



# Nexus Assessment for Tunisia

Synergies of the water, energy and food sectors  
Executive Summary



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# EXECUTIVE SUMMARY

## 1 CONTEXT OF THE STUDY

2 | The Nexus Assessment for Tunisia is a study led by the "Nexus Regional Dialogue Programme" (NRD) of the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). The NRD is jointly managed by the Directorate-General for Development and Cooperation of the European Union (EU DEVCO) and GIZ and funded by the European Union and the German Federal Ministry for Economic Cooperation and Development (BMZ). The NRD in the MENA region leads this study in collaboration with the League of Arab States (LAS) and in close cooperation with the GIZ project "Renforcement du marche solaire en Tunisie" (RMS) as well as the following Tunisian institutional partners: the Ministry of Agriculture, Hydraulic Resources and Fisheries (MARHP), in particular the Directorate General for Rural Engineering and Water Operations (DGGREE), the National Agency for Energy Conservation (ANME), the Agricultural Investment Promotion Agency (APIA), the Agricultural Extension and Training Agency (AVFA) and the Tunisian Union of Agriculture and Fishery (UTAP).

Tunisia— as other countries in the Arab region— experiences new challenges due to population growth, socio-economic transitions, political instability, land degradation and urbanization among others. The region faces an arid and extremely variable climate with increasing pressure on water resources that are both natural and human induced. Consequently, the region is highly dependent on food imports, while at the same time energy – fossil as well as renewable – is abundant. Efficiency of resource use remains low, but with the current trends of population growth and the associated growing demands for water, energy and food that will accompany it, the pressure to ensure human securities is increasing rapidly.



In view of the increasing resource scarcities and political instability, the Nexus approach offers a concept for combined risk management in this respect. Considering the close links between the water, agriculture and energy sectors, the Nexus approach addresses the interdependencies between these resource scarcities (water, energy, land) while considering human securities (water, energy, food) and sustainable development. The Nexus approach can help to reduce these pressures. Furthermore, it promotes policy coherence and political dialogue, and thus it could potentially provide a basis for regional cooperation for improved political stabilization.

Coordination and policy coherence according to the Nexus approach, which has to happen primarily at the national level, is difficult given the long-standing institutional silos and the added complexity of the Nexus approach. However, improved coordination between sectors helps to reduce negative externalities and develop synergies. Ideally, an enhanced dialogue between sectors and institutions can address the large implementation gap of existing strategies and policies by introducing a kind of inter-sectoral peer review mechanism. Thus, continued dialogue with key national stakeholders is a key methodological approach to apply a WEF Nexus approach in Tunisia and other countries in the Arab region.

## 2 METHODOLOGICAL APPROACH

This study elaborates an assessment of the WEF Nexus for Tunisia, applying and adjusting already existing Nexus methodologies to the Tunisian context and its priorities. In this assessment the most relevant linkages, trade-offs, possible synergies and opportunities that are of special interest for Tunisia are identified and thus give a first assessment of the existing or potential Nexus response options (political, administrative or technical). The analysis also includes proposed specific multipurpose projects (e.g. water supply, energy production and irrigation).

Methodology, conclusions and recommendations were discussed and validated by main stakeholders of WEF sectors in Tunisia, through three workshops, following a participative approach.

### **3 PLANS AND STRATEGIES FOR THE DEVELOPMENT OF EACH NEXUS SECTOR IN TUNISIA**

The existing sectoral planning processes stem from the Tunisian vision developed in particular sectors and include:

- The 2016-2020 Tunisian Development Plan,
- The Nationally Determined Contribution (NDC), established in 2015, and
- The National Strategy for Sustainable Development 2014-2020.

The following strategies were also considered to determine existing WEF sectoral interlinkages:

- The Water strategies 2025 and 2030 and the basis of the 2050 Water Strategy (under preparation),
- The 2030 National Energy Master Plan and the Tunisian Solar Plan which foresee the realization of new renewable energy capacity of 3,815 MW in 2030,
- National Strategy for Agricultural Development 2016-2025 and the Intensification Program of Irrigated Agriculture.

These strategies were the basis for the development of sectoral action plans that also treat each of the sectors individually.

#### **3.1 Food security**

The agricultural sector contributed 9.3% to GDP in 2016. It employed 15% of Tunisia's labour force in 2016 with additional important seasonal jobs. The sector is of social importance since it provides a permanent income for 470,000 farmers contributing to the stability of the rural population, which represents 35% of the total population. In 2009, women accounted for 34% of the agricultural labour force. The agricultural sector contributed 9.6% of total goods exports in 2016. Agricultural investments represented 8.1% of national investments in the economy in 2016.

Since 2009, a chronic deficit has existed between agricultural imports and





agricultural exports. Three crops (cereals, olive trees and fodder) occupy 80% of the area cultivated in the country. For cereals, the yield per hectare remains low at around 1.2 t/ha due to its dependence on amount of rainfall. This is below the average for the Arab countries and below half of the world average.

Yet 65% of the total area of the country consists of agricultural arable area: 5 Mha forests and 5.5 Mha courses operated by 400,500 breeders. The irrigated area represents 8% of the total arable areas of which 48.8% are private, 70% are for arboriculture and market gardening. The challenges facing the food and the agriculture in Tunisia include uncontrolled exploitation and unsustainable use of resources (soil and water), which weaken the economic and ecological potential of the agricultural sector. Unsustainable land use threatens the fertility of rare arable land. In addition, 1.1 million ha of farmland are exposed to erosion and the country is likely to lose up to 50% of its arable land due to erosion and desertification by 2050.

### 3.2 – Water resources and water security

The water sector in Tunisia is characterized by decreasing renewable water resources per capita, being less than 419 m<sup>3</sup>/capita/year and expected to be only 300 m<sup>3</sup>/capita/year by 2030. The exploitation of surface water (70% for potable water and 30% irrigation and recharge) from large dams is subject to a loss of storage capacity that could reach 43% of their initial capacity. Underground resources (wells and boreholes) contribute to 75% of total consumption - all sectors combined - and cover about 73% of the national territory. Overexploitation of aquifers alters water security and relatively large transfers of water resources between regions create structural constraints for a possible reallocation of water resources. Therefore, conflictual resource management with demands for local use of resources becomes essential. The new constitution enshrined the right to water as a right of every citizen and makes the public authorities responsible for access to the water. The constitution has also translated natural resources, including water, into a common good, and no longer as a public good, which limits the State's room for water mobilization and allocation. The competition between the irrigation and drinking water sectors requires also increasingly arbitration of the public authorities especially during the periods of scarcity. Minimizing the damage to each party is achieved through compromise, which is the solution most often adopted and accepted.

### 3.3 – Energy security

The Tunisian energy landscape is characterized by a decline in national primary energy resources against a steady increase in demand at an average annual growth rate of 4%. This will make the energy dependency rate reach 85% by 2030, if projects do not materialize to support this clear discrepancy. Between 1990 and 2017, primary energy consumption has more than doubled, reaching up to 9.5 Mtoe, while during the same period, production fell from 5.4 Mtoe in 1990 to 4.8 Mtoe in 2017. Renewable energy resources, less than 3% of Tunisia's installed capacity in 2016, require significant financial mobilization and compete with other economic sectors. Meanwhile, the energy deficit continues to grow, reaching 4.7 Mtoe in 2017 which represents about 50% of the demand while the development strategies of renewable energies, however abundant, are slow to materialize, and have led the country becoming a net importer of energy. Despite an ambitious policy based on the ambitious Tunisian Solar Plan and regulatory reforms, the monopoly of the "Société Tunisienne d'Electricité et du Gaz" (STEG) for the marketing of electricity in Tunisia seems to hinder the distribution market and consequently a faster development of renewable energy projects in Tunisia.



Tunisia's energy intensity remains high, about the double of OECD countries. The country still has an energy saving potential not yet exploited (30% energy saving by 2030) despite being ranked 18th out of 111 countries tied with South Africa in the ranking called "Rise" relative to the mastery of energy according to the World Bank.

This situation of energy dependency imposes on Tunisia major challenges related to the security of its energy supply and the competitiveness of its economy as well as a worsening of the situation of the national trade balance and the balance sheet in the country's currencies.

### 3.4 – Climate change

The impacts of climate change exacerbate the situation for the three sectors:

- Energy Security: Increased risk for major power plants mostly located in coastal regions near the large cities and thus exposed to the sea level rise;
- Water Security: By 2030, 28% drop in water resources due to extreme weather conditions and 50% of coastal aquifers will be salinized due to sea-level rise
- Food security: Loss of about 16,000 ha of agricultural land in low coastal areas by 2030 and indirect loss of the potential of the irrigable area of about 38,000 ha by 2050 due to extreme weather impacts (10% of the current irrigated area). The area of rain-fed cereal crops is expected to decrease by 30% from 1.5 million ha to about 1 million ha in 2030. In the event of successive extreme droughts, the cereal areas and arboriculture zones will decrease respectively by about 200,000 ha and 800,000 ha (central and southern regions). In addition, livestock numbers will decrease because of loss of pasture by about 80% in the centre and the south, compared to 20% in the north.

Annual production losses are estimated at about 0.5% of current GDP, mainly from tourism (55%) and agriculture (45%). This would result in job losses of around 36,000 permanent jobs.

The governmental decree n°2018-263 dated 12 March 2018, establishing a management unit by objectives for the achievement of the follow-up and coordination program of the activities related to the implementation of the "Paris Agreement" on the climate for carrying out the UNFCCC, allows for a



renewed focus on the implementation of a new climate change strategy.

### **3.5 – The imperatives of sustainable development**

Three-quarters of consumed grains are imported, making the poor most vulnerable to price inflation. In addition, disparities between the regions and economic stagnation have the effect of reducing purchasing power and preventing vulnerable people from obtaining adequate nutritious food in poor regions. The Tunisian sustainable development vision for agriculture is to ensure a sustainable food chain that improves economic, social and environmental performance throughout the life cycle of products and services through the following actions:

- Rationalize the use of natural resources and reduce sources of nuisance;
- Promote sustainable farming practices and local know-how;
- Ensure the viability of agricultural activity.

Although the new Tunisian Constitution of 27 January 2014 clearly stipulated in its article 12 that: “the State works for the achievement of social justice, sustainable development, the balance between the regions and the rational exploitation of wealth”, the National Commission for Sustainable Development (CNDD), chaired by the Head of Government and bringing together all sectors, has not met since 2009 and has not yet implemented these strategies.

## **4 CRITICAL INTERDEPENDENCIES, RISKS AND RECOMMENDATIONS**

### **4.1 – Energy and water security**

The increasing use of non-conventional water resources and the need for pumping water across large distances and vertical gradients, make the Tunisian water system very energy-intensive. The electrical demand increased by 5.3% between 2015 and 2016 for surface water pumping from dams mainly used



for drinking water purpose. It is expected that this trend will continue. Similarly, underground water resources mainly used for irrigation require more energy due essentially to the increased depth of the water, through overexploitation and increased number of pits (authorized and illicit). Relatively large transfers of water resources between regions create high energy demand in addition to structural constraints for more conflictual resource management with demands for local use of resources.

The desalination of underground brackish water (potential of 614 Mm<sup>3</sup>/year) for potable water and irrigation will generate new energy demands. The National Water Distribution Utility (SONEDE) has established an energy mastery department and aims to save 15% of energy by 2020.

Opportunities for increasing energy efficiency and energy security in the water sector include:

- Increasing energy efficiency of water utilities through infrastructure optimization and rehabilitation;
- Deploying photovoltaic technology for pumping and other uses in the water sector, including for desalination;
- Using the energy potential of biogas and bio solids in wastewater treatment plants to offset some of the energy needs; and
- Implementing energy storage stations by pumping and turbining near dams and canals, where possible.

#### **4.2 – Water and food security**

The agriculture sector consumes 80% of the water resources and has a chronic deficit between agricultural imports and agricultural exports since 2009. The irrigated sector accounts for 37% of agricultural value, 27% of agricultural employment and only 20% of the value of agricultural exports. It should be noted that 92% of irrigated perimeters are equipped with water saving systems.





Given Tunisia's transitional situation following the changes brought about by the revolution and the political changes, the development of efficient strategies based on the strict application of laws and regulations seems to be difficult especially in the rural areas with scarce water resources. For these reasons, farmers using underground water illegally largely have expanded their irrigated areas and created additional stress on water resources while providing parallel agricultural activities out with the official taxation system of the country.

Opportunities for addressing the linkages between water scarcity and food production are:

- Economic incentives and reduced subsidies to promote efficient use of water in irrigation, and varieties of non-water-intensive crops;
- Diversification of economic activities in regions suffering from water stress to present alternatives to agriculture for the rural population;
- Use of treated wastewater in agriculture (increase of sewer connection and sewage treatment flow in decentralized facilities); and
- Actions against the impacts of climate change that pose significant risks to maintaining the level of agricultural productivity with adverse impacts on water and land.

### **4.3 – Water and energy security**

For the entire period between 2005 and 2018, hydropower production in Tunisia was very limited and varied between 45 and 145 GWh/year depending on the rainfall (less than 1% of the national electricity production). Thus, the hydraulic dams in Tunisia are mainly designed and used for the needs of irrigation and transfer. The other renewable energy sources (solar and wind) can better contribute to the Tunisian energy security than they can do to the water scarcity issue.

It should be additionally noted that a pilot project of a pumped storage and turbinning targeting energy storage station in Oued El Melah (Beja) with a capacity of 400 MW is currently under planned. This major infrastructure project, with a cost estimated of about 1.2 billion Tunisian dinars, will ensure continuity in the electricity grid.

### **4.4 – Energy and food security**

The energy consumption of the food sector is about 11% of the country's energy consumption. Agriculture makes up 78% with water pumping being the largest energy consumer. Agri-food industries contribute 32% of agricultural

value and 20% of industrial added value, while employing 80,000 people.

In 2015, the consumption of wells and low-voltage borehole pumping for irrigation accounted for 62% of the total consumption of the agricultural sector and about 3.6% of Tunisia's total electricity consumption. Solutions to introduce solar water pumping have been introduced since 2014. The low electricity tariff for the agricultural sector represents the highest barrier for introducing energy efficiency and renewable energy to the agricultural sector.

Opportunities for addressing the linkage between energy and food production are:

- Revising the energy tariff for water pumping to promote energy efficiency and reinforcing the solar pumping in the agricultural sector
- Introduce smart meter applications that allow remote monitoring and control of electricity produced and water pumped
- Increasing water use efficiency and with that reducing the overall water demand and accordingly also energy demand in agriculture
- Shifting to energy- (and climate-) smart agricultural practices, such as applying agro-ecological and recycling principles, e.g. in tillage, nutrient management and crop rotation
- Using food imports strategically to reduce agricultural water and energy demands
- Promoting the use of photovoltaic systems for other uses than solar pumping in the sector and the related net-metering system

#### **4.5 – Type of agriculture according to water and energy availability**

Agricultural policies partly consider the availability of water resources. Both sectors are essentially managed by General Directorates of the MARHP. However, these policies do not consider the availability of energy resources. The latter are expressed according to a vision developed by the Ministry in charge of energy from the agricultural strategic plans however, without confrontation or analysis of the availability of resources and even less from the perspective of a holistic energy security strategy. Tunisia is lacking a comprehensive agricultural strategy with support mechanisms adapted to the development of value chains and the country's food challenge, in particular through the establishment of an agricultural map.

The Tunisian agricultural strategy 2016-2020 supports the development of organic production areas essentially for export (from 300 ha in 1997 to 220



000 ha in 2015) without consideration of the available resources: water, energy and arable land. The most exported products are olive oil, dates and aromatic and medicinal plants that are water and energy intensive.

The agricultural map of Tunisia is still under development and needs to include energy as an additional determining factor. For example, the Northwest water transfer policy should be adjusted to represent a better balance between supply and demand in space and time. It should reinforce first the demand in resource-rich regions targeting the reduction of the energy consumption for the transfer water pumping.

#### **4.6 – Compromises and risks associated to silo approaches**

The priority challenge is to sustainably increase agricultural production to meet the needs of a growing population, with increased scarcity of land and water resources in the context of climate change. Indeed, the agricultural sector should not only be the response to food crises, but also a pillar of economic development.

Faced with a severe energy deficit (more than 25% of Tunisia's trade deficit), the country's objective in 2017 has been to accelerate the implementation of renewable energy projects. This requires significant investments that are in competition with other economic sectors due to the silo approach. However, the agricultural sector has one of the lowest electricity tariffs in Tunisia that do not allow for such high investment levels. Similarly, Tunisia remains ahead in terms of energy efficiency policy, but the work - and the corresponding investments - must continue. The goal is to achieve 30% energy savings by 2030. Unless a compromise between energy and agriculture is made for the tariff adjustment on the mid or long-term period, such a development is still built in undesirable silos.

The analysis of the sustainability of national policies for the management of groundwater resources shows that they are moving towards a «relative failure» since current resource management translates into significant negative externalities for natural resources. Current water pricing, which covers no more than 25% of actual costs, is well below the cost of operation and does not support the increasing water use efficiency strategy in agriculture. However, it should also be pointed out that most irrigated perimeters managers do not pay their water bills, which moves the discussion towards a level of reflection more appropriate to the current situation of lack of collection of water fees and governance of the "Groupeement de Développement Agricole" (GDA) and

the “Commissariat Régional de Développement Agricole” (CRDA). Thus, water pricing does not consider sustainability and impacts on the country’s resources. Nothing extensive has been attempted to find a solution for the state of water stress or even to apply the existing regulation for irrigation.

The pressure on natural resources, especially in rural areas, is explained by the lack of diversification of the economy in certain regions and results in a high dependency on the agricultural sector. With the support of regional and national authorities, the private sector is often pushed to contribute heavily to the agricultural sector by offering the only viable projects.

## **5 – MAPPING OF RELEVANT INSTITUTIONS FOR CRITICAL INTERCONNECTIONS IN TUNISIA**

### **5.1- The main players in the energy sector**

The ministry in charge of energy is responsible for administering and organizing the energy sector so as to achieve Tunisia’s national objectives. The minister in charge of energy supervises the most important entities dealing with energy in Tunisia:

- ANME, responsible for the implementation of policies for the rational use of energy and the development of renewable energies,
- The Tunisian Company of Electricity and Gas (STEG), which produces, transports and distributes electricity on the public network,

The Law No. 2015-12 on the production of electricity from renewable energies is the most important text on renewable energies in Tunisia. The purpose of the law is to put in place a legal regime for the implementation of electricity generation projects based on renewable energy sources, either for self-consumption, for the needs of local consumption or for exportation.

### **5.2 – The main actors in the water and food sector**

The MARHP with its “Direction Générale du Génie Rural et de l’Exploitation des Eaux” (DGGREE) and the “Direction Générale de Production Agricole” (DGPA) is the official body responsible for all aspects related to the development of the agricultural sector in Tunisia. The responsibilities include the exploitation of surface water resources through the construction and operation of dams and other facilities for agricultural production. The MARHP is also in charge for the overall monitoring of the water sector. Nonetheless, the coordination between the various General Directorates within the Ministry needs to be reinforced.



## 6 – RECOMMENDATIONS FOR TUNISIA

### 6.1 – Action strategy in Tunisia

The common guidelines for the sustainable improvement of the WEF Nexus are listed below:

- Switch from water, energy and food cost compensation (e.g. electricity cost for water pumping) to targeted “rate” compensation (e.g. for poor and vulnerable population only),
- Technical capacity building and support to government policies to ensure a good understanding of the Nexus and silos issues,
- Support for the preparation of the actual background and the integrated prospective analysis and strategy of the agricultural sector (not only at the level of subsectors),
- Support for the implementation of regional and international agreements, treaties and conventions e.g. for sustainable development and climate change mitigation and adaptation.

### 6.2 – Integration of WEF Nexus into coordination mechanisms

#### 6.2.1. Existing coordination mechanism

Several coordination mechanisms between the water, energy and food sectors exist and reflect basic coordination and integration, which could be a starting point for better synergies, in particular:

- Technical committees to oversee specific needs and advance sector mandates, covering WEF Nexus linkages (e.g. a renewable energy development committee for agriculture at the MAHRP integrating representatives from ANME, STEG and other energy related entities)
- Cross-sectoral functions include the ministries and institutions concerned and headed by:
  - The National Water Committee,
  - The National Energy Committee,
  - The National Committee for Agriculture and Fisheries.

#### 6.2.2 – New Coordination Mechanisms

- **Option 1.** Establish a WEF Nexus Council for the Head of Government: The council would make recommendations in the short and long term based on the proposed opportunities presented in the present Nexus study; It would be composed of experts and specialists

from the water, the energy and the food sectors, including sectoral ministries and industry professionals who have a good knowledge of the sectors. It would institutionalize participatory actions and public-private partnerships to advance WEF Nexus interconnections at the highest political level.

- **Option 2.** Creation of a WEF Nexus Committee at the Ministry of Investment Development and International Coordination (MDICI):  
The committee could be composed of «liaison officers» responsible for reviewing policies and programs in the three sectors. Given the significant impacts of climate change, the «liaison officers» of the Ministry of Local Affairs and Environment (MALE) could be invited to join the committee. This will support coordination and synergies between the current «liaisons» and may include other sectors. This could significantly support the integration of Nexus priorities.

### 6.3 – Integration of WEF Nexus into existing planning processes

Additional indicators covering critical interconnections between the WEF links can be integrated in the existing monitoring and evaluation system of development programs to measure:

- The use and efficiency of consumed energy for water treatment and transport, targeting the intensification of water leakage reduction, the increase of energy production from wastewater, the increase of renewable energy use, the improvement of energy efficiency in the treatment and transport of water and the reduction of disincentive subsidies
- The use and efficiency of water use for food production, targeting the increase of water use efficiency and its recovery, the improvement of agricultural practices especially in rain-fed crops, the promotion treated wastewater and unconventional water sources reuse for agricultural irrigation and groundwater recharge, the reduction of disincentives such as energy subsidies for water pumping in the agricultural sector.
- The use and efficiency of recycled agricultural wastes for energy production, targeting the biogas production out of liquid wastes, the biomass reuse at the farm level for cogeneration and heating usages, the waste valorisation at the agri-food industries, and the use of wastes with calorific values for the production of residue derived fuels.
- The use and efficiency of water for energy production, targeting the energy generation from water flow sources, the pumping and turbinning system near existing rivers, and the marine energy or ocean energy and all renewable energies extracted or which may be from the marine environment.



- The use and efficiency of lands for water and energy production, transport and distribution, targeting the allocation of lands for strategic development of the water and energy at regional and national levels including their maintenance and other right of ways

Such a monitoring and evaluation system will require capacity building of the involved entities representatives in information management and technical capabilities as well as communication and awareness.

#### **6.4 – Capacity Building Needs Assessment:**

##### **Information Management**

- Ensure basic information required for critical WEF interconnections to allow a regular assessment of the achieved progress related to the 3 sectors linkages and solutions;
- Support the National Institute of Statistics (INS) to establish a solid geographic information system (GIS) on WEF linkages capable of providing necessary data on the situation of water, energy and agriculture;
- Other specialized information systems in Tunisia, such as the national water information system, should include basic information on the critical WEF interdependencies.

##### **Technical Capacities**

- Strengthen the technical know-how of the relevant staff of targeted ministries and other stakeholders related to WEF interconnections by assisting in the design and delivery of solutions to the Nexus case study, and exposing them to similar Nexus experiences for example,
- Enable technical staff to reach and support policy makers. An immediate action could be to invest in technical training related to the





critical interconnections of programs and strategies to the 2025 and 2030 horizons,

- Support the integrated implementation of the Sustainable Development Goals as an entry point to facilitate the adoption of the WEF Nexus approach.

#### **Communication and Awareness**

- Strengthen communication and awareness as an important pillar to bring decision makers to WEF Nexus interconnections,
- The adoption of the WEF Nexus approach involves regular communication between different institutions with different mandates,
- To avoid the «silo» approach of sectoral planning and to ensure common understanding as well as the negotiation of new coordination mechanisms, it is of utmost importance to develop the communication and negotiation skills of relevant staff.

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