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# What does it take to accelerate investment in Water-Energy-Food Nexus Projects?

White Paper

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## 1. The Water-Energy-Food Nexus

African and Middle Eastern countries face complex challenges, including widespread poverty, unemployment, food and water insecurity, limited infrastructure, economic and political instability. In the next years, expanding populations and economies will add stress to the existing systems, increasing demand for resources like water, food, and energy: projections indicate substantial growth in water consumption (+283% by 2030 compared to 2005 levels), food demand (+60% by 2030 compared to 2015 levels), and electricity demand (+70% by 2030 compared to 2016 levels)<sup>1</sup>.

In this context, the Water-Energy-Food (WEF) Nexus has gained prominence in international development agendas, aligning with 14 out of 17 Sustainable Development Goals. The WEF Nexus highlights connections that offer a transformative perspective to enhance access to clean energy combined with water and food, drawing special attention to solutions and business models that address crucial developmental needs. Scaling up these models can enhance economic productivity and promote socio-economic well-being, aiding countries in reducing trade-offs, sustaining an efficient and sustainable use of limited natural resources and adapting to climate change.

### Setting the context: MENA and Niger Basin regions

Looking at the target regions, Middle East and North Africa (MENA) comprises countries with varying income levels, from high-income oil-exporting nations in the Gulf to lower-middle-income nations. Despite these differences, the entire region is a major food importer, and most countries have limited agricultural land availability, with two-thirds having less than 5% available for agriculture. In 2020, 20% of the world's acutely food-insecure population was in the MENA region, despite it only representing 6% of the global population<sup>2</sup>.

In the other target region, five out of nine Niger Basin countries are among the least developed globally. These economies heavily rely on agricultural and traditional activities, employing over 80% of the local workforce. Given the region's rapid population growth and vulnerability to climate change, finding transformative solutions for integrated resource use is crucial.

Both regions heavily depend on agriculture, often for subsistence purposes. Despite a longstanding tradition in farming, many businesses operate with traditional and inefficient resource use. Rain-fed subsistence agriculture accounts for 78% of the Basin's total agricultural production<sup>3</sup>. This is particularly relevant due to water stress and its exacerbation by climate change effects.

<sup>1</sup> UNEP & IRP, Options for decoupling economic growth from water use and water pollution, 2016

<sup>2</sup> World Bank, Mena has a food security problem but there are ways to address it, 2021

<sup>3</sup> EU/GIZ, Niger Basin Nexus profile. 2018



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Understanding the energy sector of these regions is important for investigating how sustainable energy could boost agricultural development and facilitate the spread of water-saving technologies. The regions have distinct energy profiles, with MENA having better energy access compared to Niger Basin countries, where electrification remains a challenge, especially in rural areas. While the MENA region aims to derive 75% of energy from clean sources by 2050, Basin countries face low energy consumption but increasing demand due to population growth and urbanization, compounded by cross-border energy exchange difficulties.

Despite a growing interest in the connections between the three sectors, and with more institutions and organizations moving beyond the silo mentality, several challenges and barriers still hamper the deployment of WEF nexus projects: i) lack of viable and scalable business models; ii) inadequate financing schemes for implementation and scale-up of Nexus projects; iii) lack of adequate capacities to regulate, supervise and manage integrated projects.

Concrete recommendations and actions to address the above-mentioned barriers and to exploit the opportunities of the WEF Nexus are presented in the following chapters.

## 2. Prioritising promising and scalable WEF Nexus solutions

New business models are explored every day and therefore identifying the best model among all the options is not the objective of this paper, but rather to point out at the variety of available opportunities in the MENA and Niger Basin regions.

Among the most promising WEF Nexus solutions, three that are gaining momentum have been identified (see the full analysis<sup>4</sup> of +40 applications at this [link](#)) narrowing the scope to irrigation systems, agrivoltaic technologies and productive uses of energy - sectors able to attract private sector investment and scale developers' solutions - and screening the most interesting applications based on specific criteria (market size, scalability/replicability, WEF Nexus relevance, innovation, affordability, enabling environment, attractiveness for the agriculture & water sectors, attractiveness for the solar-PV sector).

- **PV shading for horticulture**, which is a specific application of the broader "photon sharing" (also known as agrivoltaic - APV) represents the simultaneous use of areas of land for both solar photovoltaic power generation and horticulture. The technology is already proven in the target area and all the APV applications can be considered some of the most interesting examples of the WEF Nexus: PV energy can power any type of water pumping, irrigation and cultivation systems, that allow for improving crop production and sustain PV-powered post-harvest processing. With focus on water component, lifecycle assessments report that APV can lead to a reduced evapotranspiration of crops due to panel shading effects, consequently to a decreasing

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<sup>4</sup> RES4Africa, Designing innovative solutions for the Water, Energy and Food Nexus. A comprehensive review of business models for the WEF Nexus, 2023



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water consumption by 14-29% in comparison to conventional crop production<sup>5</sup>. These elements are particularly interesting in water stressed areas and where water needs large amount of energy to be used. APV, and PV shading for horticulture specifically, is gaining growing recognition as a promising means of integrating agriculture and solar-energy harvesting. APV are considered particularly attractive for the agricultural sector since agri-players can share land use and reduce the related-costs (both for CAPEX and OPEX). For what concern APV attractiveness for energy players, on one side, it has an increased complexity and require extra effort to be actualized, presenting a potential barrier to market acceptance instead of a sole solar-PV. On the other side, it helps PV developers to build cross-sectorial partnerships and deploy new projects.

- **Precision irrigation**, including drip irrigation, is a set of solutions for promoting a modern concept of agriculture with a large potential market size. It can be considered as a transversal solution for farmers and/or companies who want to improve their own productivity and/or commercial activities. However, precision irrigation coupled with solar energy comes at significant costs, thus the potential market is restrained to medium-large farmers. Precision irrigation is a useful approach to sustain agriculture activities, especially in countries affected by water scarcity (where adequately applied avoiding possible rebound effect) and where farmers highly rely on rainfed agriculture. In the MENA region in particular, 11 out of 17 countries are considered water-scarce and at the same time agriculture activities are responsible for the use of almost 85% of the region's water resources. The adoption of drip irrigation solutions could help save water resources by 30% and 50%<sup>6</sup>, in both regions with limited risks in terms of innovation and replicability, as a consistent number of businesses adopting this technology already exist. In conclusion, despite a high attractiveness for agri-business players, precision irrigation might be less appealing for PV sector players, unless the business model foresees the involvement of medium-large sized enterprises or integration with mini-grid applications.
- **Cold storage** plays a crucial role in the development of food value chains in the target regions, where there is a consistent market gap in the conservation of food and about 40% of the production is lost before reaching the market due to post-harvest spoilage and transportation<sup>7</sup>. Improving cold chains could lead to an increasing shelf life that allows to reduce losses and, consequently, increase small farmers' ability to negotiate better prices, especially in poor-grid or off-grid settings. Rising temperatures driven by climate change are expected to cause an increase in refrigeration demand, while a continuing rapid population growth will increase the demand for food. The growing urbanisation will make more people depend on functioning cold chains for their daily supply. In terms of scalability, the challenge is to reach a volume of production able to activate cold hubs in an enabling environment, bearing in mind that food cold chains may vary significantly, depending on the local context. There are different cooling technologies and they are all proven technologies to address different types of usage:

<sup>5</sup> Marrou H., Dufour L. and Wery J., How does a shelter of solar panels influence water flows in a soil-crop system? Eur. J. Agron, 2013a

<sup>6</sup> FAO, The State of Land and Water Resources for Food and Agriculture in the Near East and North Africa region - Synthesis report, 2022

<sup>7</sup> FAO, SAVE FOOD: Global Initiative on Food Loss and Waste Reduction, 2017



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with the presence of private actors (developers/operators/technology providers) active in the target areas, there are no relevant risks related to the innovation of the technology. In terms of affordability, pre-cooling and temperature-controlled storage are more affordable for farmers than refrigeration and freezing. In terms of attractiveness for the business sector, cold storage has the potential to yield advantages throughout the entire cold chain, reducing losses starting from the post-harvest stage and extending to transportation, logistics, and extended storage periods.

For distinct reasons, all three proposed applications have the potential to provide additional tools for addressing the impacts of climate change, particularly in rural communities. Agrivoltaic solutions have the capacity to enhance productivity while minimizing soil usage. Precision irrigation applications offer a means to optimize water resource utilization and curtail emissions linked to energy consumption. Lastly, cold storage has the potential to enhance supply chain efficiency and contribute to mitigating food insecurity.

Comparing business models for the same application reveals that minor changes in the business setup can lead to significant variations in the execution phase. Factors such as the actors involved, asset ownership, financing arrangement, geographical scope, and regulatory framework all heavily impact the potential success of a business. Expanding the viewpoint to include comparisons across diverse applications yields similar findings.

Despite the substantial development opportunities presented by these technologies, accessing finance remains a hurdle. This makes the financial structure of the business models even a more pivotal element that can either bolster or restrict the growth of specific technologies, influencing their potential for replication and scalability.

### 3. Financing the Nexus

Over the past decade, funding mechanisms and tools to boost sustainable resource management projects have grown significantly. However, the fragmentation of financing instruments has made accessing them more complex as they vary in funding types, recipients, geographical scope, eligible projects/activities and project's ticket size. This complexity is heightened when dealing with financing mechanisms tailored for Nexus-focused projects. Since the concept is relatively new, most available funding instruments target individual water, energy, or food projects, rather than integrated Nexus initiatives.

Analysing available financing mechanisms (see the full analysis<sup>8</sup> at this [link](#)) brings out several aspects relevant to the funding and advancement of the WEF Nexus concept. Firstly, there exists a perception issue concerning the scale of WEF projects. These projects are often regarded as being on a smaller scale, even though the definition of the Nexus encompass large project as well. Such a perception could potentially hinder the mobilization of financial resources. Secondly, the development of WEF projects necessitates interdisciplinary expertise across all implementation stages, both from project

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<sup>8</sup> RES4Africa, Financing the Water, Energy and Food Nexus. A comprehensive review of Financing Mechanisms for the WEF Nexus, 2023



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developers and donors/financiers. This requirement for diverse competencies encounters challenges due to the aforementioned perception of projects as small-scale. Consequently, there might be reluctance to assign large and complex teams to projects perceived as having limited scope. Furthermore, there is a notable lack of dedicated funding sources specifically targeting the WEF Nexus. Despite the presence of multiple financing mechanisms capable of supporting WEF Nexus projects, the majority of these funds lack explicit targets related to the Nexus concept. Lastly, the scarcity of data on supported WEF Nexus projects stems from the absence of specific WEF-related objectives. As a result, information regarding the extent of support provided by financing institutions for the Nexus concept remains limited.

Given the potential of WEF Nexus in tackling multiple challenges posed by climate change, those limitations call for a path of improvement through a series of actions:

- **Build collaboration and coordination mechanisms** between local institutions working for creating an enabling environment and financing institutions to improve project bankability and accelerate the deployment of WEF Nexus projects. An example of effective multi-stakeholder cooperation is the DREAM initiative in Ethiopia.
- **Promote WEF-specific funding windows** within existing financing mechanisms or one-stop-shop mechanisms to reduce fragmentation of funding while facilitating channel financing from different sectors to integrated projects. Mainstreaming the Nexus in the finance space should include supporting financing mechanisms that are active in at least one of the three sectors to adopt WEF nexus approaches, strategies, targets, KPIs and create multi-sectoral expert teams to evaluate and oversee integrated projects effectively.
- **Prioritise and advocate for the adoption of high-impact Nexus projects**, by working with public institutions and utility-scale companies to develop infrastructure plans integrating Nexus approaches as well as by supporting the scale-up of successful small-medium scale initiatives. Prioritising Nexus projects with high-impact potential could facilitate the implication of multiple actors, thus favouring the sharing of expertise between sectors.

#### 4. Strengthening the capacity of youths, professionals and decision-makers

Continued efforts are required to support the development of the future leaders of Sub-Saharan Africa and MENA regions through specialized institutional and vocational trainings. Capacity building emerges as a pivotal instrument to support key actors within the water, energy, and food sectors. This entails tailored trainings for youths, institutional representatives, civil servants, as well as mid- and senior-level managers within utilities, government bodies, and related sectors. Capacity building initiatives hold the potential to raise awareness about the WEF Nexus, inform stakeholders about available technologies, delve into financing mechanisms, and comprehensively understand the regulatory and





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legislative framework related to the Nexus concept. Achieving this objective with customized and comprehensive insights marks a crucial milestone in fostering the development of highly skilled workforces, entrepreneurs and decision-makers.

The integration of the Nexus within training and supporting programs assumes paramount significance as it not only enhances awareness but also foster Nexus-centric thinking into the development of future strategies, programs and initiatives, as the stakeholders engaged in capacity-building programs are expected to be able to incorporate principles and approaches of the Nexus into their work. In this context, the following recommendations merit consideration in order to strengthen Nexus-related capacities:

- **Support institutional capacity-building** tailored to public entities to enhance their skills in program implementation and monitoring. This should include training and capacity building activities aimed at strengthening knowledge on the WEF Nexus concept and approaches, decentralized renewable energy solutions, agribusiness development, natural resources management, policies and regulatory frameworks, and financing. Supporting institutional capacity building plays an important role in enhancing the capacities of organizations to provide the proper coordination and monitoring that complex Nexus strategies and initiatives require.
- **Foster the establishment of dedicated university programs, professional training modules, and other educational initiatives**, with the objective to contribute building a workforce of experts able to navigate and manage the complexities of the WEF Nexus. Training and capacity buildings should aim also at raising awareness about the importance of resource management and integrated solutions, as well as financing and technology.
- **Promote local innovation through SMEs and start-ups.** In Africa, SMEs provide an estimated 80% of jobs, representing an important driver of economic growth. Sub-Saharan Africa alone has 44 million SMEs, almost all of which are micro<sup>9</sup>. Fundings secured by African start-ups have grown more than 10 folds in 5 years, reaching an historical 2b USD in 2021<sup>10</sup>. However, despite this growth, start-ups still face significant challenges, including limited access to funding and know-how, inadequate infrastructure, and regulatory barriers. Sector-wise, the energy and agri-sectors are still relatively unexploited, with the ecosystem dominated by Fintech, E-commerce and E-health. This discrepancy represents an opportunity to expand incubator and accelerator services for renewable energy, food and water sectors providing necessary technical assistance and access to finance.

The incorporation of WEF Nexus within capacity building and entrepreneurship support programs holds the potential to reshape the trajectory of developmental efforts in Africa and MENA. By aligning training, skill enhancement and support programs with the principles of the WEF Nexus, stakeholders can collectively strive towards sustainable progress, ultimately steering these regions towards a more prosperous future.

<sup>9</sup> CSIS 2021, Supporting Small and Medium Enterprises in Sub-Saharan Africa through Blended Finance

<sup>10</sup> Disrupt Africa "The African Tech Startups Funding Report 2021"



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