. allies in the north Pacific;
- Geopolitical tensions feeding the trade war between the United States and China, and the tightening of sanctions by the United States and NATO against Russia;
- Central banks around the world withdrawing financial support by raising interest rates to control inflation, and governments reducing social safety nets to assist vulnerable groups as government debt in emerging market and developing economies (EMDEs) has reached a 50-year high, thus sharply narrowing fiscal space;
- Highly synchronous tightening of monetary and fiscal policies, which is projected for 2023, constituting a major brake on global demand growth;
- Relentless catastrophic and life-threatening weather events; e.g., the 2022 Pakistan floods killing 1,739 people, with damages estimated at $14.9 billion, and economic losses at $15.2 billion (Wikipedia, Pakistan Floods); 18 climate-disaster events in the United States in 2022, killing 474 people, with losses of $1 billion each[3] (NOAA National Centers for Environmental Information, 2023).

Global growth in 2023 is projected to decelerate to its third weakest pace in nearly three decades, foreshadowing the global recessions of 2009 and 2020 (World Bank, 2023). The fear is that further adverse shocks will trigger a deeper recession. The policy path ahead for EMDEs is fraught with "*difficult choices among exchange rate stability, capital mobility, and monetary independence: the so-called monetary trilemma*" (Dinh, 2022). Policy failures could lead to further crises, exacerbating debt distress in the developing world, even lower growth, and greater poverty and vulnerability.

Major socio-economic implications of Morocco's growth performance during the 2000s: Despite the gradual lowering of GDP growth rates, a major achievement in Morocco has been the substantial reduction in poverty and the virtual disappearance of extreme poverty in the 2000s. From 2007-14, extreme poverty ($1.90/day at 2011 PPP) decreased from around 2.5% of the population to below 1%. At the lower middle-income poverty line ($3.20/day at 2011 PPP), it fell from 17.5% to below 8% (World Bank, 2019). The wellbeing of the bottom 40% also improved. This achievement is remarkable considering that in the 1990s, poverty and economic vulnerability increased: from 1990/91 to 1998/99, poverty increased from 13.1% to 19% of the population, and economic vulnerability (defined for the group at or below 50% above the poverty line) from 35% to 44%. Poverty is mainly rural: although 46% of the population is rural, 66% of the poor live in rural areas. Despite these negative developments in the 1990s, several socio-economic indicators improved. Thus, (i) adult illiteracy was reduced from 55% to 48%; (ii) net primary school enrollment rose from 58% to 70%, including for girls in rural areas, from 28% to 47%; (iii) the crude death rate decreased from 7.7 to 6.3 per 1000 people; (iv) life expectancy increased 67 to 69 years; and (v) child labor

3. California was battered by powerful winter storms in early January 2023, causing catastrophic flooding and mudslides. Governor Newsom declared a state of emergency and President Biden visited the state on Jan. 19, 2023.

was reduced from 18% to 14% (World Bank, 2001).

By the end of 2021, there was also a substantial recovery of jobs lost in 2020, when GDP contracted by 7.1%. But such job growth is far from sufficient to address the average yearly job deficit. Between 2000 to 2019, the working-age population grew by about 374,000 annually, while additional jobs created per year averaged only 112,000, resulting in a yearly deficit of 262,000 jobs. The job intensity of growth worsened after the global financial crisis of 2008-09 (World Bank, 2022). This big job deficit is a central socio-economic problem facing Morocco, the two groups most negatively impacted being young people[4] and women.

The slow transformation of Morocco's economy has been problematic for generating productivity-enhancing job creation: Salient features of Morocco's slow structural transformation in comparison with other upper middle-income economies (World Bank, 2018) include:

Agriculture has become relatively less important in the national economy over the past three to four decades. In 1977, agriculture as a share of GDP was 14%, and agricultural employment was 40% of total employment (World Bank, 1980). In 2014, the respective shares were: 10.7%[5] and 39.4%. In other upper middle-income economies[6], the agriculture/GDP fell from about 20% in 1980 to less than 10% in 2014, and agricultural/rural labor moving to non-agriculture has been able to obtain higher productivity and income earning jobs.

The share of the manufacturing industry has stayed at around 20% of GDP (1980-2014), and services at nearly 60% during the same period. Over the same period in other upper middle-income economies, the respective shares have been: manufacturing industry from around 30% falling to almost 20%, and services rising from 40% to 60%.

This slow transformation process results from lack of inter-sectoral dynamism, meaning labor is unable to move from lower productivity to higher productivity jobs—typically, informal labor in low-paying jobs in agriculture and rural areas, such as jobs without contracts, security, or career prospects, moving to other similarly informal, low-skill, insecure service sector or manufacturing jobs in urban areas.

Is Morocco mired in a middle-income trap? Total factor productivity (TFP) growth of 1.1% (2000-14) is not enough to generate dynamic and sustained job-generating growth (Dadush, 2017). To avoid the middle-income trap, Morocco would need sustained higher TFP growth; in fact, "*two generations higher productivity gains than in the past*" (World Bank, 2018). In analyzing the characteristics of 13 economies[7] which have grown at 7% per year for over a period of 25 years since 1950, the Commission on Growth and Development (2008) identified "*five conditions that a country must meet to attain and maintain a high level of growth: sound leadership and good governance; participation in the global economy; high investment and savings levels; flexible resources, especially in terms of jobs; and a policy of inclusion designed to share the benefits of*

4. What constitutes 'youth' is defined differently. Young people aged 15-29 make up 30% of Morocco's population (Rhanem, 2015). Those aged 15-24 make up 17.5% of total population, and 26.4% of working age population (age 15-64) (World Bank Group, 2018). Young people (15-24) were 27.2% of total Moroccan population in 2021 (WDI).

5. Given the high volatility of agricultural GDP because of the importance of cereals and recurrent droughts, agriculture/GDP averages 13% over the medium term, and agriculture employment/total employment nearly 40% (World Bank, 2022).

6. An upper-middle-income country has per-capita GDP of between $4,126 and $12,735.

7. The 13 economies are: Botswana, Brazil, China, Hong Kong, Indonesia, Japan, the Republic of Korea, Malaysia, Malta, Oman, Singapore, Taiwan, and Thailand. The Commission believes that India and Vietnam "*may well be on their way*" to joining this group. The Commission is sponsored by the following six organizations: (i) Australian Agency for Development (AusAID); (ii) Dutch Ministry of Foreign Affairs; (iii) Swedish International Development Corporation Agency (SIDA); (iv) U.K. Dept. of International Development (DFID); (v) The William and Flora Hewlett Foundation; and (vi) The World Bank Group.

globalization, provide the poor with access to services and reduce gender inequalities" (World Bank, 2008). The Commission did single out special challenges of middle-income countries because "*increasingly growth must come from knowledge, innovation, and a deeper stock of physical and human capital.*" The New Development Model (2021) called for by H.M. Mohamed VI attributes Morocco's slow transformation and the lack of innovation to a range of factors which include non-competitive forces and oligopolistic structures. Thus, speaking of recurrent blocks to Morocco's development, it states: "*The second block lies in the slow pace of the structural transformation of the economy, which is hampered by the lack of openness to new, innovative and competitive players… The public system of incentives contributes to maintaining the preference of economic operators for income-generating and protected activities. It does not yet sufficiently encourage innovative activities that create more value, nor SMEs based in the regions*".[8]

Substantial socio-economic progress due to human capital investment but subjective poverty has increased: The human face of development is at least as important as GDP and productivity growth. Morocco's socio-economic progress represents a mixed picture. There have been major improvements in the health and education status of Moroccans since independence. An important indicator is life expectancy at birth. In the 1950s, life expectancy at birth was 42 years; by 2017 it reached 77 years (Benkassmi et al, 2020). Selected indicators of the human capital investment made in basic education and health are presented in Annex Table 5. This Table shows both the major improvements over decades, and factors which still undermine the food security of the poor and the vulnerable, including anemia among pregnant women, and stunting and wasting of children under five. Although extreme poverty had virtually disappeared in Morocco by the 2010s, subjective poverty increased (2007-14). Households considering themselves poor (hence subjectively poor) increased from nearly 42% (2007) to around 45% (2014), up to 40.3% in urban areas, and 54.3% in rural areas.[9] Some 55.3% of women and 57.6% of Moroccans below age 25 feel poor. Even 44% of the middle class consider themselves poor. Some 39.3% of households feel poverty has increased, and 63.9% feel that inequality has increased (World Bank, 2019).

SECTION II: WATER AVAILABILITY IN A WORLD IMPACTED BY CLIMATE CHANGE AND ITS MAJOR USER: AGRICULTURE

Government's policy and institutional response to water scarcity and volatility: Developing irrigation has been the primary response of governments to water scarcity and volatility. Irrigated agriculture was and is still viewed as essential to help Morocco achieve the overarching goal of food self-sufficiency in strategic crops, and to earn foreign exchange. Specifically, Moroccan governments' responses have been shaped by three main concerns: in the earlier decades, augmenting supply; in later decades, managing demand; and improving water use efficiency or water productivity.

- Up to the 1980s, the primary focus was on mobilizing water and promoting large-scale irrigation. The *Programme National de l'Irrigation* was launched in 1967 to achieve H.M. Hassan II's goal of achieving one million ha. of irrigated[10] land before 2000. Major institutional structures to manage irrigated areas soon followed, including DGH (the Hydraulics Directorate), ONI,

8. The General Report of NDM (April 2021) lists four blocks to development. The three other blocks are: "*Lack of vertical coherence between the development vision and stated public policies; the limited ability of the public sector to design and implement public policies and provide accessible and quality public services in areas that are essential to the daily life and well-being of citizens; and a sense of insecurity and unpredictability that restricts initiatives because of a gap between certain laws containing "grey areas" and social facts on the ground*".

9. Given a population estimated of around 31 million (2007), an estimated .418X31= 12.96 are subjectively poor; at 34 m (2014), an estimated 15.3 m (.45X34) were subjectively poor. Estimated (approx.) subjective poor for 2007: Urban: 0.386(0.6X31=18.6) 7.18; Rural 0.472(0.4X31=12.4) 5.85. For 2014: Urban 0.43(0.6X34=20.4) 8.77 m; rural: 0.543 (0.4X34=13.6) 7.38. To sum up on subjective poverty: Total: for 2007: 12.96; for 2014: 15.3 m; Urban: 2007: 7.18; 2014: 8.77 m; Rural: 2007: 5.85; 2014: 7.38 (using % in Fig 7, WBG, 2019).

10. Irrigated areas grew from around 160,000 ha in 1960 to 1.5 million ha by the 2010s (Serghini, 2014).

(National Irrigation Directorate), MAMVA (Ministry of Agriculture)[11] and nine regional irrigation offices (ORMVAs).[12] The ORMVAs are responsible for the operation of large-scale irrigation perimeters, including (i) the implementation of the Agricultural Investment Code (AIC, 1969, Code des *Investissements Agricoles* or CIA), according to which they are to fully recover the operation and maintenance costs and up to 40% of initial investment costs from beneficiaries[13]; (ii) beneficiaries were to pay a lump sum of 1500 dirhams/ha/year and to conform to the cropping patterns specified in the AIC; (iii) ORMVAs were to allocate water to farmers required by these cropping patterns; (iv) deliver extension advice to farmers; and (v) manage the infrastructures.

- In the 1980s, GoM promoted small and medium size irrigation perimeters (*Petites et Moyennes Hydrauliques*, PMH) by rehabilitating and/or constructing them. These perimeters are sourced from small dams, springs, tube wells, *khettaras*, wadi weirs for spate or continuous irrigation.
- In the 1990s, the Water Law 10-95 signaled a shift from the exclusive emphasis on supply augmentation of previous decades to demand management, a key principle within an Integrated Water Resources Management approach. The Law adopts the user-pays and polluter-pays principles. Within this approach, a High Council for Water and Climate was established to ensure coordination at the basin level as decentralized River Basin Organizations (*Agences de Bassins Hydrauliques, ABHs*) were created. Molle *et al* (2019) pointed out that the adoption of this new approach and the Law 10-95 had, unfortunately, little impact on the irrigation sector.
- The period since 2000 has been marked by increasing concern for water use efficiency and its productivity. The 2050 National Water Plan (*Plan National de l'Eau, PNE*), requiring an investment of $40 billion, is to increase the mobilization of about 4.6 billion cubic meters of water/year by 2050. On the demand side, to contain its growth, government would further modernize water-saving micro-irrigation techniques, and reduce losses in the conveyance of potable water (World Bank, 2022). To control demand and manage the increasing gap between supply and demand, the government established the National Program for Water Savings in Irrigation (2007, P*rogramme Nationale d'Économie en Eau Irriguée,* PNEEI). The PNEEI was subsumed under the MPV (2008-18), within which subsidies for drip irrigation were further raised[14] from 60% to 80% for large farms, and to 100% for small farms.

The increasing scarcity of water is aptly viewed by the NDM as a "*direct threat to the country's economic, environmental, and social balances, particularly in arid and semi-arid regions...*" The New Development Model (General Report, 2021) therefore calls for institutional reform of the water sector that provides "*greater transparency on the costs of the resource at each stage of its mobilization… introduce[s] a pricing system that reflects the real value of the resource and encourages rationalizing its use and managing its scarcity*".[15]

Despite substantial irrigation investments, water—scarce and volatile resource, under threat from climate change—continues to have determining impact on agricultural and GDP growth: Morocco

11. The current full name is the Ministry of Agriculture, Maritime Fisheries, Rural Development, Water, and Forests. At the beginning, it was the Ministry of Agriculture and Agrarian Reform.

12. ORMVAs: Offices Régionaux de Mise en Valeur Agricoles. There are nine ORMVAs : Loukkos, Moulouya, Gharb, Doukkala, Tadla, Haouz, Souss-Massa, Ouarzazate, and Tafilalet.

13. All farmers with less than 5 ha of land were exempt from the investment charges; farmers between 5 - 20 ha were partially exempt. Some 77% of farmers were therefore exempt (World Bank, 1995).

14. Subsidies for micro-irrigation was raised several times from the 1980s on. In 2002, the National Program for the Development of Micro-irrigation was launched, with a target of reaching 114,000 ha. However, by 2007, only around 39% of the target had been reached (Molle et al, 2019).

15. The NDM lists as "*Strategic Choice 5: Preserve water resources through better use of the resource and more rigorous management of its scarcity for present and future generations*".

is considered a 'climate hotspot'. It has already experienced warming trends since the 1960s, observing average increases of 0.2° Celsius per decade, exceeding the global average. Under climate change, the downward trend of precipitation is expected to continue, with increasingly erratic patterns (WBG, 2022). The extent to which rainfall is expected to decrease varies across climate scenarios and time horizons. According to Ouraich (2010), scenarios developed by the Intergovernmental Panel on Climate Change project that rainfall will decrease by 20% by 2050, and will then decrease by more than 40%. According to simulations of extreme water scarcity, yields from rainfed crops would fall on average by 15% by 2050, while increasing by 5% on average for irrigated crops[16] (Taheripour *et al*, 2020). Morocco has invested heavily in irrigation to address recurrent droughts for decades, but of course, it has not prepared for climate change. Successive governments, since independence, have built more than 120 large dams and related infrastructure, increasing the total capacity of water mobilized from 2 billion to almost 20 billion cubic meters. However, the actual volume stored declined for most of the 2010s. The overall filling rate reached only 33% in early 2022 (WBG, 2022). At a much higher filling rate, and with this substantial infrastructure, irrigated crops occupied 20%-25% of total harvested land, and contributed to roughly 65% of the monetary value of crops (Taheripour et al, 2020), although they occupied only 6% of total cultivable land (WDI, 2019).[17] Rainfall volatility continues to have a determining impact on Morocco's agricultural GDP, as has been very apparent in the 2020s, and Morocco still imports around 40% of its total cereal consumption in a non-drought year (Ait Ali *et a*l, 2022).

Although the PMV (*Plan Maroc Vert 2008-18*) invested heavily in irrigated agriculture, the determining impact of rainfall is not surprising, since Moroccan agriculture is still primarily rainfed, and rainfed cereals dominate the cropping mix. Cereals—common or soft wheat,[18] durum wheat, barley, and maize—cover almost 66% of utilized agricultural area (UAA),[19] and contribute around 40% of agricultural value-added in non-drought years (Serghini, 2014). The coefficient of yield variation of wheat in Morocco is 0.34 (2000-20), compared to 0.23 in Tunisia, and 0.18 in Algeria and Spain. Erratic rainfall causing high fluctuations in rainfed wheat production inevitably impacts on macroeconomic volatility: rainfall shocks explain close to 37% of the variance of GDP over the medium term, even though agriculture is only around 13% of GDP (World Bank, 2022).

Demand for water is expected to increase as availability of water decreases: Currently, agriculture consumes more than 80% of available water. As water availability decreases, non-agricultural demands are expected to increase through urbanization and industry. Urban water demand is expected to rise by 60%-100% in most large Moroccan cities by 2050 (WBG, 2017). Increased temperatures are expected across the entire North Africa region, with mean annual temperatures projected to increase by 1.5°C to 3.5°C by 2050, and possibly by more than 5°C by end of this century. By the 2090s, temperature is projected to increase by 10%, and average precipitation is projected to decrease by 20%, with a 30% reduction for the Saharan region (WBG, 2021). With warmer temperatures, the rate of evapotranspiration will accelerate and biodiversity will be negatively impacted. As more frequent and more severe droughts are projected, they will expand desertification.

16. There is much variation by region and by crop.

17. Estimates of the area under irrigation vary considerably as there are uncertainties in the definition and measurement of what constitutes irrigation. Official Moroccan sources do not include spate and seasonal irrigation (World Bank, 1995). In addition, some estimates use total agricultural area, some total cropland, some total harvested area. For example, according to two different estimates: (i) at the end of 2010, 1.46 million ha of irrigated land as % of total agricultural area of 8.7 million ha or 17% (Molle et al, 2019); (ii) FAO 2016 data: 1.5-1.7 millon ha irrigated, or 15% to 18% out of 9.6 million ha of cropland (Taheripour, 2020).

18. Wheat alone occupied 39.4% of harvested area (2016 data) of Morocco (Taheripour, 2020).

19. UAA is 13% of total area of Morocco. In terms of agro-climatic zones, only 30% of the total area is relatively well watered, with 400mm rainfall per year; another 24% is classified as intermediate bour with 200-400 mm of annual rainfall; while some 46% of total area is classified as very low rainfall or mountain or pre-Saharan oasis (see Tables 1 & 2 in Annex A).

While these are model projections, not predictions, they nevertheless require attention. The New Development Model (NDM) expresses the concern that Morocco could lack water by 2030—in a little less than a decade. The existential challenge imposed by climate change is clear: the agriculture sector will have to do more with less water—in relative and absolute terms—and soon. Thus, the focus of agricultural policy on achieving self-sufficiency in strategic food commodities[20] as food security must be restructured, as the policy has not been able to transform agriculture into an inclusive and resilient sector that is productive and profitable for smallholders. In particular, the policy has not been able to reduce the dualism of agriculture, thus leaving the majority, the smallholders, as low productivity and highly vulnerable to climatic risks. This dualism is a drag on successful agricultural transformation.[21] At the same time, producer incentives to promote these strategic commodities have benefitted mainly large farmers, as shown by the case of the most important crop, wheat.[22] In addition to dualism and inequity, much of this precious water is wasted, as estimates of the water footprint assessment of Morocco's river basins show.

Use of scarce water could generate more economic value by relocating crops: A water footprint[23] assessment of Morocco's river basins shows that Morocco is not obtaining the highest value—in terms of economic water and land productivity—from its scarce resources of water and cultivated land. Such value could significantly increase if crops were relocated among basins, with relocation of course subject to the demands of climate and soils available. The assessment used cropping data and prices from 1996-2005 for all the river basins.[24] It found that the five crops that consumed the most water—green (rain) and blue (surface and ground)—were the crops with the lowest economic water and land productivities. These crops are: almonds, maize, barley, olives, wheat. For example, for wheat, the economic water productivity[25] was $0.08/m3; for almonds, $0.02/m3. The production of tomatoes yielded the highest economic value, in terms of water and land use. The largest potential water savings could be obtained by relocating maize and wheat. The potential water savings compare well with the additional dams Morocco plans to build (Schyns et al, 2014). While the actual dollar numbers are outdated for 2023, their main message is still very relevant: that Morocco could save substantial amounts of water and obtain higher economic water and land productivities by reconsideration of its cropping mix and crop locations.

The water-energy nexus in Morocco under climate change: Given the increasing scarcity and volatility of water projected under climate change, Morocco plans to resort to unconventional water resources, in particular, waste water and sea water. This plan will require an entire new approach to energy generation. A central goal of the National Water Plan 2050 (PNE) is to narrow the supply-demand gap of coming decades—projected to reach 7 billion cubic meters/year by 2050—through

20. These 'strategic' commodities are water intensive. See Table 4 on water requirements of selected products in the MENA region. The water-using nature of wheat, which occupies around 40% of harvested area, is a major problem for agriculture when water is an increasingly scarce resource. Area under common wheat grew from 450,000 ha in 1979-80 to around 1.9 million ha by 1997-98 (Serghini, 2014).

21. To assess the degree of dualism of Moroccan agriculture, the data on agrarian structure should be updated by the Agricultural Census (AC) of 2016. There have been only 2 AC; in 1974 and 1996. https://www.fao.org/fileadmin/templates/ess/ess_test_folder/World_Census_Agriculture/WCA_2020/WCA2020_MRs/MR_Morocco_2016_final_response_01.pdf.

22. In fact, only a minority of farms benefit monetarily from this incentive structure—farms over 50 ha contribute 50% of the volume on the market, but they constitute less than 1% of all farms and 16.5% of the wheat area, while over 50% of farms, each less than 5 ha, sell only 10% of the total traded (Serghini, 2014).

23. The water footprint of a product is the "*volume of freshwater used to produce the product measured over the full supply chain…it is an indicator of fresh water use that looks not only at direct water use by a producer or consumer, but also at the indirect water use*" (Schyns et al, 2014).

24. The eight river basins are: From north to south along the Atlantic coast: Loukkos, Sebou, Bouregreg, Oum Er Rbia, Tensift, and Souss Massa. In the interior, along the east, from north to south: Moulouya, and Sud Atlas. The only two river basins for which ground water stress is not severe are Loukkos and Sud Atlas. The most ground-water stressed basin is Bouregreg, in particular, the Berrechid and Chaouia aquifers (Schyns et al, 2014).

25. The economic water productivity represents the economic value of farm output per unit of water consumed.

measures to increase both supply and reduce demand[26] (WBG, 2022). Thus:

- To increase supply, the state plans to invest in more dams and other water infrastructure, desalination plants, waste water use, and rainfall harvesting; and
- To curb demand, the state has expanded the use of micro-irrigation techniques.

However, by increasing the efficiency of water use and the financial returns from irrigated crops, the PMV and the PNEEI have increased demand for irrigated water at the basin level, while saving water at the crop level to the point of further depleting aquifers, especially the southern aquifers[27]. The counterintuitive impact of water-saving technologies leading to increasing use of the scarce resource is called the *Jevon's Paradox* which occurs when *"technological progress or government policy increases the efficiency with which a resource is used, but the falling cost of use increases its demand, negating the efficiency of the gains*" (World Bank, 2022).[28]

To expand supply, an enormous amount of energy is required for desalination and to make waste water usable. Currently, Morocco relies primarily on a carbon-intensive power sector. Morocco will have to switch from reliance on coal-fired large thermal plants by gradually deploying renewable energy and energy-storage technologies, with natural gas as a transition fuel. This switch is in line with Morocco's Nationally Determined Contribution (NDC) which offered a 45.5% reduction of its greenhouse gas emissions (GHG) by 2030 compared to a business-as-usual scenario.[29] Water is required in all phases of energy production and the generation of electricity. At the same time, energy is also required to treat waste water before re-use, and to extract, convey, and deliver water. The close interdependencies between water and energy present both a challenge and an opportunity. How Morocco manages these interdependencies is also critical for Morocco's development since Morocco wants to become a champion in the production of green hydrogen (GH) and its derivatives, such as ammonia, an important input in the nationally important phosphate-to-fertilizer industry. GH requires clean water and renewable energy. Of course, a transition path for decarbonization will have to be worked out. As pointed out by Berahab (2022): "*this would imply the coexistence of both types of energy, until the structures are in place to gradually substitute fossil fuels with clean, reliable, viable alternatives.*"

26. Demand management represents another major challenge that Morocco is addressing, as (i) demand is not sufficiently curbed despite substantial subsidization to promote more efficient water use through drip irrigation. Counterintuitively, increased efficiency of water use has encouraged more water use, not less, the so-called *Jevon's Paradox*, thus contributing to the overexploitation of aquifers; (ii) water tariffs still barely cover operation and maintenance costs; and (iii) there are substantial water losses in the transport and distribution networks.

27. Major southern aquifers include Haouz, Ouarzazate, Souss-Massa, Tafilalet, and Tadla. Groundwater is a strategic resource which represents 20% of total water resources or a total of 5.4 billion cubic meters (BCM) per year across 9 basins. There are six major hydro-geological areas which contain 103 aquifers of variable importance, local and regional (Wikipedia, last updated Nov 11, 2022).

28. The same point is made by Molle et al (2019), who argue that the private benefits (in terms of increased yields and incomes) come with a huge environmental cost, namely the depletion (or net evapotranspiration) of more water which translates into further depletion of the aquifers. They point out that a growing body of evidence from the field does not support the claim of water savings from the use of micro-irrigation techniques.

29. During COP 26, Glasgow, Dec 2021, Morocco's revised NDC: 18.3% of the target of 45.5% is unconditional, and the remaining 27.2% is conditional upon international assistance (WBG, 2022).

SECTION III: THE TRANSFORMATION OF AGRICULTURE AND FOOD GIVEN THE WATER-ENERGY NEXUS: KEY POLICY CONSIDERATIONS

To replace the elusive quest for food self-sufficiency with food security, what are key policy considerations? For over six decades, the GoM has invested and intervened massively in agriculture and food in the name of self-sufficiency of strategic food commodities. Yet, the self-sufficiency rate for these food commodities is either well below the levels of the 1970s and highly erratic, or if the rate is 100%, as with meat and milk, tariffs are prohibitively high and do not strengthen the food security of the poor and vulnerable, a major portion of the population. For the all-important soft wheat, the self-sufficiency rate declined from nearly 83% in the early 1970s to around 60% by the 2010s (Serghini, 2014). It is now clear that despite major investments in irrigation, Morocco continues to be highly vulnerable to droughts because cereals occupy nearly two thirds of UAA in an agriculture which is still primarily rainfed, and farmers tend to over-exploit aquifers despite increased use of highly subsidized drip irrigation. The 'perfect storm' made up of (i) the succession of recent droughts; (ii) the assault of the COVID-19 pandemic in 2020; and (iii) the inflationary impact of the Russia-Ukraine war in 2022, all within the context of climate change, is severely testing Morocco's resilience and resolve to recover from these multiple crises by embracing the New Development Model. For agriculture, the vision is to achieve "*… food sovereignty driven by modern, high value added, inclusive and responsible agriculture.*" Therefore, instead of the decades-old FSS, what are the key policy considerations for the NDM approach to food sovereignty to achieve food security, if Morocco is to sustainably manage the water-energy nexus? In these considerations, the use of water and energy consistent with the decarbonization targets of a dynamic and inclusive Morocco are central.

Availability—adequacy of supply

Domestic production, marketing and processing, national strategic stocks, and imports.
Since the strategic food commodities are likely to remain import substitutes in the short and longer terms:

- Given their high-water intensity in an environment of increasing water scarcity and volatility, how should domestic pricing and marketing of, and trade in, these commodities be restructured, to make them more resilient to climate change, increase value added, and improve their contribution to income growth of the poor and vulnerable?
- How best to shape and manage the political economy of transitioning from a longstanding FSS policy to food sovereignty to ensure food and water security, consistent with the vision of the NDM[30]?
- Given that severe climate events, including droughts and floods, are projected to increase, what should Morocco's trade and stock building policy be to make Morocco more resilient, e.g., by better diversifying risks and preparing for shocks?
- Given that the GoM is fiscally constrained after the increased financial support given to households to withstand the pandemic assault, what funds would be released by changing the policy of support for strategic commodities, and how can these funds be redeployed to further food and water security in the context of climate change?

30. Experience shows that policy reforms which are expected to alter fundamental power structures are highly vulnerable to the opposition of groups that stand to lose in the short term. Serghini (2014: 39) made the same point with respect to large-scale farmers of wheat, who are the primary beneficiaries of the producer policy support.

- How should the FSS policy for strategic food commodities be restructured, so that smallholders at the farm level, and a competitive private sector (at the processing and sale levels), produce water-efficient and resilient supplies, and can be profitable?
- In the context of climate change, smallholders producing any crop or livestock need assistance in terms of research and extension, and marketing, that will enable them to be resilient, better adapt to climate change and thrive. What should be the public investments in these supporting structures?
- How should trade be used to make the best use of Morocco's scarce water[31], while diversifying risks to maximize predictability, despite the inevitable ups and downs of foreign commodity markets?
- How should national strategic stocks of, say, wheat be built, financed, and managed to prepare for climate and market-induced shocks?

Access and stability—purchasing power of the poor and vulnerable

Access is primarily a function of income, level and distribution of consumer purchasing power, affordability through price stability (or lack thereof), and consumption subsidies.

- Recent growth (2007-14) has been more pro-poor as Morocco's Gini coefficient has decreased slightly from 0.407 to 0.395; in urban areas it has changed from 0.411 to 0.388; in rural areas from 0.331 to 0.317 (World Bank, 2019). But growth still needs to be made more inclusive to increase employment and reduce poverty and vulnerability. How can overall growth policy be more pro-poor and employment generating, in particular with respect to two major vulnerable groups, unemployed young people[32] and women?
- The NDM refers to the problem of poor quality in the delivery of public services as the third block, because it impedes the provision of "… accessible and quality public services in areas that are essential to the daily life and well-being of citizens." How should the delivery of these services be made more cost-effective and higher quality? Would better targeting need to be based on updated survey data describing the characteristics of the poor and vulnerable?

Utilization—nutritional adequacy

Socio-economic indicators have improved substantially since 2000. Unfortunately, there are still basic health problems which undermine the health status of millions of poor and vulnerable Moroccan children and women (see Annex Table 3 for selected indicators of human capital investment from the 1950s). With respect to both education and healthcare, the NDM fully acknowledges the aspirations of all Moroccans for quality services. In its discussion of the Morocco of the future (up to 2035), the NDM presents selected metrics for goals to be achieved by 2035. To turn this vision into reality, key policy considerations include:

- How can (i) accessibility, (ii) staffing, and (iii) operations of basic health clinics, especially in currently underserved areas, be improved given the fiscal space available in the short run, and how can these be improved over time?

31. The Schyuns et al (2014) study found that Morocco's virtual water trade (water content of exports and imports) for the 1996-2005 period saved Morocco water. It was a net importer of water.

32. According to the NDM, the young constitute 25% of the Moroccan population (General Report, 2021: 57).

- While still in recovery mode, and since the fiscal space is tight following COVID-19, how can the provision of basic healthcare services to infants, children, and mothers be strengthened in a cost-effective and a financially sustainable way?
- Over the longer term, nutrition education complemented by access to better basic healthcare will inevitably strengthen the health status of the poor and vulnerable. How can such nutrition education be delivered and disseminated in a way that changes behavior over time?

Summary and conclusion

For over 60 years, Morocco's approach to food security has been by promoting FSS and ensuring access to strategic commodities by the poor and vulnerable. This policy did not achieve food security but it did enable government to maintain social stability by guaranteeing sufficient basic staples to the poor and vulnerable in lean times. In a region where social turmoil has been an ever-present danger, this is a major achievement. However, the financial, economic, and environmental cost has been enormous—a cost future generations should not have to bear. Addressing increasing water scarcity and volatility now requires a paradigm shift, that is a fundamental rethink of business-as-usual FSS policy. As stated in the NDM, "*change is necessary and urgent.*"

What is a more sustainable and cost-effective way to ensure social stability during lean times, and to achieve food security for all during most times? In this post-pandemic, crisis-prone, and climate change world, Morocco is at a crossroads in terms of its approach to food security and the role of agriculture and food policy within it.

Specifically, with the threat of increasing water scarcity and volatility under climate change, continued reliance on building more dams and promoting more efficient water use, including through more drip irrigation, is far from enough to address this existential challenge successfully. As called for by the NDM, demand management that uses "*a pricing system that reflects the real value of the resource and encourages rationalizing its use and managing its scarcity*" is also required urgently. Incentives and behaviors must change. The renewed emphasis on demand management should be implemented within a holistic framework to transform Morocco's dualistic agriculture into an inclusive sector, in which smallholders in rainfed agriculture are climate resilient, productive, profitable, and food secure. Given Morocco's NDC pledges, this transformation must be put on a resilient and low-carbon path.

Annex Tables on Morocco

Table 1

Land Uses[33]

Uses	Areas in 1000 Ha	Percent
Agriculture land (UAA)	9.2	13.0
Forest	5.7	8.0
Alfa	3.3	4.6
Rangeland	21.3	30.0
Other land	31.5	44.4
Surface Nationale	71.1	100.0

Table 2

Area of agro-climatic spaces

Agricultural spaces	Rainfall (mm)	Areas (1000 of hectares)	Area in %
Favorable bour	Greater than 400	2 610	30
Intermediate bour	Between 300 and 400	2 088	24
Unfavorable bour	Between 200 and 300	2 088	24
Mountain	Between 400 and 1000	1 305	15
Pre-Saharan oasis	Less than 200	609	7
Total		**8700**	**100**

Table 3

Average labor requirement for Moroccan agricultural activities

Agricultural activities	Labor employed
Cereals – modern technology	1.5 days per HA
Cereals – semi-modern technology	3 days per HA
Cereals – traditional technology	14 days per HA
Legumes	50 days per HA
Vegetables	130 days per HA
Olives	30 days per HA
Other plantations	66 days per HA
Sheep and goats	100 heads per worker
Cattle	10 heads per worker

33. Omar Mhirit et Faiçal Benchekroun, les écosystèmes forestiers et periforestiers : situation, enjeux et perspectives pour 2025, *Cinquantenaire de l'Indépendance du Royaume du Maroc*.

Table 4

Water requirements and costs for some agricultural products in the MENA Region, 2003[34]

Products	m^3 of water/T	Water cost index
Tomatoes	450	0.07
Olives	500	0.11
Wheat	1450	1.00
Fruits	1500	0.25
Sugar	5000	3.40
Milk	6000	1.70
Cattle meat	42500	2.20

Source: Hassan, Serghini. Dec 2014. Rethinking African Agriculture and Rural transformation in the Global Context: Challenges, Opportunities and Policy Options: The case of Morocco
Tab. 1 & 2: p 5-6; Tab. 3 & 4: p 43

Table 5

Selected Indicators of Human Capital Investment (1950s-2020s)

	Item	Units	1950s-1990s	2000s	2010s	2020s
1	Adult literacy rate	%	30.26 (1982)	56.08 (2009)	73.75 (2018)	98.6 (2021)
2	Net primary school enrollment	%	59.00 (1982) 70.00 (1999) [a]	90.00 (2009)	99.00 (2018)	
3	Life expectancy at birth	years	42.0 (1950s) 69.0 (1999) [a]		76.1 (2017)	77.4 (2023)
4	Infant and child mortality	Deaths/1000 live births	76.0 (1987-1991)		22 (2017)	18.7 (2020) [b]
5	Infant mortality	Deaths/1000 live births	57.0 (1987-1991)		18 (2017)	16 (2020)
6	Maternal mortality	Deaths/100 000 live births	332 (1992)		112 (2010) 72.6 (2016)	
7	Vaccination of children under 5	%	<50.0 (1987)		87.7 (2011)	
8	Anemia in pregnant women	%		44.7-53.5 (1993-2005)		42.8 (2021) [c] 84.6 (mild) [c] 11.5 (moderate) [c] 3.85 (severe) [c]
9	Stunting for children under 5	%		25.0 (2000)	15.0 (2017)	
10	Wasting for children under 5	%		12.0 (2000)	2.5 (2017)	

34. World Bank, *Trade, Investment, and Development in the Middle East and North Africa*, 2003.

Sources and Notes:

1. *Adult literacy rate:* 1982, 2009, 2014: Statista: Adult literacy rate in Morocco 1982-2018. https://www.statista.com/statistics/1171965/adult-literacy-rate-in-morocco/
For 2021: "Literacy Rate in Morocco, 2010-2021". Globaldata. https://www.globaldata.com/data-insights/macroeconomic/literacy-rate-in-morocco/#:~:text=Literacy%20Rate%20in%20Morocco%20(2010%2D2021%2C%25),-20.00%25%2040.00%25%2060.00&text=The%20literacy%20rate%20-reached%2098.16,of%20Morocco%20increased%20by%2021.95%25.

2. *Net primary school enrollment*:1982, 2009, 2018: WDI. Morocco 1971-2018. https://data.worldbank.org/indicator/SE.PRM.NENR?locations=MA
For 1999 [a] : World Bank. March 30, 2001. *Kingdom of Morocco Poverty Update*. In 2 vol. Main report. Report # 21506-MOR. (p i)

3. *Life expectancy at birth*: 1950s, 2017: "10 Facts about Life Expectancy in Morocco." The Borgen Project. https://borgenproject.org/10-facts-about-life-expectancy-in-morocco/#:~:text=A%20recent%20report%20found%20that,average%20life%20expectancy%20in%201950.
Also: in Benkassmi M. and T. Abdelkhadek. June 2020. Building Human Capital: Lessons from Country Experiences—Morocco: Achievements and Challenges. World Bank. Washington D.C. (p 20)
For 1999 [a] : World Bank. March 30, 2001. *Kingdom of Morocco Poverty Update*. In 2 vol. Main report. Report # 21506-MOR. (p i)
For 2023: Moroccan Life Expectancy 1950-23. Macrotrends. https://www.macrotrends.net/countries/MAR/morocco/life-expectancy#:~:text=The%20current%20life%20expectancy%20for,a%200.29%25%20increase%20from%202020. This estimate does not take into account the impact of COVID-19 in 2020 and afterwards.

4-6. *Mortality- Infant and Child, Infant, maternal*: Benkassmi M. and T. Abdelkhadek. June 2020. Building Human Capital: Lessons from Country Experiences—Morocco: Achievements and Challenges. World Bank. Washington D.C. (p 21)
2020 [b] : Morocco under 5 mortality rate. Knoema. https://knoema.com/atlas/Morocco/Child-mortality-rate#:~:text=In%202020%2C%20child%20mortality%20rate,deaths%20per%201%2C000%20live%20births.
Infant mortality 2020: infant mortality in Morocco 2010-2020. Statista. https://www.statista.com/statistics/807047/infant-mortality-in-morocco/#:~:text=Infant%20mortality%20rate%20in%20Morocco%202020&text=The%20infant%20mortality%20rate%20in,deaths%20per%201%2C000%20live%20births.

7. *Vaccination of children under 5*: Benkassmi M. and T. Abdelkhadek. June 2020. Building Human Capital: Lessons from Country Experiences—Morocco: Achievements and Challenges. World Bank. Washington D.C. (p 25)

8. *Anemia in pregnant women*: 1993-2005: Worldwide Prevalence of Anemia (1993-2005) WHO Global Database on Anemia. (Fig.3.1b). WHO refers to this range as "moderate".
2021 [c] : The most affected age group was 25-35 age group. Farouqi et al. Open Journal of Obstetrics and Gynecology; Vol.12 No.12, December 2022 "Prevalence of Iron Deficiency Anemia among Moroccan Pregnant Women"

9. *Stunting for children under 5*: Global Nutrition Report 2022: Morocco—the Burden of Malnutrition at a Glance. Stunting is low height for age, resulting from chronic poor nutrition, repeated infection and inadequate psychosocial stimulation. In Africa, the rate is 30%.

10. *Wasting for children under 5*: Global Nutrition Report 2022: Morocco—the Burden of Malnutrition at a Glance. Wasting is low weight for height, resulting from chronic inadequacy of food in quality and quantity, and from frequent illnesses.

Bibliography

Ait Ali, Abdelazziz, Uri Dadush, Fatima Ezzahra Mengoub & Isabelle Tsakok. April 2022. The Russia-Ukraine War and Food Security in Morocco. Policy Brief PB -34/22. https://www.policycenter.ma/sites/default/files/2022-05/PB_34-22_Tsakok%20EN.pdf

Alyahya, Mohamamd and Travis Sanchez (edi). Sept. 2021. "Morocco's National Response to the COVID-19 Pandemic: Public Health Challenges and Lessons Learned". JMIR Public Health Surveillance; 7 (9): e31930. Reviewed by Amira El Rifay and Sina Azadnajafadad. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8451960/#:~:text=Given%20the%20exceptional%20nature%20of,restriction%20of%20the%20movement%20of

Anouar, Souad. March 02, 2022. "Moroccan Minister 'Food security is at the heart of Green Generation Strategy' ". https://www.moroccoworldnews.com/2022/03/347374/minister-food-security-is-at-the-heart-of-green-generation-strategy

Barna, Mark. Oct 2021. "Global COVID-19 vaccination rates influenced by more than wealth: Leadership can drive vaccine uptake". The Nation's Health, Vol. 51 (8), 1-6. https://www.thenationshealth.org/content/51/8/1.3#:~:text=In%20recent%20months%2C%20Morocco%20has,immunized%2031%25%20of%20its%20population.

Benkassmi M. and T. Abdelkhadek. June 2020. Building Human Capital: Lessons from Country Experiences—Morocco: Achievements and Challenges. World Bank. Washington D.C. https://openknowledge.worldbank.org/handle/10986/34208 License: CC BY 3.0 IGO."

Berahab, Rim. 2022. "Sanctions and Energy Supplies: Challenges and Opportunities for the Global South". Ch X in *Aftermath of War in Europe: The West vs The Global South*. Ishmael, Len (edi). Policy Center for the New South.

Commission on Growth and Development. 2008. *The Growth Report: Strategies for Sustained Growth and Development*. World Bank: Washington D.C. https://openknowledge.worldbank.org/bitstream/handle/10986/6507/449860PUB0Box3101OFFICIAL0USE0ONLY1.pdf?sequence

Dadush, Uri. Dec 07, 2017. "Moroccan job market issues, and labor trends in the Middle East and North Africa". Bruegel blogpost. https://www.bruegel.org/blog-post/moroccan-job-market-issues-and-labour-trends-middle-east-and-north-africa

Dinh, Hinh T. Dec 2022. "Sailing on a Storming Sea: Policy challenges for developing countries 2022-2025". Policy Paper, PP-20/22. Policy Center for the New South. https://www.policycenter.ma/sites/default/files/2022-12/PP_20-22_Hinh%20Dinh_VF.pdf

Farouqi, A., Rabbani, M., Moukal, A., Aghrouch, M. and Ajdi, F. 2022 "Prevalence of Iron Deficiency Anemia among Moroccan Pregnant Women". Open Journal of Obstetrics and Gynecology, 12, 1258-1266. doi: 10.4236/ojog.2022.1212110. https://www.scirp.org/journal/paperinformation.aspx?paperid=122100

Global Nutrition Report 2022: Morocco—the Burden of Malnutrition at a Glance. https://globalnutritionreport.org/resources/nutrition-profiles/africa/northern-africa/morocco/

Kingdom of Morocco. April 2021. *The New Development Model: Releasing energies and regaining trust to accelerate the march of progress and prosperity for all--General Report*. https://www.csmd.ma/documents/CSMD_Report_EN.pdf

Molle, François, Carlos Sanchis-Ibor, Llorenç Avellà-Reus (eds.) 2019. Irrigation in the Mediterranean: Technologies, Institutions, and Policies. Springer Nature Switzerland.

NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2023). https://www.ncei.noaa.gov/access/billions/, DOI: 10.25921/stkw-7w73

Ouraich, I. 2010. "Climate Change Impact on Moroccan Agricultural Sector." Summary of World Bank and FAO Report, Department of Agricultural Economics, Purdue University, West Lafayette, IN.

Rhanem, Karima. 02/25/2015. "Country sheet on youth policy in Morocco." https://pjp-eu.coe.int/documents/42128013/47262196/Morocco+country+sheet-2015.pdf/bb33a361-ce20-472c-bdb3-20096a129e9f#:~:text=2.-,Statistics%20on%20young%20people,under%2040%20for%20election%20purposes.

Schyns, Joep F., Arjen Y. Hoesktra. June 2014. "The Added Value of Water Footprint Assessment for National Water Policy: A Case Study of Morocco." PLoS ONE 9 (6) . Vol. 9, Issue 6. www.plosone.org.

Serghini, Hassan. Dec 2014. Rethinking African Agriculture and Rural transformation in the Global Context: Challenges, Opportunities and Policy Options: The case of Morocco.

Taheripour, Farzad, Wallace E. Tyner, Iman Haqiqi, and Ehsanreza Sajedinia. 2020. *Water Scarcity in Morocco: Analysis of Key Water Challenges*. https://openknowledge.worldbank.org/bitstream/handle/10986/33306/Water-Scarcity-in-Morocco-Analysis-of-Key-Water-Challenges.pdf?sequence=1&isAllowed=y

WHO Global Database on Anaemia. 1993-2007. https://apps.who.int/iris/bitstream/handle/10665/43894/9789241596657_eng.pdf;jsessionid=C0450528AB6DB04085DD6F72E9933580?sequence=1

Wikipedia. 2022. "Hydrogeology of Morocco and Western Sahara (Moroccan Saharan)" Last updated Nov 11, 2022. https://earthwise.bgs.ac.uk/index.php/Hydrogeology_of_Morocco_%26_Western_Sahara_(Moroccan_Sahara)

Wikipedia. 2023. "2022 Pakistan floods". Last edited Jan 11, 2023. https://en.wikipedia.org/wiki/2022_Pakistan_floods#:~:text=From%2014%20June%20to%20October,15.2%20billion)%20of%20economic%20losses.

World Bank. May 02, 1980. *Memorandum on Morocco's Agricultural Sector: Identification of Issues and Bank Strategy*. Report No.2667a-MOR. https://documents1.worldbank.org/curated/en/114101468280177392/pdf/multi-page.pdf

World Bank. June 1995. *Kingdom of Morocco: Water Sector Review*. Report No. 14750-MOR. https://documents1.worldbank.org/curated/en/593081468756981890/text/multi-page.txt

World Bank (on behalf of the Commission on Growth and Development). 2008. *The Growth Report: Strategies for Sustained Growth and Inclusive Development*. Report # 44986. https://openknowledge.worldbank.org/server/api/core/bitstreams/df194a38-cb6f-5553-8fd8-e48a8a7c9574/content

World Bank Group (WBG) Nov 2017. *Managing Urban Water Scarcity in Morocco.* Water Global Practice. https://openknowledge.worldbank.org/bitstream/handle/10986/29190/122698-WP-P157650-Summary-Report-Urban-water-scarcity-in-Morocco-ENG-P157650-2017-12-25-04-12.pdf?sequence=1&isAllowed=y

World Bank Group (WBG) June 2018. *Kingdom of Morocco: Governing towards efficiency, equity, education and endurance: A Systematic Country Diagnostic*. https://openknowledge.worldbank.org/bitstream/handle/10986/29929/123653.pdf?sequence=5&isAllowed=y

World Bank. March 30, 2001. *Kingdom of Morocco Poverty Update*. In 2 vol. Main report. Report # 21506-MOR. https://documents1.worldbank.org/curated/en/863701468756995460/pdf/Main-report.pdf

World Bank. January 18, 2019. *Country Partnership Framework for The Kingdom of Morocco, for the period FY19-24.* Report No. 131039-MA. https://documents1.worldbank.org/curated/en/101781550869524206/pdf/Program-Document-Morocco-CPF-P166669-01252019-636865562861022997.pdf

World Bank Group (WBG). 2021. *Morocco: Climate Risk Country Profile*. https://climateknowledgeportal.worldbank.org/sites/default/files/2021-09/15725-WB_Morocco%20Country%20Profile-WEB.pdf

World Bank. April 14, 2022. Morocco's Economic Update. https://www.worldbank.org/en/country/morocco/publication/economic-update-april-2022#:~:text=Outlook,a%20faster%20recovery%20of%20tourism.

World Bank. Spring 2022. *Morocco Economic Monitor: The Recovery is Running Dry*. https://documents1.worldbank.org/curated/en/099529307192239926/pdf/IDU020d792070df4a04e830957f0f9fd56c0f71e.pdf

World Bank. Oct. 2022. Morocco Jobs Programmatic Policy Note Overview. https://documents1.worldbank.org/curated/en/099620310212237340/pdf/P1710000a1d8b50d0800c0ca144ae2d8ae.pdf

World Bank Group (WBG). October 2022. *Morocco Country Climate and Development Report.* https://openknowledge.worldbank.org/bitstream/handle/10986/38240/Morocco_CCDR.pdf?sequence=13&isAllowed=y

World Bank. Jan 2023. *Global Economic Prospects.* A World Bank Group Flagship Report https://openknowledge.worldbank.org/bitstream/handle/10986/38030/GEP-January-2023.pdf

World Development Indicators (WDI). Irrigated land % of total agricultural land in Morocco (2004-2019). https://data.worldbank.org/indicator/AG.LND.IRIG.AG.ZS?locations=MA

WDI. GNI/Cap Atlas Method (Current $). https://data.worldbank.org/indicator/NY.GNP.PCAP.CD

WDI. Youth (15-24) as % of total Moroccan population (2012). https://data.worldbank.org/indicator/SL.UEM.1524.ZS?locations=MA

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