Project proposal

Let the sun shine; exploitation of the Water-Energy-Food nexus in the Middle East

Time: 1 March-31 December, 2019

Lead agency:
Amsterdam Centre for World Food Studies, VU University, Netherlands

National and international counterparts:
Al-Quds University, West Bank, Palestine
Jordan University of Science and Technology (JUST), Irbid, Jordan
Ministry of Agriculture, Ramallah, West Bank, Palestine
Palestinian Water Authority, Ramallah, West Bank, Palestine
Ministry of Water and Irrigation, Amman, Jordan
Ministry of Agriculture, Amman, Jordan
Food and Agriculture Organization of the United Nations, Rome, Italy

Total budget: 280 000 €.

Summary
Water scarcity is a serious constraint on the economic and social development in the Middle East, and finds expression in fierce competition between agriculture and fast growing urban settlements. The tension is likely to mount in the near future under persistent demographic pressure, while rainfall conditions are expected to worsen under climate change. Moreover, the extricate link with energy in every stage of the water cycle and, vice versa, the high dependency of water in conventional energy processes creates now serious problems because of increased energy prices and high water consumption rates by the energy sector, further reducing the water availability for agriculture and food production. The intended project aims to address this issue by introducing an integrated Water-Energy-Food approach using solar cells and introduction of efficient and affordable agricultural water management strategies. The project has a special focus on food security and family farming, horticultural development and evaporation reduction of open canals. The project implements pilots that align to practical solutions that can be upscaled to other, still, unvisited sites. Moreover, pilots constitute the empirical basis for an energy component in the water-economy model for the Jordan River Basin to evaluate, locally and across the border, the economic and ecological effects of widespread WEF policy interventions.

Figure 1. Sprinkler irrigation with solar power (Source: AGNISOLAR)

Problematique

Building a sustainable future in the Middle East in response to common economic and environmental challenges requires a paradigm shift that acknowledges interconnectedness between water, energy and food (WEF) sectors to addresses, simultaneously, prevailing water scarcity, food insecurity and climate change hazards. It is well known that agriculture produces one-quarter of global greenhouse emissions and also falls victim to the consequent effects of lower and more erratic rainfall patterns with obvious impacts on food security.

Moreover, water scarcity undermines food security and leads to increased pressure on the energy sector, as more energy is needed to secure sufficient water for agricultural, industrial and consumer use while, vice versa, cooling of electricity generating processes reduce water availability for other sectors. These effects are not only experienced at a local level but also across the border as reduction or a full stop of transboundary water transfers puts a serious strain on international relationships in a region already rife with political conflict. Prospects under future scenarios remain bleak as climate change exacerbates water scarcity while a growing and more affluent population demands its share of water for food, fiber, fodder and energy. The World Bank[1] calculated that water scarcity in 2050 reduces agricultural production in the MENA region by 60 percent while replacing conventional with less water intensive electricity systems amounts to a cost of USD 50 billion.

Figure 2. Solar water pumps (source: Lubi Solar Water Pump)

Water scarcity and energy generation has been mostly addressed by interventions in either the water or energy sector, but addressing the Sustainable Development Goals[2] requires an integrated WEF approach and asks for the involvement of all key stakeholders.

Possibilities offered by the WEF nexus seem promising in the Middle East as solar and wind energy as sustainable renewable sources can increase irrigation efficiency for food production and deliver energy for innovative water treatment methodologies and desalination techniques. Moreover, sharp drops in prices makes solar powered irrigation systems an affordable technology for both large and small-scale farmers in developing countries. These integrated solutions are economically feasible for farmers and land users with potential positive impacts on water management at national and cross-border scales.

Water scarce Jordan and Palestine are particular cases in point. Climatic conditions in both countries favor implementation of large scale solar energy fields that can meet the high energy demands from water generating and purifying activities that should assure suitable water deliveries for food production. Moreover, adopting renewable energy contributes to a reduction of the energy sector's water use while energy surplus from solar and wind parks could be traded nationally or internationally and broaden political agendas for ongoing negotiations.

A necessary transition should be realized in both countries putting environmental, social and economic sustainability at the centre, to ensure food and nutrition security for all, preserve the environment and provide jobs and social development opportunities for rural dwellers. Such a transition should be incremental to existing

[1] Borgomeo, E., A. Jägerskog, A. Talbi, M. Wijnen, M. Hejazi, and F. Miralles-Wilhelm. 2018. "The Water-Energy-Food Nexus in the Middle East and North Africa: Scenarios for a Sustainable Future." World Bank, Washington, DC.
[2] Meeting the Sustainable Development Goals (SDGs)

policy lines. Hence to align to current policies the project will focusing Palestine on fortifying value chains (Isaac, 2015) while in Jordan recent focus is on water efficiency and family farming (Economic Policy Council, 2018).

The project.

Figure 3. Solar energy for water and food (Source: Newland)

Rather than formulating solutions for its individual components the project address water scarcity in the Middle East using an integrated approach that considers the WEF nexus as an interconnected system. Planned interventions should, therefore, account for the impact on related WEF factors and result in efficient, practical and sustainable solutions that contribute to the realization of the SDGs. Specifically, the project focusses on increasing water efficiency while reducing dependency of water demanding energy in the Middle East using a two-pronged approach.

First, it implements pilot studies in Jordan and Palestine.

- In Jordan solar panels are placed over a part of the King Abdullah Canal (KAC) to combine reduction of evaporation losses with energy generation for desalination of brackish water; dedicated field experiments support quantification and modelling.
- Furthermore, in line with the foreseen alliance with the Ministry of Agriculture in Jordan in the Kuwait-Jordan-FAO tripartite (see also section Sustainability), the project will implement solar systems at farm level that should contribute to the implementation of small scale irrigation schemes for home gardens.
- A horticultural project in Palestine is the base for a case study where solar panels deliver energy for cooling cells and treating waste water that is used for flower irrigation.

Case studies are conducted under controlled and natural conditions to facilitate statistical analysis and increase usefulness for policy making. Furthermore, results of interventions are compared with control groups to measure significance and corresponding marginal contribution.

Second, findings of the case studies and information from literature serve as input for the existing regional water economy model (Veen, et al., 2017) that is extended with a specific energy module to calculate environmental (e.g. CO2 emissions) and economic benefits of various policy interventions. This spatially explicit water economy model was designed and developed in a four-year project, funded by SIDA, and covers the entire (Upper and Lower) Jordan River Basin. The model represents natural and controlled water flows for 48 districts, 26 time steps of two weeks, five layers (surface, human control, root zone, rivers and aquifer) four water qualities (Cl, NO3, BOD, pure water). The model has an agricultural component that uses the actual distribution of land qualities to simulate possibilities for agricultural production under rainfed and irrigated conditions (e.g. Sonneveld et al., 2018).

Summarized, the research objectives are:

1. Obtain a deeper insight in the WEF nexus
2. Provide empirical evidence for interventions with solar panels to increase water efficiency and assure food security. Specifically, the research projects will test
    a. the impact on reducing evaporation by solar panels that are constructed over the King Abdullah canal, with possible extension to other canals,
    b. the use of renewable (solar) energy at farm level for small scale irrigation of allotment plots to secure food diversity and nutritious crops in the rural areas of Jordan

c. the use of renewable (solar) energy at farm level to further develop the high-value floriculture market chain in the West Bank that particularly includes females and allows to improve the food security status in the context of the West Bank.

3. Develop a tool that informs decision makers on the economic and ecological (e.g. CO2 emissions) impact of their WEF related policy interventions.

Figure 4. Food diversity through solar powered irrigation ((source FAO)

Stakeholder involvement

Success of this project will largely depend on adaptation of new techniques by water users, the energy sector and decision makers. The project will, therefore, maintain a continuous contact with a multi-stakeholder group that includes representatives of governmental, non-governmental and farmer organizations through dedicated activities that initially aim to solicit suggestions and comments, and later on to discuss outcomes and to define practical policy options.

Alignment with national and international policies and programs

Project objectives are consistent with government initiatives of participating countries to improve support to decision makers in the formulation of efficient water policies that are based on clean energy (MoEMR (2007); MWI, 2016a and 2016b; Ibrik, accessed 2018). Project objectives are also in line with the Dutch and European Union policy for partnership building in the Middle East (e.g. European Commission, 2007). The project will closely collaborate and seek active contact with regional initiatives like the Regional Water Data Banks Project (RWDBP; http://www.exact-me.org/), SMART projects of the Karlsruhe University and the Red Sea-Dead Sea Water Conveyance Study Program (http://go.worldbank.org/TDZM48OXO0) of the World Bank. Furthermore, the project will take stock of new initiatives and seek collaboration with these. The close interaction with policy makers and government officials in the participating countries may be noted as well. For example, the partner JUST has an advisory role in the Ministry of Water and Irrigation in Jordan and close ties with the Ministry of Agriculture. The Al-Quds University is regularly consulted by the Ministry of Agriculture and the Palestinian Water Authority. Aforementioned partners provide a strong anchor for dissemination of findings in the MENA region and beyond.

Dissemination of project findings through article publications in international journals, policy documents in both English and Arabic and presentation at workshops in the region should assure that decision makers and other stakeholders will be fully informed and can interact with the project findings.

Sustainability

Sustainability of the project is assured by embedding project activities in long-term initiatives. In Jordan, the pilot provides useful information for the WASEC project, an EU funded initiative (2019-2022) that aims to fortify water curricula of HEI's in the Middle East. Moreover, the Jordan University of Science and Technology (JUST) is a long term and trustworthy partner of ACWFS with many ongoing interpersonal connections. Furthermore, ACWFS has been invited by the FAO to partner in the workgroup 'Sustainable Agricultural Water Use' of the global framework for water scarcity (WASAG). The invitation aligns with ACWFS's role in the Kuwait-Jordan-FAO tripartite partnership, to lead research Component 1: *Sustainable agriculture in water scarcity by providing a policy support for the Agricultural sector in the Hashemite Kingdom of Jordan with exchanging experience (expected Budget 2 million USD).* The pilot in Palestine falls under the Palestinian Dutch Cooperation (PADUCO) initiative and partners

with the Al-Quds (AQU) and Hebron Universities, the city of Amsterdam, Waternet, PUM (retired Dutch experts) and the Al-Taybeh municipality. PADUCO is in its second phase (2017-2021) and stands a good chance to be extended with a third (four-year) phase. Next to the pilots, JUST and AQU partners were fully involved in the development of the water economy model that forms the basis for the simulations of policy and technology impact. Partners, jointly with staff members of the Ministries of Agriculture will be versed in the operation of the water-economy model that is extended with an explicit energy component. The spatial water-economy-energy model through its innovative characters makes the project a suitable candidate for funding of a follow-up phase. For this the project will prepare a follow-up proposal that describes the relevance of scaling up activities and its large scale contribution to mitigate climate change effects. Candidate sponsors are the GEF, OFID and the Dutch Government.

Strengthening the long-term perspective of ACWFS

The project reinforces the already unique knowledge and network base of ACWFS in the MENA region and, in addition, produces tangible inputs for further cooperation. As such, it has to be seen as an investment that enhances the options for externally funded research projects, such as those mentioned above. It also enhances the knowledge base within the VU University, through the employment of young researchers who gain experience in this specific transdisciplinary research area, both in terms of methods and in a geographical sense.

Expected impacts

Project findings, on the short term, will contribute to mainstream an integrated WEF approach in Jordan and in the Palestine Territories to attain the SDG's. In particular, but not exclusive, the following SDG's are directly addressed: no poverty (SDG1), zero hunger (SDG2), clean water and sanitation (SDG7), clean and affordable energy (SDG7).

An important output of this project is the capacity building component using co-creation and active learning processes to assure that project output is sustained and academic experience enriched and institutionalized. Furthermore, the water-economy-energy model will support decision makers in selection of the appropriate interventions.

The project will formalize the decision making process on selection of WEF intervention for various target groups identified. The water-economy-energy tool, based on empirical evidence gained during the project, presents an unbiased integration of planning objectives for independent identification and ranking of most suitable planning solutions. Users can assign weights to emphasize importance of factors for specific local conditions and target groups. The water-economy-energy tool will be delivered within a user friendly shell to facilitate its use by stakeholders.

Finally, since this project aims to contribute to a sustainable and economically feasible improvement of the WEF nexus, a wide and well targeted dissemination of its findings is essential. Therefore, the project capitalizes on existing networks that enhance communication with policy makers and stakeholders using fora, newsletters, conventional and social media. The project's impact pathway presented below provides in a conceptual and concise manner the integration of the formulated project objectives in relation to output and research uptake with clear and verifiable indicators.

Table 1. Theory of Change & Research Impact Pathway with indicators

Objectives	Output	Output: verifiable indicators	Outcome	Outcome: verif. indicators
1. Provide a better understanding of the WEF nexus.	- New insights in WEF performance - Shared new understandings in policies, NGO programs	- Scientific and non-scientific publications, databases, models, new production techniques - Policy/extension documents	- Uptake of new WEF techniques by early adopters - Improved WEF technology deliver clean energy increase irrigation efficiency and food security.	- Established and/or enhance solar energy sources for efficient water management policies. - Emergence of new WEF interventions - > 10% of agricultural producers in Jordan and Palestine adopting solar energy for farm development - >10% of farmers adopting efficient irrigation techniques. - >50% of KAC covered with solar panels - Decision Support Tool is widely used to inform decision makers in support of WEF interventions/
2. Provide empirical evidence for impact of WEF interventions	- Pilot 1. Solar Panels for evaporation reduction and desalination - Pilot 2. Solar energy and small scale irrigation for food security - Pilot 3. Solar energy at the service of horticulture	- Publications on pilot results a) databases and models b) policy documents c) workshops/training - Pilot as models for expansion of project findings	- WEF policies foster a) sustainable water management techniques b) Increase nutritious and affordable food to cities c) Improved value chains	
3. Prepare informed decision makers on WEF related policies.	- Water-Economy-Energy model, operational and a) resource-efficient agro-ecological diversity b) dietary choice, antenatal care c) reduce food waste d) increase food quality.	- Technical reports - Workshops training technical staff - Scientific publications. - Transfer pilot data to water-economy-energy model - Prospective scenarios - Policy briefs - 4 trained staff members of Ministries	- Research uptake by Ministry of Agriculture and Ministry of Water Resources in Jordan and Palestine of the water-economy-energy mode to improve a) Agricultural water management b) Affordable food c) Improved value chains	
4. Empowerment of stakeholders/co-creation of scenarios	- Organize workshops for public and private accelerators to exchange experiences and ensure sustainability and adaptability of WEF interventions	- Platform for: a) public and private accelerators to exchange experiences and b) interested parties for adaptation of WEF techniques	- Uptake by Ministries to organize extension programs	- Workshops - Digital portals with information on WEF interventions
5. Dissemination	- Special focus on family farms in Jordan, and young food and horticulture entrepreneurs in Palestine	- Policy briefs - Discussion papers - Scientific papers - Educational programs/Video's	- Uptake local and national authorities to organize a dissemination campaign - Well informed	- 20% of the target groups is involved in an empowerment program.
6. Upscaling project findings	- Establish a WEF network for researchers, practitioners, private sector and policy makers	- Workshops network members learning /showcasing best WEF practices - Newsletters	- authorities initiate WEF network for researchers, private sector / policy makers	- Established WEF network - Quarterly newsletter
7. Sustainability	- Project embedded in current and future projects - WEF decision support tool attractive for follow-up activities	- Continuation of project - Well trained ACWFS staff members continue research - Counterpart adopt research program	- Ministries and research institutes further develop the water-economy-energy model	- Widespread adoption of WEF interventions that contribute to a sustainable development of the agricultural sector.

Project management

The project establishes an advisory board that oversees project activities approves internal audits and authorizes deliverables. The board is chaired by Project Leader, dr. C.F.A. van Wesenbeeck, Director of ACWFS and co-chaired by the directors of participating institutes. Dr. A. ALfarra, a FAO land and water officer with a recognized seniority in the region will give advice and support in the co-supervision of post-docs. The advisory board will have regular teleconferences and meet one time during the project period.

Postdocs. The project will contract two post-docs for the period 1 March-31 December 2019 who are responsible for the pilots and the extension of the water-economy model with an energy component.

Supervision. The post docs will be supervised by Senior Researchers of the ACWFS (dr. B.G.J.S. Sonneveld, W.C.M. van Veen), Al-Quds University (prof. A. Marei), JUST (prof. F. Abdullah, prof. H. Qdais) and the FAO officer (dr. A. Alfarra).

Risks and related risk minimizing strategies concern

- Recruitment of post-docs. The Centre's network covering the Wageningen University and Research Centre, Technical University Delft and the Twente University are being approached for the timely recruitment of post-docs. The first signals receive are positive.

- Accessibility. The study area lay in trurbulent region with many conflicts. Yet, given the current stable situation the expectations are that in the short time of the project no major conflict will arise. If this is not the case all people from the project will not take any risk and abandon dangerous zones.

- Financial risks. No financial risks are foreseen.

Project budget, working schedule and deliverables

Details of the project budget, working schedule and deliverables are found below.

Project budget (in Euro's)

Personnel costs	months	Euro's
VU senior	6	50279
Al-Quds	4	12000
JUST	4	12000
VU-postdoc 2x	18	113982
	SUB-TOTAL	**188260**

Workshop	Unit	
Workshop kick-off	1	5000
Workshop transition	1	5000
	SUB-TOTAL	**10000**

Travel	Unit	Days	total
Post-docs	4	50	4000
Senior staf	4	10	3500
Counterparts	1	10	2000
	SUB-TOTAL		**9500**

Material	Unit	Costs
Solar cells	144	72000
	SUB-TOTAL	**72000**

GRAND-TOTAL	**279760**

Activities	1	2	3	4	5	6	7	8	9
Kick-off									
Pilot 1, KAC coverage									
Pilot 2, family farming									
Pilot 3, horticulture									
Model development									
Scenario development									
Final workshop									
Deliverables	a	b,c	d,e	f		g	h,i	j,k	l

Chronogram and deliverables

code	deliverables
a	Inception report
b	Implementation report Pilot KAC coverage
c	Report on model development; approach for accommodating Energy
d	Implementation report Pilot famly farming
e	Progress report on model development;
f	Implementation report Pilot horticulture
g	Final report model development
h	Final report Pilot KAC coverage
i	Final report Pilot family farming
j	Report on policy scenarios; upscaling project results
k	Final report Pilot horticulture
l	Final report

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