FACTSHEET 6

Solar Power and the Water-Energy-Food Nexus

SESA
Smart Energy Solutions for Africa

Figure 1: **Solar Powered Pump** (Getty Images / Toa55)

About the Sustainable Energy Solutions Catalogue

The Sustainable Energy Solutions Catalogue provides an introduction to the solutions deployed during the SESA project. The catalogue targets energy practitioners, policy makers and civil society, especially at local level. In the catalogue, readers can find key facts about specific sustainable energy solutions (technologies, business models, impact areas), or learn about approaches and concepts that help ensure the viability and long-term success of sustainable energy in the African context.

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1 Introduction

Promoting the transition to clean and affordable energy for all in Africa requires understanding the relationship between energy, water, and food resources. Climate change is resulting in increased water stress and shorter growing seasons in agricultural systems across Africa, an increase in aridity, and water-related extreme climate events such as droughts (IPCC, 2022). This is exacerbated by an increase in the share of population facing food insecurity, which affected nearly one in four people in 2021 (FAO et al., 2022).

The Water-Energy-Food (WEF) Nexus concept offers a framework that can help to reduce trade-offs and increase synergies in securing the goals of energy, water and food security (Terrapon-Pfaff et al., 2018; Srigiri and Dombrowsky, 2021). Electricity from decentralised solar is a cost-effective solution to meeting energy needs and also plays a central role in achieving the goals of the WEF Nexus. This factsheet presents how different solar power solutions can effectively address the WEF Nexus, and gives examples of how this is already happening in the African context.

2 The technology

Some of the key solar-powered technologies that can boost water and food security include solar water pumps and irrigation systems, agrivoltaics, and water filtering and purification systems. Internet and communication technologies (ICT) and Internet-of-Things (IoT) can also support the efficient use of water in agriculture. These technologies are described here in turn. For further examples of WEF Nexus solutions, including food storage and processing, see also the Factsheet on solar power for productive use, in this catalogue.

2.1 Solar-powered water pumping and irrigation

Solar-powered irrigation systems (SPIS) consist of PV panels on a mounting structure that are connected to a controller unit that runs an electric pump. The pumped water can be either directed to a water storage reservoir or to an irrigation system. Before it flows into the irrigation system, the water can be filtered or mixed with fertiliser (Figure 1).

For SPIS to adequately address the WEF Nexus, it is crucial that they are coupled with sustainable irrigation practices. This requires solid knowledge of the farming practices, the water demand of different crops, and the water availability patterns (Energypedia, 2020). These factors strongly impact the type of SPIS that can be used in a specific field or farm.

2.2 Agrivoltaics

Agrivoltaic systems are an excellent example of the use of solar technologies in the context of the WEF Nexus. In an agrivoltaic system, crops are grown underneath solar panels. The mounted PV panels provide shade and reduce water evaporation, therefore leading to lower irrigation requirements (Figure 2). Additionally, the PV arrays can be used as rainwater channels for irrigation (Ersoy et al., 2021). The electricity generated can be used for multiple purposes, such as powering the water pumping and irrigation, cold storage or processing.

Agrivoltaic systems have the potential to increase agricultural productivity and generate clean energy while reducing competition for agricultural land. Falling costs of photovoltaic systems are making agrivoltaic systems more viable economically, with particular potential in arid and semi-arid regions (Fraunhofer ISE 2020). In the African context, agrivoltaic systems are being currently piloted in Mali, Gambia and Kenya (see Examples boxes).

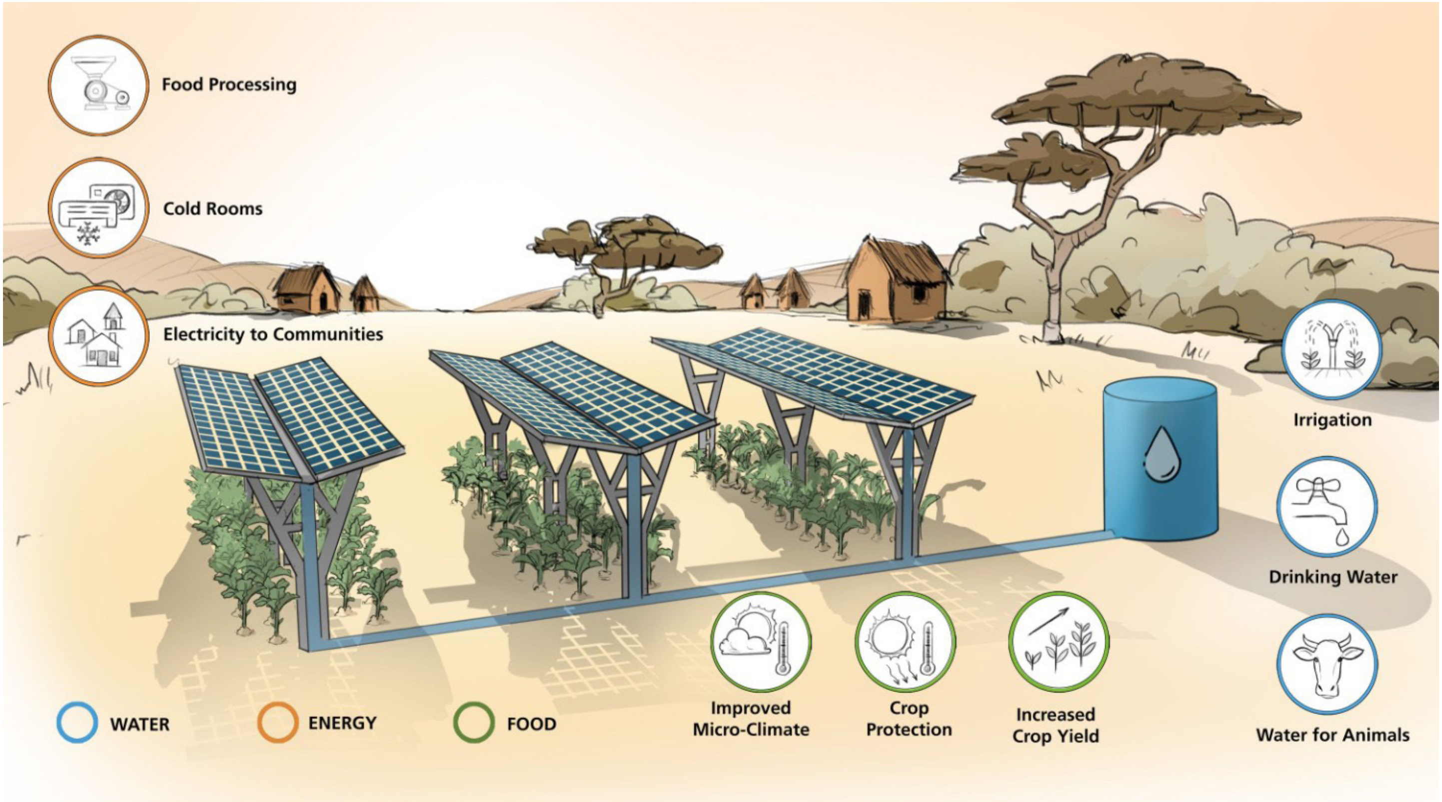

Figure 2: **Schematic diagram of a solar agrivoltaics system** (Fraunhofer ISE 2020)

2.3 Solar water treatment

Generating safe drinking water for households or livestock, or treating saline groundwater so that it is suitable for irrigation, is another area where solar technologies can help address the WEF Nexus. Small-scale and mobile solar water treatment systems can be advantageous in remote and rural areas that are not connected to the grid (Figure 3).

Solar power can drive electrochemical water treatment processes such as electrocoagulation and reverse osmosis, where the electricity powers pumps that push water through semiporous membranes. Water treatment technologies can also use solar energy for heating, or solar ultraviolet light (EPCM, 2022).

Hydropanels are an innovative solar-powered water treatment technology. They take in ambient air via fans and collect water vapor from it, which they transfer onto a material that can absorb moisture. The hydropanel then converts the vapor collected into safe liquid water, which is then mineralised by adding magnesium and calcium (Kart, 2022).

Lastly, desalinating sea or saline borehole water holds potential in areas where groundwater is saline. While water desalination usually takes place in large-scale facilities, there are also examples of solar-powered decentralised desalination units in Africa (Nzuki and Elliott, 2022).

2.3 ICT and IoT in the WEF Nexus

Remote monitoring or Internet of Things (IoT) platforms are increasingly available for the management of the water cycle in agriculture. For water efficient management of SPIS, for example, soil sensors and small weather stations can analyse data and provide users with rain forecasts and best irrigation timing advice on their mobile devices, or they can automatically disable a farmer's pump and notify them if their well runs dry (GOGLA, 2019). For water treatment facilities, communication technologies and data analysis can enhance the effective use of water, fertilisers and nutrients.

Examples of application in the African context — 1

Watermed 4.0, Miliana (Algeria)

The idea: Management of whole water cycle in agriculture through smart technologies.

The business model:
- Solar PV
- Decision support system based on IoT

The business model:
- Pilot research project (universities and research institutions involved)

The impact:
- Increased water use efficiency for agriculture and food processing
- Enhancement of export potential

For further information visit:
→ www.watermed-project.eu

Figure 3: **OffGridBox unit delivering clean water** (OffGridBox, 2022)

3 Business and financing models

A business model that considers all three sectors (energy, water, and food) at the same time has, potentially, a higher return than one that considers them individually. Based on an analysis of 20 rural electrification projects in Sub-Saharan Africa (SSA), projects that provided electricity together with other WEF Nexus-related services were found to be more financially sustainable than those providing only electricity (Aresti et al., 2019). However, despite the potential for attracting different streams of investment, truly integrated WEF Nexus-oriented business models in Africa remain a niche (Dalton et al., 2019). Financing geared towards entrepreneurs in this space is still rare (see, for example, the financing from the WE4F Grand Challenge (WE4F, 2022)). A number of programmes are supporting African entrepreneurs in building the WEF Nexus into their business models (ENI CBC Med, 2021).

3.1 Consumer financing and affordability

Like other business models for solar solutions, nexus-oriented models need to address the challenge of affordability, in particular, when they are geared towards smallholder farmers. Solar systems are more affordable than conventional diesel-powered systems over their whole lifetime. For example, when replacing diesel-powered irrigation systems, solar water pumps lead to fuel cost savings, and are overall 35% cheaper than the diesel system. However, the solar system has a comparatively higher upfront cost.

Approaches to overcome the affordability challenge include joint ownership models, the service-provider model, or the incentive to multiple use of the system. Different consumer-financing models, such as pay-as-you-go (PAYGO) and micro-finance, can also be used to facilitate the initial investment in a solar system. For example, the Senegalese company Bonergie offers several consumer-financing models to overcome the affordability challenge, among them the “Asset Protection Mode” module integrated into the pump, which allows customers to pay a self-selected amount (see Example box). For more details on financing models, please consult the Factsheet on productive use of solar energy in this catalogue.

3.2 Partnerships and synergies

On top of the affordability challenge, solar energy business models that embrace the link between water, energy and food systems have a higher level of complexity: they require a strong understanding of the links between different resources and value chains. For example, solar water pump businesses require agronomy and irrigation expertise. For this reason, energy businesses that apply a WEF Nexus approach often partner with other businesses. For example, solar pump providers partner with irrigation equipment providers and other businesses that provide complementary services, including financing solutions (Efficiency for Access, 2019).

Indeed, energy businesses that apply a WEF Nexus approach always need to partner, engage with and/or share data with other businesses or public organisations in the agricultural and water sectors, and broker agreements and compromises, sometimes between competing interests. For example, in agrivoltaic systems, the business model needs to encompass the farm owner and operator (and the landowner, if different) as well as the PV system owner and

Examples of application in the African context 2

Bonergie (Senegal)

The idea: Solar water pumping and irrigation systems.

The technology:
- Integrated solar PV system and irrigation equipment
- ICT and IoT elements to remotely control the pumps

The business model:
- Flexible payment plan, where farmers make a partial down payment and pay the balance in monthly instalments within 18 months
- Customers can select the amount to pay at the frequency of their choice, e.g. whenever income is generated. Bonergie sends a code to the customer for the number of days paid. When the code expires, the pump stops working.

The impact:
- Increased irrigation efficiency and protection of groundwater resources from over extraction
- Diversification of crop harvest throughout the year, expansion of seasonal growing cycles
- Increased incomes, reduced energy costs in the long-term

For further information visit:
→ https://bonergie.com

operator (Fraunhofer ISE 2020). In jointly owned solar water pumps, there needs to be an agreement among the owners on the sharing of the water resource, not just the pump (Gebrezgabher et al., 2021; IRENA and FAO, 2021).

Finally, nexus-oriented business models in the agricultural sector share many features with productive use business models: they revolve around the development of local skills and local businesses, the building of access to markets, and a strong engagement with the communities involved.

It is important to remember that business models are always context-specific and need to be based on a strong understanding of local needs. In the case of nexus-oriented businesses, it is key to identify their impacts, trade-offs, investment opportunities and business synergies.

4 Socio-economic and sustainability impacts

Solar energy solutions implemented under a WEF Nexus approach can deliver a range of health, economic, environmental and inclusion-related benefits.

Solar-powered irrigation is one of the best studied solutions in terms of impacts on livelihoods of smallholder farmers. Providing access to modern irrigation can have a significant impact on agricultural yields. In fact, some case studies show that yields can increase as much as two- to three-fold (Efficiency for Access, 2019). The impact of irrigation is higher when accompanied by other support such as access to markets. When replacing diesel-powered irrigation systems, SPISs lead to fuel cost savings, by making the solar water pump system 35% cheaper than the diesel system.

Impacts of SPIS on livelihoods go beyond increases in yield or income. When coupled with drip irrigation, SPISs are proven to significantly increase nutritional intake, particularly during the dry season (Burney et al., 2010). An increase of the quality and availability of food and a decrease in food imports has also been observed (RES4Africa, 2019).

Despite their potential benefits, SPIS are also a perfect example of the potential risks of solar solutions when the WEF Nexus is not taken into account. Experience in India and Morocco has shown that SPIS can lead to groundwater depletion if not properly designed (Beaton et al., 2019; Gupta, 2019). To reduce this risk, there need to be incentives for the farmers to irrigate efficiently. Potential solutions to mitigate the risk of overextraction include making water-table data available to solar water pump companies and smallholder farmers, smart metering on pumps that tracks water usage and allows pre-set pump operation times, encouraging pump sharing, and rigorous water accounting to regulate groundwater use (Efficiency for Access, 2019).

Other solar solutions that consider the WEF Nexus approach can also lead to positive socio-economic and sustainability impacts. For example, solar water treatment systems can lead to significant improvements in health and reduce the time required to collect water (WeTu, 2022). Agrivoltaic systems have the potential to reduce competition for agricultural land while increasing agricultural productivity and generating clean energy. This is particularly important for improving resilience to climate change.

Figure 4: **Rows of crops under solar irrigation system** (Bonergy, InfraCo, 2022 / Audy Valera)

5 Scaling-up

Delivering access to energy, while ensuring the security of water and food resources, lies at the heart of development goals in Africa. This is of particular importance in rural regions, which rely predominantly on agriculture. There are currently 500 million rural dwellers in Sub-Saharan Africa (SSA), and these are set to become more than 900 million by 2050. More than two-thirds of rural dwellers in SSA currently have no access to electricity (crucial for crop irrigation, processing, and storage) and the majority of cropland is rainfed only, resulting in reduced and unstable yields (Falchetta et al., 2022; Mumssen, 2022).

In order to scale up the deployment of solar solutions that embrace a WEF Nexus approach, a variety of levers are needed, including policy, appropriate business and financing models, technology and product adaptation, and partnerships among various stakeholders.

High-level political support for and ownership of the WEF Nexus is the first step to integrating it into public policy and planning. This needs to be coupled with a continuous dialogue among different institutions and stakeholders, and a build-up of institutional capacity and knowledge that can support decisions. For example, efforts are currently underway to institutionalise the WEF Nexus in the Southern Africa region. This includes integrating the concept into national economic plans, as well as into the specific energy, water, agriculture, rural development, nutrition, industry and climate strategies.

Solar-water pumps are, once again, a good example of how policy efforts can support the scale-up of the WEF Nexus approach. In India, a mapping of policies promoting off-grid solar pumps indicated a potential to increase their effectiveness by taking into account the WEF Nexus. In particular, they found that solar pump programmes could lead to savings from subsidy expenditure on electricity and diesel (Beaton et al., 2019).

Finally, mobilising large investments for nexus-focused solar solutions is key to scale up. Sometimes, this may not only be a case of increasing existing financial resources, but also of redirecting them so that they take into account the links across the energy, water and food sectors. Financing institutions and governments can provide funds, blended finance, soft loans, and other incentives to private developers that apply the principles of the WEF Nexus in their projects and business plans. Subsidies for the agricultural sector and for solar power are a particular area where nexus-oriented financing opportunities can be leveraged.

Examples of application in the African context 3

Water Kiosk (Kenya)

The idea: Solar water desalination systems delivering safe drinking, irrigation, fish farm and sanitation water from saline and polluted water resources for off-grid communities around Africa.

The technology:
- Solar PV

The business model:
- Payments are done when water is collected from Kiosk

The impact:
- Reduced time use for water collection
- Job creation
- Additional services, e.g., community WiFi
- Potential for additional value-added business around the Water Kiosk's infrastructure

For further information visit:
→ https://waterkiosk.africa

6 Solar Power and the WEF Nexus in SESA

Implemented in nine African countries, the EU-funded SESA project is developing and testing solutions to accelerate the energy transition in Africa. The focus of the project is on the exploration of innovative technologies and services in urban and rural contexts. SESA partners in various countries are working on solar solutions within a Water-Food-Energy Nexus framework. Their activities are briefly outlined below.

6.1 Kenya Living Lab

SESA partner WeTu is developing innovative solutions within the WEF Nexus as part of the SESA Kenya Living Lab. The main objective in this Living Lab is to demonstrate sustainable energy access solutions that are relevant for both urban and rural contexts in Africa, centred around solar PV off-grid electricity generation for multiple uses, e-waste management, and integration of local Info Spots for digital access to information on energy, climate change and digital skills. The Living Lab comprises two project sites: Kisegi, a rural village in Homa Bay County, and Katito, a peri-urban community in Kisumu County.

WeTu deploys a solution to pump and purify drinking water. The water purification system is designed for the treatment of surface water from Lake Victoria combined with rainwater (Kisegi site, ultra-filtration unit), or for underground water from a borehole (Katito site, reverse osmosis). In the Katito site, WeTu uses a solar power to pump water from a 150-meter-deep borehole. This water is then stored in water storage tanks, filtered, and pumped again into elevated tanks. The obtained clean drinking water can be purchased through a water ATM (Figure 5).

WeTu also offers solar-powered night fishing lanterns for night fishing, which enable more effective fishing of omena fish, a vital food source in the Lake Victoria region (Figure 6). This also increases income for fishers and reduces reliance on traditional energy sources such as batteries or kerosene lamps.

Figure 5: **Water ATMs run by WeTu** (WeTu, 2023)

7 Climate-proofing

Climate proofing is a term that refers to the process of mainstreaming climate change into mitigation and/or adaptation strategies and programmes (Climate Policy Info Hub, 2022). The goal of climate proofing is to ensure that climate-related risks and opportunities are integrated into the design, operation, and management of products and infrastructure. In order to achieve that, projects have to be screened for climate risks, vulnerabilities and opportunities early in the design stages.

The increased demand for freshwater, energy and food driven by demographic and economic changes in many African countries, coupled with the effects of climate change, is projected to deepen current water and food insecurity, and lead to severe economic and environmental impacts. Applying a WEF Nexus approach is a climate change adaptation measure itself, enhancing resilience to climate change in agricultural and energy systems. For instance, solar powered water pumps, coupled with efficient water management, have the potential to expand seasonal growing cycles and mitigate periods of low or irregular rainfall. This can make farmers more resilient to droughts or changing rainfall patterns (Efficiency for Access, 2019).

For more information on climate proofing of sustainable energy along the WEF Nexus, see also the factsheet 'Productive use of Solar Energy', in this catalogue.

Figure 6: **Solar powered night fishing lantern on a WeTu designed float** (WeTu, 2023)

8 Relevant tools and capacity building materials

WEF Nexus Discovery Map

Data visualization tool and research repository to support project development that embraces the WEF Nexus, e.g., identify project locations, find country-wide WEF indices. New projects can be added.
→ www.water-energy-food.org//resources/tool-wef-nexus-discovery-map

Toolbox on Solar Powered Irrigation Systems (SPIS)

Offers essential information and tools for the implementation of SPIS, including calculation sheets, checklists and guidelines, e-learnings and tutorial videos for practitioners who advise SPIS end-users, financiers, or policymakers. The toolbox also contains guidance on water management and governance, markets, financing, design and maintenance of irrigation systems. It can also be downloaded as an app.
→ https://energypedia.info/wiki/Toolbox_on_SPIS

World Bank: Solar Pumping Handbook

Handbook on solar pumping including an introduction to pumps and their components, guidance for choosing the right system and locating it, or information on typical water consumption of crops and livestock.
→ https://documents.worldbank.org/en/publication/documents-reports/documentdetail/880931517231654485/solar-pumping-the-basics

Water and Energy for Food (WE4F) Portal

Gathers information about clean energy, water- and energy-efficient technologies to enhance agricultural production and value. The portal provides information on sustainable energy and water use along the whole value chain, including guidance on policies, financing and business models.
→ https://energypedia.info/wiki/Portal:Water_and_Energy_for_Food

Solar Pumping Toolkit

Offers guidance on solar pumping, including site assessment, technical design and tender, installation and operation, maintenance, monitoring and evaluation.
→ https://energypedia.info/wiki/Solar_Pumping_Toolkit_-_The_Global_Solar_%26_Water_Initiative

Interactive map “Potential for Solar Photovoltaic Based Irrigation”

Online interactive tool to assess land in SSA that is suitable for solar irrigation. A map with search criteria identifies suitable regions, based on the quality of solar radiation. The parameters to modify include regions, water source (ground or surface water) and pump capacity.
→ http://sip.africa.iwmi.org

WEF Nexus in Africa Initiative

The Water-Energy-Food Initiative is a network of academic, public, and private sector institutions addressing the scientific, social, environmental, and engineering challenges at the WEF Nexus. The purpose is to provide technical knowledge for local solutions through public-private partnerships. In addition to relevant publications the website provides information on webinars.
→ https://wefnexus.org

9 Bibliography

Aresti, M., Barclay, A., Cherubini, P., Dubois, O., Eveillé, F., Fioriti, D., Gambino, V., Gertig, C., González García, A., Micangeli, A., Shehata, J., Stritzke, S., Tacconelli, C., Traini, L., Trotter, P., van den Berg, L., Volk, T., 2019. Re-thinking: access to energy business models: ways to walk the water-energy-food nexus talk in Sub-Saharan Africa. (Accessed Nov 16, 2022). https://wefnexus.org/2020/02/res4africa-wef-nexus-publication

Beaton, C., Jain, P., Govindan, M., Garg, V., Murali, R., Roy, D., Bassi, A., Pallaske, G., 2019. Mapping Policy for Solar Irrigation Across the Water–Energy–Food (WEF) Nexus in India. The International Institute for Sustainable Development. (Accessed Nov 16, 2022). www.iisd.org/system/files/publications/solar-irrigation-across-wef-nexus-india.pdf

Burney, J., Woltering, L., Burke, M., Pasternak, D., 2010. Solar-powered drip irrigation enhances food security in the Sudano–Sahel, Proceedings of the National Academy of Sciences, 107(5), 1848–1853. https://doi.org/10.1073/pnas.0909678107

Dalton, J., Welling, R., Meyer, K., Koundouno, J., Carreno Lindelien, M., Riddell, P. J., 2019. Increasing returns on investment opportunities by applying a nexus approach - Best practice nexus case studies. IUCN. (Accessed Nov 16, 2022). https://portals.iucn.org/library/sites/library/files/documents/2019-047-En.pdf

Efficiency for Access, 2019. Solar Water Pump Outlook 2019: Global Trends and Market Opportunities. (Accessed Nov 16, 2022). https://efficiencyforaccess.org/publications/solar-water-pump-outlook-2019-global-trends-and-market-opportunities

Energypedia, 2020. SPIS Toolbox - Solar Powered Irrigation Systems. (Accessed Nov 16, 2022). https://energypedia.info/wiki/SPIS_Toolbox_-_Solar_-_powered_Irrigation_Systems

ENI CBC Med, 2021. NEX-LABS training for Entrepreneurs and SMEs on business models for solutions in Water, Energy and Food sectors. (Accessed Nov 16, 2022) www.enicbcmed.eu/nex-labs-training-entrepreneurs-and-smes-business-models-solutions-water-energy-and-food-sectors

EPCM, 2022. Solar powered rain water harvesting system - EPCM Holdings. (Accessed Nov 16, 2022). https://epcmholdings.com/solar-powered-rain-water-harvesting-system

Ersoy, S.R., Terrapon-Pfaff, J., Ribber, L., Merrouni, A. A., 2021. Water Scenarios Modelling for Renewable Energy Development in Southern Morocco. Journal of Sustainable Development of Energy, Water and Environment Systems, 9(1), 1–28. https://doi.org/10.13044/j.sdewes.d8.0335

Falchetta, G., Adeleke, A., Awais, M., Byers, E., Copinschi, P., Duby, S., Hughes, A., Ireland, G., Riahi, K., Rukera-Tabaro, S., Semeria, F., Shendrikova, D., Stevanato, N., Troost, A., Tuninetti, M., Vinca, A., Zulu, A., Hafner, M., 2022. A renewable energy-centred research agenda for planning and financing Nexus development objectives in rural sub-Saharan Africa. Energy Strategy Reviews, 43, 100922. https://doi.org/10.1016/j.esr.2022.100922

FAO, IFAD, UNICEF, WFP, WHO, 2022. The State of Food Security and Nutrition in the World 2022 https://doi.org/10.4060/cc0639en

Fraunhofer ISE, 2020. APV-MaGa – Agri-Photovoltaik für Mali und Gambia: Nachhaltige Stromproduktion durch integrierte Nahrungsmittel-, Energie- und Wassersysteme. (Accessed Nov 16, 2022). www.ise.fraunhofer.de/de/forschungsprojekte/apv-maga.html

Gebrezgabher, S., Leh, M., Merrey, D. J., Kodua,T. T., Schmitter, P., 2021. Solar Photovoltaic Technology for Small-scale Irrigation in Ghana: Suitability Mapping and Business Models. (Accessed Nov 16, 2022). www.iwmi.cgiar.org/publications/iwmi-research-reports/iwmi-research-report-178

GOGLA, 2019. How solar water pumps are pushing sustainable irrigation. (Accessed Nov 16, 2022). www.gogla.org/about-us/blogs/how-solar-water-pumps-are-pushing-sustainable-irrigation

Gupta, E., 2019. The impact of solar water pumps on energy-water-food nexus: Evidence from Rajasthan. Energy Policy, 129, 598–609. https://doi.org/10.1016/j.enpol.2019.02.008

IPCC, 2022. Sixth Assessment Report - Regional fact sheet - Africa. (Accessed Nov 16, 2022). www.ipcc.ch/report/ar6/wg1/downloads/factsheets/IPCC_AR6_WGI_Regional_Fact_Sheet_Africa.pdf

IRENA and FAO, 2021. Renewable energy for agri-food systems – Towards the Sustainable Development Goals and the Paris agreement.
https://doi.org/10.4060/cb7433en

Kart, J., 2022. Solar-Powered SOURCE Hydropanels Can Produce Up To 5 Liters Of Drinking Water Per Day. Forbes. (Accessed Nov 16, 2022).
www.forbes.com/sites/jeffkart/2022/01/13/solar-powered-source-hydropanels-can-produce-up-to-5-liters-of-drinking-water-per-day/?sh=698546997cdd

Mumssen, Y.U., 2022. Bold action needed for a water-secure Africa. (Accessed Nov 16, 2022).
https://blogs.worldbank.org/water/bold-action-needed-water-secure-africa

Nzuki, R. and Elliott, E., 2022. Officially open: Clean water transforming community lives in Kitui County, Kenya. SNV. (Accessed Nov 16, 2022).
https://snv.org/update/officially-open-clean-water-transforming-community-lives-kitui-county-kenya

OffGridBox (2022)
www.offgridbox.com

RES4Africa, 2019. Applying the Water-Energy-Food Nexus Approach to Catalyse Transformational Change in Africa. (Accessed Nov 16, 2022).
www.res4med.org/wp-content/uploads/2019/07/RES4Africa-Applying-the-water-energy-food-nexus-approach-to-catalyse-transformational-change-in-Africa.pdf

Srigiri, S.R. and Dombrowsky, I., 2021. Governance of the Water- Energy-Food Nexus for an Integrated Implementation of the 2030 Agenda - Conceptual and Methodological Framework for Analysis. Deutsches Institut für Entwicklungspolitik. (Accessed Nov 16, 2022).
https://uploads.water-energy-food.org/resources/DP_2.2021.pdf

Sub Sahara Farmers Journal, 2022. Northern farmers in Ghana adopt solar-powered irrigation system. (Accessed Nov 16, 2022).
https://subsaharafarming.com/northern-farmers-in-ghana-adopt-solar-powered-irrigation-system

Terrapon-Pfaff, J., Ortiz, W., Dienst, C., Gröne M., 2018. Energising the WEF nexus to enhance sustainable development at local level. Journal of Environmental Management, 223, pp. 409–416.
https://doi.org/10.1016/j.jenvman.2018.06.037

Watermed 4.0 Project, 2022. Objectives. (Accessed Nov 18, 2022).
www.watermed-project.eu

WeTu, 2022. WeWater. (Accessed Nov 28, 2022).
https://wetu.co.ke/wewater

World Bank, 2018. Solar pumping: the basics. World Bank. (Accessed Nov 16, 2022).
https://documents1.worldbank.org/curated/en/880931517231654485/pdf/123018-WP-P159391-PUBLIC.pdf

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