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

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1. Introduction

In order to achieve sustainable management in water, energy, and food, the WEF nexus approach has been widely accepted in MENA countries as the most influential and appropriate solution. This procedure will reduce trade-offs and build synergies. Despite this, challenges and constrains are still faced, where progress in its implementation in the region remains limited. Hence, the following recommendations are proposed.

1. Bridging the nexus science-policy interface gap by establishing a research network.
2. Creating a forum for nexus governance best practices in order to bridge the institutional framework gap.
3. Establishing collaborative capacity building programs to bridge the nexus capacity gap.
4. Forming research and development teams to promote nexus technology implementation.

2. Benefit of NEXUS approach in the future condition of MENA region

Being one of the most energy intensive, water and food deficient regions in the world, the MENA region is one where all three sectors are indistinguishably linked. This interdependence is intensifying with time as the demand for resources increases due to external factors such as population growth, industrial expansion, inefficient WEF supply chains, and the expected impacts of climate change. It is valid that sustainability and security are endangered if the sectors keep getting addressed independently without recognizing the trade-offs with other sectors. For instance, achieving food security by domestic production without due consideration to the limitations of water resources will lead to over-exploitation, deterioration, and loss of water resources. Eventually, it will also lead to the loss of agricultural productivity and the deterioration of the agriculture sector. Hence, the strong interdependencies of the three sectors calls for replacing the existing conventional silos policy and decision making approach, when addressing the management of these three vital sectors, through nexus thinking and an approach that integrates planning and management across sectors to reduce trade-offs and build synergies. Such an approach will improve resource efficiency in the MENA region and provide larger sustainability levels for its resources. It will also help the region's countries achieve their commitments toward the Sustainable

Development Goals (SDGs) and Paris 2015 Climate Summit. The water-energy-food nexus approach addresses the resource challenge in the MENA region, while achieving the countries' global mandates as defined by the SDGs. Moreover, this is achieved by adopting integrated resource planning and management of these three vital sectors while minimizing environmental risks. This will achieve a green, circular, and low carbon economy in MENA region countries'. The benefit of the NEXUS approach is recognized; however, the current situation presents very minimal implementation in the MENA region. In order to implement such an approach in the future. Some of the following steps need to be taken:

- Analyzing existing policies and strategies, and how can they be shaped more sustainably
- Serving countries' requirements and needs to secure relevance
- Conducting consultations to secure multi-stakeholder involvement, defining ownership and roles, which will guarantee long-term sustainability.
- Designing measurable and tangible outcomes.
- Youth and gender inclusion with focus on adding value and impact in this field, while focusing on the environment
- Linking with countries of focus to create synergies and utilizing available knowledge.

2.1 Components that ensure a WEF nexus enabling environment.

- WEF Nexus Scientific Aspects: in order to support evidence based policy making – it is important to bridge the nexus knowledge gap through the role of scientific research. This will result in identifying trade-offs and possible synergies.
- WEF Nexus Governance Aspects: establishing a nexus institutional structure for nexus planning and management, in order to mainstream nexus policies in existing sectoral policies.
- WEF Nexus capacity aspects: developing institutional and individual capacities for nexus planning and management.
- WEF Nexus Investment Aspects: forming policies, legislation, and regulations that involve the private sector to implement and adopt WEF nexus innovations.

2.1.1 WEF Nexus Scientific Aspect

The WEF nexus integration in the policy cycle in the MENA region, can be implemented through a set of measures, including:

- Bridging the knowledge gap of the WEF nexus at the national and regional levels by understanding and quantifying the inter-linkages between water, energy, and food.
- Identifying and analysing the WEF nexus cross-sectoral interactions, trade-offs, and risks.
- Adopting a WEF nexus approach policymaking to increase policy coherence among the three sectors and climate change policies to provide integrated solutions and mitigate nexus-related risks.
- Implementing integrated planning and management that reduces trade-offs and builds synergies across the three sectors.
- Adopting the water-energy-food nexus approach in the planning and management of these three sectors to reduce the risk of supply in all three sectors and enable the region to move toward higher levels of resource efficiency, equity, and sustainability.

2.1.1 WEF Nexus Governance Aspects

However, adopting an integrated nexus approach to resource management requires vital factors, including the coordination and collaboration among institutions. Therefore, it is significantly essential to bridge the institutional framework gap. The institutional framework governing the elements of the WEF nexus in the majority of MENA countries is mostly fragmented. This has in the past, and even today, delayed the comprehensive and inclusive management of these interlinked three sectors. This fragmented institutional framework has also led to a sectoral approach to policy planning and, consequently, fragmented policies.

On average, in the MENA region and in focus countries, there are directly/indirectly related to WEF management. In addition, the fragmentation also exists within the sectors themselves. For instance, water management (groundwater, surface water desalination, and waste water), and the users associated (municipal, agricultural, and industrial) are governed by various institutions with limited coordination among them. This is also the case in the

energy sectors, where many organizations don't have coordination mechanisms between them. Hence, strengthened mechanisms are essential to implement WEF nexus approach effectively. The institutional structures and governance can be enhanced through integrated resources management by such means:

- Analysing current national institutional arrangements and identifying the weaknesses and gaps that limit the implementation of WEF nexus approach in the focus countries.
- Working towards empowering current institutions that are already developing and implementation WEF strategies or policies. This will ensure the development of a comprehensive WEF nexus national strategy, a key element of which is data homogenization and sharing.
- Enhancing coordination and collaboration mechanisms among institutions to mainstream the WEF nexus approach at local, national, and MENA regional levels; this does not necessarily require the establishment of new institutions for the WEF nexus.

2.1.3 WEF Nexus capacity aspects

Moreover, it is also important to bridge the capacity cap. The design of the management of these primary resources needs to be careful, in order to ensure that securing one of these primary resources does not compromise the others. Hence, the development of a multi-stakeholder platform is important to achieve linkages and opportunities. When the complex interlinkages and dependencies of the WEF nexus are understood, it is easier to translate them into solution and synergies that increases nexus system thinking and problem solving. Other external pressures the drive nexus, such as climate change, population growth, and political factors, call for the impending need to create capacity building programs and knowledge management systems at all levels involved. These platforms can only be created by building capacity at different levels, including institutional, academic, and private sectors. Many MENA countries have competent professionals in the fields of water, energy, and food/agriculture, and there is no need for new staff for the WEF nexus. It is highly necessary to create an inter-sectoral capacity building program and cooperate among these professionals.

To achieve integrated policy making, the multi-sectoral teams should be equipped with qualitative and quantitative frameworks. This will contribute in understanding the challenges and exploring potential synergies of the WEF nexus. WEF nexus system thinking and nexus mainstreaming into sectoral policies can be enhanced by the following:

- The development of WEF capacity building programs to create competencies in dialogue and conflict resolution, data management and analysis, and an understanding of the WEF nexus at technical and policy levels.
- Identifying tools and data sets for scale specific conditions and goals (local, national, and regional).
- Applying outcomes from holistic nexus tools and comprehensive data sets to guide the management of water, energy, and food resources.

2.1.4 WEF Nexus Investment Aspects

The introduction of new and appropriate technologies can improve resource efficiency and productivity in the water, energy, and food sectors, and contribute to their collective security and sustainability. For example, implementing technologies to reduce food waste and enhance water use efficiency is an example of clear synergy among sectors. It shows how an efficiency enhancement in one sector can lead to less consumption in the others. However, technological and innovative solutions within the WEF nexus, where two or three components of the nexus are integrated as inputs to each other, not only enhance resource efficiency but also expand the available natural resource base. Thus, they contribute even more to the sustainability and security of the three sectors.

3. NEXUS mainstreaming in MENA countries

Nevertheless, there are some good examples of the adoption of innovative solutions within the nexus in many MENA countries. These include integrated seawater energy and agricultural systems, renewable energy generation from domestic wastewater, solar desalination, agriculture waste-to-energy, landfill-gas-to-energy, and aquaponics-energy. These pioneering projects demonstrate that the potential and benefits of technology and innovation are fully harnessed within the WEF nexus and must therefore be funded, scaled up, and replicated. Enhancing the role of technological innovation in taking up WEF nexus

projects can happen through encouraging the scaling up and replication of on-going WEF nexus related projects. In addition, building capacity for policymakers and institutionalize regional knowledge management systems to share best practices on the WEF nexus. Enhancing and deepening the understanding of WEFE Nexus interdependence by countries and stakeholders is important. As this concept has been understood at a deeper level, several steps have been taking to ensure cross-sectorial cooperation when developing policies, and forming technical agendas. The MENA region follows a procedure of action lines that provide outcomes with local solutions that may be replicated and up-scaled.

WEFE Nexus technical solutions can be in the form of:

1. Improving natural resources management
2. Increase resources' use efficiency
3. Raising crop productivity 'per drop' and 'per KWh'
4. Mobilizing alternative sources to increase the local water budget, etc.

3.1 Opportunity of NEXUS mainstreaming and income generation

Following the COVID-19 situation, unemployment in the MENA region has significantly increased, especially within youth and women. Adopting the WEFE technical solutions will provide solutions that will positively impact this situation, while achieving sustainability objectives. Income generating opportunities, new jobs (green/blue jobs), new skills, new job fields (sustainable agriculture, integrated urban water management, industry, tourism), and new markets will be presented (approximately 50 million jobs will be created in the MENA, including technical/managerial). This, however requires the correct support, political will, planning tools, and investment. Therefore, focusing on potential employment and entrepreneurship opportunities that are related to WEFE Nexus mainstreaming, will provide income generation and will create a new market in the long-term with more youth and women involved (equal participation). Hence, following the drastic impact that COVID-19 had on the economy, this presents an opportunity for a green recovery that tackles many challenges.

3.2 Future of nexus mainstreaming: examples form focus countries

When tackling future nexus mainstreaming, the options differ due to different factors.

3.2.1 Jordan

Some of these options could include focusing on sustainable agriculture through the harvesting of rainwater and greywater, recycling, the reuse of brackish water, solar powered desalination, coupled with renewable energy sources for agriculture and food production and/or water supply of off-grid communities for access to safe drinking water. In addition to achieving sustainable agriculture, this can be done by considering environmental needs as well and optimizing existing infrastructure like common rainwater harvesting systems (wadi's). Also, increased capacity and efficiency can be achieved through small dams. Moreover, reusing treated wastewater for food production is effective, while creating new income generation and market creation opportunities through integrating resource efficiency options. In order to understand how WEFE sectors are effected by land uses and changes in water infrastructure, there should be a development of a nexus decision support tool which integrates data on water, energy, food, and climate.

3.2.2 Lebanon

As for Lebanon, it is important to understand the proposed actions and policy relevant priorities on the National level, in order to present a projected future condition. To begin, the national policy needs to be better informed through relevant assessments and knowledge production including a review of all proposed and existing waste water treatment plants to asses' potential for reuse in the area. In addition, conducting a socio-economic assessment is necessary, this can be implied through potential reuse including valorising and assessing acceptability in order to select the most appropriated inform policy. Moreover, on the regional level, it is important to work towards common export/import norms so that processes become uniform across the region since trade policies is key for WEF nexus implementation. Not mentioning achieving common certification for WEF produced food.

3.2.3 Tunisia

Like Jordan, Tunisia faces the option of optimising the efficiency of water distribution networks, powered by renewable sources. In addition to developing a decision support tool that enhances energy efficiency in water distribution networks, connecting dams.

3.3. Examples of potential projects from focus countries

3.3.1 Jordan

Central Jordan Valley – Utilisation of non-conventional water resources for green house farming

There are approximately 90,000 greenhouses in the Jordan Valley. This poses a clear opportunity to explore irrigation powered by solar energy throughout non-conventional water resources. This project focuses mobilising non-conventional water sources for food production. This can happen through testing crop productivity by variable sources of water, including brackish, rainwater, and treated wastewater. In addition to evaluating how these sources can increase food production and protect soil health. Considering that the Jordan valley is an area with many greenhouses, the opportunity to explore harvesting rainwater from greenhouse domes (and using them as collection surfaces), is clear, whereas this will propose potential income generation opportunities for new farmers, and with the clear Nexus benefits proposed, there will be a new market for rainwater harvesting presented.

Mafraq, Jordan – This project focuses on enhancing water harvesting in arid regions, by improving food security and sustainable natural resources. This area is inhabited by vulnerable Syrian and Jordanian communities. Hence, the project aims towards increasing the availability of water through several techniques including rainwater harvesting techniques to ensure irrigation of crops for animals, and improving the efficiency of irrigation through solar energy. Not mentioning, increasing rainwater retention and storage capacities for dams, testing the productivity of crops and the degree of climate resilience. Choosing to optimise existing and current water infrastructure, rather than building a new one is more sustainable. This project will achieve water security while creating income generating sources for farmers. Another Nexus opportunity is animal waste composting, as this will also prevent leaching and groundwater pollution.

3.3.2 Lebanon

Zahleh (Bekaa region Lebanon) – Local wastewater treatment plant with high energy cost is a potential to gear towards an integrated approach of renewable energy use and reuse of treated water in area (seeking low investment cost and replicability on national level).

3.3.3 Tunisia

North Tunisia – Optimising the water distribution network through renewable sources, and decreasing electricity consumption levels in specific pumping stations; this can be done through installing solar panel energy systems. This can result in energy efficiency and reduction of energy costs, while distributing water to farmers in the area, which benefits local farmers and guarantees water and food security.

4.0 Recommendations and conclusion

Despite the fact that the nexus approach to policy planning and opportunities in the MENA region are fairly different, but the priorities in various countries are very similar. For instance, due to its climate conditions and availability of land, Jordan is considered more ready to use solar energy. Such opportunities could present entry points for the countries to mainstream WEF nexus approach. In terms of the level of progress made in degree of WEF nexus mainstreaming amongst the focus countries, it is rather different. Whereby, some countries are actively seeking more integrated policies, arising from different needs or drivers, while others are still lagging behind with no clear vision for integrated policies. Existing strategies in the MENA region both on national and regional levels should be revisited and modified to have a more integrated approach. In addition, further efforts are needed to ensure proper implementation of the few existing strategies that are already integrated. A “nexus” approach should be considered as guidance to the design of any project, in particular the conceptual stages while looking for possible “integrated” alternatives for what is currently being proposed. The nexus approach is not only about reducing tradeoffs and improving efficiencies between the different sectors it asks for a complete rethinking of the purpose of the project and how it contributes to resource security in general.

The following concepts are common requirements if advanced nexus will be implemented:

- Conducting a baseline assessment of the WEF sectors. Accounting for water is a key issue that private sector should consider. Water must be valued, and risks of water scarcity quantified and incorporated into financial modeling for all businesses and industries.

- Exploring alternative uses for treated wastewater (including in urban areas) and working on treated wastewater quality assurance.
- Enhancing exchange of data and improved monitoring data is key for the implantation of WEF nexus.
- Increasing the awareness of local communities and stakeholders such as farmers in order to increase social acceptance and buy in. A participatory approach and increasing accountability could be drivers to a behavioral change towards unconventional methods of applying the nexus.
- Private-Public partnerships with social equity provisions could help in advancing the implementation of the nexus and mobilizing resources towards its financing.
- Identifying, studying, proposing, and promoting regional water-energy-food nexus projects and areas of cooperation that have significant mutual economic and social benefits to each party. Such initiatives will increase the rate of cooperation and constructive dialogue in the region, thus building confidence and trust. Furthermore, regional mega projects should also be considered such as desalination, large-scale conveyance, cross-border renewable energy generation, and large-scale irrigation efficiency initiatives. Mega projects would require high levels of trust among country partners to commence. However, once initiated, they would act as a long-lasting bond between countries and a cause for continuous cooperation and collaboration.