Solar Irrigation

CCARDESA
Centre for Coordination of Agricultural Research and Development for Southern Africa

Technical Brief 22

Solar irrigation systems utilise solar energy to pump water to fields and distribute it through drip irrigation or other systems. Solar irrigation is a low-emission agricultural technology that replaces fossil fuel irrigation pumps reducing greenhouse gas emissions. This approach has the potential to reduce energy costs for irrigation and provide energy independence in rural areas. It provides opportunities to increase productivity by shifting from rainfed to irrigated agriculture in some areas. Solar irrigation systems require intensive management and regular monitoring to ensure the sustainable use of water resources. It requires maintenance of solar panels and irrigation equipment but can quickly yield a positive return on investment. Solar irrigation can be implemented for crop irrigation and livestock watering schemes and can improve food security, produce high value crops for sale, reduce energy costs and drive rural development. Although an expensive technology, solar irrigation can introduce significant operational savings if managed and maintained appropriately. It is considered a climate smart option as it can increase productivity, enable farms to adapt t climate changes and improve resilience, and the use of solar power reduces the use of on-grid, or diesel generator power, reducing emissions.

MOST SUITABLE AGRO-ECOLOGICAL CONDITIONS

Value chain

- Maize
- Sorghum
- Rice
- Livestock
- Other

Soil texture

- Light
- Medium
- Heavy

Climatic zone

- Arid
- Semi-arid
- Sub-humid
- Humid

Water source

- Rainfed
- Partly irrigated
- Irrigated

Annual average rainfall (mm)

- < 250
- 250 - 500
- 500 - 750
- 750 - 1000
- 1000 - 1500
- > 1500

Topography

- Flat to gentle slope (0 – 5 %)
- Moderate to rolling slope (6 – 15 %)
- Hilly slope (16 – 30 %)
- Steep slope (> 30 %)

MOST APPROPRIATE CONDITIONS AND REQUIRED INPUTS

Farming system

Does it require collective action

- Yes
- No

Characteristics

- Subsistence
- Commercial Small
- Commercial Medium
- Commercial Large

Farm size (ha)

- < 2
- 2 to 5
- 5 to 10
- > 10

Mechanisation

- Manual
- Animal
- Mechanised

Human resources

Labour intensity – level of effort

- Low (household)
- Medium (seasonal)
- High (outside labour)

Gender/youth smart (low investment/low labour requirements)

- Yes
- No

Financial resources

Initial investment

- Low
- Medium
- High

Maintenance Costs

- Low
- Medium
- High

Access to finance capital or credit required

- Yes
- No

Enabling Environment

Extension support

- Yes
- No

Access to inputs

- Yes
- No

Market access

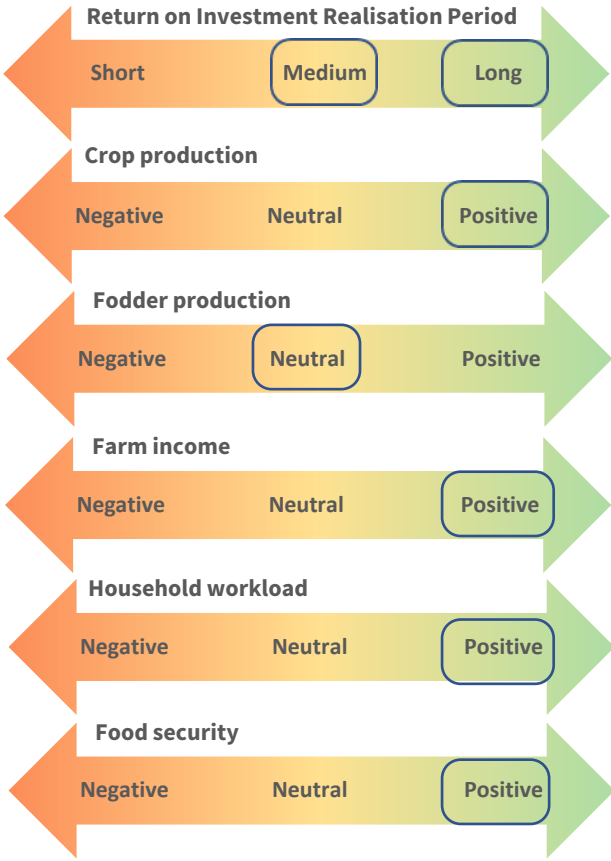
- Yes
- No

The purpose of this technical brief is to guide where this **practice, technology or strategy** could be applied. It may be applicable in other circumstances, but this brief focuses on where it is possibly **most suitable**. Content is general, and should be contextualised depending upon locality. The brief provides an overview, details of appropriate agroecological characteristics, appropriate conditions and inputs, possible outcomes and impacts, how the **practice, technology or strategy** should be applied, potential benefits and drawbacks, and provides suggestions for further reading in terms of CCARDESA materials and other sources, including those used to develop this technical brief.

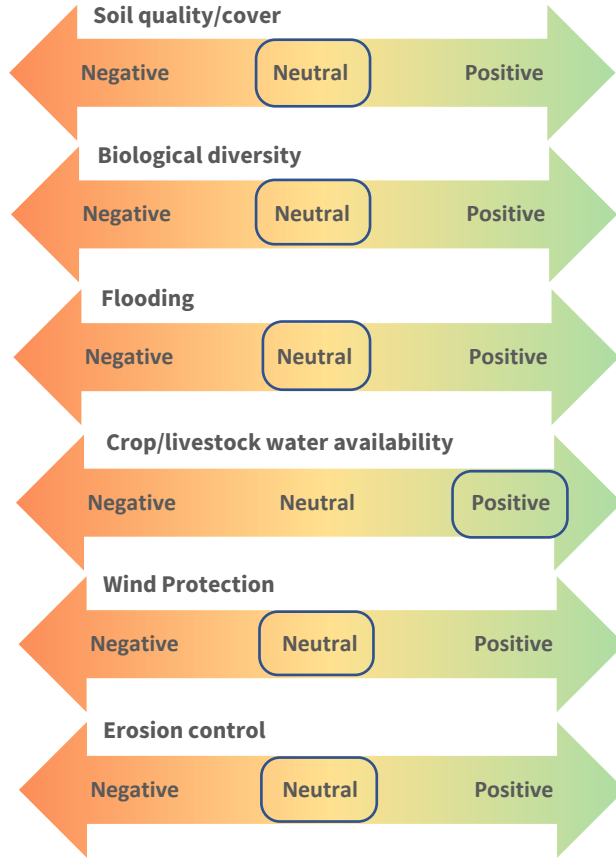
*CCARDESA is a subsidiary of SADC, coordinating and harmonising agricultural research and development in Southern Africa. This **Technical Brief** is part of a series of materials designed to support **Knowledge Products on climate smart agriculture** available here: www.ccardesa.org/saaiks-knowledge-hub*

POSSIBLE IMPACT/OUTCOMES

Socio-Economic Impacts Positive or Negative



Ecological Impacts Positive or Negative



These descriptors indicate whether the practice, technology or strategy has a positive, neutral , or negative impact or outcome
Those with no box are deemed not-applicable

TECHNICAL APPLICATION

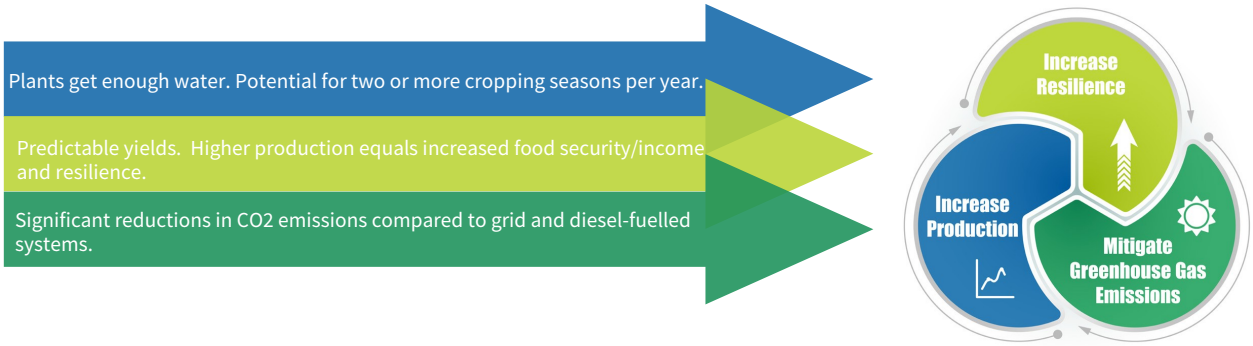
To effectively implement solar irrigation:

- **Step 1:** To determine the solar pump system Crop water requirements, location, water sources etc. Do required research. Is water sourced from an above ground or below ground source?
- **Step 2:** Source required materials to implement a solar irrigation system from regional or international suppliers including:
  - Photovoltaic (PV) panels to generate electricity (80-300 W system depending on context);
  - a structure to mount the panels;
  - a pump controller;
  - a surface or submersible water pump; and
  - a distribution system or storage tank for water.
- **Step 3:** Identify funding sources as initial costs, as well as maintenance costs, must be considered and modelled prior to purchasing a system. There are regional and international solar irrigation producers. These costs differ dramatically given the complexity of the context, starting at costs approximately USD $2,400 for equipment only. If drilling is necessary the cost increases significantly depending on depth, substrate etc. Community-based investment, micro-leasing and rental services can be possible funding models to explore.
- **Step 4:** Determine whether there is sufficient solar irradiation for the proposed area – consult and specialist; and/or the national meteorological service.
- **Step 5:** Identify area suitable to install solar panels. The area should be easily accessible, and all trees/bush should be cleared. To determine most appropriate site and angle of panels, etc, consult an expert.
- **Step 6:** The availability of technical expertise must be considered before implementation to ensure that any technical issues do not result in long period of service disruption.

Maintenance costs and expertise should be considered before installing solar irrigation systems. A detailed cost benefit analysis is advisable. Other key technical considerations include: Legal permits to extract water from the source as water extraction may impact community watershed levels.

CLIMATE SMART AGRICULTURE OUTCOME(S)

Reflecting how this **practice, technology or strategy** contributes to Climate Smart Agriculture outcomes



SUMMARY/KEY ISSUES

Benefits

- Energy independence will introduce significant cost savings for farmers
- Solar powered irrigation can significantly boost productivity, due to increased ability to sustainably irrigate crops
- Consistent irrigation can help to mitigate climate impacts, and aid adaptation
- Reduces operational costs for diesel or on-grid power to pump water
- Reduces greenhouse gas emissions.

Drawbacks

- Solar irrigation is expensive to implement and there are costs for maintenance. Therefore, savings or access to credit will be required.
- Access to solar equipment, spares and parts, and the transportation of the above may be complicated and/or expensive.
- Over and above cost and access technology, other issues such as access to land and water sources are important factors.

REFERENCE MATERIAL

CCARDESA Related Content

- CCARDESA, 2019. Knowledge Product 10, Decision Tool: Climate Smart Water Management Options for Maize & Sorghum. Gaborone, Botswana
- CCARDESA, 2019. Knowledge Product 11, Decision Tool: Climate Smart Water Management Options for Rice. Gaborone, Botswana
- CCARDESA, 2019. Technical Brief 64, Flood Irrigation. Gaborone, Botswana

Additional Information

- The Food and Agriculture Organisation (FAO), 2018. Water Scarcity Initiative (WSI), Solar Powered Water Lifting for Irrigation in the Nile Delta, Egypt. Rome, Italy.
- The Food and Agriculture Organisation (FAO), 2018. Solar–Powered Irrigation Systems: A clean – energy, low – emission option for irrigation development and modernisation. Rome, Italy.
- The Food and Agriculture Organisation (FAO), 2018. The benefits and risks of solar-powered irrigation – a global overview. Rome, Italy.

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