Istituto Affari Internazionali

The Food-Energy Nexus and Italy–Morocco Cooperation

by Michaël Tanchum

New-Med research network

ABSTRACT

The unwinding of global food production chains due to the combined shocks of Covid-19 and the war on Ukraine, made worse by the impact of climate change on the food-water-energy nexus, will require the six nations of the western Mediterranean – Morocco, Algeria, Tunisia, Spain, France and Italy – to develop new forms of economic cooperation. An Italy–Morocco partnership on green energy food production can be a model for resilient food production chains. Italy has set a precedent for such a cross-cutting partnership through the successful integration of Italian firms into Morocco's automotive manufacturing ecosystem. Italian participation in Morocco's production of green hydrogen and its derivative green ammonia would help render fertilisers, a fundamental component of food production, more resilient against natural gas supply shocks. Utilising the commercial symbiosis between Italy's agricultural food production industry and Morocco's emerging green energy food production ecosystem, cooperation in green fertiliser production could serve as a springboard for deeper Italian-Moroccan cooperation in the development of sustainable and resilience food production value chains in the western Mediterranean.

Italy | Morocco | Agriculture | Food security

keywords

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The Food-Energy Nexus and Italy–Morocco Cooperation

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Introduction

The combined impact of climate change-driven pressures on the food-water-energy nexus and the accelerated unwinding of global supply chains in the wake of Covid-19 and the war in Ukraine will require new forms of economic cooperation among western Mediterranean nations to ensure food security across the region. The abundant solar and wind resources and ample mineral reserves for fertilisers on the western Mediterranean's southern shore provide enormous potential. These can promote robust trans-Mediterranean values chains for food production powered by renewable energy and using green hydrogen-derived fertilisers in conjunction with climate-smart, innovative agro-technologies (agro-tech). The way the six countries of the region – Spain, France, Italy, Morocco, Algeria and Tunisia – manage their partnerships to expand trans-Mediterranean commercial connectivity will determine the extent to which resilient and sustainable food production value chains can be established. Within this constellation of actors, the Morocco–Italy relationship can play a critical role, in the process also helping to re-launch wider forms of Euro-Mediterranean cooperation and integration.

To realise the western Mediterranean's potential to become a hub for green energy food production requires cooperation that can bridge political and economic divisions in the region. Private-sector investment and joint ventures in these industries, facilitated by public-private partnerships can create new patterns of commercial connectivity across the western Mediterranean that cut across traditional dividing lines between Atlantic and central Mediterranean coastal states.

* Michaël Tanchum teaches at Universidad de Navarra and is a non-resident fellow in the Economics and Energy Program at the Middle East Institute (MEI) in Washington and is senior fellow at the Austrian Institute for European and Security Policy (AIES). The author would like to thank Maria Victoria Andarcia, Matilde Romito and Rocco Schwerfel for their research assistance.

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An important example of such cross-cutting investment has been the successful integration of Italy's automotive firms into Morocco's automotive manufacturing sector, contributing to the establishment of a highly robust trans-Mediterranean manufacturing value chain. During the 2022 supply shocks to the automotive sector brought about by the Russian invasion of Ukraine, Italian firms operating factories in Morocco played a crucial role in helping to ensure trans-Mediterranean supply-chain resilience. Building on this experience of private-sector collaboration, enhanced Italy–Morocco cooperation in renewable energy, green hydrogen driven fertiliser production and agro-tech can act as an engine to develop innovative, efficient and sustainable food production value chains in the western Mediterranean.

1. The western Mediterranean food-energy nexus: Ensuring fertiliser supply chain resilience

At its most basic of levels, the food-water-energy nexus begins with plants that combine sunlight with water and minerals to create edible forms of energy for animal and human consumption. To achieve this result at an industrial-scale requires ample energy resources. Indeed, food production currently consumes one-third of global energy demand, with much of that stemming from the use of modern synthetic fertilisers. The use of fertilisers over the past century has produced an enormous increase in crop yields, enabling the world's population to boom from 1.8 billion to 8 billion people by November 2022. Spain, France and Italy are among the world's top ten food exporters in large part due to the availability of affordable synthetic fertilisers.[1] Fertilisers are also playing an important role in Morocco's rise as a major exporter of fruits and vegetables.

The key constituent of most synthetic fertilisers is ammonia (NH_3), composed of nitrogen and hydrogen, which provides the source of nitrogen in the mineral nitrogen fertilisers used in agriculture. Nitrogen is available from the atmosphere, while the hydrogen used to make ammonia is produced from natural gas through a process called steam methane reforming (SMR), in which methane reacts with pressurised high temperature steam. SMR produces a considerable amount of carbon dioxide that is released into the atmosphere. Hydrogen produced by this method is called "grey hydrogen" and is a major contributor to climate change. The use of SMR also means that natural gas accounts for at least 80 per cent of the variable cost of the fertiliser.[2] By November 2021, the spike in natural gas prices due to Covid-19 induced supply shocks saw the cost of producing ammonia rise to 1,000 US dollars per ton compared to 110 US dollars earlier in the year.[3] This in turn

[1] This is particularly true in Spain and Italy, which generally have poorer soil quality and fewer fresh water resources than France.

[2] Ron Sterk, "High Fertilizer Prices, Tight Supplies May Adversely Affect 2022 Acreage", in *Food Busines News*, 6 December 2021, https://www.foodbusinessnews.net/articles/20163.

[3] Ibid.

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created a commensurate price rise in mineral nitrogen fertilisers.[4]

The additional natural gas and fertiliser supply shocks that followed Russia's invasion of Ukraine created an immediate and acute food crisis that revealed fragilities in the food security systems across Mediterranean basin states. While in the early stages of the crisis the focus was mostly directed at North Africa's shortages of cereal grains and food oils, Europe also witnessed the shutdown of a significant portion of its fertiliser manufacturing and food processing capacity due to a shortage of fertilisers produced in Russia and Ukraine as well as energy price increases. On top of this, Europe also experienced a considerable drop in crop yields due to a severe drought, thus revealing the structural vulnerabilities across both shores of the Mediterranean. Europe uses mineral fertilisers for 50 per cent of its food production.[5] Two months into the war, Europe's fertiliser giant Yara shuttered two-thirds of its ammonia production, the basic constituent of mineral nitrogen fertilisers, including its plants in France and Italy.[6]

By September 2022, numerous European plants making ammonia and more complex fertilisers were forced to shut down partially or entirely due to high natural gas prices. Production halts were experienced across the European continent from Spain's Fertiberia,[7] to Germany's BASF[8] and Poland's Grupa Azoty.[9] Indicative of the structural nature of Europe's fertiliser production shutdown, BASF announced that it will permanently reduce its chemicals manufacturing capacity in Europe. During the first three quarters of 2022, BASF spent 2.2 billion euro more on natural gas for its European production sites compared to the same period in the previous year.[10] With its European production already not cost-competitive compared with its facilities outside the continent, BASF's CEO explained that "the significant increase in natural gas and power prices over the course of this year is putting pressure on chemical value chains", forcing the company to downsize in Europe "as quickly

[4] Russ Quin, "DAP Fertilizer Tops $700 Per Ton for First Time in a Decade", in *Progressive Farmer*, 22 September 2021, https://www.dtnpf.com/agriculture/web/ag/crops/article/2021/09/22/dap-fertilizer-tops-700-per-ton-time.

[5] Benjamin Fox and Eleonora Vasques, "Europe Searches for Alternatives in Fertiliser Supply Battle", in *Euractiv*, 25 August 2022, https://www.euractiv.com/?p=1798682.

[6] Yara International, *Yara Implements Further Production Curtailments in Europe*, 25 August 2022, https://www.yara.com/corporate-releases/yara-implements-further-production-curtailments-in-europe.

[7] "La crisis energética obliga a Fertiberia a parar su planta de Palos de la Frontera", in *Canal Sur*, 6 September 2022, https://www.canalsur.es/noticias/1853033.html.

[8] Ludwig Burger, "BASF Readies More Ammonia Production Cuts in Gas Supply Crunch", in *Reuters*, 27 July 2022, https://www.reuters.com/business/energy/basf-considers-more-ammonia-production-cuts-gas-supply-crunch-sources-2022-07-27.

[9] Grupa Azoty, *Grupa Azoty S.A. Temporarily Shuts Down Nitrogen Fertilizer, Caprolactam and Polyamide 6 Production Units in Consequence of Record Gas Prices*, 22 August 2022, https://tarnow.grupaazoty.com/en/news/grupa-azoty-s-a-temporarily-shuts-down-nitrogen-fertilizer-caprolactam-and-polyamide-6-production-units-in-consequence-of-record-gas-prices.

[10] Patricia Nilsson, "BASF to Downsize 'Permanently' in Europe", in *Financial Times*, 26 October 2022, https://www.ft.com/content/f6d2fe70-16fb-4d81-a26a-3afb93e0bf57.

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as possible and also permanently".[11] Despite being cited as the reason, BASF had already been working to expand its production capacity outside of Europe for several years prior to Moscow's February 2022 invasion of Ukraine, due to long-standing concerns over European energy costs and over-regulation.

Europe's shortage of fertilisers is compounded by the fact that Russia supplied about one-third of its ammonia and mineral nitrogen fertilisers prior to the war in Ukraine.[12] Before the outbreak of the war, Morocco also figured as a key European supplier, providing Europe with 41 per cent of the class of mineral nitrogen fertilisers known as phosphate fertilisers.[13] Europe's reliance on Morocco is also accompanied by political sensitivities since about 10 per cent of Morocco's phosphate income derives from the Bou Craa mine located in the disputed Sahara region, over which Europe has not recognised Morocco's claim of sovereignty.[14] Five months into the war, Europe was looking to Morocco to help fill the supply shortfall from Moscow. As the Director General of Fertilisers Europe, the European fertiliser manufacturers' trade association, explained to the press in late August 2022, "The most obvious solution is to buy more fertilisers from North Africa – particularly Morocco".[15]

On the Mediterranean's southern shore, pressure on fertiliser supplies is similarly acute in Tunisia and Algeria. The price of Tunisia's domestically produced fertiliser rose by over 90 per cent during the 2021–22 cropping season compared to the previous year, causing 5 per cent drop in the area sown for Tunisia's 2022 wheat crop and 15 per cent drop in the area sown for its 2022 barley crop.[16] Although Algeria is rich in natural gas and phosphates, two of the main resources used in mineral nitrogen fertiliser manufacturing, fertiliser use in the country is far lower than that of its neighbours. Using 2019 as a pre-pandemic baseline, fertiliser consumption for Algerian agriculture was 20.7 kilograms (kg) per hectare of arable land, compared to 56.7 kg in Tunisia and 65.3 kg in Morocco.[17] To address this shortfall, Algeria's state-owned energy company Sonatrach signed an agreement in 2018 with China's CITIC Construction to build a 6 billion US dollars integrated phosphate production complex.[18] Once operational, the facility would see Algeria's annual phosphate output rise to 10 million metric tons, resulting in increased

[11] Ibid.

[12] Benjamin Fox and Eleonora Vasques, "Europe Searches for Alternatives", cit.

[13] OCP Group, *Sustainability Report 2020*, August 2021, p. 34, https://ocpsiteprodsa.blob.core.windows.net/media/2021-08/OCP-Sustainability_report_2020.pdf.

[14] Alex Kasprak, "The Desert Rock that Feeds the World", in *The Atlantic*, 29 November 2016, https://www.theatlantic.com/science/archive/2016/11/the-desert-rock-that-feeds-the-world/508853.

[15] Benjamin Fox and Eleonora Vasques, "Europe Searches for Alternatives", cit.

[16] UN Food and Agriculture Organization, "Tunisia", in *GIEWs Country Briefs*, 27 July 2022, https://www.fao.org/giews/countrybrief/country.jsp?code=TUN.

[17] World Bank Data: *Fertilizer Consumption (kilograms per hectare of arable land) Algeria, Tunisia, Morocco*, https://data.worldbank.org/indicator/AG.CON.FERT.ZS?locations=DZ-TN-MA.

[18] "Algeria, China Sign Pacts Ahead of 6-bln-USD Mega Phosphate Project", in *Xinhua*, 27 November 2018, http://www.xinhuanet.com/english/2018-11/27/c_137633212.htm.

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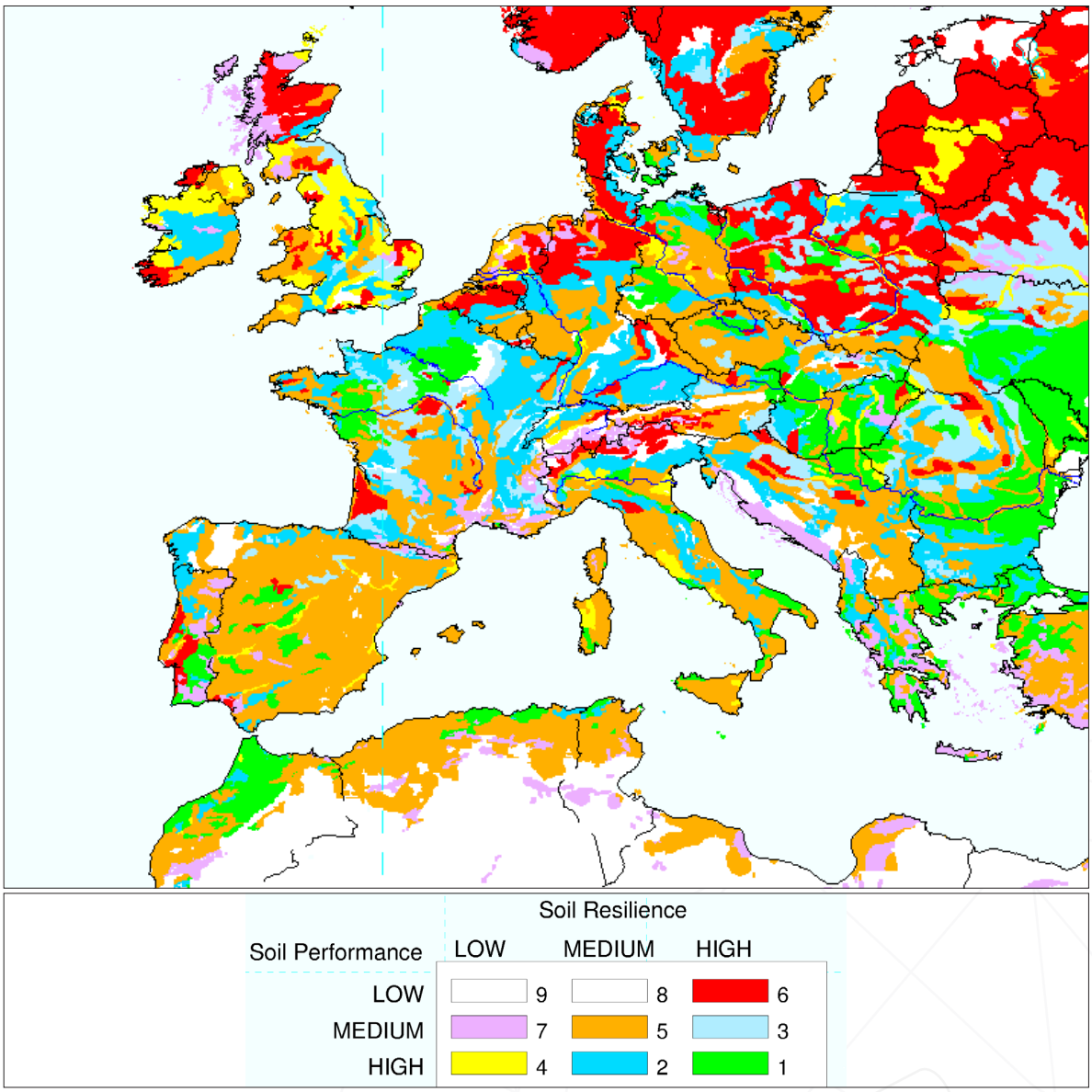
annual nitrogen phosphorus fertiliser output worth around 2 billion US dollars at pre-pandemic price levels. Use of this domestically produced fertiliser would help boost Algeria's crop yields in the future.

Figure 1 | Soil quality in the western Mediterranean



Source: Tim Kettler, "Soil Genesis and Development, Lesson 6 - Global Soil Resources and Distribution", in *Plant and Soil Sciences e-Library*, 2015, http://passel.unl.edu/Image/mmamo3/TimKettler/InhLandQual/LandQualityAll-Opt-Large.gif.

Fertiliser use is the immediate key to increasing food production yields, particularly in the Maghreb, where there is significantly less arable land and climate change-driven heat and drought conditions have caused soil degradation. It is also essential to maintain the comparatively high levels of agricultural output in the countries on the western Mediterranean's northern shores, whose fertiliser consumption

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dwarfs that of its Maghreb partners. Using 2019 again as the baseline year for comparison, consumption of fertiliser per hectare of arable land in Spain was 157.5 kg while France used 156.7 kg and Italy used 128 kg,[19] two to seven times more than that used in the Maghreb nations.

The China–Algeria fertiliser partnership serves as a cautionary tale that European leadership in the future development of trans-Mediterranean food production value chains is not geographically preordained. European nations currently constitute the major consumer end-markets for the phenomenon of nearshoring across variety of industrial sectors. The emergence of sub-Saharan Africa's urban regions as important consumer end-markets is positioning Maghreb nations as economic and political gatekeepers of newly emerging Euro-African commercial corridors.[20] The lower costs of operations and positive demographic growth curve of the workforce-aged population have incentivised China, Turkey and the Arabian Peninsula states to also increase their manufacturing presence in the Maghreb to service both European and African markets.[21] That European firms will play a leading role in the configuration of western Maghreb-to-western Europe food production value chains should not be taken as foregone conclusion.

2. Climate change and the food-water-energy nexus in the western Mediterranean

The fragilities in western Mediterranean food systems are not temporary but reflect structural vulnerabilities in the food-water-energy nexus that are, in large measure, caused by the debilitating effects of climate change-driven severe weather events and extreme water stress. The stark decline in Russian natural gas supplies and Russian-made natural gas-derived fertilisers to Europe ultimately points to the need for food production systems that move beyond the use of fossil fuels and toward renewable energy sources and green hydrogen-derived fertilisers.

The pressures on the food-water-energy nexus are further compounded by the western Mediterranean's growing water scarcity. Tunisia's agriculture is extremely vulnerable to extreme weather events as about 80 per cent of the nation's poorly managed water resources are used for agriculture.[22] Record high temperatures combined with alternating bouts of drought and torrential floods

[19] World Bank Data: *Fertilizer Consumption (kilograms per hectare of arable land) Spain, France, Italy*, https://data.worldbank.org/indicator/AG.CON.FERT.ZS?locations=ES-FR-IT.

[20] Michaël Tanchum, "Europe–Africa Connectivity Outlook 2021: Post-Covid-19 Challenges and Strategic Opportunities", in *IAI Papers*, No. 21|20 (May 2021), https://www.iai.it/en/node/13326.

[21] Michaël Tanchum, "Turkey's Maghreb–West Africa Economic Architecture: Challenges and Opportunities for the European Union", in *CATS Working Papers*, No. 3 (June 2021), https://www.swp-berlin.org/en/publication/turkeys-maghreb-west-africa-economic-architecture-challenges-and-opportunities-for-the-european-union.

[22] Layli Foroudi, "Thirsty Crops, Leaky Infrastructure Drive Tunisia's Water Crisis", in *Reuters*, 1 November 2019, https://reut.rs/2WwDrpr.

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have significantly degraded the soil. Drought has also caused a chronic decline in Tunisia's water reserves. In September 2021, water volumes in Tunisia's dams were 34 per cent lower compared to the same period in 2020.[23] Drought is also contributing to increased silting in Tunisia's dams, further reducing the country's water storage capacity. By 2035, Tunisia's dams in Mellègue and R'mili will become completely silted.[24] Tunisia will have to implement a variety of remedial measures to cope with the crisis, including the construction of energy-intensive sea water desalination plants to ensure its future water supply and food production. Without significant natural gas reserves, Tunisia's use of sea water reverse osmosis (SWRO) desalination plants will require sizeable investments in power generation from renewable energy sources, as SWROs require 10 times the amount of energy to produce the same volume of water as conventional surface water treatment.

Conditions in Algeria are even more dire. Algeria has the Maghreb's lowest annual rainfall, registering only 62 mm in 2021,[25] about 2.5 time less than what Morocco receives and about 10 times less than what Italy receives by comparison. Alarmingly, Algeria's fresh groundwater withdrawal rate exceeds the annual recharge rate by over 600 per cent.[26] Similarly to Tunisia, Algeria's dams are heavily impacted by siltation and contamination. Utilising its abundant natural gas reserves, Algeria has already turned to SWRO desalination technology, rehabilitating and upgrading four of its existing plants[27] and planning to build an additional three.[28] Between the competing demand pressures placed on natural gas for desalination, fertiliser production, other industrial uses and domestic power generation as well as vital export revenues, Algeria will also need to turn to renewable energy for sustainable food production systems.

Morocco faces similar conditions but has been far more pro-active in addressing the sustainability of its food production because of its long-term strategy for expanding its high-value agricultural export sector. This strategic objective was significantly advanced by Rabat's 2010–2020 Green Morocco Plan (*Plan Maroc Vert*, PMV), which has resulted in Morocco's agri-food sector now accounting for 21 per cent of its exports.[29] Morocco is expanding on its PMV with a new 10-year initiative called Green Generation 2020–2030 intended to enhance

[23] "Water Stock in Dams Down to 722.8 Million Cubic Meters", in *Tunisie Afrique Presse*, 17 September 2021, https://www.tap.info.tn/en/Portal-Economy/14394669.

[24] "ONAGRI: Deux barrages seront totalement évasés en 2035 si rien n'est fait", in *La Presse de Tunisie*, 21 August 2021, https://wp.me/paSHqw-rMs.

[25] Trading Economics: *Algeria Average Precipitation*, https://tradingeconomics.com/algeria/precipitation.

[26] Food and Agriculture Organization of the United Nations (FAO) ACQUASTAT database.

[27] Inès Magoum, "Algeria: 4 Desalination Plants to be Reactivated between June and August 2021", in *Afrik 21*, 18 June 2021, https://wp.me/p9KwTe-8Fl.

[28] Inès Magoum, "Algeria: Three Seawater Desalination Plants to Be Constructed Soon", in *Afrik 21*, 12 May 2020, https://wp.me/p9KwTe-5qq.

[29] European Training Foundation (ETF), *The Future of Skills. A Case Study of the Agri-Food Sector in Morocco, Summary Note*, 2021, https://www.etf.europa.eu/en/node/7097.

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the resilience and sustainability of the country's agricultural production.[30] To mitigate its vulnerability to the impact of climate change, Morocco's 40 billion US dollars National Water Plan 2020–2050, includes the construction of more SWRO desalination plants that will ultimately require new power generation capacity from renewable energy sources.[31]

The extreme pressures on the food-water-energy nexus are not confined to the southern shores of the western Mediterranean. The nations on the northern shores are also increasingly experiencing the debilitating impact of climate change on food production. One of the most striking examples was the summer 2022 drought that brought Italy's Po River to record lows, directly impacting 40 per cent of Italy's food production and 55 per cent of its hydroelectric power generation, in turn contributing to even higher costs for food production.[32] The severity of the drought in Italy's northern agricultural heartland, which then Prime Minister Mario Draghi declared was "undoubtedly" linked to climate change,[33] led Rome to declare a 6-month state of emergency in Emilia-Romagna, Friuli-Venezia Giulia, Lombardy, Piedmont and Veneto regions, while providing 36.5 million euro to producers in the affected localities.[34] Coldiretti, Italy's national farmers' association, has estimated the damage to Italy's agricultural sector at 3 billion euro.[35]

Food security is necessitating an increased inter-dependence between western Europe and the western Maghreb to achieve supply chain resilience for both regions. The development of new food production value chains requires climate-smart, innovative agro-tech powered by green energy. With its abundant solar and wind energy resources, tremendous green hydrogen/green ammonia potential and ample mineral reserves for fertilisers, the southern shore of the western Mediterranean possesses promising potential to be a locus of production at all stages of the value chain from the soil up. Morocco's Green Generation 2020–2030 plan to transition to sustainable and resilient industrial-scale agriculture through renewable energy and green hydrogen points to the larger possibilities for the region.

A consensus has been emerging among European actors about the importance of enhancing Europe–North Africa connectivity and value chains, as reflected in

[30] "Morocco's King Launches 'Green Generation 2020-2030'", in *Asharq al-Awsat*, 15 February 2020, https://english.aawsat.com/node/2132676.

[31] Morocco Government, *Head of Government: 2020-2050 National Water Plan, Roadmap to Face Challenges for Next 30 Years*, 25 December 2019, https://www.maroc.ma/en/news/head-government-2020-2050-national-water-plan-roadmap-face-challenges-next-30-years.

[32] Paolo Santalucia, "As Po Dries Up, Italy's Food and Energy Supplies are at Risk", in *AP News*, 17 June 2022, https://apnews.com/article/e0274e5f2b4dd6bb2854cc7a970f75f6.

[33] Federica Marsi, "Farmers Watch Crops Wither Amid Italy's Worst Drought in 70 Years", in *Al Jazeera*, 14 July 2022, https://aje.io/cdmyep.

[34] "Italy Declares State of Emergency in Five Regions over Drought", in *Al Jazeera*, 5 July 2022, https://aje.io/kbk3au.

[35] Federica Marsi, "Farmers Watch Crops Wither Amid Italy's Worst Drought in 70 Years", cit.

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the European Union's 2021 Global Gateway strategy and follow-up initiatives,[36] as well as individual member state initiatives such as Spain's 2020 *Horizonte África* strategy.[37] It is in this context, that an Italy–Morocco partnership can offer great potential to develop green energy and innovative food production value chains. A model for such cooperation is found in the example of Italy's partnership with Morocco in developing trans-Mediterranean automotive manufacturing value chains.

3. Italy–Morocco value chain integration: Examples from the automotive industry

Italy's integration into Morocco's automotive manufacturing sector has played, and continues to play, an important role in the advance of the Moroccan automotive industry. In this, it serves as an outstanding example of how Italy–Morocco cooperation can play a vital role in maintaining trans-Mediterranean supply-chain resilience. Automotive products, both vehicles and parts, comprise Morocco's largest category of exports to Italy, constituting 33 per cent of overall exports to Italy prior to Russia's invasion of Ukraine.[38] Morocco's automotive manufacturing ecosystem[39] revolves primarily around the factories of French automakers Renault and Peugeot (formerly Groupe PSA and now part of Stellantis along with Italian automaker Fiat) supported by approximately 200 international suppliers operating their own local manufacturing plants, about 10 per cent of which are Italian firms.

The rise of Morocco's automotive sector was facilitated by Rabat's 2014–2020 Industrial Acceleration Plan (*Plan d'accélération industrielle*), which, along with Rabat's concurrent development of high-speed, high-volume capacity transportation, incentivised foreign automotive manufacturers to locate their plants in Morocco. Almost all of the Italian firms operating in Morocco established plants during this period, with some even creating a second or third production facility. The Italian wiring harness company SEWS Cabind, now owned by Japan's Sumitomo, is one of the Italian firms with the largest operations in Morocco. SEWS Cabind's Moroccan plants primarily supply the factories of Fiat Chrysler (now part of the Stellantis conglomerate) abroad.[40] Headquartered in Collegno near Turin, the company's three Moroccan production sites have a combined workforce of

[36] Michaël Tanchum, "Europe's Winning Formula for Spending €150 Billion in Africa", in *Euractiv*, 15 February 2022, https://www.euractiv.com/?p=1712351.

[37] Spanish Ministry of Industry, *Directrices de la estrategia Horizonte África*, July 2020, https://www.mincotur.gob.es/en-us/actuaciones_institucionales/paginas/estrategia-horizonte-africa.aspx.

[38] Observatory of Economic Complexity (OEC) website: *Italy/Morocco*, https://oec.world/en/profile/bilateral-country/ita/partner/mar.

[39] Michaël Tanchum, "Morocco's Africa-to-Europe Commercial Corridor: Gatekeeper of an Emerging Trans-Regional Strategic Architecture", in *AIES Fokus*, No. 8/2020 (July 2020), https://www.aies.at/publikationen/2020/fokus-20-08.php.

[40] Sumitomo Electric, *Sews-Cabind Maroc Ain Harrouda*, 2015, https://sumitomoelectric.com/sustainability/csr/feature/2015/sews-cabind.

ISSN 2610-9603 | ISBN 978-88-9368-286-2

6,340 Moroccans.[41]

Morocco's importance in wiring harness manufacturing has recently come to the fore for helping to preserve automotive supply chains following the sudden shutdown of Ukraine's automotive wiring harness manufacturing plants due to Russia's 2022 invasion. A wiring harness bundles wires in a protective housing to optimise space and protect a vehicle against electrical fires and short circuits that could result from vibrations and abrasions. More vital than semiconductors, no passenger car or commercial vehicle can be built without wiring harnesses. The inability of Ukraine's factories to produce wiring harnesses led to a shortage that forced global manufacturers, particularly those in Europe from Volkswagen to Ford, to cut production.[42] European automakers looked to the wiring harness plants in nearby Morocco to fill the supply shortfall, among which the Moroccan factories of the Italy's SEWS Cabind played a central role.

Similarly, the Moroccan operations of the Geneva-headquartered, French-Italian semiconductor manufacturer STMicroelectronics, are playing an increasingly important role in ensuring supply chain resilience for automotive microchips. In 2021, STMicroelectronics plant in Bouskoura inaugurated a new production line in Morocco to manufacture chips for US electric car pioneer Tesla,[43] a development which has in turn lead Stellantis's German auto manufacturing subsidiary Opel to begin electric vehicle (EV) production in Morocco, making the latter the first manufacturer of all-electric passenger cars in North Africa.[44] The German automaker's Rocks-e model, an upgraded version of Citroën's Ami EV microcar, is being produced in Kenitra at the plant of its sister company Peugeot (Opel and Peugeot were both part of Groupe PSA that merged with Fiat Chrysler to form the multinational conglomerate Stellantis). In 2023, Fiat will be producing a similar mini-EV at the Kénitra plant, billing it as the new electric version of its classic Topolino model (the Fiat 500 produced from 1936 to 1955), initially producing 35,000–40,000 units per year.[45]

The Moroccan factories of Lombardy-based companies Magneti Marelli, now part of the US-headquartered Marelli conglomerate, and MTA Automotive Solutions, a leading Italian company in the production of electrical and electronic automotive components, collectively employ over 1,000 Moroccans. Italy accounts for about

[41] SEWS Cabind website: *Sews-Cabind: Italy, Morocco, Poland and Albania*, http://www.sews-cabind.com/?p=750.

[42] Nathan Eddy, "Leoni Boosts Ukraine Wire Harness Output amid Risk of Russian Rocket Attacks", in *Automotive News Europe*, 23 March 2023, https://europe.autonews.com/node/403376.

[43] Michaël Tanchum, "Morocco Finds On-Ramp into EV Manufacturing through Electronic Chip Production for Tesla", in *MEI Articles*, 20 July 2021, https://www.mei.edu/node/83136.

[44] Michaël Tanchum, "Morocco's 'First in North Africa' Electric Car Production Is a European Manufacturing Gain over China", in *MEI Articles*, 3 September 2021, https://www.mei.edu/node/83366.

[45] Angel Sergeev, "Fiat Topolino to Be Resurrected as Rebranded Citroen Ami: Report", in *Automotive News*, 11 April 2022, https://www.motor1.com/news/579092/fiat-topolino-citroen-ami-report.

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10 per cent of the firms in Morocco's automotive ecosystem. While many Italian automotive component manufacturers in Morocco are smaller and generally employ 30 to 150 people, the manufacturing output of specialised components enables the robust functioning of Morocco's automotive ecosystem. Some of the better-known Italian automotive firms with production sites in Morocco include Sogefi, a leader in the manufacture of automotive filtration systems; the automotive air conditioning systems manufacturer Denso Thermal Systems; and Fustellatura Guarnizioni Industriali Srl, commonly known as FGI, which specialises in the production of rubber and foam seals. Most of Italy's automotive firms operating in Morocco are headquartered either in the Piedmont region, in or near Turin, or in the Lombardy region, in or near Milan. Regional and municipal government-to-government relationships should be promoted alongside national initiatives to optimise the role of public-private partnerships in expanding Italy–Morocco cooperation beyond the automotive sector to Morocco's ecosystems engaged in green energy and food production.

4. Italy–Morocco green hydrogen cooperation: A foundation for western Mediterranean food production value chains

The creation of fertiliser manufacturing value chains using renewable energy and green hydrogen are essential for the establishment of sustainable and resilient food production value chains in the western Mediterranean. One of the highest priorities in this domain is transitioning fertiliser production from using ammonia synthesised from natural gas-derived grey hydrogen to ammonia synthesised from green hydrogen. While Morocco has shown promising success in this endeavour, its original partners in the development of green hydrogen and green ammonia manufacturing have come from outside the western Mediterranean. Yet, more recently in 2021, western Mediterranean actors also entered the fray. The Italian multinational oil and natural gas services company Saipem and Italy-based Alboran Hydrogen signed a memorandum[46] in March for the joint construction of five green hydrogen production plants in Morocco, specifically for the production of green ammonia.[47]

Morocco's rise as a global leader in green hydrogen was prompted by the objective to use its derivative green ammonia to supply its massive fertiliser industry. Operated by the state-owned company OCP (formerly *Office Chérifien des Phosphates*), Morocco is now the world's fourth largest fertiliser exporter, following Russia, China and Canada.[48] OCP specialises in the production of nitrogen phosphorus

[46] Saipem, *Saipem and Alboran Hydrogen Together for Green Hydrogen Production in Italy and the Mediterranean*, 4 March 2021, https://www.saipem.com/en/node/1086.

[47] Modeste Kouamé, "Production d'hydrogène vert Saipem et Alboran Hydrogen s'activent", in *Les Eco*, 15 March 2021, https://leseco.ma/?p=174870.

[48] Michaël Tanchum, "Morocco - a Top Fertiliser Producer - Could Hold a Key to the World's Food Supply", in *The Conversation*, 10 July 2022, https://theconversation.com/morocco-a-top-fertiliser-

ISSN 2610-9603 | ISBN 978-88-9368-286-2

fertilisers, as Morocco possesses over 72 per cent of the world's phosphate rock reserves from which the phosphorus used in these fertilisers is derived.[49] OCP's total revenue in 2020 amounted to 5.94 billion US dollars,[50] accounting for about 20 per cent of the Morocco's export revenues.[51]

While Morocco has abundant phosphorus reserves, its lack of natural gas places a limiting factor on the resilience of its fertiliser production, which requires nitrogen-rich ammonia, now produced from natural gas-derived grey hydrogen, to make nitrogen phosphorus fertilisers. For example, diammonium phosphate or DAP $(NH_4)_2HPO_4$, the most popular type of phosphorus fertiliser worldwide, is produced from the reaction phosphoric acid (H_3PO_4) and ammonia (NH_3). Without domestic natural gas production, OCP needed to import 1.5 to 2 million tons of ammonia per year to meet its production requirements prior to the outbreak of the war in Ukraine.[52] Since the war, OCP has eyed a 58 per cent increase in its production capacity to fill European and global fertiliser supply shortfalls.[53]

To create sustainable and resilient production, Morocco will ultimately need to replace part or all of its imported ammonia made from grey hydrogen with "green ammonia" synthesised from green hydrogen produced using its domestic renewable energy resources. In contrast to natural gas-derived grey hydrogen, green hydrogen is produced by using electricity generated from renewable sources to split water (H_2O) into its hydrogen (H_2) and oxygen (O) components, creating carbon-free (hence, "green") hydrogen.

The majority of green hydrogen's production costs, about 70 per cent, come from the electricity required to split water into its hydrogen and oxygen components and could be powered by Morocco's solar energy and wind energy resources. Germany became Morocco's first foreign partner in the development of green hydrogen production when OCP signed a 2018 cooperation agreement with the Fraunhofer Institute to develop a pilot green hydrogen manufacturing project in Benguerir in partnership with Morocco's Institute for Research in Solar Energy and New Energies (IRESEN).[54] Replicating the institute's pilot plant in Germany, the Benguerir plant is slated to include a green ammonia synthesis unit for annual

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[49] Statista: *Phosphate Rock Reserves Worldwide in 2021, by Country*, January 2022, https://www.statista.com/statistics/681747.

[50] OCP Group, *Sustainability Report 2020*, cit., p. 14.

[51] Fitch Ratings, *Fitch Revises Outlook on OCP to Stable; Affirms at 'BB+'*, 28 October 2020, https://www.fitchratings.com/research/corporate-finance/fitch-revises-outlook-on-ocp-to-stable-affirms-at-bb-28-10-2020.

[52] Julie Chaudier, "Will Hydrogen Fuel Morocco's Industrial Projects of the Future?", in *The Africa Report*, 6 September 2021, https://www.theafricareport.com/124184.

[53] "Exportations d'engrais: une double opportunité pour le Maroc", in *Médias24*, 5 June 2022, https://medias24.com/2022/06/05/engrais-une-double-opportunite-pour-le-maroc.

[54] Trevor Brown, "OCP's Green Ammonia Pilot Plant, and the African Institute for Solar Ammonia", in *Ammonia Energy Association Articles*, 17 August 2018, https://www.ammoniaenergy.org/?p=3213.

ISSN 2610-9603 | ISBN 978-88-9368-286-2

production capacity of 1,460 tons of green ammonia, but with the potential for up to 600,000 tons per year with capacity expansion.[55]

Upon Germany's promulgation of its "German National Hydrogen Strategy" in June 2020,[56] Morocco became the first country to sign a green hydrogen agreement with Berlin to create Africa's first industrial plant for green hydrogen production using Morocco's solar power infrastructure.[57] This second green hydrogen plant is managed by the Moroccan Agency for Solar Energy (Masen), Morocco's privately owned, publicly funded integrated renewable energy projects company, and is financed by the German development bank KfW.[58] Masen spearheaded the development of Morocco's massive Noor solar power complex, the world's largest solar power facility, having received 830 million euro (about 934 million US dollars) in German financing facilitated by KfW, amounting to 41.5 per cent of the investment total.[59] While important for Morocco's green hydrogen and green ammonia ecosystems, these two projects have been conducted within a development aid framework and have faced political setbacks due to a political row over Berlin's posture toward Rabat's autonomy plan for the Sahara region until Germany's February 2022 political reconciliation with Morocco that was confirmed with the 25 August 2022 visit of Germany's foreign minister to Rabat.[60]

The leading project in Morocco is an 850 million US dollar green ammonia plant being developed by the Ireland-headquartered hydrogen technology firm Fusion Fuel using its HEVO proprietary technology with the Athens-based Middle East construction company Consolidated Contractors building the installation. Diversifying its partners, Morocco announced the launching of its HEVO Ammonia Morocco project in July 2021, three months after the rupture in relations with Germany.[61] Morocco's largest green ammonia and green hydrogen project to date, the HEVO facility is slated to produce 183,000 tons of green ammonia per year by 2026, equivalent to about 10 per cent of OCP's 2021 production input requirements.

The Netherlands is the world's second largest food exporter and as a large consumer of fertiliser, the Dutch have also entered Morocco's green ammonia ecosystem. The Geneva-headquartered Dutch energy and commodity trading giant Vitol has

[55] OCP Group, *Sustainability Report 2020*, cit., p. 132.

[56] Federal Government, *The National Hydrogen Strategy*, June 2020, https://www.bmwk.de/Redaktion/EN/Publikationen/Energie/the-national-hydrogen-strategy.pdf.

[57] Morocco Government, *Morocco, Germany Sign Green Hydrogen Cooperation Agreement*, 10 June 2020, https://www.maroc.ma/en/news/morocco-germany-sign-green-hydrogen-cooperation-agreement.

[58] Julie Chaudier, "Will Hydrogen Fuel Morocco's Industrial Projects of the Future?", cit.

[59] Oliver Ristau, "Solar Power from the Desert", in *KfW Stories*, updated 27 October 2021, https://www.kfw.de/stories/environment/renewable-energy/solarstrom-aus-der-wueste.

[60] "German Foreign Minister Visits Morocco after Diplomatic Row", in *Deutsche Welle*, 25 August 2022, https://www.dw.com/en/a-62923298.

[61] "Morocco, Germany Renew Ties after 'Misunderstandings'", in *Euractiv*, 16 February 2022, https://www.euractiv.com/?p=1713684.

ISSN 2610-9603 | ISBN 978-88-9368-286-2

signed a memorandum to manage offtake from the HEVO project to market green ammonia in Europe and other nearby markets.[62] On 25 August 2022, Netherlands-based green ammonia company Proton Ventures secured financing from a Dutch investment firm to build a green ammonia plant in Jorf Lasfar port.[63] The investment was backed by a loan guarantee from the Dutch credit export agency Atradius DSB. The pilot green ammonia plant will have an annual production capacity of 1,460 tons,[64] the same as the delayed Fraunhofer Institute project in Benguerir.

In this context, the actualisation of the 2021 Saipem-Alboran agreement to construct and operate a green hydrogen plant in Morocco to feed green ammonia and fertiliser production is critical for setting the direction of Italy–Morocco green energy cooperation. The geography of natural gas deposits in the Maghreb has led Italian energy diplomacy to naturally focus on Algeria, with Italian energy major Eni being the leading foreign partner of Algeria's Sonatrach. The relationship deepened further on 26 May 2022 when the two companies agreed to boost Algerian piped gas sent to Italy by 10 per cent to help Italy diversify from Russian supplies.[65] Saipem is under the "joint control" of Eni (a 31.19 per cent shareholder) and CDP Industria (12.82 per cent), the holding company of Italian investment bank Cassa Depositi e Prestiti.[66] Thus, the Saipem-Alboran green hydrogen project in Morocco represents an important opportunity to rebalance Italian energy diplomacy in the Maghreb, bringing it into congruence with manufacturing relationship that Rome and Rabat have developed through the automotive sector. Such a development would advance the progress already achieved by Rome in its involvement in Morocco's renewable energy sector, specifically wind power. In 2019, Enel Green Power (EGP), the renewable energy subsidiary of Italy's multinational power giant Enel, signed a research and development cooperation agreement with Morocco's IRESEN.[67] EGP operates two wind power plants in Morocco and is constructing a third that will bring the company's EGP's total wind power capacity in Morocco to 807.8 MW.[68] Since Italy's Ministry of Economy and Finance is the largest shareholder

[62] Ruth Sharpe, "Morocco Outlines Plans for New Green Ammonia Project", in *Argus Media*, 20 July 2021, https://www.argusmedia.com/en/news/2235820-morocco-outlines-plans-for-new-green-ammonia-project.

[63] Yahya Benabdellah, "Le projet pilote de production d'ammoniac vert ouvre de grandes perspectives pour le Maroc", in *Medias24*, 4 September 2022, https://medias24.com/2022/09/04/le-projet-pilote-de-production-dammoniac-vert-ouvre-de-grandes-perspectives-pour-le-maroc.

[64] Proton Ventures, *UM6P and Proton Ventures Sign an Agreement for the Construction of the Green Ammonia Pilot in Jorf Lasfar*, 25 July 2021, https://protonventures.com/?p=2063.

[65] Eni, *New Agreement Reached by Sonatrach and Eni to Accelerated the Development of Gas Projects and Decarbonization via Green Hydrogen*, 26 May 2022, https://www.eni.com/en-IT/media/press-release/2022/05/new-agreement-eni-sonatrach-gas-development-green-hydrogen-draghi-tebboune.html.

[66] Saipem website: *Saipem's Main Shareholders and Share Capital*, https://www.saipem.com/en/investor-relations/shareholders.

[67] Enel Green Power, *A New Partner in Developing Renewable Resources in Morocco: A Cooperation Agreement Has Been Signed with IRESEN*, 26 September 2019, https://www.enelgreenpower.com/media/news/2019/09/development-renewables-morocco-iresen.

[68] Enel Green Power, *Morocco*, last update 30 September 2022, https://www.enelgreenpower.com/countries/africa/morocco.

ISSN 2610-9603 | ISBN 978-88-9368-286-2

in EGP's parent company Enel,[69] the collaboration already served as an indication of Rome's commitment to deepen its green energy relationship with Rabat.

How quickly Morocco actually replaces the grey ammonia in its fertiliser manufacturing with climate-friendly green ammonia will depend on several factors including Morocco's foreign investment partnerships. Ultimately, the sustainability of Morocco's fertiliser industry will require considerable capital expenditures to develop its nascent green ammonia sector and the additional power generation capacity from renewable energy sources that it requires. The participation of Morocco's western Mediterranean partners France, Spain and Italy can accelerate this process. For Rome, deepening its involvement in Morocco's renewable energy and green hydrogen sectors provides an important opportunity to chart a new course for its post-fossil fuel energy diplomacy in the western Mediterranean, while remaining complimentary with broader EU priorities and decarbonisation pledges.

5. Italy–Morocco partnership for sustainable and resilient food production

The regionalisation of food production as part of the unwinding and nearshoring of global value chains requires Italy–Morocco green hydrogen cooperation to be placed within a wider strategic framework. This should integrate value chains for the production of food exports while ensuring improved supply chain resilience. Italy is the world's tenth largest agricultural food exporter and is becoming increasingly dependent on Moroccan-manufactured fertilisers to maintain its export levels.[70] Fertilisers now constitute one of the fastest-growing Moroccan exports to the Italian market.[71] For its part, Morocco has been significantly increasing its own agricultural exports to Europe and beyond. In 2021, Morocco was the world's fourth largest exporter of tomatoes, expanding in key markets in Europe.[72] For example, Morocco has emerged as the United Kingdom's second largest supplier of tomatoes in the post-Brexit period. Between January and November 2021, the UK reduced its tomato purchases from Spain by about 24 per cent while tomato imports from Morocco rose by almost 34 per cent.[73] A similar phenomenon is occurring with Moroccan citrus and berry exports to Europe.

[69] Enel Integrated Reporting 2021: *Governance*, https://integratedreporting2021.enel.com/en/timeline/glance/governance.

[70] Humboldt, *Top 10 Agricultural Exporters*, 5 July 2018, https://humboldt.global/?p=929.

[71] OEC website: *Italy/Morocco*, cit.

[72] Daniel Workman, "Tomatoes Exports by Country", in *World's Top Exports*, last updated 6 July 2022, https://www.worldstopexports.com/tomatoes-exports-country.

[73] Safaa Kasraoui, "Moroccan Tomatoes Outperform Spain's in UK Market", in *Morocco World News*, 28 January 2022, https://www.moroccoworldnews.com/2022/01/346788/moroccan-tomatoes-outperform-spains-in-uk-market.

ISSN 2610-9603 | ISBN 978-88-9368-286-2

With the advent of expansive power generation from renewable energy sources in Morocco and positive growth rate among the Kingdom's workforce-aged population, Morocco is poised to become the locus of even more agricultural and food exports to Europe. A potential commercial symbiosis exists between Italy's agricultural food production industry and Morocco's emerging green energy food production ecosystem. The integration of Italian firms into Morocco's automotive ecosystem serves as an important precedent for Rome and Rabat to chart a path to encourage similar integration in the agricultural and food production sectors. One notable precedent within the agricultural sector itself can be found with the establishment and expansion of the Italian olive plant firm Oleaplant Group in Morocco. Founded in 1997 by an Italian investor and farmer, Oleaplant has emerged as a major international producer and exporter of olive plants, as well as one of the early leaders in Morocco's shift to intensive agriculture.[74] With a production capacity reaching 20 million olive seedlings per year, Oleaplant exports its olive plants to farmers in countries around the Mediterranean basin, the Balkans and the Middle East.

Robust engagement between the Italian and Moroccan agricultural sectors can be facilitated by public-private partnerships promoted by the appropriate platforms within a joint bilateral framework. Such a framework would also be conducive to developing cross-sectoral ventures involving companies involved in renewable energy generation, green ammonia production and food production. OCP, whose activities involve green energy, green ammonia and agricultural outreach to famers, would be positioned to play a constructive role. In addition to bilateral engagement at the national level, municipal and regional government institutions can play important supportive roles, given the regional nature of agriculture in both countries. Such agreements could be promoted between localities in Italy's agricultural regions and those of Morocco, particularly in the Souss-Massa region that traditionally accounts for the majority Morocco's vegetable and citrus fruit exports.[75]

6. Future outlook and potential

To ensure food security on both shores of the western Mediterranean, the six nations of the region – Morocco, Algeria, Tunisia, Spain, France, and Italy – will need to work together to develop sustainable food production chains based on green energy and climate-smart agro-tech. The urgency of the situation is not confined solely to the southern shore of the western Mediterranean. The unwinding of global food production chains and the climate change-driven pressures on the food-water-energy nexus mean that food production in the nations on the northern

[74] See official website: https://www.oleaplant.com/en/index.php.

[75] Souss-Massa Regional Council, *Souss Massa Region in Figures*, December 2019, https://www.soussmassa.ma/system/files_force/publicaltion_files/Région%20en%20chiffre%20Souss%20Massa%20angl%201.pdf.

ISSN 2610-9603 | ISBN 978-88-9368-286-2

shores is at risk as well. Although Spain, France and Italy remain among the world's top ten food exporters, the extreme water stress increasingly experienced in these nations combined with their dependence on fossil fuel-derived fertilisers makes their current modes of food production unsustainable. The abundant solar and wind energy resources and ample mineral reserves for fertilisers on the western Mediterranean's southern shore provide the latter with the potential to develop robust trans-Mediterranean values chains for climate-smart food production powered by renewable energy and using green hydrogen-derived fertilisers.

The creation of such resilient, green energy food production chains across the western Mediterranean means that regional cooperation needs to cut across the traditional east-west divide between Atlantic coastal states and central Mediterranean coastal states. The state of high tension between Morocco and Algeria, exacerbated by the ongoing dispute over the Sahara region, continues to serve as a central stumbling block to wider western Mediterranean cooperation. An Italy–Morocco commercial partnership in green energy food production can serve as a trailblazing relationship to create conditions conducive to breaking this impasse. Italy has already set an important precedent for such a cross-cutting partnership through the successful integration of Italian automotive firms into Morocco's automotive manufacturing ecosystem, contributing to the establishment of a highly resilient trans-Mediterranean manufacturing value chain for car production.

A foundational step would be Italian participation in Morocco's production of green hydrogen and its derivative green ammonia – both produced through renewable energy – as a way to shift from natural gas-derived fertilisers to climate-friendly fertilisers, making an essential component of food production value chains more resilient against natural gas supply or price shocks. The actualisation of the agreement between Italian firms Saipem and Alboran to construct and operate a green hydrogen plant in Morocco to feed green ammonia and fertiliser production would greatly advance Italy–Morocco cooperation in green energy food production. It would also help to rebalance Italian energy diplomacy in the Maghreb from its traditional focus on natural gas production and urgent need to transition to renewable energy. Rome and Rabat develop a platform to promote greater Italian-Moroccan cooperation in green hydrogen and green ammonia production, with an eye toward the future inclusion of other western Mediterranean nations.

Utilising the commercial symbiosis that exists between Italy's agricultural food production industry and Morocco's emerging green energy food production ecosystem, Italian-Moroccan cooperation in green fertiliser production could serve as a springboard for the integration of Italian agricultural and food production firms in Morocco's food production ecosystem in a similar manner as has occurred in Morocco's automotive manufacturing ecosystem. To this end, Rome and Rabat should consider developing a joint bilateral framework in which appropriate platforms can promote public-private partnerships that would facilitate such integration in green energy food production.

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Via dei Montecatini, 17 - I-00186 Rome, Italy
T +39 06 6976831
iai@iai.it
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