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# REALIZING THE POTENTIAL AND MANAGING THE RISKS OF SOLAR IRRIGATION IN THE NEAR EAST AND NORTH AFRICA

May 2020

SDGs:



Countries:

Egypt and Tunisia

Project Codes:

TCP/RAB/3604

FAO Contribution:

USD 276 000

Duration:

1 April 2018 – 31 December 2019

Contact Info:

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### Implementing Partners

Ministry of Water Resources and Irrigation, Egypt.  
Ministry of Agriculture, Marine Fisheries and Water Resources, Tunisia.

### Beneficiaries

Decision-makers dealing with solar irrigation in regional organizations; Ministry of Water Resources and Irrigation, Egypt; Ministry of Agriculture, Marine Fisheries and Water Resources, Tunisia; Non-governmental Organizations (NGOs) and civil society organizations (CSOs); banks; SPIS users and service providers; farmer organizations; water user associations; agricultural extension officers and irrigation managers.

### Country Programming Framework (CPF) Outputs

#### *Egypt 2012-2017*

Priority Area B: Improving productivity and efficiency in the agricultural sector, especially Output 2.2. on irrigation modernization.

Priority Area D: Conserving natural resources and adapting to impacts of climate change.

#### *Tunisia 2016-2020*

Priority Area 3: Ensuring sustainable natural resource development and mitigating the impact of climate change.



## BACKGROUND

In recent years, solar irrigation has become increasingly interesting for countries as a reliable, clean-energy solution for agricultural water management, especially in areas with high-incident solar radiation. As investment costs for solar-powered irrigation systems (SPIS) are decreasing, SPIS technologies are becoming a viable option for many farmers. In rural areas, solar irrigation can be a means to ensuring access to energy for agriculture, and possibly for other users in rural areas that lack reliable access to electricity or where diesel fuel is expensive. Some countries are promoting SPIS in the framework of national action plans against climate change, as a way of reducing greenhouse gas (GHG) emissions in agriculture. The conditions for SPIS vary from country to country, in terms of biophysical and climatic suitability, techno-economic feasibility, institutional arrangements, regulations and policy support, financing and economic viability of systems. There is now an opportunity to not simply introduce a clean-energy, climate-smart and relatively affordable technology, but to think strategically about how this technology can be used to regulate groundwater use, provide energy access to rural areas, and promote innovative investment models and organizational structures. Against this background, the project sought to strengthen institutional capacities in two target countries, Egypt and Tunisia, by learning from existing experiences to understand how to promote and regulate the use of SPIS, and fostering policy dialogue across sectors to ensure a coordinated approach to SPIS, with the overall aim of improving natural resources management and encouraging low-emission and climate-smart agriculture; as well as providing training for technical experts to act as multipliers of knowledge.

## IMPACT

The project significantly enhanced the awareness and knowledge of the target countries on the adoption and use of SPIS. This will facilitate the development of a regulatory framework, leading to more secure and reliable access to water, one of the main elements for enhancing productivity and therefore rural livelihoods. In addition, the adoption of SPIS will lead to reduced GHG, thus mitigating the impacts of climate change.



## ACHIEVEMENT OF RESULTS

The project focused on enhancing the awareness and building the capacities of relevant stakeholders on SPIS adoption and implementation, through regional dialogue, knowledge transfer, training activities, the sharing of successful experiences, and the establishment of policy frameworks.

A regional workshop was implemented as a dialogue under the umbrella of the League of Arab States (LAS), and included participation from countries of the Arab region, such as Jordan, Sudan and Yemen, to discuss the benefits and risks of SPIS, and how to best manage them in order to ensure efficiency and inclusiveness in implementing the SPIS framework. A key message that emerged from the regional dialogue was the need to move from policy discussions to identifying effective approaches to boost investment and farm applications of renewable energy for irrigation. The collaboration with *Deutsche Gesellschaft für Internationale Zusammenarbeit* (GIZ) made it possible to expand on this deliverable, through the organization of a regional one-day training workshop on Innovative Financing Modalities for Solar-Powered Irrigation Systems (SPIS) in the Arab Region, as a back-to-back event to the regional dialogue.

Two country assessment reports on SPIS in Egypt and Tunisia were prepared and provided to national project partners; and two national policy reports were developed for the two countries. The original project plan envisaged the development of policy briefs; however, the collaboration with the GIZ enabled the expansion of this output to the production of policy reports with broader scope and deeper analysis. These were prepared in French for Tunisia and in English for Egypt, and were translated into Arabic to serve as case studies in the wider Arab region.

At the request of the national project coordinator (NPC) in Egypt, the project also supported the acquisition of remote monitoring equipment for four sites using solar energy for groundwater irrigation. The installed equipment was integrated in the national water resources monitoring system at the Ministry of Water Resources and Irrigation, and formed a pilot to be expanded in the future plans of the Ministry.

Training materials on SPIS were developed for the two Training of Trainers (ToT) workshops, which were held in Tunisia and Egypt respectively, taking into consideration national conditions and available capacities. The workshops focused on building the capacities of national officials in relation to SPIS framework and technology. Given that SPIS were relatively new in many countries of the region, these workshops aimed at introducing the technology through a structured approach, which reviewed the policies and enabling environment, in addition to the technical aspects of the systems. This included focus discussions on the risk concerning non-renewable groundwater.

In addition, a study tour to India was organized, in the framework of South-South Cooperation, to provide exposure to the Indian experience on SPIS, exchange experiences, and enhance the capacities of the participants. It comprised formal meetings with stakeholders, including officials and experts of international organizations, as well as site visits to projects, and meetings with beneficiary farmers and local implementing agencies.

Additional training workshops were requested by the NPCs in both Egypt and Tunisia, in order to reinforce the technical capacities of staff and to increase awareness among farmers on the options and feasibility of SPIS. To this end, in Tunisia, three subnational (governorate-level) workshops on the SPIS toolkit were organized in Tunis, Medenine and Kairouan, in close collaboration with the GIZ, for a total of 74 participants. In Egypt, three subnational workshops were organized in Beheira, Assiut and El Minia governorates, covering a total of 220 participants (technical staff/engineers and local farmers). The workshops also provided an opportunity for farmers to engage with technical staff of the ministries.





## IMPLEMENTATION OF WORK PLAN

All the planned activities were successfully implemented, and within the planned budget. However, the implementation of the project was delayed by some administrative constraints, thus a six-month no-cost extension was requested and approved, in order to complete project activities.

Two Letters of Agreement (LoAs) were signed with implementation partners, one with the Arab Organization for Agriculture Development (AOAD) and one with the International Commission on Irrigation and Drainage (ICID). However, a delay was encountered in the starting date of the LoA with the AOAD. In addition, some time was spent in discussions with the GIZ to identify synergies between the planned activities of the two organizations. This led to widening the scope of some activities and deliverables, as highlighted above.

Three countries were initially targeted for the project. However, two of the countries withdrew. These were replaced with another country (Tunisia), reducing the number of participating countries to two. Given the reduced number of countries, there was sufficient budget for the implementation of additional activities, including the provision of support to the groundwater monitoring system of the Ministry of Water Resources and Irrigation in Egypt, and the organization of two technical sessions on SPIS in the Cairo Water Week conferences in 2018 and 2019. The technical sessions of the two conferences highlighted the outputs of the project, including the policy dimension of SPIS, and the impacts and risks associated with groundwater management. At the request of the NPC in Tunisia, additional training of engineers of the Ministry of Agriculture, Marine Fisheries and Water Resources on the “Toolbox on Solar-Powered Irrigation Systems” was organized.

## FOLLOW-UP FOR GOVERNMENT ATTENTION

A number of follow-up actions were identified, as outlined below, for which it is recommended that donor funding be sought.

It is advised that further assistance be provided for innovative sustainable financing modalities of SPIS in selected countries, as well as for linking SPIS to sustainable management of groundwater resources, in order to highlight effective approaches to reduce the risk of overabstraction and unsustainable groundwater use. In addition to the intraregional communication that was achieved during the project, the provision of additional technical support in these two areas would form the basis for developing a network to serve as a platform of exchange of experiences and best practices.

It emerged from the two country assessment reports prepared on SPIS in Egypt and Tunisia that it was necessary to enhance awareness of the potential and risk mitigation of SPIS. The assessments also highlighted the need for more capacity-building activities, particularly on the technical elements of the design, operation and maintenance aspects of these systems.

The two national policy reports that were developed for the participating countries emphasized the need for comprehensive regulatory frameworks to guide and manage the expansion of the use of renewable energy for irrigation, within a vision of sustainable use of water resources. It is also recommended that more assistance be provided to the two participating countries to develop action plans on the basis of the policy reports that were prepared. In addition, there is the need for wider intra and interregional collaboration to exchange best practices.

Following the regional dialogue and training workshops, it was highly recommended that investment and finance-related aspects of SPIS be considered in many countries of the region.

Finally, it is recommended that the groups involved in the training workshops be utilized by the two partner ministries in Egypt and Tunisia, to further disseminate the acquired knowledge and initiate a nationwide debate on the role of SPIS in sustainable land and water management.

## SUSTAINABILITY

### 1. Capacity development

The project developed two SPIS assessment studies, two policy reports, one SPIS regional overview report, one regional dialogue report, and capacity-building materials and reports. These deliverables will help countries develop their own framework to support the adoption and implementation of SPIS by relevant stakeholders. The exchange of experiences between countries allowed them to analyse gaps and opportunities in terms of policy framework needed to implement SPIS.

Many national institutions were actively involved in the project activities. In Tunisia, for example, the national institution in charge of energy (National Agency for Energy Management [ANME]) is collaborating with other institutions, depending on their field of intervention, to continue implementing a sustainable framework of SPIS implementation. In Egypt, although the use of renewable energy is officially mandated to the Ministry of Electricity and Renewable Energy, the Ministry of Water Resources and Irrigation, through the support of the project, is looking into SPIS from a water management perspective. This requires enhanced coordination between the two ministries, not only to promote the use of renewable energy, but to do this with a clear scope for enhancing water productivity and farmers' livelihoods.

During the project, various partnerships were established. Close collaboration was achieved between FAO, LAS, GIZ and AOAD, with which discussions to pursue joint activities beyond the project are under way. Moreover, an informal platform for the exchange of experiences between the two water ministries in both Egypt and Tunisia was established.

### 2. Gender equality

The project dedicated a special module titled "Promoting Women's Access and Management of SPIS" in the ToT workshops, to enhance women's position in the implementation of SPIS. In addition, the project sought to maintain gender balance among the participants of the training workshops, as much as possible. Men and women benefited equally from the project activities, both in decision-making and/or capacity building.



### 3. Environmental sustainability

The adoption of SPIS will not only contribute to promoting sustainable agriculture production and supporting rural livelihoods, it will also encourage relevant stakeholders to adopt clean sources of energy, and to participate in the sustainable preservation of the ecosystem. A lower GHG emission footprint of the irrigation sector contributes to environmental sustainability and pollution control. Although the promotion of uncontrolled/unregulated use of SPIS could lead, in particular, to unsustainable use of groundwater resources, the project was designed to highlight the sustainability issue and reflect it at the policy discussion level, e.g. in the two sessions of the Cairo Water Week conferences.

### 4. Human Rights-based Approach (HRBA) – in particular Right to Food and Decent Work

The Human Rights-based Approach was not the overarching criteria in the project design; however, the subject matter of SPIS was very relevant. Without a clear regulatory framework, SPIS could jeopardize the human rights-based approach, by favouring access to water to those who can afford to install the relatively costly equipment; thus, not only threatening the sustainability of water resources, but also creating an equity divide that would harm the poor. The project aimed at highlighting the need for a regulatory frameworks that took into consideration effective governance systems that included appropriate monitoring and enforcement measures, as well as rules and criteria for innovative financing of SPIS systems, to ensure equitable access to financing to the poor.



### 5. Technological sustainability

Solar-powered irrigation and related systems are simple technologies that can be used by a wide range of groups, if local governments adopt adapted frameworks for their implementation. These technologies aim to replace fossil energy exploitation in groundwater pumping and irrigation with solar energy, in countries of the Arab region, where an adequate amount of sunshine is guaranteed.

One of the outputs of the project concerned knowledge transfer to relevant stakeholders, which included the development of SPIS assessment reports and national policy reports, regional overview and policy dialogue on the risks and benefits of SPIS, ToT workshops, and a study tour to India to gain knowledge on similar experiences related to SPIS implementation and innovative financing modalities.

Given that this technology is new for the targeted countries, and for almost all countries in the Arab region, it is recommended that funding be sought to provide further technical assistance for the targeted countries, to continue implementing a suitable SPIS framework for their contexts. These two countries will serve as pilots and models to other countries, for adopting this technology in the future.

### 6. Economic sustainability

In Tunisia, the Ministry of Energy, Mines and Renewable Energies, in cooperation with other specialized institutions, is allocating special incentives for institutions and individuals that adopt solar energy related technologies (photovoltaic and solar panels). These incentives also aim to promote solar energy related technologies entrepreneurship. In Egypt, discussions on the role and commitment of the private sector was initiated during the project, which could result in meaningful structure for private financing of SPIS.

All the training materials and reports were shared with relevant stakeholders and beneficiaries, and are affordable to anyone interested in adopting SPIS technology. At this stage, the project provided analysis framework and training materials to ease the adoption of SPIS by relevant stakeholders. However, in order to enlarge the adoption of this technology, more funds are needed to develop and implement upscaled SPIS-related projects.



### DOCUMENTS AND OUTREACH PRODUCTS

- ❑ SPIS Assessment Report for Tunisia (prepared in French and translated into Arabic). K. Bedoui. November 2018. 67 pp.
- ❑ SPIS Assessment Report for Egypt (prepared in English and translated into Arabic). A. El Saady. June 2019. 93 pp.
- ❑ Tunisia SPIS Policy Report. November 2019. AOAD. 63 pp.
- ❑ Egypt SPIS Policy Report. June 2019. AOAD. 43 pp.
- ❑ Regional Overview Report. December 2019. AOAD and GIZ. 90 pp.
- ❑ SPIS Regional Policy Dialogue Report. December 2019. AOAD. 50 pp.



## ACHIEVEMENT OF RESULTS - LOGICAL FRAMEWORK

Expected Impact	The project will contribute to the promotion of sustainable agriculture production and support rural livelihoods	
Outcome	Improved knowledge, developed capacities and empowered relevant stakeholders in the selected countries to make informed decisions about how to adopt, promote and regulate the use of SPIS	
	Indicators	<ol style="list-style-type: none"> <li>1. Number of SPIS-related activities to foster regional exchange of experiences and knowledge transfer as a result of FAO support.</li> <li>2. Number of countries provided with support for the design, monitoring and implementation of approaches, policies and interventions that promote equitable access to and sustainable management of SPIS technology as a result of FAO support.</li> <li>3. Number of stakeholders (those involved in finance, design and management) trained in the SPIS technology as a result of FAO support.</li> </ol>
	Baseline	<ol style="list-style-type: none"> <li>1. 0</li> <li>2. 0</li> <li>3. 0</li> </ol>
	End Target	<ol style="list-style-type: none"> <li>1. Two country assessment reports prepared, translated into Arabic and shared with the relevant institutions of the two participating countries (Egypt and Tunisia). Three countries were initially targeted for the project. However, two of these countries withdrew, and were replaced with another country. Thus, the number of participating countries was reduced to two.</li> <li>2. Two national policy briefs developed; one regional workshop conducted.</li> <li>3. Study tour conducted; training materials on SPIS developed; series of training workshops conducted.</li> </ol>
	Comments and follow-up action to be taken	<ol style="list-style-type: none"> <li>1. Two country assessment reports on SPIS in Egypt and Tunisia were prepared and provided to national project partners. It is recommended that donor funding be sought to provide further assistance on innovative sustainable financing modalities of SPIS in selected countries; as well as on linking SPIS to sustainable management of groundwater resources, in order to highlight effective approaches to reduce the risk of overabstraction and unsustainable groundwater use. In addition to the intraregional communication that was achieved during the project, the provision of additional technical support in these two areas would form the basis for developing a network to serve as a platform of exchange of experiences and best practices.</li> <li>2. Two national policy reports developed for Tunisia and Egypt; and one regional workshop conducted. Although the original project plan envisaged the development of policy briefs, the collaboration with the GIZ enabled the expansion of this output to the production of policy reports with broader scope and deeper analysis. The reports were prepared in French for Tunisia and in English for Egypt, and were translated into Arabic to serve as case studies in the wider Arab region. The regional workshop was implemented as a dialogue under the umbrella of the LAS, and included participation from additional countries, such as Jordan, Sudan and Yemen. In addition, a one-day regional training on innovative financing approaches for SPIS was organized back-to-back with the regional dialogue. Both the policy reports and the regional dialogue were implemented through an LoA with the AOAD. On request from the NPC in Egypt, the project also supported the acquisition of remote monitoring equipment for four sites using solar energy for groundwater irrigation. The installed equipment was integrated within the national water resources monitoring system at the Ministry of Water Resources and Irrigation, and forms a pilot to be expanded in the future plans of the ministry. It is recommended that funding be sought to provide more assistance to the two participating countries, to develop action plans on the basis of the policy reports that were prepared during the project.</li> <li>3. A study tour to India was organized for the two NPCs, within the framework of South-South Cooperation (implemented through an LoA with the ICID). Training materials on SPIS were developed for the two ToT workshops held in Tunisia and Egypt respectively. The two-day workshop in Tunisia targeted 30 officials from the Ministry of Agriculture, Marine Fisheries and Water Resources and affiliated institutions at the governorate level. In Egypt, the two-day workshop was attended by 33 officials from the Ministry of Agriculture, the Ministry of Water Resources and Irrigation, the Ministry of Higher Education and Scientific Research, and the National Research Centre. Both workshops were organized in coordination with the GIZ and implemented through an LoA with the AOAD.</li> </ol>

<b>Expected Impact</b>	<b>The project will contribute to the promotion of sustainable agriculture production and support rural livelihoods</b>		
<b>Outcome</b>	Improved knowledge, developed capacities and empowered relevant stakeholders in the selected countries to make informed decisions about how to adopt, promote and regulate the use of SPIS		
	<b>Comments and follow-up action to be taken</b>	Additional training workshops were requested by the NPCs in both participating countries. The aim of the workshops was to reinforce the technical capacities of staff and to increase awareness among farmers on the options and feasibility of SPIS. The workshops also provided farmers with the opportunity to engage with technical staff of the ministries. No specific follow-up action is required. However, it is recommended that the groups involved in the training workshops be utilized by the two partner ministries in Egypt and Tunisia, to further disseminate the acquired knowledge and initiate a nationwide debate on the role of SPIS in sustainable land and water management.	
<b>Output 1</b>	Develop a coordinated approach to promoting, financing and regulating the use of SPIS		
	<b>Indicators</b>	<b>Target</b>	<b>Achieved</b>
	A regional policy dialogue to discuss the risks and benefits of SPIS, and how to best manage those risks.	One regional policy dialogue to discuss the risks and benefits of SPIS, and how to best manage those risks	Yes
<b>Baseline</b>	0		
<b>Comments</b>	A regional policy dialogue was organized in Cairo under the auspices of the LAS, and was attended by participants from countries of the Arab region to discuss the benefits and risks of SPIS, and how to best manage them in order to ensure efficiency and inclusiveness in implementing an SPIS framework. A key message that emerged from the regional dialogue was the need to move from policy discussions to identifying effective approaches to boost investment and farm applications of renewable energy for irrigation. An effective regulatory framework, however, needs to be in place to mitigate the risks of unsustainable use of water resources, particularly concerning groundwater. Collaboration with the GIZ made it possible to expand on this deliverable by organizing a regional one-day training workshop on Innovative Financing Modalities for Solar Powered Irrigation Systems (SPIS) in the Arab region, as a back-to-back event to the regional dialogue. The theme and scope of the training was selected in coordination with LAS, AOAD, GIZ and the two NPCs in Egypt and Tunisia.		
<b>Activity 1.1</b>	<b>Country Assessment Reports.</b> Assessing potential for SPIS (in terms of suitability, technical feasibility and enabling environment) and identifying risks		
	<b>Achieved</b>	Yes	
	<b>Comments</b>	Two country assessment reports on SPIS in Tunisia and Egypt were prepared. A follow-up action formulated after the achievement of this activity was the need for wider awareness of the potential and risk mitigation for SPIS. In addition, the assessments highlighted the need for more capacity-building activities, particularly on the technical elements of design, operation and maintenance aspects of these systems.	
<b>Activity 1.2</b>	<b>National policy briefs.</b> Elaborating policy options for the promotion and/or regulation of SPIS		
	<b>Achieved</b>	Yes	
	<b>Comments</b>	As mentioned above, two national policy reports were developed for Egypt and Tunisia. The reports highlighted the need for comprehensive regulatory frameworks to guide and manage expansion of the use of renewable energy for irrigation, within a vision of sustainable use of water resources. A follow up action formulated after the achievement of this activity was the need for wider intra and interregional collaboration to exchange best practices.	
<b>Activity 1.3</b>	<b>Regional Policy Dialogue.</b> Facilitating dialogue to identify ways to finance and regulate SPIS use		
	<b>Achieved</b>	Yes	
	<b>Comments</b>	One regional dialogue workshop was conducted. As indicated above, the workshop was complemented by a back-to-back one-day regional training workshop on innovative financing of SPIS in the Arab region. During the dialogue and training workshops, it was highlighted that the role and commitment of the private sector (through various incentive/disincentive systems) needed to be incorporated within an overall national regulatory framework. A follow-up action formulated after the achievement of this activity was the importance of considering investment and finance-related aspects of SPIS in many countries of the region.	



<b>Output 2</b>	In-country capacities of technical and financial advisory staff on how to promote, finance, design, set up and manage SPIS, as well as on how to cope with risks are strengthened		
	Indicators	Target	Achieved
	Number of training sessions and study tour.	Two national training workshops and one study tour.	Yes
<b>Baseline</b>	0		
<b>Comments</b>	Two national training sessions, one in Egypt and one in Tunisia, were conducted. In addition, one study tour to India was organized, in the framework of South-South Cooperation, to exchange experiences and enhance the capacities of the participants (two NPCs and the FAO regional water officer) related to SPIS policy and technology frameworks.		
<b>Activity 2.1</b>	<b>Study tour to highlight good practices, gain insights into how the potential of SPIS is realized</b>		
	<b>Achieved</b>	Yes	
	<b>Comments</b>	The study tour was organized through an LoA with the ICID to provide exposure to the Indian experience on SPIS. It comprised formal meetings with stakeholders, including officials and experts of international organizations; as well as important site visits to projects and meetings with beneficiary farmers and local implementing agencies. The underlying driving factors for SPIS are mostly country and site-specific. It was realized that the socio-economic context for the subsidy system for SPIS in India is different from that of Egypt or Tunisia; thus, in order to achieve similar results to those achieved by India, actions would need to adapt the proposals and measures to local conditions. In addition, it would be necessary to perform in-depth analysis of the suitability of the overarching national and possibly local social, economic and political settings. Another element refers to the commitment of all stakeholders, including that of the private sector. Conducive policies, not necessarily connected to water and agriculture, are usually the drivers for private-sector participation.	
<b>Activity 2.2</b>	<b>Training Material. Deepening and mainstreaming former activities at expert level</b>		
	<b>Achieved</b>	Yes	
	<b>Comments</b>	Training materials for the ToT workshops were developed, taking into consideration national conditions and available capacities. This was done in close consultation with national project partners and in coordination with the GIZ.	
<b>Activity 2.3</b>	<b>Training workshops. Deepening and mainstreaming former activities at expert level</b>		
	<b>Achieved</b>	Yes	
	<b>Comments</b>	Two national training workshops were conducted, one in Egypt and one in Tunisia, to build the capacities of national officials related to SPIS framework and technology. Given that SPIS were relatively new in many countries of the region, these workshops aimed at introducing the technology through a structured approach, which reviewed the policies and enabling environment, in addition to the technical aspects of the systems. This included focus discussions on the risk concerning non-renewable groundwater. Additional training workshops were requested by the NPCs in both Egypt and Tunisia. In Tunisia, three subnational workshops on the SPIS toolkit were organized at governorate level in Tunis, Medenine and Kairouan, in close collaboration with the GIZ, for a total of 74 participants. In Egypt, three subnational workshops were organized in Beheira, Assiut and El Minia governorates, covering a total of 220 participants (technical staff/engineers and local farmers). The workshops provided an opportunity for farmers to engage with technical staff of the ministries. The aim of the workshops was to reinforce the technical capacities of the staff and to increase awareness among the farmers on the options and feasibility of SPIS.	

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