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Is Solar Pumping the Answer to WEF Nexus in the MENA Region?

Case studies from Tunisia, Morocco and Jordan

Nexus Webinar:
Carbon Reduction and Energy Efficiency in the Water and Wastewater sector

Dr. Nisreen Lahham, Nexus Dialogue Programme (GIZ Cairo Office)
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20.03.2019

Outline

- The Nexus Dialogue Programme.
- SPIS in the MENA Region.
- NRD MENA Study: SPIS Impacts in Tunisia.
- GIZ-FAO Study: SPIS Impacts in Morocco.
- NRD MENA Study: WEF Nexus Assessment of SEF in Jordan.

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The Nexus Dialogue Programme

The Nexus Dialogue Programme

Funding Institutions

European Union (EU)

German Ministry for Economic Cooperation and Development (BMZ)

Global Management

Global Nexus Secretariat (GNS) (hosted by GIZ)

Regional Implementation

Middle East & North Africa- MENA

LAS

GIZ

Latin American & the Caribbean-LAC

CEPAL

GIZ

Niger Basin

NBA

GIZ

Southern AFRICA

SADC

GWP

CENTRAL ASIA

IFAS

CAREC

Activities of the NRD in the MENA Region Phase I

- Support the League of Arab States (LAS) as the main counterpart: Providing Nexus knowledge.
- Support compilation of Nexus experts: Nexus capacity Building trainings.
- Carry out Nexus country assessments at national levels (Tunisia and Sudan).
- Carry out small Nexus demonstration projects: (SPIS and SEF).
- Develop a regional Nexus Action plan.

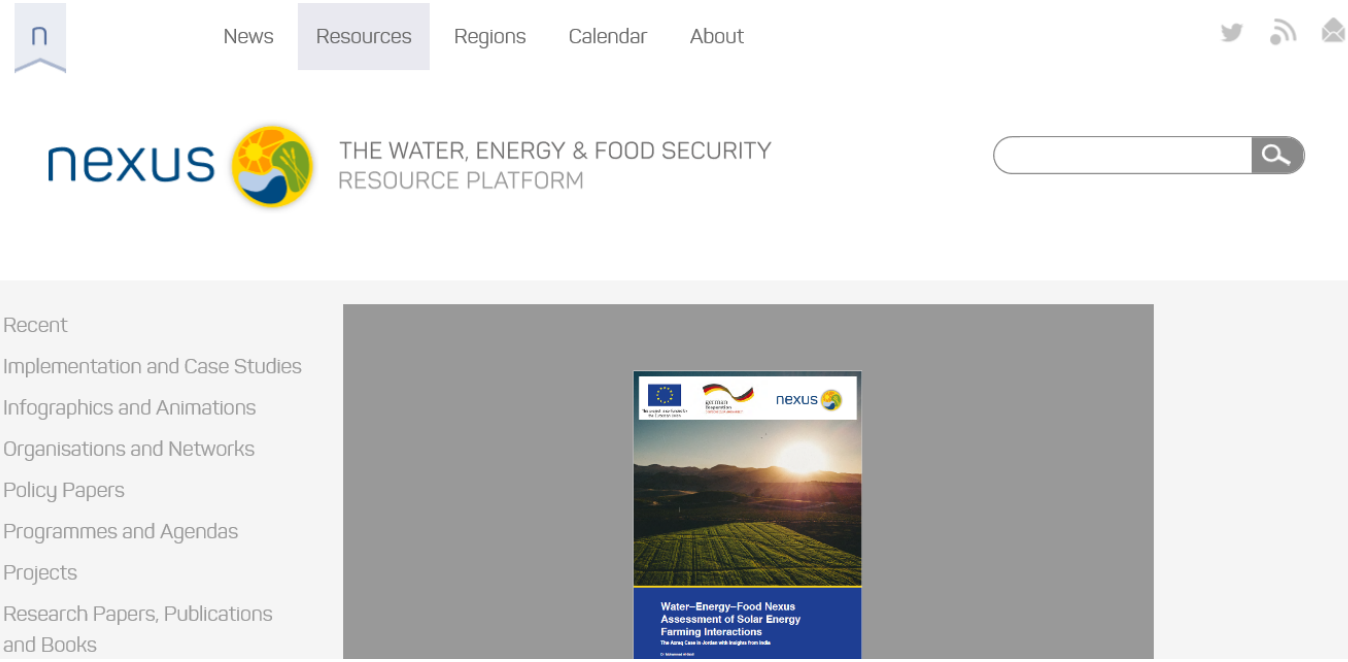
Nexus Resource Platform

www.water-energy-food.org

- **Central knowledge hub** on the Water-Energy-Food Security Nexus
- Reports, articles, news from research and practice, conferences, expert interviews, jobs
- **MENA sub-site with arabic content**

@NEXUSPlatform #Nexusplatform

www.facebook.com/nexusresourceplatform/



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SPIS in the MENA Region

Solar Powered Irrigation systems (SPIS) in the MENA Region

SPIS is one of the fastest growing applications for solar energy technologies throughout the region

- Rapidly growing prices for fossil pumping installations.
- Phasing out of power and diesel subsidies for farmers and agro-industries.
- Growing supply bottlenecks for diesel and power for on-grid pumps.
- Extension of farming and hence irrigation into remote regions unconnected to the grid.
- The quickly dropping costs of PV panels and the improved technical performances of the solar pumping technologies.

SPIS Impacts

Benefits that come at Risks

- Create jobs with economic benefits.
- Reduce the farmer's recurring production costs.
- Mitigate climate change impacts.
- A sustainable green business.

- Encourage greater water extraction.
- Lead to over-exploitation of groundwater.
- A sustainability risk for environment.

Solar pumping has to be integrated into a broader approach to reduce overconsumption of water and find ways to monitor and regulate water extraction

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NRD MENA Study: Impacts of SPIS in Tunisia

التعاون الألماني
DEUTSCHE ZUSAMMENARBEIT

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Organisation des Nations Unies pour l'alimentation et l'agriculture

الجمهورية التونسية
وزارة الفلاحة

الوكالة الوطنية للتحكم في الطاقة
ANME

Agence de Promotion des Investissements Agricoles
APIA

Objectives

- Understand the links between the use of solar pumps by farmers and the potential impacts on water consumption.
- Examine the socio-economic effects of solar pumps.
- Realize the costs and benefits of SPIS compared with other technologies.
- Highlight rules, regulations and policies needed to manage the risks and realize the potentials of SPIS.
- Provide recommendations to promote sustainable use of the technology.



Context

- Increasing periods without rain and increasing demand creating stress for water resources.
- Large parts of groundwater resources are not renewable (regeneration rate of 10,000 years).
- Diesel subsidies are continuously decreased, energy costs increased.
- The GoT subsidizes the installation of SPIS (depending on fund used 300 – 1 000 EUR / kWp or 50% of installation costs).
- The major part of farmers do not pay their water extraction fees.

→ Hypotheses:

→SPIS lead to 0 DT operation costs for farmers.

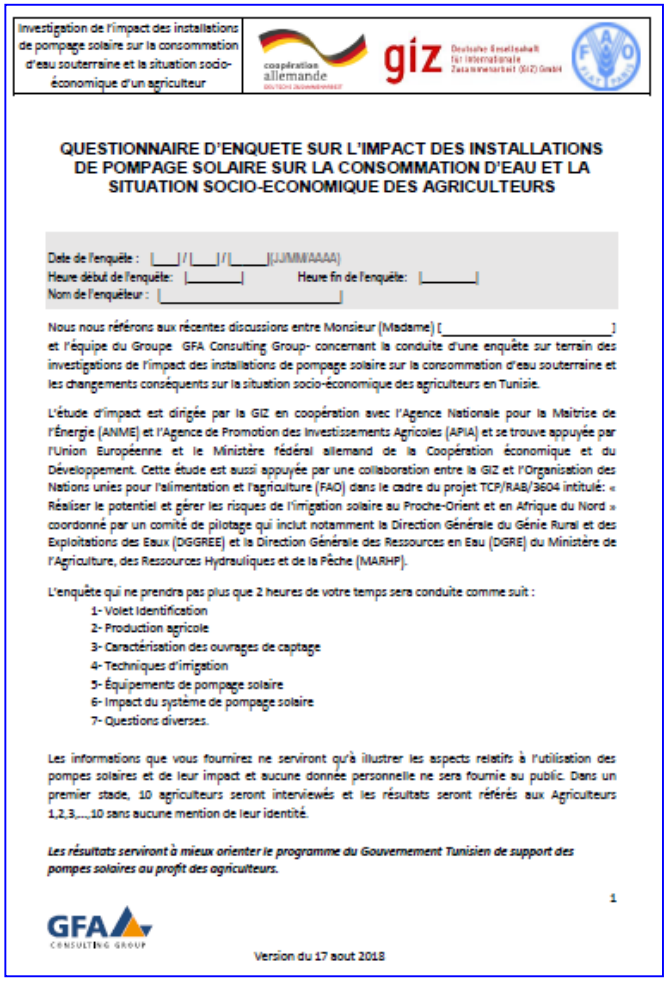
→Farmers may thus increase the volumes pumped to intensify their agriculture or extend the irrigated surface.

Approach and methodology

- Small survey to gain evidence and study trends concerning these hypotheses.
- Review of existing literature and analysis of existing laws/regulations.
- Sample of 24 farms, profound wells in 4 governorates.
  - 20 out of 124 SPIS subsidized by the Energy Agency since 2010.
  - 4 illegal wells.
- Validation with 23 institutions from the water, energy and food sectors.

Questionnaire

- General data on interviewee
- General data on farm
- Production
- Irrigation techniques
- SPIS equipment used
- Impacts



Investigation de l'impact des installations de pompage solaire sur la consommation d'eau souterraine et la situation socio-économique d'un agriculteur

coopération allemande — giz — FAO

QUESTIONNAIRE D'ENQUETE SUR L'IMPACT DES INSTALLATIONS DE POMPAGE SOLAIRE SUR LA CONSOMMATION D'EAU ET LA SITUATION SOCIO-ECONOMIQUE DES AGRICULTEURS

Date de l'enquête : |___|/|___|/|____|(JJ/MM/AAAA)
Heure début de l'enquête: |_____| Heure fin de l'enquête: |_____|
Nom de l'enquêteur : |_____|

Nous nous référons aux récentes discussions entre Monsieur (Madame) [_____] et l'équipe du Groupe GFA Consulting Group- concernant la conduite d'une enquête sur terrain des investigations de l'impact des installations de pompage solaire sur la consommation d'eau souterraine et les changements conséquents sur la situation socio-économique des agriculteurs en Tunisie.

L'étude d'impact est dirigée par la GIZ en coopération avec l'Agence Nationale pour la Maitrise de l'Énergie (ANME) et l'Agence de Promotion des Investissements Agricoles (APIA) et se trouve appuyée par l'Union Européenne et le Ministère fédéral allemand de la Coopération économique et du Développement. Cette étude est aussi appuyée par une collaboration entre la GIZ et l'Organisation des Nations unies pour l'alimentation et l'agriculture (FAO) dans le cadre du projet TCP/RAB/3604 intitulé: « Réaliser le potentiel et gérer les risques de l'irrigation solaire au Proche-Orient et en Afrique du Nord » coordonné par un comité de pilotage qui inclut notamment la Direction Générale du Génie Rural et des Exploitations des Eaux (DGGREE) et la Direction Générale des Ressources en Eau (DGRE) du Ministère de l'Agriculture, des Ressources Hydrauliques et de la Pêche (MARHP).

L'enquête qui ne prendra pas plus que 2 heures de votre temps sera conduite comme suit :

1- Volet Identification
2- Production agricole
3- Caractérisation des ouvrages de captage
4- Techniques d'irrigation
5- Équipements de pompage solaire
6- Impact du système de pompage solaire
7- Questions diverses.

Les informations que vous fournirez ne serviront qu'à illustrer les aspects relatifs à l'utilisation des pompes solaires et de leur impact et aucune donnée personnelle ne sera fournie au public. Dans un premier stade, 10 agriculteurs seront interviewés et les résultats seront référés aux Agriculteurs 1,2,3,...,10 sans aucune mention de leur identité.

Les résultats serviront à mieux orienter le programme du Gouvernement Tunisien de support des pompes solaires au profit des agriculteurs.

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GFA CONSULTING GROUP

Version du 17 aout 2018

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Results

Financial Parameters

- The major motivation for investment was to save on energy spending.
- SPIS owners were highly satisfied with the technology.
- The investment cost of SPIS is considered to be high.
- The fragmentation of agricultural holdings considerably limits the large-scale dissemination of SPIS.
- Profitability of SPIS are relatively low due to the preferential tariffs of electricity in the agricultural sector.
- SPIS are financed from farmers' own funds. None of them was set up with a financing scheme incorporating bank loans.

Irrigation systems

- All farms use drip irrigation systems, which enhances the value of the water at the plot.
- Authorized wells are mandatorily equipped with water-saving irrigation systems.
- Only 20% seek advice from public agricultural agencies. Farmers with respective financial resources seek advice from private consultants.
- None of the farmers have received advice to calculate their water demand.
- All individual well owners reject the idea of collective drilling for fear of the difficulties of managing common property and the risk of not having enough water for their crops.

Water storage

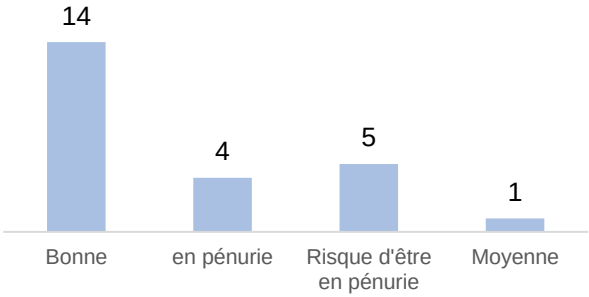
- 37% of farmers do not invest in water storage due to their limited financial resources.
- Water storage systems are under-sized because of constraints in financial resources.

Water resources

Q: Are the quantities of water pumped sufficient?

Yes	10
Partly	1
No	13

Perception of farmers concerning the groundwater situation in their region



- With minimal operating costs, SPIS may lead to an increase in water consumption. More than 80% pump more water than before.
- Farmers believe that they use free and inexhaustible water. More than 1/2 of the farmers have increased the irrigated areas.
- 88% believe that increasing the amounts of water, increases necessarily the yield.
- 58% believe that the groundwater situation in their region is good. In Kebili, farmers are aware of the situation, but believe that the communication on this is exaggerated.

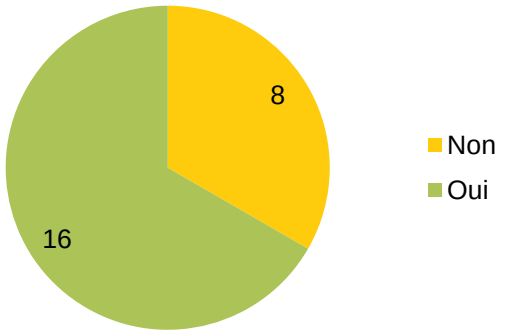
Monitoring of water demand and water fees

- 2/3 of farmers monitor their water demand only irregularly.
- 50% do not have water meters.
- They monitor to control the performance of the SPIS.
- None of the farmers pay the obligatory water fees.

Q: Do you have water meters?

Yes		12
No	Not existing	10
	De-installed	1
	Never installed	1

Q: Do you monitor your water demand?



Co-benefits for the agricultural sector

- Access to SPIS encouraged farmers to exploit new dry or unused agricultural areas- expansion of agricultural activity.
- Job creation has been observed.
- Local workforce stays in the region.
- Two emigrants could return to Tunisia to work on the newly irrigated farms.

Illegal wells and SPIS

- SPIS installed at illegal wells are not subjected to inspections and thus bear a number of risks such as:
  - Non-conformity to technical and security standards ;
  - Additional pressure on water resources ;
  - Evolving of « pseudo » installers ;
- From 2015 to 2018 supposedly more than 1,000 SPIS have been installed at illegal wells.

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GIZ- FAO Study: Impacts of SPIS in Morocco

https://www.water-energy-food.org/resources/resources-detail/pompage-solaire-investigation-de-l-impact-des-installations-de-pompage-solaire-sur-la-consommation-d-eau-et-la-situation-socio-economique-d-un-agriculteur-dans-3-zones-pilotes-au-maroc/

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Organisation des Nations Unies pour l'alimentation et l'agriculture

Powering Agriculture

Integrated water resources management

Promoting employment through renewable energy and energy efficiency in the MENA region

Sustainable Energy in the Provinces of Midelt and Tata (EDMITA)

Context

- Planned subsidy of 50% of the cost of installing PV panels with a ceiling of 15,000 MAD/ ha up to 5 ha.
- Risk of accelerating the overexploitation of groundwater resources.
- Hypothesis: "*The installation of a solar pumping system increases a farmer's water consumption because of the reduced cost*".
- Testing the hypothesis through survey of farmers.



Methodology

- General survey of 150 farmers in three regions; Marrakesh, Tata, Midelt.
    - 50% with SPIS
    - 50% without SPIS
- Questionnaire on:
    - Identification of the farm.
    - Characterization of well properties and pumping equipment.
    - Agricultural production.
    - Agro-economics.

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Results of the survey

Appreciation of SP

- Very high level of satisfaction of SP due to low operating cost.
- 96% think about converting to SP for economic reasons and to get continuous energy supply.
- Yet, they haven’t done this conversion because of absence of subsidies, the high investment costs and refusal of suppliers to use the installment payment method.

Impacts of SP on water consumption

- Trend towards increased water consumption through:
  - Extension of the irrigated areas.
  - Introduction of intercropping.
  - Increase in water allocation to the same crop.

- The increase of water consumption is variable in the zones and this is according to the water availability and the type of crop.
  - The increase in consumption is much more attributed to small and medium sized farms.

Impact of conversion to SP on the socio-economic situation of the farmer

- For smallholders, the economic impact is substantial.
- The conversion to SP impacts the socio-economic situation of the farmer through:
  - Cost savings.
  - Improvement of the Crop Profit Margin.
  - Use of savings on operating costs in Investment in increasing production- social/ family life.

Farmers views on “conditional subsidy” SP installations

More than half of the farmers surveyed are in favor of conditional subsidy, under the main condition of guaranteeing them sufficient volumes of water to cover the crops’ water needs.

Condition	Yes	No	If so, under what conditions? Yes	If not, what are the reasons? No
Q1 : Abandon individual well and use a collective well equipped with PV	57%	43%	• The costs of maintaining the system to be covered by the public agencies • The water rounds are fixed and respected	• Difficulty in managing common property • Risk of conflicts between farmers
Q2 : Accept the installation of control and data collection equipment	86%	14%	• The volume of water contracted is sufficient to cover the water needs of the crops	• Water is a gift from God • Restriction of management flexibility • Risk of insufficient volume contracted • Risk of reduced production due to insufficient water
Q3 : Agree to enter into a contract that commits farmers not to exceed a given volume of water	73%	27%		

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Recommandations

Rules and regulations

- Introduce control mechanisms to ensure
  - Payment of water fees
  - Sanctioning illegal wells
- Control the sale of speed controllers. Require certification on the equipment used.
- Limit the volume of water that the farmer is allowed to pump.
- Installation of water meters.
- Require the correct sizing of SP installations: “Proper sizing to prevent the risks of increased water consumption avoiding oversizing”
- Prohibition to extend irrigation area and the introduction of intercropping.

Subsidies

- Condition the subsidy to the introduction of a water management plan. Installing a localized drip irrigation system.
- Condition the subsidy to the existence of a storage system.
- Encourage collective SPIS: granting preferential subsidy rates to farmers wishing to switch from individual to collective pumping.
- Reinforce control inspections after installation to ensure the use of a metering system. Carry out visits to check the authorized volumes, the extension of the irrigated area and the introduction of intercropping.
- Penalize installers that install at illegal wells (withdrawal of certificate, etc.).

R&D

- Create GIS maps to track illegal wells. Use remote sensing for extension and crop pattern control.

- Promote holistic planning for SPIS: links between energy, water and agricultural production.
- Elaborate of a practical guide on the sizing of agricultural SP installations.
- Conduct Nexus audits of large farms to assess impacts on energy, water and agriculture, and improve the sustainability of the farm.

- Introduce digital control tools. Promoting simplified smartphone applications for irrigation management.

- Asses/ compare the impacts of the introduction of solar pumping on climate change mitigation and adaptation.

Capacity Development and Awareness-Raising

- Promote the cooperation between institutions (ANME/APIA)

- Raise awareness for the issue among
  - Installers
  - Farmers
  - Training centers
  - Public agricultural services
  - Civil society

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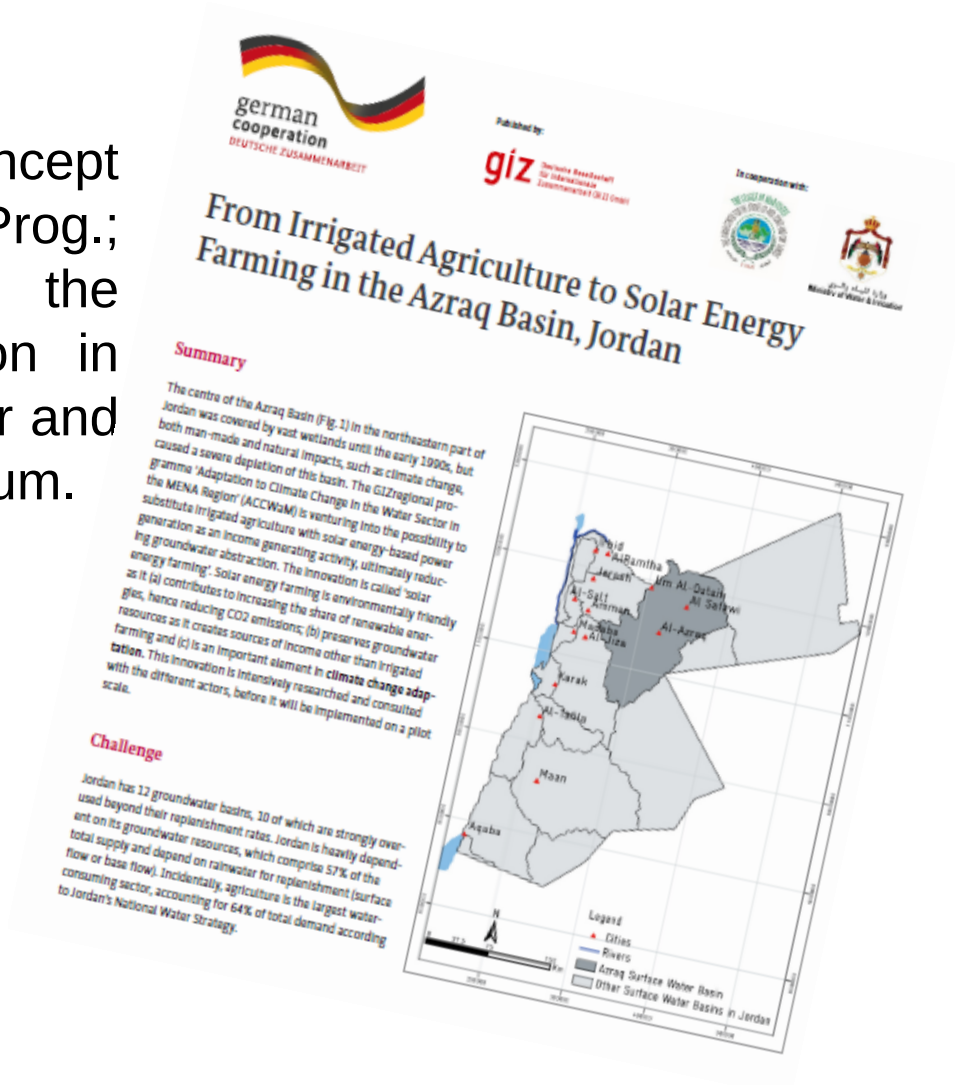
NRD MENA Study: Water-Energy-Food Nexus Assessment of Solar Energy Farming Interactions

The Azraq Case in Jordan with Insights form India

https://www.water-energy-food.org/resources/resources-detail/water-energy-food-nexus-assessment-of-solar-energy-farming-interactions-the-azraq-case-in-jordan-with-insights-from-india/

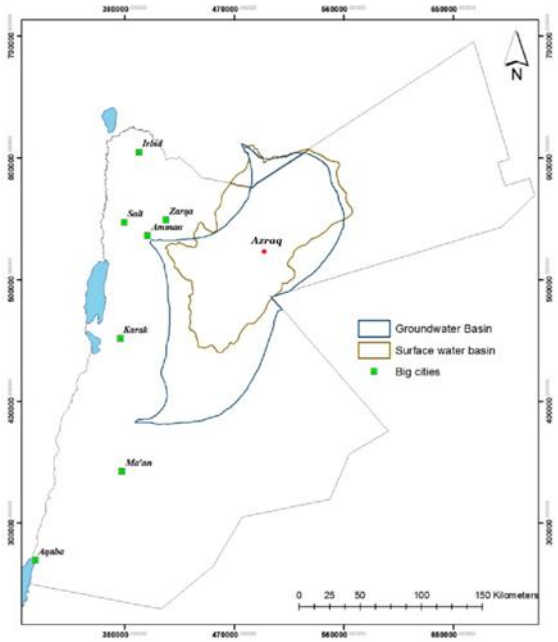
Solar Energy Farming- A Nexus Application in Jordan

The Solar Energy Farming (SEF) concept was initiated by GIZ ACCWaM Prog.; Adaptation to Climate Change in the Water Sector in the MENA Region in cooperation with the Ministry of Water and Irrigation and the Highland Water Forum.



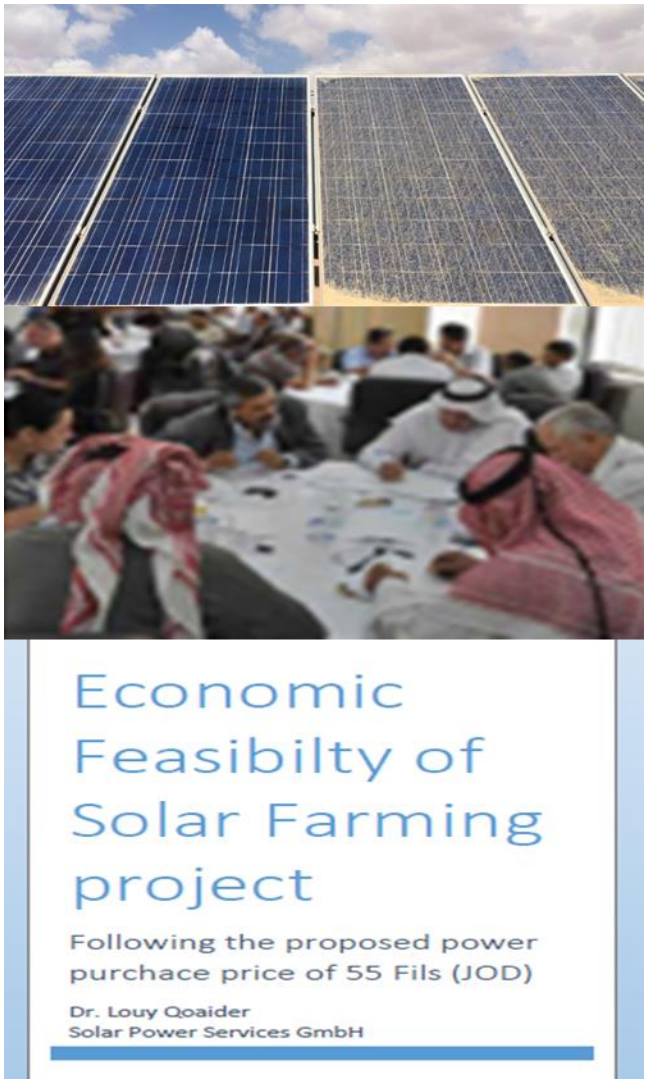
Solar Energy Farming- Rational

- SEF project aimed at reducing the abstraction of ground water resources in Azraq by substituting irrigated agriculture with another source of income; investing in solar energy.
- Severe depletion of this basin- was covered by vast wetlands until the early 1990s.



Solar Energy Farming- ACCWaM Project

- A pilot plant with a size of 200kWp was intended to be built as a showcase to demonstrate the feasibility of solar farming.
- The project was intensively researched and consulted with different stakeholders.
- The project got a cabinet decision to award it an exception (due to its scale) to be executed under the direct proposal scheme.
- A feasibility study was conducted at low power purchase price of 55 Fils (JOD)/KWh.
- The project faced many obstacles and ended up in December 2015 with no implementation.



Objectives of the NRD Study on Solar Energy Farming in Jordan

- Suggesting a model for implementing the Water-Energy-Food Nexus approach in Jordan.
  - Motivating farmers to invest in a solar plant, and generating electricity to be sold to the electricity utility, as an alternative source of income.
  - Preserving groundwater by creating an alternative source of income.
  - Shifting farmers from “being fossil fuel energy consumers (water pumping) to clean energy producers (photovoltaics) and reducing CO2 emissions.
- Analysis of international SEF experiences with a special focus on India.
- Lessons learnt and illustration of options for enhancing SEF in Jordan and the region.



Lessons Learnt

- SPIS could be combined with feed-in tariff. Farmers can make rational decisions about how to use energy and water: selling electricity, rainwater harvesting- post harvesting treatment- cooling- drying.
- Community-based approaches that reorganize farmers as energy cooperatives providing solar energy, irrigation services, and water-use monitoring can achieve a higher level of integration by bundling the required financial and land resources, contributing to better regulation and monitoring.
- The specific dual (solar-agricultural) design of the SEF plant allows for productive land use for agricultural underneath the solar panels, although may increase water use.
- If adequate incentives are not attached, cheap energy raises water use.

Lessons Learnt

- Mini grids with storage options may be suggested where it is impossible to connect all farms using solar mega plants and national grids.
- Net-metering of solar pumps may be financially supported, working like the case of roof-top solar power.
- The high feed-in tariffs represent another form of subsidization. This may promote a wide use of SP especially by marginalized and poor farmers.
- Subsidization through cheap loans by governmental banks might not be enough to encourage farmers due to the high investment costs. Public engagement is needed through special loan programs to increase the access to affordable loans for farmers.

Way Forward

- FOA RNE conducting a study on impacts of SPIS in Egypt.
- Comparative analysis for Tunisia- Morocco- Egypt- policy advice.
- The League of Arab States/ Arab Organization for Agricultural Development- FOA RNE conducting a regional policy dialogue on SPIS.
  - What are the viable business models for SPIS in the MENA region?
  - What types of capacity development programs are needed to support farmers, extension workers, the private sector and others?
  - How can SPIS empower women and promote gender equity?
  - What are the opportunities for knowledge exchange and technology transfer?

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Thank you for your attention!