



WORKING PAPER

WEF - ARAB WORLD

WATER, ENERGY, FOOD NEXUS:

**AN OUTLOOK ON PUBLIC INSTITUTIONS
IN THE ARAB WORLD**

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WATER, ENERGY, FOOD NEXUS: AN OUTLOOK ON PUBLIC INSTITUTIONS IN THE ARAB WORLD

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The Arab countries represent a range of models of “integrated institutions” that could act as a gateway towards a Water, Energy and Food nexus approach.

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INTRODUCTION

The Arab world, which represents around 10% of the world land area and is home to more than 400 million inhabitants, is a region of extremes in terms of its natural richness.¹ It tops the charts with its oil and natural gas reserves, but at the same time is a region of extreme aridity with most of its territories represented by barren deserts. In fact, five out of the top ten countries with the largest oil reserves in the world² and eight out of the world's top ten most-water stressed countries, are within the Arab region.³

Central to the Arab world's future and its pursuit of sustainable development is its ability to deal with a three-fold challenge represented by: a) the need for an efficient response to water scarcity, b) an enhanced management of energy in the view of the climate change constraints and c) ensuring that the rapidly growing Arab population enjoys the benefits of food security. This Water-Energy-Food (WEF) nexus is critical to the Arab world, and the policies devised by Arab countries to tackle this challenge will set the tone for the sustainable development of the region for the years to come.

While more integrated planning and management of resources may require new technologies, including planning and management tools and models, it can only be delivered through the relevant institutions. These institutions will almost certainly be required to make changes in the way they work, and how they perceive each other. As such, Integration raises 'institutional challenges' with both "opportunities and impediments to joint decision-making."⁴

Key to a nexus approach is stronger institutions that are better interlinked. "There are large opportunities

to be realized if the nexus is addressed coherently across all scales, through multi-level governance with differentiated (but clearly defined) responsibilities of institutions."⁵

The institutional structure both at the national and inter-regional level is a key factor in shifting policy-making in the Arab world towards a nexus approach. What are the entry points in existing institutions towards introducing integrated thinking? How can existing institutions be strengthened to realize a nexus approach? Is there a need for new and additional institutions on both national and regional levels that are capable of linking and harmonizing policy planning of the WEF nexus elements?

In order to start answering these questions, it is important to have a clear background of existing institutions concerned with the resources and sectors of the WEF nexus in the Arab countries. Accordingly, the objective of this paper is to provide an overview of the realities of the resources and sectors integrated in the WEF nexus and the institutional landscape governing them. The paper will go through the main elements of the WEF nexus, the governing institutions and existing policies on the national level of selected case countries, and regional and interregional institutions.

1 UNDP. "Water Governance in the Arab Region: Managing Scarcity and Securing the Future." 2013. Accessed April 18, 2015. http://www.arabstates.undp.org/content/dam/rbas/doc/Energy%20and%20Environment/Arab_Water_Gov_Report/Arab_Water_Gov_Report_Full_Final_Nov_27.pdf.

2 Badkar, Mamta. "15 countries sitting on gigantic oceans of oil." *Business Insider*, Countries May 11, 2012. Accessed April 22, 2015. <http://www.businessinsider.com/15-countries-with-the-biggest-oil-reserves-2012-4?op=1>.

3 Reig, Paul; Maddocks, Andrew and Gassert, Francis. "World's 36 Most Water-Stressed Countries." *World Resources Institute*, December 12, 2013. Accessed April 22, 2015. <http://www.wri.org/blog/2013/12/world-s-36-most-water-stressed-countries>.

4 Scott, Christopher; Pierce, Suzanne; Pasqualetti Martin; Jones, Alice; Montz, Burrell and Hoover, Joseph. "Policy and institutional dimensions of the water-energy nexus." *Energy Policy* 39 no. 9 (October 2011): 6622.

5 Hoff, Holger. "Understanding the Nexus." Background paper presented at the Bonn 2011 Conference: *The Water, Energy and Food Security Nexus*. Stockholm Environment Institute, 2011. Accessed May 30, 2015. <http://www.sei-international.org/mediamanager/documents/Publications/SEI-Paper-Hoff-UnderstandingTheNexus-2011.pdf>.

ELEMENTS OF THE WEF NEXUS: RESOURCES AND SECTORS

The WEF nexus represents a unique challenge to the Arab world, a region where poor governance often complicates the disadvantaged and disproportionate distribution of natural resources such as water, fossil fuel and arable lands. To have a better understanding and definition of the WEF nexus it is important to identify the resources and sectors that are constituents of the nexus.

Water

The Arab world is among the poorest⁶ regions of the world in terms of renewable water resources per capita. There is, however, a marked regional variation within the Arab world; in fact the Levant with its 1,108 m³ per capita fares better than the severely water-scarce Gulf which has merely 241.5 m³ per capita of fresh and renewable water resources.⁷ The inter-regional

variations are also significant, for example Iraq enjoys 2,751 m³ of water per capita whereas Jordan's renewable water resources are just shy of 150 m³ per capita.⁸ Future forecasts paint a darker picture, some studies and modelling forecasted that by 2025 only Iraq and Sudan will stay above the water scarcity limit of 1,000 m³ per capita, and just by a narrow range.⁹

The main water resources per country are presented in Table 1. An important factor that impacts the Arab world water security is the dependence of many of its countries on trans-boundary water resources (see Table 1 and Table 2). A recent assessment determined that close to 70% of the West Asia region's water resources are shared, both surface and underground resources, however, very few mechanisms for cooperation between all basin and groundwater sharing countries are in place.¹⁰

Table 1

Water resources in select Arab countries¹¹

COUNTRY	TOTAL RENEWABLE SURFACE WATER RESOURCES (10 ⁹ M ³)	TOTAL RENEWABLE GROUND WATER RESOURCES (10 ⁹ M ³)	TOTAL ACTUAL RENEWABLE WATER RESOURCES (10 ⁹ M ³) ^A	RENEWABLE WATER RESOURCES PER CAPITA (M ³) IN 2014	DEPENDENCY RATIO (%) ^B
Egypt	56	2.3	57.3	710.5	96.91
Jordan	0.65	5.4	0.94	128.8	27.21
Lebanon	3.803	3.2	4.5	933.8	0.7854
Morocco	22	10	29	878.6	0
Saudi Arabia	2.2	2.2	2.4	83.25	0
Tunisia	3.42	1.595	4.6	419.7	9.101
United Arab Emirates	0.15	0.12	0.15	16.05	0

a. It corresponds to the maximum theoretical yearly amount of water actually available for a country at any given moment.

b. "The ratio refers to Indicator expressing the percent of total renewable water resources originating outside the country. This indicator may theoretically vary between 0% and 100%. A country with a dependency ratio equal to 0% does not receive any water from neighboring countries. A country with a dependency ratio equal to 100% receives all its renewable water from upstream countries, without producing any of its own".

⁶ UNDP. "Water Governance in the Arab Region: Managing Scarcity and Securing the Future."

⁷ Arab Organization for Agricultural Development (AOAD). Accessed April 21 2015. <http://www.aoad.org/index.htm>.

⁸ Ibid.

⁹ Arab Forum for Environment and Development (AFED). "Arab Environment: Water, Sustainable Management of a Precious Resource," 2010. Accessed April 16, 2015. <http://www.afedonline.org/en/inner.aspx?contentID=569>.

¹⁰ UN-ESCWA and BGR (United Nations Economic and Social Commission for Western Asia; Bundesanstalt für Geowissenschaften und Rohstoffe). *Inventory of Shared Water Resources in Western Asia. Beirut, 2013.* Accessed April 14, 2015: <http://waterinventory.org/sites/waterinventory.org/files/00-inventory-of-shared-water-resources-in-western-asia-web.pdf>.

Table 2

Main trans-boundary basins of the Arab world¹²

BASIN	BASIN	COUNTRIES	AGREEMENTS
Euphrates	Sajour, Jallab, Balikh, Khabour	Iraq, Syria, Turkey and Iran	Bilateral: Syria-Turkey in 1987 and 2009. Iraq and Turkey (MoU in 2009). Iraq and Syria in 1990.
Jordan-Yarmouk	Yarmouk, Banias, Hasbani, Jordan	Lebanon, Syria, Jordan, Palestine and Israel	Bilateral: Jordan and Syria in 1953 and 1987; Israel and Jordan in 1994 (annex II of the peace treaty); Israel and the Palestine in 1995 (part of the Oslo agreement).
Nahr Al Kabir		Lebanon and Syria	Main agreement in 2002 to share the river's water between Lebanon and Syria.
Nile	White Nile, Sobat, Blue Nile	Egypt, Sudan, South Sudan, Burundi, Congo, Eritrea, Ethiopia, Rwanda, Tanzania and Uganda	Basin wide agreement: Nile Basin Initiative launched in 1999 and endorsed by all basin countries. In 2010 upstream countries (Burundi, Tanzania and Uganda, Rwanda and Ethiopia) signed an agreement to seek more water rights. Egypt and Sudan opposed.
Orontes (Al Assi)	Afrin and Karasu	Lebanon, Syria and Turkey	Bilateral: Lebanon and Syria in 1994; Syria and Turkey in 2009.
Senegal		Mauritania, Mali and Senegal	Basin wide initiative: Nouwakchat declaration of 2003.
Tigris	Batman, Khabour, Greater Zab, Lesser Zab, Adhaim, Diyala, Cizre, Wadi Tharthar	Iraq, Syria and Turkey	Bilateral: Iraq and Turkey in 1946; Iran and Iraq in 1975; Iraq and Syria in 2002; Syria and Turkey in 2009

¹² UN-ESCWA and BGR. *Inventory of Shared Water Resources in Western Asia*; & "Nile Basin Initiative," 2015. Accessed April 14, 2015: http://www.nilebasin.org/index.php?option=com_content&task=view&id=13&Itemid=42; & "Organisation pour la Mise en Valeur du fleuve Senegal (OMVS)". Accessed April 17 2015 <http://www.portail-omvs.org/>.

The Arab region relies on various water sources; conventional and non-conventional, renewable and non-renewable. Groundwater is the cornerstone of conventional water resources for a majority of the Arab countries.¹² Table 3 examines the main aquifers tapped in large parts of the Arab world. It should be noted that renewability or replenishment rates are very low in many of these aquifers.

Table 3

Select aquifers vital to the Arab world's provisioning in water¹³

AQUIFER	AREA (SQUARE KILOMETERS)	SHARED COUNTRIES	RENEWABILITY (MILLIMETERS PER YEAR)	AGREEMENTS
Anti-Lebanon	1,055	Lebanon and Syria	Medium to high (20 to 100 mm/yr)	None
Basalt Aquifer System (West)	7,000	Jordan and Syria	High	Groundwater-related provisions in the 1987 agreement regarding the utilization of the waters of the Yarmouk River.
Neogene Aquifer System (South-East), Dibdibba-Kuwait Group: Dibdibba Delta basin	153,000	Iraq, Kuwait, Saudi Arabia	Very low to low (0–20 mm/yr)	None
Saq-Ram Aquifer System (West)	308,000	Jordan, Saudi Arabia	Low (2–20 mm/yr)	None
Um Er Raduma Dammam Aquifer System (South): Rub' al Khali	680,000	Oman, Saudi Arabia, United Arab Emirates, Yemen	Very low to low (0–20 mm/yr)	None
Umm er Radhuma-Dammam Aquifer System (Centre): Gulf	281,000	Bahrain, Qatar, Saudi Arabia	Very low to low (0–20)	None
Nubian Sandstone	200,000	Libya, Egypt, Sudan, Chad	NA	None

12 Siddiqi, Afreen and Anadon, Laura Diaz. "The Water-Energy Nexus in the Middle East and North Africa." *Energy Policy* 39, no.6 (August 2011): 4529-4540. <http://www.sciencedirect.com/science/article/pii/S0301421511003065>.

13 UN-ESCWA and BGR. *Inventory of Shared Water Resources in Western Asia; & UN-ESCWA (United Nations Economic and Social Commission for Western Asia). Knowledge Management and Analysis of ESCWA Member Countries Capacities in Managing Shared Water Resources. United Nations: New York, 2009. Accessed April 21 2015: <http://www.escwa.un.org/information/publications/edit/upload/sdpd-09-7.pdf>.*

Desalination and wastewater reuse are the most prominent non-conventional water resources of Arab states. Wastewater reuse offers a chance for most Arab countries to improve their water usage and alleviate pressure on surface, ground and desalination.¹⁴ The affluent Arab states of the Gulf region are currently leading the use of non-conventional water resources, both in desalination and wastewater reuse as shown in Table 4, noting that data availability is erratic for most Arab countries which hinders long term analysis and forecast. Wastewater treatment can relieve much of the problem of surface water pollution in countries like Lebanon, Egypt and others offering at the same time the promise of covering a large share of the water needs of countries especially if it is coupled with efficient irrigation techniques.¹⁵

Table 4

Non-conventional water resources in selected Arab countries¹⁶

COUNTRY	DESALINATED WATER PRODUCED (10 ⁹ M ³ PER YEAR)	TREATED MUNICIPAL WASTEWATER (10 ⁹ M ³ PER YEAR)			
		PRODUCED MUNICIPAL WASTEWATER	COLLECTED MUNICIPAL WASTEWATER	TREATED MUNICIPAL WASTEWATER	DIRECT USE OF TREATED MUNICIPAL WASTEWATER
Egypt	0.100 (2002)	8.50 (2011)	6.500 (2011)	4.80 (2011)	0.700 (2011)
Jordan	0.100 (2005)	0.18 (2008)	0.118 (2010)	0.11 (2010)	0.084 (2005)
Lebanon	0.0473 (2006)	0.31 (2011)	0.103 (2009)	0.004 (2006)	0.002 (1991)
Morocco	0.007 (2000)	0.70 (2010)	0.292 (1991)	0.12 (2010)	0.070 (2008)
Saudi Arabia	1.033 (2006)	0.73 (2000)	0.649 (2009)	0.67 (2003)	0.217 (2006)
Tunisia	0.013 (2001)	0.25 (2010)	0.240 (2003)	0.19 (2008)	0.068 (2010)
UAE	0.950 (2005)	0.50 (1995)	..	0.29 (2006)	0.248 (2005)

¹⁴ AFED. "Arab Environment: Water, Sustainable Management of a Precious Resource."

¹⁵ UNDP. "Water Governance in the Arab Region: Managing Scarcity and Securing the Future."

¹⁶ FAO. "FAO Aquastat Website."

Energy

While not all nations have adequate supplies of oil and gas, all Arab countries have a high potential to harness the power of the sun and wind to produce clean energy.¹⁷ It is estimated that oil and gas account for 36% of the region's GDP.¹⁸ However, oil and gas distribution is not uniform across the region with the Gulf nations being the richest in this resource as shown in Table 5.

Table 5

Oil and natural gas production, export and consumption in selected Arab countries¹⁹

COUNTRY	TOTAL OIL PRODUCTION (THOUSAND BARRELS PER DAY)	OIL CONSUMPTION	OIL NET EXPORT/IMPORT (-)	TOTAL OIL PRODUCTION (BILLION CUBIC FEET)	NATURAL GAS CONSUMPTION	NATURAL GAS NET EXPORT/IMPORT (-)
Egypt	711.69	725.00	-13.31	2163.40	1792.24	371.16
Jordan	0.16	108.61	-108.44	8.12	37.43	29.31
Lebanon	0.0	104.86	-104.86	0.0	0.0	0.0
Morocco	5.06	206.16	-201.11	2.12	29.88	-27.76
Saudi Arabia	11840.68	2861.00	8979.68	3507.84	3507.84	0.0
Tunisia	66.63	89.28	-22.65	68.16	116.89	-48.73
UAE	3398.19	669	2729.19	1874.26	2220.89	-373.63

Currently, most energy produced within the Arab world is derived from fossil fuels. Renewable energies on the other hand contribute little to the total energy budget. Hydropower remains the most tapped source of renewable energy in most Arab countries, notably in countries with perennial streams and rivers.²⁰ Biomass and waste (combustible renewables) as a source of energy are poorly represented in most Arab countries except for Tunisia, a leader in this sector, which secures up to 12% to 15% of the country's energy needs (see figures 1 and 2).

17 International Renewable Energy Agency (IREA), League of Arab States and Regional Center for Renewable Energy and Energy Efficiency (RCREEE). "Pan Arab Renewable Strategy 2030: roadmaps of actions for implementation." IRENA, 2014. Accessed April 15 2015: http://www.irena.org/DocumentDownloads/Publications/IRENA_Pan-Arab_Strategy_June%202014.pdf.

18 Abdel Gelil, Ibrahim; El-Ashry, Mohamed and Saab, Najib, eds. *Sustainable Energy in the Arab World: Prospects, Challenges and Opportunities*. Arab Forum for Environment and Development (AFED), 2013. Accessed April 22 2015: http://apps.unep.org/publications/pmdocuments/-Arab_Environment_6_Sustainable_Energy-2013ArabEnvironment_SustainableEnergyProspects_201.pdf.

19 US Department of Energy. "US Energy Information Administration," last modified July 2015. Accessed April 13 2015: <http://www.eia.gov/>.

20 Abdel Gelil et al. "Sustainable Energy in the Arab World: Prospects, Challenges and Opportunities."

The Arab world is lagging behind in energy efficiency and the per capita use in the Gulf states is among the highest in the world whereas energy transport systems are wasteful and lose as much as 19.4% in transmission and distribution, much higher than the world average of 8.3%.²¹

Most energy strategies within the Arab world have set goals of increasing the share of renewable energies in the energy make-up; for example Tunisia, is aiming for 30% share of renewable energies in the electricity mix by 2030 whereas Morocco hopes to reach 12% by 2020, Egypt an ambitious 20% by 2020.²² Lebanon's National Energy Efficiency Action Plan set 12% of the share of renewables as the national target by 2020. Saudi Arabia has set a target of securing around a third of its local energy needs through renewable sources by 2032.²³

21 Ibid.

22 "Energylopedia", last modified July 23, 2015. Accessed April 20 2015: https://energylopedia.info/wiki/Main_Page.

23 Abdel Gelil et al. "Sustainable Energy in the Arab World: Prospects, Challenges and Opportunities."

Figure 1

Contribution (%) of combustible renewables and waste to the total energy consumption in selected Arab countries between 1995 and 2011²⁴

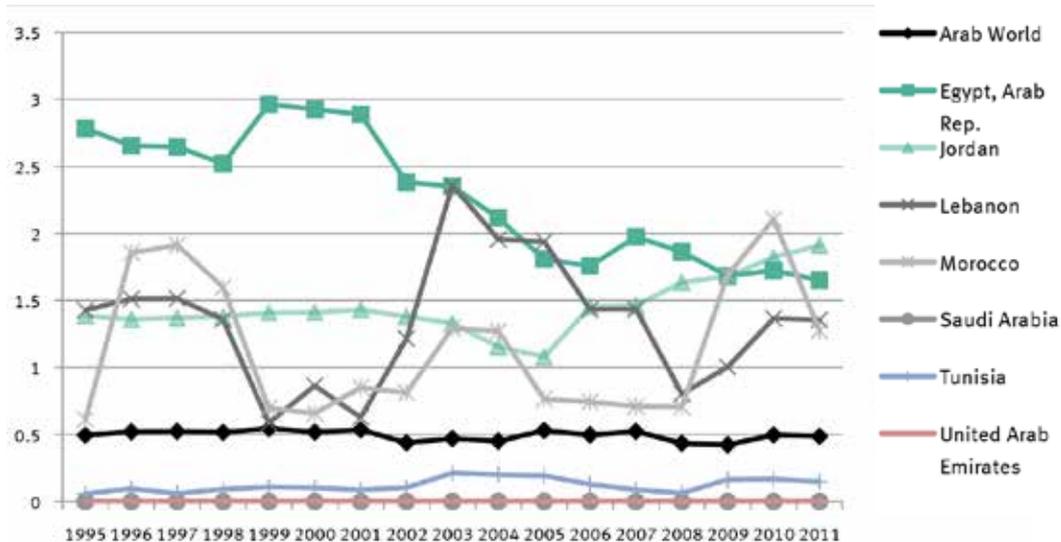
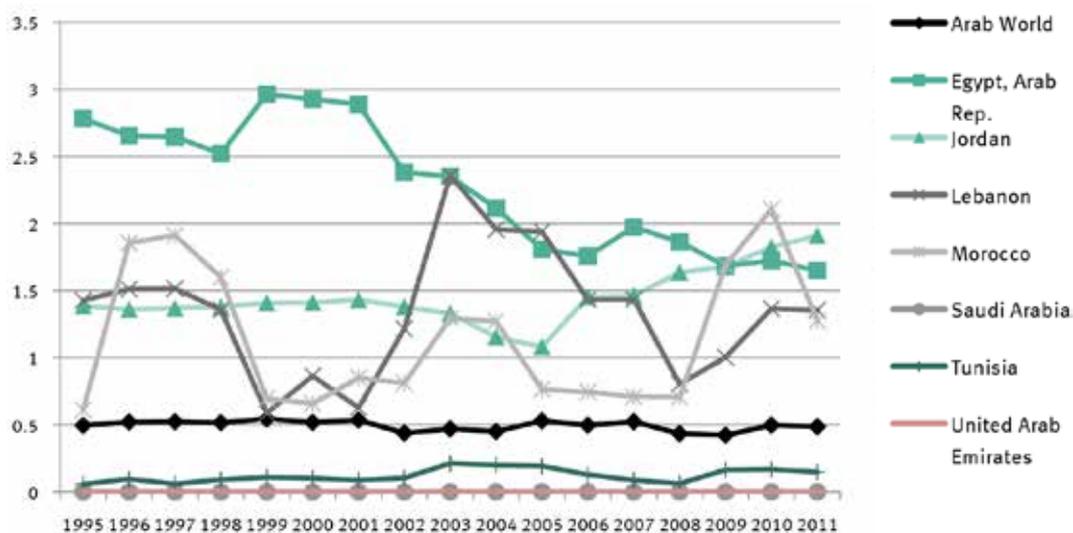


Figure 2

Contribution (%) of renewable and nuclear energies to the total energy consumption in selected Arab countries between 1995 and 2011²⁵



24 The World Bank. "World Bank Database", last modified 2015. Accessed April 13: <http://data.worldbank.org/indicator>.

25 Ibid.

Food

To this date, the Arab world is the most dependent region in the world on foreign import sourcing. Close to 60% of the main agricultural products that form the basis of the Arab population diet originate from outside the region.²⁶

Cereals, roots and tubers supply the largest fraction of dietary energy in most Arab countries as evidenced. However, no Arab country is able to meet more than 60% of its local needs of staple cereals as shown in Table 6, noting that the Arab world allocated around 47.5% of its arable lands in 2010 to cereal production, a value slightly above the world average of 45.5% for the same year.²⁷

Table 6

Cereal self-sufficiency in select Arab countries in 2011²⁸

COUNTRY	CEREAL SELF-SUFFICIENCY (%)
Egypt	56.3
Jordan	3.66
Lebanon	10.96
Morocco	58.91
Saudi Arabia	11.15
Tunisia	46.79
UAE	1.06

26 Khouri, Nadim, UN-ESCWA (United Nations Economic and Social Commission for Western Asia). *Setting priorities for food security in the Arab world: Early results of an international collaboration. Paper presented at the joint IFPRI-ESCWA Conference Food Secure, Arab World, A roadmap for policy and research, Beirut, February 2012. Accessed April 22 2015: http://www.escwa.un.org/about/editors/Download.asp?table_name=about_oespresentations&field_name=id&fileID=14.*

27 Food and Agriculture Organisation of the United Nations (FAO). "FAOSTAT Statistics division website", 2015. Accessed on April 15 2015: <http://faostat3.fao.org/home/E>.

28 Arab Forum for Environment and Development (AFED). "Arab Environment: Food Security in Arab Countries: Challenges and Prospects", 2014. Accessed [April 22 2015]: <http://www.afedonline.org/conference2014/brochure.pdf>.

Land holdings and farm sizes are important factors in the Arab world where the tendency is for small land holdings that do not offer appealing opportunities for large scale investment in the sector. For example, in Lebanon's Bekaa region, the country's food basket, most land holdings fall below the size of 0.5 to 2 ha; large ownership represent less than 20% of the total land area.²⁹ A similar situation is witnessed in Egypt, Morocco and Tunisia where most family-owned farms are barely 2 ha, although in Morocco, large companies operate a very high percentage of agricultural lands, which some estimates put to above 70%.³⁰ Jordan's average farm size was estimated in 2012 to be at 3.3 ha but most farmers (60%) own lands of less than 3 ha.³¹

The food production sector's contribution to the GDP in most Arab nations compared to other sectors such as industry is low, but it is the single biggest user of fresh water in the Arab world, nearing 90% in some countries like Saudi Arabia and Morocco (see Table 7).

Table 7

Agriculture contribution to GDP and water withdrawal³²

COUNTRY	AGRICULTURE % OF GDP	INDUSTRY % OF GDP	FRESH WATER (%) WITHDRAWAL BY AGRICULTURE
Egypt	14.5	39.2	86.38
Jordan	3.4	29.7	64.96
Lebanon	7.2	19.8	59.54
Morocco	16.6	28.5	87.79
Saudi Arabia	1.8	60.6	88
Tunisia	8.6	30.0	80
UAE	0.7	59.0	82.84

29 Ministry of Agriculture, Lebanon. 2010. *Agricultural Census 2010, website*.

30 Ghanem, Hafez. "Agriculture and Rural Development for Inclusive Growth and Food Security in Morocco." *Global Economy and Development at Brookings Institution, Working paper 82. February 2015. Accessed April 12 2015: http://www.brookings.edu/~media/Research/Files/Papers/2015/02/agriculture-rural-development-inclusive-growth-morocco-ghanem/Agriculture_WEB_Revised.pdf?la=en.*

31 Verner, Dorte; Lee, David; Ashwill, Maximillian and Wilby, Robert. "Increasing Resilience to Climate Change in the Agricultural Sector of the Middle East: The Cases of Jordan and Lebanon." *World Bank Publications, March 2013. Accessed April 12 2015: p. 168, <http://elibrary.worldbank.org/doi/pdf/10.1596/978-0-8213-9844-9>*

32 The World Bank. "World Bank database."

WEF interdependencies in the Arab world

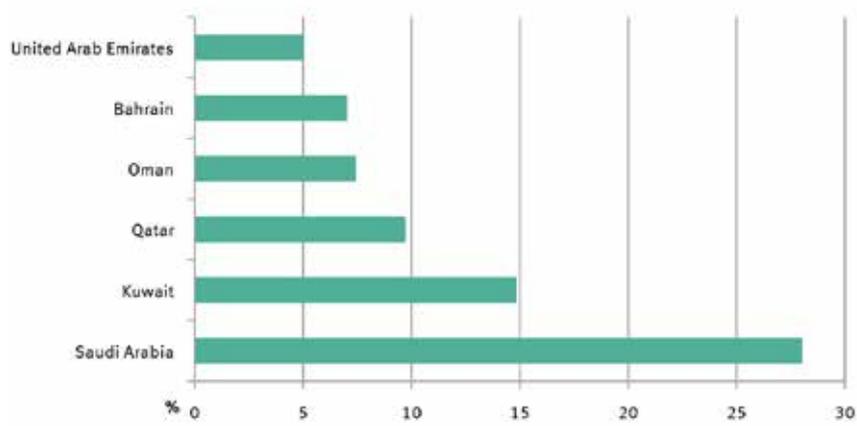
While the link between food production and water is clear, it's not always evident to make the connection between the water and energy sectors. However, energy is needed throughout the water lifecycle, from extraction, purification, pumping and transporting across complex networks before reaching end-users. Out of all the means to source water desalination is the most energy-guzzling, noting that Saudi Arabia and the UAE alone produce around a third of the desalinated water in the world.³³ It is estimated that Saudi Arabia uses around 25% of its oil and gas production to produce electricity and water in desalination energy-water cogeneration plants.³⁴ The process of groundwater pumping is energy-demanding, especially when tapping deeper aquifers, and it consumes close to 10% of fuel consumption in a country like Saudi Arabia,³⁵ whereas in Jordan it consumes close to 15% of the country's generated electricity.³⁶ On the whole, it is estimated that the water cycle uses close to 15% of the electrical consumption in the Arab world and continues to increase.³⁷

Water is also crucial throughout the energy production lifecycle, which further manifests the dependence of the two sectors. Water is needed in the generation of energy at various stages but mostly for cooling of thermal plants. Cooling can use fresh or other water sources. Arab countries, on average, use 0.5% of freshwater resources for cooling relying instead on sea or brackish water. Egypt, consumes more freshwater for its electricity generation, with 25% of its electrical generation capacity being based on fresh water systems.³⁸

Investing in renewable energies makes sense from a water perspective. If Arab countries meet their set target shares of renewable energies in the overall energy mix significant savings would be made in water withdrawals, consumption and their associated energy spending. Projections have shown that if the GCC countries achieve their renewable energy plans they could reduce their water withdrawal and consumption for power generation by 20% and 22% respectively, in other terms 18 trillion liters of withdrawn water and 220 billion liters consumed (see figure 3).³⁹

Figure 3

Estimated reduction of water withdrawals in the GCC countries for energy generation if the renewable energy goals of 2030 are met.



33 UN-ESCWA (United Nations Economic and Social Commission for Western Asia). *Water Development Report 3, Role of desalination in addressing water scarcity*. United Nations: New York, 2009. Accessed April 20 2015: <http://www.escwa.un.org/information/publications/edit/upload/sdpd-09-4.pdf>.

34 UNDP. "Water Governance in the Arab Region: Managing Scarcity and Securing the Future."

35 Siddiqi and Anadon. "The Water-Energy Nexus in the Middle East and North Africa."

36 National Energy Research Center. "Energy Efficiency in Jordan. November 2009. Accessed April 19 2015: http://www.encharter.org/fileadmin/user_upload/Conferences/2009_November/S2P1Shahin.pdf

37 Abdel Gelil et al. *Sustainable Energy in the Arab World: Prospects, Challenges and Opportunities*

38 Siddiqi and Anadon. "The Water-Energy Nexus in the Middle East and North Africa."

39 International Renewable Energy Agency (IREA). "Renewable Energies in the Water, Energy and Food Nexus." January 2015. Accessed April 19 2015: http://www.irena.org/DocumentDownloads/Publications/IRENA_Water_Energy_Food_Nexus_2015.pdf.

40 Ibid.

Some alternative energy resources that are promoted as “cleaner” options with respect to their CO₂ emittance rates are highly water-demanding; such is the case of biofuels and nuclear energy which consume over 3,700 liters of water per one million BTU and 757-3028 liters/MW, respectively.⁴¹

Out of all sectors, food production systems are the most water-demanding in the Arab world. Agriculture consumes close to 90% of water in some Arab countries. The use of groundwater for the attainment of self-sufficiency in key food staples, Saudi Arabia may have effectively depleted two-thirds of finite water resources.⁴²

Optimizing water use efficiency in the agricultural sector is a pressing demand, as current estimates indicate that average irrigation efficiency in 19 Arab countries is less than 46%.^{43 44} The adoption of more water-efficient irrigation measures and better agronomic practices, reuse of drainage water and treated wastewater and investment in rain-water harvesting especially in rain-fed areas among others are seen as key options to reduce the unreasonably high water demands of the agricultural sector.⁴⁵

The dependence of the Arab world on food imports means that it is a net importer of virtual water. Some studies have indicated that the Arab world imports in food the equivalent of 12% of its annual renewable water resources, however for Egypt, Jordan and Saudi Arabia the percentage is much higher, being 31%, 398% and 580%, respectively.⁴⁶ Though reliance on foreign imports creates a delicate situation for the Arab countries’ food security, it does save it from using around 83% of green water, 9% of blue water and 8% of grey water.

Subsidies are increasingly viewed as a barrier to the efficient management of the WEF nexus. The inefficient use of water, food and energy has been linked to the amount of subsidies these sectors receive, encouraging a negligent attitude towards spending at various levels, from households, to industries and agriculture.⁴⁷ The agricultural sector’s growth in Saudi Arabia wouldn’t have been possible without the low-cost water, fuel and no taxation policies on raw material and machinery.⁴⁸ Egyptian processed agricultural goods benefit from incentives on the inputs used in their processing. Additionally, the Fund for Equalizing Import and Export Prices was established with the aim to support export capabilities of the agricultural and textile sectors.⁴⁹

Fossil fuels’ consumption is highly subsidized in many Arab countries, especially in the oil-rich nations, where subsidies for residential fuel consumption are as high as 95%.⁵⁰ Moving away from subsidies needs to be phased out if efficient management of resources is to be expected, as such, the UAE’s Ministry of Energy reviewed in 2010 its tariff rates to impose higher ones on industrial and government groups, thereby cross-subsidizing residential energy consumption.⁵¹

41 Mohtar, Rabi and Daher, Bassel. “Water, Energy and Food: the ultimate nexus” in *Encyclopedia of Agricultural, Food, and Biological Engineering*, Second Edition. Taylor and Francis, October 2014. DOI: 10.1081/E-EAFE2-120048376.

42 Chatham House. “Energy, Environment and Resources Summary: Global Food Insecurity and Implications for Saudi Arabia.” April 2013. Accessed April 11 2015: <http://www.chathamhouse.org/sites/files/chathamhouse/public/Research/Energy,%20Environment%20and%20Development/290413summary.pdf>.

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47 Ibid.

48 Information Office of the Royal Embassy of Saudi Arabia. “Royal Embassy of Saudi Arabia Washington DC Website.” Accessed April 22 2015: http://www.saudiembassy.net/about/country-information/agriculture_water/government_programs.aspx.

49 El-Nahrawy, Mohamed A. Egypt, Country Pasture/Forage Resources Profile. FAO, 2011. Accessed April 19, 2015: <http://www.fao.org/ag/AGP/AGPC/doc/Counprof/PDF%20files/Egypt.pdf>.

50 Abdel Gelil et al. *Sustainable Energy in the Arab World: Prospects, Challenges and Opportunities*.

51 Ventures Middle East. “GCC Energy Sector, Quarterly Review”. September 2011: <https://www.pipelineme.com/media/797142/GCC-Energy-Sep-2011.pdf>.

WEF INSTITUTIONS IN ARAB COUNTRIES

National Institutions

This background paper looks at public institutions of the WEF nexus within a select number of countries that represent the various Arab regions: Mashreq, Arabian Peninsula, Nile Valley or Middle Arab Region and the Maghreb. Egypt, Jordan, Lebanon, Morocco, Saudi Arabia, Tunisia and United Arab Emirates were selected as examples from these regions. These countries differ in their income levels and their approaches to governance. Table 8 represents the main institutions within these countries.

Table 8

National public stakeholders that affect the WEF nexus in select Arab countries.

COUNTRY	STATE AGENCIES	MANDATE	OTHER KEY PUBLIC STAKEHOLDERS	RELEVANT NATIONAL STRATEGIES
Egypt	Ministry of Water Resources and Irrigation	Managing the water resources of Egypt most notably the Nile River and large irrigation projects the likes of the Aswan Dam. Optimizing water usage especially in irrigation to maximize field efficiency, planning and implementing projects to benefit from other surface, ground and sewage water resources, boost water transport network efficiency, provide enough water savings to allow land reclamation and re-settlement projects, protect the Northern Delta shores from erosion, represent Egypt in all negotiations with countries within the Nile Basin, and promote and engage in research.	Ministry of Drinking Water and Sanitation Facilities (provision of drinking water and sanitation)	National Water Resources Plan (issued in 2005 and valid until 2017). The plan is devised into 11 intervention categories focusing on policy and reform, physical interventions, capacity building, research and raising awareness among others.
	Ministry of Electricity and Renewable Energy	Provision of electricity for the economy and citizens, determine the tariff rates, determine the strategic needs of the sector and investigate new resources of electricity and energy, data gathering and analysis, offering consulting services to similar institutions in the Arab world and elsewhere.	National Water Research Center (Planning and strategic directions)	National Energy Efficiency Action Plan (2012). The plan aims to optimize the use of available energy sources, improve energy efficiency in demand and supply chains, and restructure the electricity sector to encourage investments and operationally to establish an Energy Efficiency unit within the Ministry of Electricity.
	Ministry of Petroleum	Managing the fossil fuel and mineral wealth of the country and oversight of the main five national companies investing in the sector. The ministry strives to insure the energy demands of the Egyptian economy, diversify energy resources, discover new fields, and give the Egyptian economy an edge through the provision of energy at cheaper rates.		Agricultural Sustainable Development 2030 (2014). It aims at modernizing Egyptian agriculture to achieve food security and improve the livelihood of the rural inhabitants, through the efficient use of resources and utilization of the comparative advantages of the different agro-ecological regions of Egypt.
	Ministry of Agriculture and Land Reclamation	Set out the nation's agricultural and land reclamation strategies and enhance the performance of the sector, devise the policies for cooperative work and management of neglected and reclaimed lands, lead agricultural research, determine re-settlement policies in reclaimed desert lands, promote rural development, manage the country's animal and plant production as well as that of fisheries.		

COUNTRY	STATE AGENCIES	MANDATE	OTHER KEY PUBLIC STAKEHOLDERS	RELEVANT NATIONAL STRATEGIES
Jordan	Ministry of Water and Irrigation	Monitoring of the water sector, water supply and wastewater system and the related projects, planning and management, the formulation of national water strategies and policies, research and development, information systems and procurement of financial resources.	Water Authority of Jordan (provision of drinking water and sanitation)	National Water Master Plan (launched in 2004) and National Water Strategy 2009–2022. The strategy aims to secure safe and sufficient water for Jordan, ensure better management of groundwater, implement cost-reflective water tariffs and adapt to the growing needs of the population and the economy.
	Water Authority of Jordan	In charge of water and sewage networks.		
	Jordan Valley Authority	Responsible for the socio-economic development of the Jordan Rift Valley, including water development and distribution of irrigation.		
	Ministry of Energy and Mineral Resources	In charge of the comprehensive planning for the sector, providing energy in its various forms for development ends, exchanging electric power with neighboring countries, attracting international capital for investment, the production of oil derivatives, transportation of oil and gas, and utilizing local energy sources.		
	Ministry of Agriculture	The ministry through its various directorates manages the country's plant and animal production in addition to the management of the country's forests and rangelands. The ministry maintains three main institutions: the National Agricultural Research and Extension Center, Credit Loan Institution and the Jordanian Cooperative Institution.		National Energy Efficiency Strategy (2005-2020). It deals with increasing efficiency of the energy sector, increasing the share of renewable energy, promoting investment in the field through tax exemptions and gradually remove oil and electricity subsidies.
Lebanon	Ministry of Energy and Water		Ministry of Economy and Trade	National Energy Efficiency Action Plan
	For Water:	Producing national water policies and strategies, national scale studies, Overseeing and monitoring the WEs, licensing wells, assisting in the licensing of mines and quarries, designing, building and implementing major water facilities.	Ministry of Public Health	National Water Sector Strategy released by the Ministry of Energy and Water in 2010
	Water Establishments (WEs)	System operation and maintenance, implement the national water plan and the national wastewater plan, irrigation plans, water quality	Ministry of Finance	Electricity policy paper Agriculture sector strategy paper for years 2010 -2014 (new one is being developed)
	Litany River Authority	Planning and operating		
	For Energy	Setting the policies for the sector and developing the master plan, proposing comprehensive rules to regulate the services, proposing draft laws and decrees, proposing public safety conditions and environmental conditions and technical specifications.		
	Electricité du Liban	Handles 90% of the generation, transmission, and distribution of electricity.		
	Ministry of Agriculture	Producing agriculture policies, responsible for crops and animal resources, rural development and natural resources.		
Ministry of Environment	Point of reference for all environmental regulations and policies, and controls pollution across all different sectors.			

COUNTRY	STATE AGENCIES	MANDATE	OTHER KEY PUBLIC STAKEHOLDERS	RELEVANT NATIONAL STRATEGIES
Morocco	<p>Ministry of Energy, Mining, Water and the Environment</p> <p>Ministry of Agriculture and Fisheries</p>	<p>Prepare and implement national strategies related to energy, mining and geology, develop and implement a national strategy for renewable energies and energy efficiency, oversight of public and private entities that are engaged within these sectors, planning for mining and geological exploration, make sure that the country has enough energy reserves especially during crises, regulate the electric, gas and fuel markets, promote cooperation between different actors to support the growth of the energy and mining sectors.</p> <p>Prepare the country's agricultural development strategies, reform the administration to boost national agricultural performance, rationalize irrigation water usage, encourage investment in the agricultural sector, update the legal framework related to agricultural activities, participate and promote agricultural research and academic teaching, partake in free-trade negotiations, upgrade the country's agro-industry, promulgate quarantine laws and regulations, propose and implement policies aiming to nurture rural development and coordinate with the inter-ministerial commission for rural and mountain zones development.</p>	<p>National Water Utility (provision of drinking water and sanitation)</p> <p>Supreme Council for Water and Climate (Water Inter-Ministerial Committee)</p> <p>ONEE (Office National de l'Electricité et de l'Eau Potable) a public law company answering to the (MEMEE)</p>	<p>National Water Strategy 2009–2030. It aims to enhance water storage capacity, improve access of the population to safe drinking water, develop efficient irrigation schemes, boost the country's hydroelectric capacity, reform the laws to foster decentralization and promote nation-wide planning, tackle water savings in agriculture, industries and tourism while promoting behavioral changes and revision of tariffs. Finally, the strategy envisions the protection of delicate habitats.</p> <p>Morocco Green Plan (adopted in 2008). It aims to support and reform the agricultural sector and foster its links to international markets. The plan overall deals with crosscutting issues, namely water economy, land tenure, farmers' cooperative mechanisms, access to markets and binding trade agreements.</p> <p>National Energy Strategy (2009). Improve energy security while addressing environmental concerns by diversifying energy sources, optimizing electricity mix, increasing energy production from renewable sources and promoting energy efficiency. The strategy tackles legislative changes and reforms.</p>

<i>COUNTRY</i>	<i>STATE AGENCIES</i>	<i>MANDATE</i>	<i>OTHER KEY PUBLIC STAKEHOLDERS</i>	<i>RELEVANT NATIONAL STRATEGIES</i>
Saudi Arabia	Ministry of Water and Electricity	The ministry manages the water and energy sectors of the Kingdom, including the management of dams, tapping of aquifers and promoting the use of treated wastewater. The ministry also manages the electrical needs of the population and continuously seeks to enhance grid performance. Recently, the Kingdom has been trying to privatize the electricity sector in the hope of optimizing services.	National Water Company (provision of drinking water and sanitation)	National Water Strategy (2014). The aim is to conserve water resources, improve governance and management, provide high standard water services to the Saudi people, develop and introduce technological and institutional innovations and conserve the environment.
	Saline Water Conversion Agency (SWCC)	Government entity responsible for desalinating sea water, in order to augment the supply of potable water to coastal and inland cities of the KSA. SWCC is also the second largest electric power producer in the Kingdom.		National Energy Efficiency Program (2008). It aims to cut electricity intensity by 30% between 2005 and 2030 and decrease peak demand by 50% compared with the 2000-2005 average. The plan tackles energy auditing, industrial and commercial regulations, efficient use of oil and gas, promoting co-generation, construction codes, and technical management and training among others.
	Ministry of Petroleum and Mineral Resources	Governs the work of the main institutions and companies responsible for the extraction of petroleum and mineral resources. Of these the most prominent are: Saudi Aramco, Aramco Gulf Oil Company, Saudi Chevron, Saudi Arabian Mining Company, the Government's Agency for Mineral Wealth in Jeddah and the Saudi Geological Survey. It should be noted that these entities have complete administrative independence and their work is only supervised by the ministry. The ministry also represents the KSA in regional and international organizations for oil producing countries such as OPEC, among others.		
	Supreme Council for Petroleum and Minerals	Its role is to coordinate with the ministry in managing the work of the aforementioned entities as well as setting up the country's policies and strategies for petroleum, gas and other hydrocarbon resources.		King Abdallah's Initiative for Saudi Agricultural Abroad. Though not technically a strategy, the initiative aims to enhance Saudi food security through long term investments abroad securing the access of Saudi Arabia to food resources.
	Ministry of Agriculture	Historically, the ministry managed the country's water resources and land reclamation projects. However, with the creation of the Ministry of Water and Electricity, the Ministry of Agriculture's current mandate focuses on desert land reclamation, agricultural research and extension, managing the animal and plant production sectors, camel and Arabian horse breeding and the management of irrigation.		

COUNTRY	STATE AGENCIES	MANDATE	OTHER KEY PUBLIC STAKEHOLDERS	RELEVANT NATIONAL STRATEGIES
Tunisia	<p>Ministry of Agriculture, Water Resources and Fishing</p> <p>Ministry of Industry, Energy and Mining</p>	<p>Planning for agricultural development in the larger sustainable development context, update the legal framework to foster agricultural development, setting out plans and strategies to benefit from the country's water resources and develop unconventional water resources while promoting water savings, regulate irrigation and promote soil and water conservation, manage forests, modernize agriculture, find new markets to support Tunisian farmers, engage in research, oversight and management of institutions that are involved in the development and growth of the agricultural sector.</p> <p>Develop and implement governmental policies in areas relevant to industry, agro-industry, services related industry, energy, mining, industrial cooperation and to the sustainable operations of the energy and mining sectors. The ministry promotes technological innovations and supports small and medium enterprises to nurture the country's economy.</p>	<p>National Water Distribution Utility (provision of drinking water)</p> <p>National Sanitation Utility</p>	<p>Long-term Water Strategy (2003–2030). The strategy has three main pillars that focus on demand management in a decentralized fashion with implications on end users, adoption of an integrated approach to water management and the preservation of water resources, their efficient use and the protection of the river environments.</p> <p>National Energy Efficiency Strategy (2008-2011), which aimed at lowering the energy intensity at the national level by 3% per year.</p> <p>National Energy Strategy (2014-2030). It aims at increasing energy efficiency, increasing the share of renewable energies beyond biomass to 12% by 2030; update regulatory frameworks to guarantee access of independent energy producers to the national grid and decentralize the energy sector to allow more involvement of regions but under the direction and supervision of the ministry.</p>

Regional institutions

At the regional level many institutional arrangements and initiatives exist on sectoral issues mainly under the umbrella of the regional bodies of League of Arab States (LAS), the United Nations Economic and Social Commission for Western Asia (UN ESCWA), and the Gulf Cooperation Council (GCC).

The League of Arab States hosts the “technical secretariats” to many Arab ministerial councils such as the Arab Ministerial Water Council (AMWC). The Arab Ministerial Council for Electricity (AMCE) and the General Assembly of Arab Ministers for Agriculture (GAAMA) are other ministerial councils under the umbrella of LAS dealing with sectors within the WEF nexus.

The Council of Arab Ministers Responsible for the Environment (CAMRE) is a regional mechanism set up to maintain coordination and cooperation among Arab countries in all matters related to environment and sustainable development. The joint committee on environment and development in the Arab region (JCEDAR) focuses on linkages between environment and development.⁵²

Other specialized regional organizations closely affiliated or functioning under LAS such as AOAD (Arab Organization for Agricultural Development) ACSAD (Arab Centre for the Studies of Arid Zone and Dry Lands), COFWS (Center for Water Studies and Arab Water Security) AAAI (Arab Authority for Agricultural Investment), RCREEE (Regional Centre for Renewable Energy and Energy Efficiency) mainly deal with sectoral issues, with few exceptions such as within ACSAD. ACSAD expertise is in the management of water and land resources of arid zones and dry lands. ACSAD deals with issues related to water, climate change, food security, and biodiversity.

The UN ESCWA on the other hand coordinates the “Regional Initiative for the Assessment of the Impact of Climate Change on Water Resources and Socio-economic Vulnerability in the Arab Region (RICCAR)” which is a collaborative effort with LAS. ESCWA, which has several sectoral committees such as that on Energy and other on Water Resources, has also collaborated with LAS to organize the Expert Group Meeting on the Water-Energy-Food Security Nexus to increase understanding of the water, energy, and food nexus and foster interactive discussion between the different committees, their delegated representatives as well as official representatives from

⁵² Tortora, Marco. “Sustainable Systems and Energy Management at the Regional Level: Comparative Approaches”. 2012: 150-152. DOI: 10.4018/978-1-61350-344-7.

Arab countries in related sectors and specialized Arab and international organizations. Another initiative by ESCWA is “Building capacity on the water-energy nexus in the region” which is being implemented under two parallel tracks. One track is aimed at senior government officials responsible for the formulation of policies and strategies, while the other targets technical staff of ministries who are more involved in the operational aspects of water and energy resources management.⁵³

The GCC Electricity and Water Cooperation Committee, which joins water and electricity officials from GCC states, is an example of an integrated “soft body” under regional organizations that can act as an entry point for a nexus approach. The committee is interested in exploring the possibility of implementing the joint legal and legislative rules to strengthen rationalizing the consumption of water and electricity.⁵⁴

Other initiatives related to elements of the nexus include the project to “Strengthen Food Security in Arab Countries;” a project funded by the Arab Fund for Economic and Social Development, the Kuwait Fund for Arab Economic Development, the Islamic Development Bank and the OPEC Fund for International Development (OFID) and is being implemented in cooperation with ICARDA.⁵⁵

The Arab Union for Sustainable Development and Environment (AUSDE), a non-governmental organization under the umbrella of the Egyptian foreign ministry, is another regional initiative. Among the AUSDE’s aims is the development and conservation of natural resources in Arab countries as well as mainstreaming sustainable development into projects. In 2015, AUSDE has indicated interest in the nexus approach by organizing a conference on Water, Energy, Climate and Food nexus in the Arab countries.⁵⁶

The TriNex – Knowledge Triangle Platform for the Water-Energy-Food Nexus project in Egypt aims to create a national platform based on universities joining forces in research, innovation and education activities (knowledge-triangle) for the water-

⁵³ *Adaptation to Climate Change in the Water Sector in the MENA Region (ACCWAM). “Partners”, last modified 2012. Accessed June 5, 2015: <http://www.accwam.com/Partners.html>.*

⁵⁴ “GCC to adopt unified policy on power, water consumption”. *Arab News, Riyadh. January 13, 2014. <http://www.arabnews.com/news/508321>.*

⁵⁵ *Arab Fund for Economic and Social Development (AFESD). “Ministerial Meeting to follow up on the “Project to Strengthen Food Security in Arab Countries”. Accessed June 13 2015: <http://www.arabfund.org/Default.aspx?nid=504&pageId=485>.*

⁵⁶ “Arab Union for Sustainable Development and Environment (AUSDE),” last modified 2015. Accessed July 15 2015: http://www.ausde.org/?page_id=60.

energy-food (WEF) nexus. This project proves that research and innovation are needed to act as the base or backbone of any attempt at the nexus approach in the region.⁵⁷

An analysis of the institutional landscape

The institutional landscape governing the elements of the WEF nexus is mostly fragmented as noticed from the above sections which has in the past and continues nowadays to delay the comprehensive and inclusive management of these interlinked priorities. In Saudi Arabia, for example, there are at least six ministries that are directly or indirectly linked to the WEF management and over six administrations, as well as over thirteen directorates involved in water management. This is not unique to Saudi Arabia; in fact it is pretty much the norm across most Arab countries.

However, Table 8, also indicates that more than one Arab country already have one model or another of “integrated institutions;” in the sense that the policy planning and/or management of two or more sectors/resources is combined under one body. For example, in Lebanon, the Ministry of Energy and Water is the main public stakeholder responsible for the policy planning and management of both the water and energy sectors in the country. The United Arab Emirates’ Ministry of Environment and Water is by mandate responsible for the development of plans, strategies, and policies in the areas of the environment and water resources as well as agriculture, livestock, fisheries, and managing desertification, and biodiversity conservation. Morocco further combines energy, water and environment under the Ministry of Energy, Mining, Water and the Environment; keeping the irrigation planning under the mandate of the Ministry of Agriculture and Fisheries. The Ministry of Water and Electricity in Saudi Arabia manages the water sector as well as “providing electricity for the population,” as such dividing the governance of the energy sector, fragmented under different institutions. The Ministry of Water and Irrigation in Jordan and the Ministry of Water Resources and Irrigation in Egypt represent another model of integration within institutions on the national level, as they cross over in their water sector planning and management into agriculture through irrigation.

The Arab countries represent a range of models of “integrated institutions” that could act as a gateway towards a Water, Energy and Food nexus approach. However, this integration within institutions is to this date poorly represented in policy. Some national strategies and policies, when examined closely reveal a glimpse of the interlinkages between the WEF nexus or offer a good starting point such as in Tunisia, Morocco and UAE. A good case is that of Jordan’s National Water Strategy. The strategy does take into account the heavy burden irrigation is placing on the water budget and suggested, among many others, policy reforms (removal of tariffs) to encourage farmers to invest less in water-demanding crops such as bananas that can be imported for cheaper prices from other countries. The strategy also takes into account energy considerations, for example, the strategy aimed for securing 20% of the energy used for water pumping from alternative energy sources and adopting whenever possible gravity operated transport systems. Another model of mainstreaming WEF nexus into policy could be UAE’s conservation strategy that crosscuts all sectors including water and energy.

The mandates of the main institutions involved in the management of the WEF nexus sectors that have been described in Table 8 clearly state that the relevant ministries are entrusted with the development of sector relevant strategies. As such, most of the strategies stated in Table 8 were developed under the supervision of relevant ministries. In some countries, the royal courts play an important role in determining the country’s priorities such as the case in Jordan⁵⁸ and in Saudi Arabia; even though the cabinet or government’s role is key, the king’s decisions still affect policies and governance of the WEF sectors.⁵⁹ To be effective in this regard, a clear determination of national priorities in light of the WEF nexus needs to be determined on a national basis and the roles of each ministry is then determined as per its mandate.⁶⁰

Policies and strategies are developed to meet local demands and reflect national priorities, as such, one of the important strategic options of the UAE in the energy sector is to reduce dependence on gas and oil for local energy demands as exporting oil, gas and their derivatives is more economically sound.

⁵⁷ The American University in Cairo. “TriNex – Knowledge Triangle Platform for the Water-Energy-Food Nexus”. Accessed July 22 2015: <http://www.aucegypt.edu/Sustainability/CSD/Pages/Trinex.aspx>.

⁵⁸ Siddiqi, Afreen; Kajenthira, Arani and Anadon, Laura Diaz. “Bridging Decisions Networks for Integrated Water and Energy Planning.” *Energy Strategy Reviews* 2, no. 1 (June 2013): 46-58. <http://www.sciencedirect.com/science/article/pii/S2211467X13000242>.

⁵⁹ Library of Congress: Federal Research Division. “Country profile: Saudi Arabia”. September 2006. Accessed April 19 2015: http://lcweb2.loc.gov/frd/cs/profiles/Saudi_Arabia.pdf.

⁶⁰ UN-ESCWA. *Water Development Report 3, Role of desalination in addressing water scarcity*.

Therefore, the UAE hopes to develop its renewable energy sector and generate energy from nuclear power to cover not less than a quarter of its energy needs by 2020.⁶¹ Nuclear power is fairly controversial and though it does not emit CO₂, it consumes a high amount of water for cooling and if any leak occurs it would contaminate the sea water on which the country is highly dependent as a source of water through desalination.⁶²

While it is clear that uniting key WEF sectors under one ministerial umbrella, when possible, is no guarantee for their integrated management and governance, however, it is a step in the right course to avoid duplication of efforts and diffuse any ill-defined mandates. The coordination and collaboration mechanisms among and between national institutions is a vital factor in achieving an “integrated approach” to resource management. “Stronger institutions that are better interlinked are key to a nexus approach, and may be more important than additional institutions.” An in-depth evaluation of institutions and governance system in each individual country is needed to better understand the weaknesses and gaps that are hindering a nexus approach, in spite of existing institutions that should be, in theory, enabling such an approach.

In mainstreaming the WEF nexus approach, several options can be proposed; however, one option is more attractive as it does not aim to create new entities with the specific mandate of managing the WEF. Instead, one body already active in developing and implementing strategies that are related to the WEF sectors can be nominated as the focal point for the development of a comprehensive WEF nexus strategy for the country. Whatever the mechanism adopted, more coordination between ministries related to WEF sectors needs to take place to meet future challenges. Countries need to assess key public entities that are already involved and influential in all of the WEF sectors as the principal overseers of the development and mainstreaming of policies and strategies that tackle the WEF sectors in an integrated and comprehensive way.

WEF Matrix of Arab Countries: Institutional challenges and opportunities

Based on the above, the Arab countries are facing mounting challenges in each of the elements of the water-energy-food nexus and the current institutional frameworks, more specifically, the actual running of these institutions is not aiding in formulating or implementing a nexus approach to managing these resources. Table 9 summarizes the general challenges as well as the opportunities that are faced by the Arab world.

⁶¹ UAE Ministry of Foreign Affairs, Directorate of Energy and Climate Change. “UAE energy outlook, Factors for global renewable energy roadmaps.” IRENA, September 2012: https://www.irena.org/DocumentDownloads/events/MaltaSeptember2012/6_Rouda_Al-Otaiba.pdf.

⁶² Abdel Gelil et al. “Sustainable Energy in the Arab World: Prospects, Challenges and Opportunities.”

Table 9

Institutional challenges and opportunities for implementing a WEF nexus approach

SECTOR	NATURAL SETTING	NEXUS CHALLENGES	OPPORTUNITIES
Water	Extreme aridity	Variation in resource availability between the countries of the region as such leading to expected variability in priorities on national level	Increased awareness on the importance of the nexus approach in Arab states among policy-makers
	Trans-boundary water represents a large share of water resources		
Energy	Groundwater resources are limited and finite	Existing subsidies on water, energy and food	Existing “integrated models” of national and public institutions; that could be strengthened and enhanced
	Rich fossil fuel resources in many Arab countries	Economies that are heavily dependent on fossil fuels	Many untapped techniques and technologies such as water harvesting, wastewater treatment and reuse, which could cover some of the local needs and alleviate pressure on groundwater
Food	New fields of oil and gas discovered/expected in the waters of the Eastern Mediterranean	Fragmentation of WEF governance structures	
	Limited size of arable lands	Public institutions traditionally divided into silos; dealing with single sectors or resources of the WEF	Research projects and small scale pilot projects that could inform policy options such as the “Desert’s Forest” project in Qatar
	Fragmented land ownership	Large number of institutions on national level dealing with the WEF nexus elements which complicates coordination	Existing cooperation between Arab nations in trans-boundary water negotiations
	Serious water limitation	Weak or non-existing coordination and collaboration mechanisms between institutions	The high potential for renewable energy in the region; ample solar insulation and winds can be harnessed to generate clean and renewable energy
	Ability to expand agriculture limited due to severe climatic constraints (poor soils, and extreme temperatures)		Some signs of the revision of the role of agriculture within national economies
			Existing dialogue platforms such as the current Arab nexus dialogue under LAS which can act as an entry point to cross border collaboration on the nexus

CONCLUSION AND RECOMMENDATIONS

Even though existing institutions of the Arab world present many challenges to a nexus approach, however many opportunities exist that should be tapped into, such as the already existing models of “integrated institutions,” the increased awareness on the importance of the nexus approach in Arab states among policy-makers, and the existing research projects and small scale pilot projects which could inform policy options. The ultimate aim is to have institutions that are able to mainstream and reflect the WEF nexus approach in policies in the Arab countries. This is important in order to ensure that these countries will not, in the near future, be sidetracked by crippling resources insecurities on their sustainable development path.

As such it is recommended that Arab countries enable their institutions to mainstream the WEF nexus through:

- ▶ Looking at their national institutional structure to acquire a better understanding of the weaknesses and gaps that are hindering a nexus approach – in some cases in spite of existing institutions that are theoretically “enabling” such an approach;
- ▶ Empower existing institution already active in developing and implementing strategies/ policies related to WEF sectors to develop a comprehensive WEF nexus national strategy;
- ▶ Enhance coordination and collaboration between institutions as it is key for mainstreaming the nexus approach at a higher level.

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