



POSITION PAPER

Mainstreaming Water, Energy, and Food in National and Municipal Policies in Selected Countries in the MENA Region

By:

Dr. Marwan Alraggad



الجمعيّة العلميّة المملكيّة
Royal Scientific Society



Horizons
For Green Development

Contents

1. Background about WEFE NEXUS in MENA.....	3
1.1 Water	3
1.2 Energy	4
1.3 Food security and Agriculture.....	4
2. Introduction	4
3. Current situation of sectorial policies.....	5
3.1 Jordan.....	5
3.1.1 Energy policies	5
3.1.2 Water Policies	7
3.1.3 Food Security	10
3.2 Lebanon.....	12
3.2.1 Energy Policies	12
3.2.2 Water Policies	13
3.2.3 Food Security Policies	14
3.3 Tunisia	15
3.3.1 Energy policies	15
3.3.2 Water policies	16
3.3.3 Food – Agriculture Policies.....	17
4. Benefits of NEXUS mainstreaming.....	18
4.1 The case study of Jordan.....	18
4.1.1 Sahara Forest Project in Aqaba, Jordan	18
4.1.2 Lajoun Integrated Ecology Centered Development Area in Karak, Jordan.....	19
4.2 The case study of Lebanon.....	20
4.2.1 Arc en Ciel, Taanayel Farm in the Bekaa Valley, Lebanon	20
4.3 Global best practices.....	20
5. Recommendations for improvement.....	21
6 Summary and conclusions	23

1. Background

The Middle East North Africa (MENA) region has been dealing with environmental challenges for too long. Over the past decades, pressures on water, energy, agricultural productivity, and food supply [in MENA](#) have markedly increased. These rising needs are majorly drawn from overall macroeconomic trends such as population growth, urbanization, and socio-economic development, maximized by the accelerating environmental degradation. As a result, the region is experiencing new challenges that require higher attention and coordination among the energy, water, and food sectors. Hence, the nexus approach in the region can be part of responding to those challenges. The relationship between water, energy, and food security should be used as an opportunity to tackle developmental issues using a multi-sectoral approach.

Perhaps more than any other region in the world, water, energy, and food security are inextricably linked in the Arab Region. The region is known to be energy intensive, and experiences water scarcity, food deficiency, and is one of the world's most economically and environmentally vulnerable to climate change. Hence, this strong interdependence between water, energy, and food calls for the nexus approach to address managing these three vital sectors through an integrated approach by magnifying trade-offs and building synergies.

The MENA Region Initiative as a model of Nexus Approach and Renewable Energy (MINARET) project aims to address the unique sustainability challenges and opportunities of the MENA region by increasing local and regional sustainability capacities using the synergies between renewable energy technology and efficiency, water management, and food security.

A four-year project kicked off in the first quarter of 2017 to be implemented in three municipalities in Jordan, Tunisia and Lebanon, which are Karak, Monastir, and Jdaidet El Chouf, respectively.

MINARET is funded by, and aligns with, the regional MENA strategy of Sweden's Development Cooperation (SIDA). The project focuses on six UN sustainable development goals, which are gender equality, clean water and sanitation, affordable and clean energy, sustainable cities and communities, climate action, and partnerships for the goals.

The project is being implemented by the National Energy Research Center / Royal Scientific Society (NERC/RSS), in partnership with Horizon for Green Development (Horizon) and the International Union for the Conservation of Nature (IUCN).

This position paper describes the current status in the three participating countries in terms of national policies for each of the water, energy, and food sectors, and highlights opportunities and synergies related to a nexus approach to these sectors.

1.1 Water

Average water availability in the Arab Region is 840m³ per person per year; only 12% of the world's average of [7000 m³ per person per year](#). The Arab Region is currently using 75% of exploitable water sources in the region and it is estimated that 58% of the region's renewable water resources will be depleted by 2030. Arab countries depend on water from different sources, including groundwater, desalination, and wastewater treatment. Groundwater provides 84% of total water supply in the Arabian Peninsula, the largest water source in Bahrain, **Jordan, Lebanon**, Libya, Oman, Saudi Arabia,

Tunisia, the United Arab Emirates and Yemen. Multistage flash distillation is the most common desalination technology used in the region and is primarily found on the Arabian Peninsula, where it supplies 8% of total water supply. Over 85% of the region's water use is dedicated to agriculture. Domestic and industrial water demands are 7.8% and 7% of total demand, respectively.

1.2 Energy

The Arab region's overwhelming dependence on traditional energy sources has had a drastic impact on greenhouse gas emissions. CO₂ emissions in the Arab region have increased by 250% from 1990-2010. Due to these effects, [as of 2013](#), the Arab region paid more attention to renewable energy sources. However, despite some advancements, regional policies that kept energy prices artificially low resulted in traditional energy sources remaining as popular and attractive as renewable sources.

1.3 Food security and Agriculture

The Arab Region is the number one importer of wheat in the world. Despite being almost self-sufficient in red meats, vegetables and fruits, the region severely lags behind the world in cereal productivity and requires twice as much land to grow the same amount of cereal as other parts of the world. Many countries have suffered from stagnant productivity for years. Seven countries account for 85% of total agriculture GDP in the region. Population is expected to reach 633 million by the year 2050 and reaching self-sufficiency in cereal production will require an additional [105 million hectares](#) of land. Land quality is limited in the region, so increases in yields will have to come from improvements in irrigation, agriculture inputs, research and development. Malnutrition is also present across the region. About 25% of children under five years old suffer from stunting and there are vast differences between countries. The poor are especially vulnerable to food insecurity in the Arab Region. The poorest families in the region are estimated to spend [35 to 65% of their income on food](#) (Food security and nutrition in the Arab Region: key challenges and policy options, 2012).

2. Introduction

The [MENA](#) region suffers from extreme water, land, and food security. These trends converge with a rapid transition towards renewable energy as well as non-conventional water. However, lack of policy consistency has caused weak governance and large implementation gaps in all sectors. Therefore, this situation strongly calls for the integration in the management and governance of natural resources (water, energy, land, biomass). Water, energy, food security, environmental, climate, and political security, can all be strengthened if approached through integration.

This is what a NEXUS approach can offer. In spite of the promising opportunity in the MENA region, there is very limited progress towards the operationalization of the nexus concept in policy making, and on the ground implementation. This is due to many challenges including insufficient incentives, limited vision, knowledge, experience to guide technology development and investment, and in particular the absence of concrete examples that reflect the added value of applying a nexus approach. This lack of evidence causes restrictions on political will to develop consistent framework conditions, structures, and funding that would support nexus implementation.

Hence, it is important to analyse the current sectoral policies in the three focus countries (Jordan, Tunisia, and Lebanon), and how they shape the implementation gaps and weak governance. In addition to studying the benefits offered by the NEXUS integrated approach.

3. Current situation of sectorial policies

3.1 Jordan

One of the main objectives of the Government of Jordan's Executive Development Programs for 2016-18 is securing energy supply and diversifying the energy sources. According to the updated Energy Strategy for (2016-18), the GoJ is currently considering the development of projects that could be implemented within short term periods, the projects focus essentially on diversification in the energy sources and avoiding future energy sources. Some of these relevant initiatives include:

- Discussions with neighbouring countries, such as the Egyptian authorities to secure the supply of contracted quantities of natural gas.
- Liquefied Natural Gas (LNG) Terminal in Aqaba which was initiated in 2015 to important LNG
- Electricity production capacities developed and financed by the private sector.
- Increasing Jordan's strategic oil and oil products storage capacity to secure 60-day strategic storage for petroleum products and development of infrastructure projects (Oil terminal rehabilitation project, Aqaba oil terminal (100 thousand tons' storage), Amman Strategic Reserve Terminal (250-300 thousand tons of light oil products and 10 thousand tons of LPG)
- Liberalization of the downstream oil sector: The GoJ granted licenses to three initial Oil Marketing Companies (OMCs) for importing and trading of white products.
- Exploitation of national energy resources: there are medium to long term prospects for oil shale and additional extraction of natural gas from Risha field.

Considering the existing technical potential for solar and wind energy in the country, the Energy Strategy calls for 10% of the Kingdom's energy mix to come from renewable energy sources by 2020. To achieve this, GoJ followed an evolving multi-faceted action plan with partners from public and private sectors to significantly increase electricity generation from renewable sources, substitute conventional fuel for renewable across sectors, and increase energy efficiency to reduce overall demand for energy without compromising economic growth.

3.1.1 Energy policies

Renewable-energy policy

The Jordanian government policies have mainly been concerned with planning, supervising, and regulating the sector's capacity in order to enhance the volume of investment. Whereby, to achieve this, Jordan has already signed agreements for more than 1000 MW of (wind and solar) renewable energy projects. [The 2007-2015 strategy](#) adopted an ambitious renewable energy target which capitalizes local resources and created a contribution rate of 10% of the country energy needs in 2020. Consequently, the RE capacity was divided as 1850 MW from which 1200 MW came from wind, 600 MW from solar PV, and 50 MV from waste. The 2007-2020 strategy has also aimed to reach a share of 30% of households equipped with solar water heaters by 2020. The government has underlined its commitment to reach the ambitious targets set in the Energy Strategy by issuing the 'Renewable Energy and Energy Efficiency' Law on 17th April 2012. Due to this law, unsolicited or direct proposals were allowed for the first time in Jordan, where an opportunity was presented and there was an ability to identify and develop renewable grid-connected electricity production projects such as wind parks, solar systems, and others to be proposed to the Ministry of Energy and Mineral Resources.

The following RE projects are considered as committed renewable energy projects until 2015 within the baseline scenario in the Jordan's Third National Communication report on Climate Change:

- Wind power project in the Tafila area with a capacity of (117 MW).
- Wind power project in the Fujeij area with a capacity of (90MW).
- Wind power project in Maan area with a capacity of (70 MW) (Gulf Grant).
- PV solar project in Quweirah area with a capacity of (70 MW) (Gulf Grant).
- PV solar project with a capacity of (10 MW) in the area of Mafraq.
- Direct proposal solar PV projects to generate solar electricity (200 MW)
- PV solar project with a capacity of (5 MW) (Spanish Grant).
- Wind energy projects from direct proposals to generate electricity (100 MW)

The Renewable Energy and Energy Efficiency Law ([REEEL](#)) was approved and released in mid-2012 (Law No. 13 for year 2012). The main objectives of the REEL included increasing the contribution of RE to the total energy mix in Jordan, promoting and exploiting RE for environmental protection and sustainable development purposes, enhancing energy efficiency in all sectors of the economy. In order to develop and connect RE systems to transmission and distribution of electrical grids in the country, Jordan follows a five-track approach. These include direct proposals, a competitive bidding system, EPC Turn-key (through grants), small scale RE scheme (Net metering), and power energy wheeling.

In addition, Jordan has managed to lay down the necessary steps that are required to achieve policy targets and attract commercial investments in this field. The following regulatory and policy frameworks were created:

- **The Renewable Energy and Energy Efficiency Law (Law No. 13)**, this law, the first in the region, allows investors to identify and develop grid-connected electricity production projects through unsolicited or direct proposal submission.
- The law also set up the **Jordan Renewable Energy and Energy Efficiency Fund (JREEEF)**. The fund is financed by national and international institutions. The fund has a legal temperament and is financially and administratively independent. Both national and foreign private companies are allowed to apply for the Fund's support when setting up renewable energy generation projects.
- **Net-metering for small RE systems** (roof tops) with fixed purchase prices for excess power, the directive allows the consumers to install, use and connect to the grid RE systems (solar, wind, bio-energy, geothermal, small hydro) if their expected generation does not exceed their average monthly consumption for the previous year (to be estimated by the distribution company in case of new users). The net value of the electricity consumption (or generation) is calculated each month.
- **Tax Incentive regime**, a bylaw was issued on tax exemptions for RE and EE systems and equipment. Article 11 states that "All systems and equipment of renewable energy sources and energy efficiency and its production inputs whether manufactured locally and/ or imported, will be exempted from all customs duties and sales tax. The Bylaw on exempting renewable energy and systems and energy saving equipment from custom fees and sales tax

(Bylaw No. 13 for year 2015), was issued by virtue of Article (11/B) of REEEL. In this bylaw, it is clearly outlined that all RE and EE systems, equipment and devices, imported and locally manufactured (and inputs for local production) are exempted from all custom fees and duties as well as sales tax). For this purpose, the bylaw establishes a special committee at MEMR to look at all applications related to tax exemption.

- The Bylaw “Jordan Renewable Energy and Energy Efficiency Fund” No. 49 for year 2015, was issued and enabled MEMR to start activities aiming to support RE and EE projects.

Energy Efficiency Policy

The [2007-2020 energy strategy](#) in Jordan has resulted in nearly 20% improvement in energy efficiency up until 2020. In 2013, the first National Energy Efficiency Action Plan was developed by the Ministry of Energy and Mineral Resources. The plan covered several recommendations and opportunities; these included the promotion of solar water heaters (SWH) in different sectors. In addition to upgrading and updating the Solar Energy Code and conducting intensive capacity building for engineers and technicians in the fields of solar and wind technologies.

In accordance to the Renewable Energy & Energy Efficiency Law, Bylaw No. (73) has been issued by the MEMR in 2012. It focused on “Regulating Procedures and Means of Conserving Energy and Improving Its Efficiency”. The main objectives of the bylaw were the following:

- Set the general policy of energy conservation and improvement of its efficiency, and submit it to the Cabinet for endorsement and enact the plans and programs necessary for its implementation.
- Encourage investment in the field of conserving energy and improving efficiency of its use.
- Monitoring energy audit procedures and implementation of systems and activities related to conservation of energy and improving efficiency of its use.
- Submit to the Cabinet information on dates of summer and winter daylight saving times.
- Take the necessary measures for implementing an emergency plan to reduce energy consumption.
- Spread national awareness in the field of conservation of energy and improvement of its efficiency.
- Opine on energy-consuming projects.
- Establish a database related to conservation of energy and improvement of its efficiency.

3.1.2 Water Policies

In regards to water governance, the Ministry of Water and Irrigation (MWI), was established and works continuously towards providing integrated water management systems, projects execution as well as strategic directions and planning for water related issues. Whereby, the MWI is regarded with two organizations: The Water Authority of Jordan (WAJ) and the Jordan Valley Authority (JVA). Construction and expansion of collection systems and treatment plants as well as water production, are mainly the main water sector expenditures. Benefits are usually transferred to beneficiaries and end users through quotas and subsidies for irrigation and domestic use.

Different policies and strategies have been developed in Jordan in order to build a management structure for the water sector. The “Jordan Water Strategy and Policy” was the first formulated

strategy in 1998, it addressed water utilities, water and wastewater reuse, groundwater as well as water used for irrigation. Consequently, the “[Water for Life: Jordan’s Water Strategy “2008-2022”](#)”, was developed and adopted, up until the National Water Strategy was formulated. This strategy set certain regulations that maintain optimal services and management levels. Hence, in Jordan, there are four national policies and strategy documents, including six sectors policies for the water sector.

[The National Water Strategy \(2016-2025\)](#) works towards ensuring sustainability of water resources, and strengthening integrated water resources management and planning, while being aligned with the SDGs adopted by the United Nations in 2015. The strategy aims to prepare the sector for future challenges by maintaining the following key areas; integrated water resources management, water, sewage, sanitation services, water for irrigation and energy; institutional reforms, management and monitoring along with other cross cutting issues such as public/private partnerships and economic dimension of water. Where Article 28 of WAJ Law, allows private sector participation, and the groundwater bylaw to protect groundwater resources.

While aligning with the Royal Initiative for Economic change, the [National Water Master Plan](#) (NWMP) was put in operation in 2004. The plan considers the United Nations Sustainable Development Goals (SDGs) and builds on new developments in the sector. For instance, the implementation of the approved Action Plan to Reduce Water Sector Losses in 2013 and the development of strategic projects (e.g. Nuclear Power plan, Oil-shale and Red–Dead conveyance). The increased demand on water resources is attributed in part to the high and sudden influx of Syrian refugees and increased costs of production in light of soaring electricity and fuel prices amidst fiscal constraints. It also builds on the recently developed sector policies.

The strategy was concerned with requirements for climate change, water-energy-food nexus, and mainly the economics and financing of water, sustainability of overexploited groundwater, and the recognition/adoption of new techniques or technologies that are available such as decentralized wastewater management, increasing the needs for utilization of surface water in municipal supply and reuse of treated waste water. While this increases the participation of the private sector, it also infuses more commercialization, consolidation, and decentralization of water and wastewater services.

Jordan recognized the need to evaluation and examine the existing water strategy at midpoint (2015), by covering its performance, outcomes, achievements, and to contextualize the current situation in the country and region, by reinforcing efforts to achieve the set strategic goals. To ensure the country’s national goals, priorities and the constant changing needs to align with the SDGs, the MWI presented an updated National Water Strategy (2016-2025). The updated strategy focuses on responding to the practical changes in the region, such as the geopolitical situation, the ongoing risks and threats posed to Jordan’s renewable water resources, a growing population, and an expanding economy that is water-energy-dependent and highly vulnerable.

Hence, due to the complex challenges that Jordan has been facing; the country revised the development plans and strategic options within the context of other crucial resources, i.e., the production of food and generation of energy to ensure a better understanding of the water-food-energy nexus. The agriculture sector is considered the largest user in terms of water use, using 51% of Jordan’s water followed by the municipalities which utilize 45%. The industrial sector makes use of 4%. The sewage service coverage in Jordan in 2015 was around 58%. Furthermore, Jordan reuses approximately [93% of its treated wastewater](#) for agriculture and is exploring additional sources of

supply, such as deep aquifers, brackish and large-scale seawater desalination (Red Sea-Dead Sea Water Conveyance Project which is currently under a PPP tendering process). Efforts are being made to optimize the use of existing resources by reducing physical and commercial losses and improving energy efficiency in water treatment and distribution.

The “Water for Life: Water Strategy in Jordan” for (2016-2025) has captured national efforts to manage the water sector and ensure optimal service levels. The strategy focuses on the limited freshwater resources and on the responsibility of all citizens, government and civil society as partners in responsible water management, protection and sustainable use. The strategy is based on the integrated water resource management approach and includes policies and strategic directions in water and sanitation, and working mechanisms with the agriculture, energy, industry, tourism and environment sectors.

The key areas of the Strategy are as follows:

- Integrated Water Resources Management.
- Water, sewage and sanitation services.
- Water for irrigation, energy and other uses.
- Institutional reform.
- Sector information management and monitoring.

The Strategy also addresses issues of climate change adaptation; transboundary/ shared water resources; humanitarian-WASH sector coordination; public/private partnerships; and the economic aspects of water. The Strategy identifies the results (objectives) to be achieved and reflects the Government’s national vision for the sustainable development of the water sector. Within the timeframe of this Strategy, the Ministry of Water and Irrigation (MWI), in coordination with other related institutions, will adopt a sector-wide integrated water resources planning and management approach, develop sector policies and legislation to enhance performance, equitable service provision and optimizing of available resources, initiate institutional reforms to restructure sector management, enhance fiscal discipline in cost recovery, improve internal efficiencies in sector coordination and management and build technical capacity.

MWI will coordinate and lead the implementation of the water-related SDGs and targets in coordination with other relevant stakeholders in Jordan. The ministry will also assess more fully the available amounts, actual quality and natural protection of Jordan’s water resources as a foundation for effective decision making, develop new partnerships with civil society and engage with all stakeholders through regular consultations in water sector project planning, thus building awareness of the efficient use and conservation of water and protecting water infrastructure. Under the new strategy, the Government is working towards a target [of 84% of wastewater service coverage by 2030](#) and will continue expanding the sewage network. The re-use of the water from sewage plants (effluent) reached 93% in 2015 and is forecasted to reach approximately 96% in 2030. These are expected to increase to 373.22 million cubic meters by 2030, an increase of 150% compared to the current measurements which were 147 million cubic meters in 2015.

3.1.3 Food Security

Jordan has always set a clear priority to the issue of food security. In spite of that, the Food Insecurity Experience Scale survey reveals that 12.8% of the total population was affected by severe food insecurity during [2014-2016](#). When studying external factors, population growth has key effect on food security. After the influx of hundreds of thousands of Syrian refugees, the official yearly overall growth rate was 3% by 2013. This situation has translated into a sharp rise in the import of basic commodities and inflation, affecting the poor disproportionately. Hence, considering that around 82% of Jordan's food requirements are obtained externally, Jordan is highly vulnerable to fluctuations in international prices of basic commodities. This turned the country's attention towards addressing the context of water scarcity. Whereby, adequate water is fundamentally an essential element in food production and security; as it ensures a safe supply of food in the short and long term. Due to the fact that water resources are used in multiple dimensions, there has always been a competition over the limited source of water in terms of municipal, agriculture, industrial, and tourism sectors. 70% of water resources were allocated to agriculture a couple of decades ago. This has dropped to 51% by the end of 2013. Hence, agriculture, as a sector will have to develop mechanisms that better reflect the value of water in agricultural production.

The sector of food and agricultural is facing many challenges such as:

- The limited availability of surface water resources in the Jordan Valley
- Rapid depletion of groundwater resources in the uplands due to over-exploitation
- Inefficient and misuse of irrigation water
- Degradation of soil and water quality
- Small size holding

Hence, in response to the challenges, the Government issued the National Strategy for Agricultural Development, in addition to the National Strategy in line with the "[Jordan 2025](#)". Policies have been also developed in order to tackle these challenges and ensure growth and sustainability in agricultural production. Below are all the [policies, regulations, and related to the agricultural sector](#).

Document	Year	Type	Description
Agricultural Policy Charter (ACP)	1998	Policy	The Charter aims to achieve consistency in agricultural development with local, regional and international requirements and changes and an integrated socio-economic development characterized by efficiency, sustainability and equity. Clear policy objectives and priority sub-sectors were defined.
Environmental Protection Law No. (52) of 1999	1995	Law	The Jordanian Environmental Law was enacted as a temporary legislation in 2003 and was ratified by the Parliament in 2006. This law provided the appropriate legislative umbrella for issuing the various detailed regulations and instructions regarding the protection of the environment

National Rangeland Strategy	2001	Strategy	This strategy was developed in 2001 with the main objectives of controlling deterioration of the rangelands and reversing the desertification process; increasing sustainable livestock production by restoring the productivity of rangelands and increasing sustainable range fodder production; supporting fodder production in order to encourage intensive breeding; and encouraging local communities and sheep breeders to adopt intensive breeding techniques to regulate stocking rates.
National Strategy for Agricultural Development: - 2002 2010	2002	Strategy	This strategy discusses the role of the agricultural sector in social and economic development to achieve sustainable agricultural and rural development, taking socio-economic and environmental aspects, e.g. protection and conservation of ago-biodiversity during such development, into consideration. The strategy presents profiles of proposed projects in the five agricultural subsectors of rained agriculture, irrigated agriculture in the Jordan Valley, irrigated agriculture in the highlands, livestock and rangelands and the marketing of agricultural produce.
National Strategy and Action Plan to Combat Desertification	2006	Strategy	The National Strategy and Action Plan (NSAP) to Combat Desertification was launched in 2006. It includes six major programs that are mainly “project-based.” The programs include several projects related to desertification monitoring and control, capacity building, natural resources rehabilitation and development
The National Agenda 2006	2006	National Strategy	The National Agenda was launched in 2006 comprising a comprehensive political and socio-economic reform plan for the country until 2017. The main goal of the National Agenda is to achieve consistent policies and ensure that they will not be subject to government change while taking into consideration the need to regularly develop and update these policies.
Irrigation Equipment and System Design Policy of 2008	2008	Policy	This policy statement follows from longer-term objectives outlined in the Water Strategy and supplements the Irrigation Water Policy and the Irrigation Water Allocation and Use Policy by establishing a policy on irrigation equipment and system design standards. The policy addresses the following themes: defining and updating equipment standards, raising farmers’ awareness of standards, testing and enforcement of standards, training and certifying drip system designers and institutional responsibilities.

Irrigation Water Allocation and Use Policy of 2008	2008	Policy	This policy statement follows from longer-term objectives outlined in the Water Strategy and elaborates on priorities specified in the Irrigation Water Policy. As such, it includes updates and extensions of selected elements of the Irrigation Water Policy. In particular, it consolidates and elaborates on elements of that policy relating to on farm water management, general management and administration, water tariffing and irrigation efficiency. The policy addresses the following themes: defining and updating crop water requirements, allocating water and managing billing practices, building farmers' water management skills, using reclaimed water, measuring deliveries and delivering water to groups.
--	------	--------	---

3.2 Lebanon

3.2.1 Energy Policies

Lebanon has been deeply affected by the global energy crisis, whereby 97% of its energy needs is importer; thereby is considered to be a net energy importer. Moreover, since the end of the civil war, not much attention has been shed on the energy sector. Lebanon, as a result continued to rely heavily on High Emission Factor Fuels (HEFF), such as light (mainly Gasoil and Diesel), and heavy fuel oil. In 2010, the Ministry of Energy and Water developed a [Policy Paper](#) that calls for readdressing the country's electricity sector by 2015. There were 10 strategic initiatives regarded with the paper regarded to the general sector improvement by mapping the short, medium, and long-term measures to be taken in order to resolve the sector's problems, starting with increased power generation to cover the existing gap (e.g., leasing electricity-generating ships, rehabilitation of existing power plants and construction of new power plants). The policy paper illustrates that the power generation of Lebanon will reach 5,000 MW in 2015. The Policy Paper also aimed to switch the energy mix from polluting fuels to Liquefied Natural Gas, and to utilize renewable and alternative energy sources to increase electricity generation efficiency. In 2011, the Policy Paper was formally approved by the Council of Ministers and it was agreed by the COM to produce 270 MW by leasing power generating ships for a period of 3 years. In addition to building 1,500 MW power plants.

Moreover, in [2009](#), the Government of Lebanon conducted the Renewable Energy Pledge by committing itself in Copenhagen in order to increase its renewable energy shares to 12% of the total electrical energy consumption by 2020. Lebanon recognized the significant advantage that RE has in terms of energy security, energy acceptability, and energy independence. Many initiatives have taken place after the pledge including CEDRO, which completed Lebanon's first Wind Atlas in 2011, and Biomass Atlas in 2012, which evidently supported the promising RE market in Lebanon. Another clean electricity production incentive tool is net metering. Piloted in Lebanon in February 2012, net metering allows consumers to inject power that is generated at their premises into the grid. Whereby, the consumer will be charged the net balance of electric energy supplied and consumed.

In regards to energy efficiency, the Council of Ministers approved [the National Energy Efficiency Action plan \(NEEAP\)](#). The plan issued 14 main initiatives including:

- Adoption of the energy conservation law and institutionalization of the LCEC.
- Promotion of decentralized PV and wind applications in the residential and commercial sectors.
- SWH for buildings and institutions.
- Design and implementation of a national strategy for efficient and economic public street lighting.
- Electricity generation from wind power and solar energy (PV).
- Electricity generation from solar energy (PV).
- Hydropower for electricity generation.
- Geothermal, waste-to-energy and other technologies.
- Financing mechanisms and incentives.
- Awareness and capacity building
- Promotion of energy-efficient equipment.

So far, Lebanon has already declared four initiatives related to the energy sector:

- Electricity Sector Policy Paper.
- 12% Renewable Energy Pledge.
- National Energy Efficiency Action Plan.
- Energy Conservation Law.

3.2.2 Water Policies

After 15 years of civil war, the management of water resources faced many rising conflicts, such as ruined infrastructure and disorganization administration a fragmented territory. In 1999, “The reform of Lebanon’s water sector was officially launched” under the [“Water Master Plan \(2000-2009\)”](#). Since then four main events took part in shaping the reform in the Lebanese water policy:

1. The adoption of a 10-year Water plan in 1999 by the Ministry of Hydraulic and Electric Resources.
2. The declaration of several water administrative laws in 2000.
3. The elaboration of a National Water Sector Strategy in 2010
4. The passing of the Water Code by the parliament in 2018

By 1999, the proposed ten-year plan (2000-2009) was projected to raise the necessary funds to study and execute works in order to satisfy water needs in various sectors (Comair, 2004). On March 9th 2012, the Lebanese Government officially adopted [its National Water Sector Strategy \(NWSS\)](#), through Resolution 2. The NWSS had seven major objectives including maximizing the potential and quality of surface water resources, improving the management and protection of groundwater resources, fulfilling deficits through groundwater/surface water, ensuring proper and continuous access to high quality water supply, providing adequate quantities and quality of water for irrigation, increasing coverage of wastewater collection networks and treatment capacities, optimizing current wastewater treatment processes and sludge disposal. Moreover, the Ministry of Energy and Water launched its National Strategy for the Wastewater Sector (NSWS) in the whip of the launching of the National Water Sector Strategy (NWSS). The Lebanese government adopted the NSWS, six months after the adoption of the NWSS, on 17 October 2012 (NSWS, 2012). Finally, on April 13, 2018, the [Water Code](#) was promulgated under Law 77. The NWSS and the Water Code are currently undergoing update workshops within the MEW and with the help of several consulting offices.

Directly after the CEDRE Conference held in Paris during April 6th 2018, the Water Code was promulgated under law 77. During the conference, Lebanon essentially received more than \$16 billion in terms of concessional loans and international donations to finance, over a period of twelve years. This included around 250 projects concerned with water, electricity, and waste management sectors. However, the fast promulgation of the Water Code happened haphazardly in order to accommodate the holding of CEDRE conference, and the parliament passed the draft water law as stated in the original version provided by the government, without any amendment. The implementation of donor-driven reform is not a new phenomenon in Lebanon. Since [2001](#), a series of four international donor conferences, known as Paris I, II, III and IV (CEDRE), took place to support the development and the strengthening of the Lebanese economy as part of a comprehensive plan of reform and infrastructure investment. In fact, they were foreign aid flows that came in the form of soft loans, many of which were contingent on a reform package that targeted several public services sectors.

Despite the extensive number of actors involved in order to improve the water sector management, there still lies [problematic areas](#) that hinder the effective reform. These include institutional duplication and the fragmentation of responsibilities. The lack of organization in structure, mismanagement, and overlap in responsibilities has led to valid drawbacks in the implementation of the existing legal and institutional framework. Whereby, Lebanon's National Water Sector (NWSS), approved by the Government in 2012, presented a necessary and important step in developing the Lebanese water sector. However, it remained a non-binding executive order that did not impose any legal requirement on the public or private entities to take actions to implement. The guaranteed institutional and legal autonomy and accountability of the Regional Water Establishments has been continuously delayed due to the lack of implementation of law 221. This holds the RWEs from moving towards financial autonomy and accountability so that they can build capacities and manage the provision of water services, while improving service levels. Whereby, currently, the RWEs are actors of businesses that are required by the government to provide services to the consumer in terms of irrigation, potable water, and wastewater.

In 2016, [“The Way Forward to Safeguard Water in Lebanon”](#) clearly presented the fragmented legislative gap and concluded that Lebanon has a well-built baseline of laws and regulations related to the water sector, but they are poorly implemented and enforced. This is due to the following:

- Lack of operational declarations for existing laws and long processes or delays in ratification of laws.
- Weak legal prosecution and absence of a single entity entitled to the enforcement and follow-up violations.
- Absence of accountability mechanisms and the presence of corruption within the monitoring agencies.
- Deficit in human and financial resources in institutions related to water sector, mainly primary stakeholders.
- Poor coordination between relevant ministers.

3.2.3 Food Security Policies

In Lebanon, the formulation and implementation of policies and programs, is the responsibility of the Ministry of Agriculture, whereby is sets the agricultural strategic framework. The [MoA](#) is entitled to developing and promoting investments that improve agricultural production and marketing. In

addition to taking vital part towards managing natural resources of the country (agricultural land, irrigation water, forests, fisheries, pasturelands), while contributing to rural development.

In 2004, the [Agriculture Strategy](#) was developed by the Government of Lebanon (GoL) to strengthen agriculture. However, due to the severe effects after the July 2006 war, the strategy could not be implemented, as priorities shifted towards relief and rehabilitation. However, the updated Strategic Plan (2010-2014), was developed in 2010, to revolved around eight pillars which set forth interventions at the central and local levels. These included

- Updating the regulatory/policy framework.
- Developing MOA's new organizational chart and improving coordination with the public, private and civil society sectors.
- Upgrading the agriculture infrastructure.
- Re-activating extension services.
- Enforcing control over all agricultural products and inputs.
- Developing value chains that focus on better quality, production, marketing and export of agricultural products.
- Establishing a credit scheme for SMEs.
- Managing natural resources (water, forests)

[The National Agriculture Strategy 2020-2025 \(NAS\)](#), provided with the agreed priorities and related set of interventions, represents the operational instrument through which the agri-food sector can contribute to absorb the crises-induced economic shocks as well as to recover the Lebanese economy. As the economic outlook is highly volatile, the NAS is purposely considered as a living document, subject to regular monitoring and open to continuous dialogue and updates to ensure a continuous relevance and response to the needs emerging in the rapidly evolving Lebanon context. Specifically, the NAS canvasses a consistent policy and investment framework for the agri-food sector that will help in: a) mobilizing required national and external resources for priority public investments; b) encouraging/triggering private investments in the sector; c) supporting the coordination between different actors; d) consolidating the policy framework.

3.3 Tunisia

3.3.1 Energy policies

In order to reduce the risks associated with climate change, Tunisia adopted and implemented a [pro-active policy](#). The Intended National Determine Contribution (INDC) submitted in 2015, summarizes the actions and targets planned by Tunisia. The contribution that Tunisia offered in regards to Climate change was based upon existing national strategies, such as the [Tunisian Solar Plan \(TSP\)](#). The TSP is an operational tool to generate power from renewable sources; wind, PV, CSP and biomass. TSP has been developed in 2009, and improved to provide a road map for renewable and energy efficiency development from 2016-2030. By 2030, Tunisia plans to reduce carbon emissions in the energy sector to 43% of overall emissions. In order to fulfill this target, Tunisia managed to develop an energy control strategy that aims towards two things, increasing energy efficiency, and developing renewable energy generation. The following principles are what guide the Tunisian strategy:

- The deployment of long-term visions and objectives. The objectives have been developed until 2030, and the action plan shows direction towards 2020.

- The creation of dialogues and partnerships. The strategy and the objectives are the result of an ongoing dialogue and reflect the expertise of all the energy stakeholders in order to achieve a realistic strategy.

A new law on renewable energies was adopted by Parliament in May 2015. The objective of this law is to promote private investment in renewables to contribute to the 30/30 objective of the Tunisian Solar Plan. The Tunisian Government has adopted a Renewable Energy Action Plan with two main objectives:

- Development of large scale projects for the production of electricity from renewable energy sources; the target RE production value is 14% of the national electricity production by 2020.
- Strengthening of the solar water heater program in the residential and tertiary sectors and its extension to the industrial sector (for process heat).

In regards to [energy efficiency](#), the Action Plan for the period of 2017-2020 was developed. The National Energy Efficiency Action Plan included 3 phases:

- Awareness raising, first concrete and grass-root actions were taken under two programs, (2000-2013) that contributed to an annual decrease of 2% in energy intensity.
- Continued implementation and voluntary investment via the mobilization of industry, construction and transport (audits, cogeneration, lighting, household appliances, buildings and transport).
- Implementation of large scale projects in order to reach the 30-30 goals – 30% of electricity shall be produced by renewable sources by 2030 (2020-2030).

3.3.2 Water policies

Due to Tunisia's hydraulic environment, Tunisia developed strategies to mobilize water resources, whereby, by 2012, these strategies led to the mobilization of more than 90% of the mobilized resources. Hence, along with the mobilization policy, the policy of transferring water from the Northwest region, which has a surplus, helped satisfy water demand. In addition, the implementation strategies for the mobilization of resources, such as desalinated water and treated waste water, have also been key in providing water to different regions and socioeconomic sectors and ensuring a relatively comfortable balance between supply and demand.

The Ministry of Agriculture, Water Resources, and Fisheries (MARHP), is responsible for the activities related to water resources management. However, all environmental related aspects, are regarded to the Ministry of the Environment. Water control falls under the authority of the Ministry of Public Health. Flood management in urban areas, is coordinated with the Ministry of Equipment. The MARHP is mainly responsible for public domain management, mobilization and development of water resources, water management projects and agricultural withdrawals as well as providing water resources for domestic and other uses.

The [water policy](#) in Tunisia falls into two main phases.

Phase (1) – 20th century: This initial phase includes supply management and the expansion of services with major investment programs (water dams, sewerage, irrigation services, intensive aquifer operations). There were three master plans (North, Central, and South) resulted in a many mobilization works, water transfer, food protection, and valorization of the use of groundwater.

Master plans have led to better distribution and water allocation, which met the demands of various sectors and helped in identifying the best land to be irrigated. During this phase, the First National Strategy for Mobilizing Water Resources (1990-2000) was developed with the following objectives: mobilize 85% of the water resource potential, realize the boreholes of recognition and exploitation, realize the piezometers of control and monitoring, improve and develop networks to measure and monitor water resources and create 21 dams, 203 hillside dams and 580 hillside lakes.

Phase-II - Medium-Term (2030) and Long-Term (2050) Strategies This phase began at the beginning of the 21st century, when Tunisia began to realize its limits and that the transition to water management was necessary. There is a slow evolution towards a new approach that takes into account the quality and quantity of water as well as the whole hydrological system, the promotion of demand management, tariff reform, the establishment of public-private partnership and the strengthening of the enforcement of environmental protection regulations. This is the concept of Integrated Water Resources Management (IWRM).

[Water strategies](#)

The various strategic studies developed in the water sector have made it possible to develop strategies for mobilization, rational exploitation, integrated and sustainable management and the conservation of water resources and protection of the environment. Three main strategies have been adopted and implemented:

- The ten-year strategy for the mobilization of water resources (1990-2000): During this phase, the Ten-Year Strategy for Water and Soil Conservation (1991-2000) was developed.
- The complementary strategy (2001 -2011): This was a complementary strategy for the mobilization of water resources during the period 2001- 2011. It aimed to mobilize 90% of the water resource potential, increase irrigated areas, reach 97% rural drinking water supply and improve the quality of water supply. This purpose of this interconnection is to balance water stocks in water works, improve drinking water quality and ensure water supply to the capital city (Tunis) and major coastal cities (Sousse, Monastir, Mahdia and Sfax) in times of drought. During this phase, the Complementary Strategy for Water and Soil Conservation (2002 -2011) was developed.
- The medium-term strategy (2030) and the long-term strategy (Water 2050): which made it possible to confront the development of water supply and demand by 2030.

The objectives are:

- a) Better knowledge of water resources
- b) Mobilization of all identified water resources
- c) Water saving efforts
- d) Rationalization of operations
- e) Involvement of users in water management
- f) The establishment of an evaluative legal base (water code)

3.3.3 Food – Agriculture Policies

The agricultural model of Tunisia has presented clear development and important advances, such as an increase in the production and an improvement in agricultural and food supply. However, due to the international crisis in 2008, the agriculture and food market was influenced negatively. Hence, Tunisia recognized the need to adapt and adjust its agricultural development model in order to

continue the process of intensification and growth of production and ensure a better distribution of the fruits of growth. The country also needs to preserve natural resources and improve the control of integration of Tunisian agriculture into the global economy.

4. Benefits of NEXUS mainstreaming

4.1 The case study of Jordan

Jordan is considered to be one of most countries in the world that suffers from water-scarcity, whereby this condition remains to increase due to population growth, climate change, and the region's geopolitical situation. Jordan heavily relies on (fossil) groundwater which is increasingly depleted. Despite agriculture being an important source of livelihoods and employment in rural areas, it still remains limited due to water scarcity and land. In which, ecosystem degradation is also a widespread phenomenon. Urban encroachment also reduces the availability of arable land. Irrigated areas are projected to shrink by about [30% by 2050](#) compared to 2010. Water quality is increasingly threatened by industrial and domestic discharge of untreated wastewater. Furthermore, the demand for energy has been growing rapidly and Jordan's energy sector is strongly import-dependent, resulting in high energy costs. Desalination for meeting drinking and irrigation water demands and for reducing the growing demand-supply gap is very energy intensive, and hence is competing with other energy demands. Moreover, desalination relies on the use of fossil fuels, causing increased greenhouse gas (GHG) emissions. Water transfers are also very energy intensive in Jordan due to large elevation differences over which water needs to be pumped.

4.1.2 Sahara Forest Project in Aqaba, Jordan

Mitigating climate change, requires a Nexus Framing shift to renewable (in particular solar). In which, energy reduces dependency on fossil fuel imports and greenhouse gas emissions. Enhancing [water availability](#), increasing crop productivity, and generating co-products and co-benefits (e.g., algae, fish, dryland restoration, greening of the desert), can take place through employing the renewable energy for desalination of seawater and for cooling of greenhouses in integrated production systems.

The production system in the Sahara Forest project was integrated through using available natural resources, mainly solar energy and sea water to improve water availability and agricultural biomass production; while providing new employment opportunities simultaneously. When a hydroponic system is used, along with the humidity in the air, water needs for food production become 50% lower compared to other greenhouses.

There were some technical and economic Nexus solutions presented in the Sahara Project. This included producing electricity through renewable energy (solar power, PV or CSP), and the production of freshwater by seawater desalination. In turn, seawater-cooled greenhouses for food production, and outdoor revegetation was implemented using run-off from the greenhouses.

The Sahara Forest Project has been implemented at pilot scale so far, including the first pilot with one hectare and one greenhouse pilot in Qatar and a larger "launch station" with three hectares and two greenhouses in Jordan). These pilots have been funded by international organizations such as the Norwegian Ministry of Climate and Environment, Norwegian Ministry of Foreign Affairs and the European Union. Alignment with national policies, institutions and funding as well as upscaling of the project is underway or planned.

The multi-sectoral planning and investments that are needed to up-scale the project require cooperation among the water, agriculture, and energy sectors and an active involvement of local actors, private companies, and investors. These cooperation and involvement mechanisms are currently being established in Jordan. Given the emphasis on the economic value of the project, public-private partnerships are considered as the appropriate business and governance model, when the project is up-scaled. Scenarios for upscaling (seawater use primarily in low lying areas close to the sea, to avoid energy-intensive pumping) include 50 MW of CSP, 50 hectares of greenhouses, which would produce 34,000 tons of vegetables annually, employ over 800 people, and sequester more than 8,000 tons of CO₂ annually.

4.1.2 Lajoun Integrated Ecology Centered Development Area in Karak, Jordan

The concept of NEXUS Framing is presented, where utilizing nonconventional water solutions such as desalination, wastewater reuse, water transfers) cause the sector to become more energy and greenhouse gas intensive. In contrast to increasing water scarcity and water quality degradation, while relying on imports of fossil energy, which constrains agriculture, and contributes to high food import dependence.

The project presented clear NEXUS opportunities, whereby renewables can provide cheaper and climate-smart energy. In addition, recycling reduces the reliance on natural resources, which mitigates water scarcity as well. Not mentioning that recycling nutrients manages to save less energy, which means less energy-intensive industrial fertilizer would be required. Hence, integrated land use systems and greening of municipal areas can make land more productive, reverse land degradation, restore ecosystems, and improve live quality. The project projected that water-, energy-, and climate-smart municipalities can increase their overall resource productivity, generate additional employment, promote economic development, and enhance human well-being.

Wastewater is treated and recycled for irrigating crops, for nursery plants and for trees (including constructed wetlands and reed vegetation in wadi); crops are also used as livestock fodder, recycling of agricultural/plant residues/nutrients e.g., through a composting facility improves biomass production; a 3 MW solar power plant provides local energy (e.g., for nurseries) and feeds excess energy into the public grid (legislation has been adjusted e.g., in terms of feed in tariffs—currently 0.25\$/kWh); land rehabilitation through ecosystem-based solutions, e.g., greening along roads, in parks and in the wadi (also for recreation) with plants from the local nursery, improves overall land productivity; native plants are re-cultivated for fodder, aromatic, medicinal and ornamental purposes (including seedbanks), reed grown in the wadi is used as construction material in the village.

[Karak municipality](#) is an independent institution which cooperates with many partners in this project, e.g., local families and communities for which the project provides additional jobs. Farmers bring their residues and receive compost and use the treated wastewater. Public institutions include the local, governorate level, and national administration, which coordinate and collaborate across sectors and scales, e.g., for all needed approvals from authorities and ministries, e.g., Ministries of Planning, Municipal Affairs, Water, Energy, and Agriculture (approved composting facility) and Energy. Other partners include Royal Scientific Society (performs studies to determine most suitable native plant species), universities (e.g., Mutah University which also performs studies in the project) and funders. The integrated approaches and experience gained support sustainability transitions beyond the municipality, e.g., strategic planning of national ministries. The private sector is involved e.g., through contracts for wastewater reuse which the project signed with the neighboring industrial complex, as

well as a joint solar project with the electricity company. Products from Lajoun are economically competitive in the local context and for local partners.

4.2 The case study of Lebanon

4.2.1 Arc en Ciel, Taanayel Farm in the Bekaa Valley, Lebanon

Agricultural production is constrained by water and energy scarcity/costs. Poor water, energy infrastructure, and low use efficiencies mutually affect water, energy, agriculture. Where urban sprawl competes with agriculture for water, land and energy. These driving forces are bottom up related to the needs and challenges that operating and managing a farm in [the Bekaa Valley](#) entails with regards to all the elements of water, energy, land and food and their interlinkages.

The Nexus Opportunities presented in the project included water storage and treatment using renewable energy, recycling of wastewater (treatment and reuse) and agricultural residues in multi-functional systems which increases resource use efficiencies and reduces pressure on water, land and energy, reducing pollution of surface, and ground water bodies while increasing agricultural production efficiency. Opportunities arise from integrating climate change adaptation (e.g., increasing water availability through wastewater recycling) and mitigation (employing water-smart renewable energy)

4.3 Global best practices

When studying the benefits of NEXUS mainstreaming, it is important to look into [global best practices](#) and study the influence of the integrated NEXUS system.

Case study 1 – To begin, in **Korat Thailand**, a "[Fine-tuning of water supply pumps](#)" project was implemented, where the monthly municipal expenditures were reduced by \$25000 for electricity by fine tuning the water supply pumps in Makhantao Pumping Station in Korat. The investment costs for the Municipality amounted to \$2.500. A study indicated that the Municipality loses more than \$ 4 million per annum for unaccounted 53% water supply. As consequence the Municipality decided to replace obsolete water meters of more than 25 years of age. A resolution was issued changing responsibilities and implementing new procedures.

Case study 2 –Multiple benefits of [water hyacinth control in Southern Africa](#)

Water hyacinth is one of the fastest growing plants, blocking sunlight from entering the water and preventing native vegetation from growing. This reduces the oxygen levels in the water, affecting fish and other aquatic life. Its rapid growth can dramatically reduce water movement, block infrastructure and channels and absorb nutrients essential for aquatic ecosystems. As it dies and decays it further depletes the amount of dissolved oxygen in the water and can become a breeding ground for mosquitos. To address the issue of water hyacinth invasion in South Africa, several iterations towards **nexus-driven solutions** were developed. The first iteration acknowledges the potential energy and food security benefits of the invasive plant. It suggests the drying of the biomass for direct burning as a source of energy and composting the rest for use as a manure to support agricultural food production. However, this was found to under-use the full potential of water hyacinth. A second iteration suggests to feed the biomass into a digester. The resulting methane could be used as a source of energy and the waste product could be used as fodder for livestock. The third and final iteration suggests to feed all the biomass to livestock, contributing most significantly and directly to food security.

Case study 3 – [Solving inefficient irrigation in Indonesia](#)

The Jati-Lahur reservoir and hydropower station is situated some 75 km to the South West of Jakarta, the capital of Indonesia. Its waters flow through Jakarta and into the Java Sea. On its way, it flows through an area of smallholder-irrigated rice paddies. Water for the rice irrigation scheme in this area comes from the Jati-Lahur reservoir and is regulated by an abstraction permit scheme since 2003. In addition, the river is also used by an artisanal capture fishery sector. Targeted capacity building activities over the years empowered rice farmers to grow more rice with less water. They could have continued abstracting their permitted amount of water from the Jati-Lahur reservoir, while also expanding the total irrigated area. This would have had no impact on the access of water for downstream populations and urban centers. However, the farmers opted for a second approach, where they increased rice yields on the existing area and reduced their total water use. Downstream flows increased, contributing to improved capture fishery benefits. Additionally, water saved by the farmers became available to industry surrounding Jakarta. Additionally, the farmers received compensation for the difference in water use compared to their permitted amount. As a result, the economic productivity of water use in the basin, physical yields and overall food production increased, while competition for water decreased.

5. Recommendations for improvement

Addressing water energy and agriculture together and applying an integrated approach to planning based on the SDGs can lead to water, energy and food security optimization by increasing resource efficiency, ascertaining and reducing trade-offs, exploiting and building synergies and improving collaboration and governance across sectors. An integrated approach aids in identifying and addressing externalities across sectors which may otherwise be overlooked. The global framework and tools available to implement the SDGs are important and diverse. Public and private finance, financial approaches, instruments and options and a range of public-private partnerships support government, the private sector and civil society in the implementation of the SDGs. Similarly, management that is based and owned in the community supports integration between different levels of government within a country; it also represents a grassroots bottom-up approach to the implementation of the SDGs. Projects that are based and owned in the community also assist in the implementation of those SDGs that require community engagement and involvement. Modelling and assessment tools illustrate the numerous benefits of an integrated approach to resource planning and can support broad implementation of many SDGs with the expansive focus on climate, land, energy, water and development. A shift in focus to an integrated approach to water and resources, such as is present under the SDGs, could benefit Jordan, Lebanon, and Tunisia by exploiting the interconnections. Potential benefits include: avoiding sunk costs that preclude funding other projects, improving the efficiency of the water system, improving the resilience of the economy and population and improving collaboration and cross-sectorial coherence across government.

Recommendations include the following:

- Increasing integrated resource management in institutional structures, there should be detailed assessment of the current national institutional arrangements in order to pinpoint the weaknesses and gaps that hinder the implementation of the WEF Nexus Approach in the focus countries.

- Empowering and strengthening already active institutions that develop and implement policies/strategies that are related to WEF sectors. This will develop a comprehensive WEF nexus national strategy.
- Adopting a WEF Nexus Approach policy to enhance policy coherence among the three sectors and climate change policies to provide integrated solutions and to mitigate nexus-related risks.
- Apply appropriate policy and legislative and economic tools to ensure that basic human needs for the three resources are met at a low, subsidized price, while excessive use is priced at a tariff that reflects the cost.
- Implement integrated planning and management that reduces trade-offs and builds synergies across the three sectors.
- Improve resource efficiency towards the transition to a sustainable economy by reforming economic policy and market incentives.
- Promote sustainable consumption and production patterns to achieve SDGs and mitigate and adapt to climate change mandates and targets as agreed upon in the Paris Climate Change Summit.
- Harness existing multi-stakeholder platforms to improve policy coherence, institutional and social learning and leadership. Multi-stakeholder platforms are needed in order to develop and explore science-policy-society linkages and opportunities to share knowledge, including the public sector (legislators, politicians, utilities, etc.), the private sector (utilities, supply chain, agricultural and industrial sector, etc.), civil society and foreign aid agencies. • The establishment of a network of leading experts in the region is encouraged to create more synergy with technical knowledge as well as in transboundary issues, international conventions and legal and institutional aspects.
- The involvement of civil society in the nexus governance can be an important asset in generating better dialogues and bringing legitimacy and accountability to governing institutions.
- Mainstream the nexus mental models, concepts and tools in policy and development plans.
- Create training programs across the various sectors to build capacity on the analytics as well as the negotiation aspects of the implementation of nexus solutions at different levels, and develop specific institutional programs and individual capacity-building programs across the three sectors.
- Legislators have a central role in facilitating institutional reforms, laws and enforcement mechanisms that will create better collaborative platforms.
- Scale up, replicate and fund on-going projects related to the nexus, including integrated seawater energy and agricultural systems, renewable energy for wastewater treatment and reuse and solar desalination.
- Build capacity for policy makers and institutionalize regional knowledge management systems to share best practices on the WEF nexus.
- Support and provide incentives for strategic partnerships and cooperation between research centers and the private sector.
- Introduce inclusive and fair rules, institutions and practices governing social interactions to improve outreach to the vulnerable, such as poor men and women, and the younger and older generations.

- Gender equity and women’s empowerment are declared goals for all Arab countries. Women should play effective roles in identifying water governance options at all levels. A first step can be training programs on gender awareness and analysis for water professionals and the community.
- Focus water development policies on eradicating poverty and improving the livelihoods of women and men.

There are several options for mainstreaming the WEF Nexus Approach. One option (which is more favorable than others as it does not aim to develop new entities with the specific mandate of managing the WEF nexus) is to make one designated body the focal point for preparing a comprehensive WEF nexus strategy for the country. Ideally, this would be a body that is already active in elaborating and implementing strategies that are related to the WEF sectors. This is possible through periodic policy dialogues and the evaluations of WEF nexus policies. Also, the Nexus Approach may be mainstreamed as part of the sustainability reporting mechanism. Other models that can possibly mainstream the nexus include:

- Shared Governance: all the units involved have representatives to a body that will be empowered and entrusted to govern the nexus.
- High Level Governance Unit: establishing an independent body with representation of all stakeholders involved in the nexus that will have resources and authority to implement policy.
- Private-Public Partnership (PPP): the implementation of the Nexus Approach is expected to conserve resources, which may be reflected in the form of financial savings.

Whichever mechanism(s) is/are adopted, more improved coordination between ministries related to WEF sectors needs to take place to meet future challenges. Arab countries need to assess key public entities that are already involved in all of the WEF sectors as the principal administrators of the development and mainstreaming of policies and strategies that tackle the WEF sectors in an integrated and comprehensive way.

6 Summary and conclusions

A WEF Nexus Approach in the Arab region, and focus countries, can provide great benefits. Adopting such an approach will guarantee achieving the sustainable development goals, whereby the interdependency among water, food, and energy in the focus countries are strongly and closely interlinked. These countries are all part of the Arab region, this region is considered to be one of the most vulnerable regions in the world, and is highly affected by climate change. The policy landscape from the water-energy-food framework is complex and fragmented, where these sectors are usually viewed independently of each other. Water, energy, and food security are vital concepts when considering the sustainability in the future of the Arab world. Due to the adoption of certain policies, the focus countries have been able to tackle the nexus challenge, and set a tone to the sustainable development of the region in the years to come.

National and regional efforts to address many environmental issues have presented an extraordinary opportunity for a needed institutional reform in order to mainstream the nexus thinking in policy development and implementation. In order to achieve effective resource management, the institutional framework governing the elements of the WEF nexus need to be strengthened. Some countries presented different models of integrated institutions, however the interlinking of their priorities still needs support, as many institutions governing these sectors are fragmented because of

the existence of multiple and overlapping jurisdictions. The institutional framework that governs the elements of the WEF nexus in these countries is mainly fragmented which delays the comprehensive and inclusive management of these interlinked priorities. Which consequently led to a sectoral approach to policy planning, rather than an interlinked one. The fragmentation also arises from within the sector itself, where more than one authority is responsible of governance. For example, in Jordan, one ministry controls allocation of water, while another controls irrigation water use. Hence, good environmental governance can be achieved if there is equality and equity presented in policy and strategy formulation.

Tapping into the Nexus Approach confirms several opportunities to increasing awareness in policy making and piloting research projects and small-scale projects. The ultimate aim is to have institutions that are able to mainstream and reflect the WEF Nexus Approach in policies in Arab countries in light of the mandate and targets of both the SDGs. This is important because it guarantees that no rising resource insecurities delay their sustainable development path. When adopting and implementing an “integrated nexus approach”, coordination and collaboration mechanisms are vital mechanisms.