

Expanding Water Access through Solar Pump Solutions

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World Food
Programme



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01 Solar Pump System

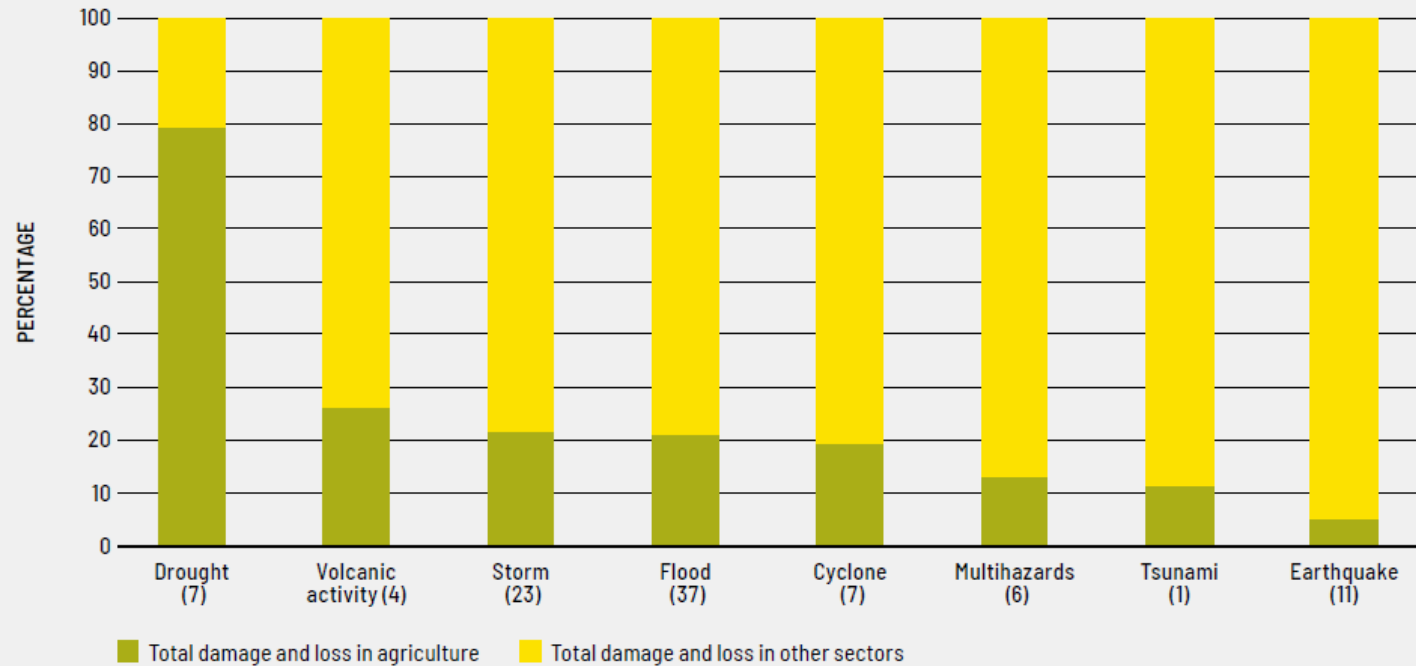
FAO

The Impact of
Disasters on
Agriculture and Food
Security 2025

– *Digital solutions for
reducing risks and impacts*

FIGURE 6

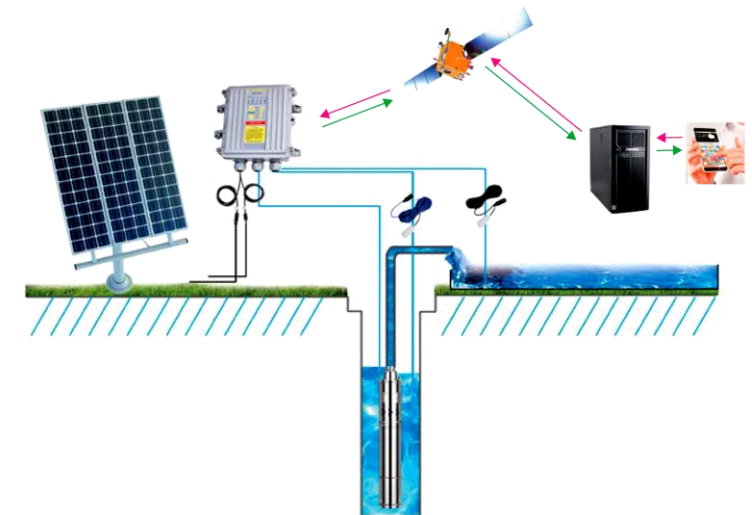
ECONOMIC LOSS IN AGRICULTURE
AND NON-AGRICULTURAL SECTORS
BY HAZARD TYPE (SHARE)



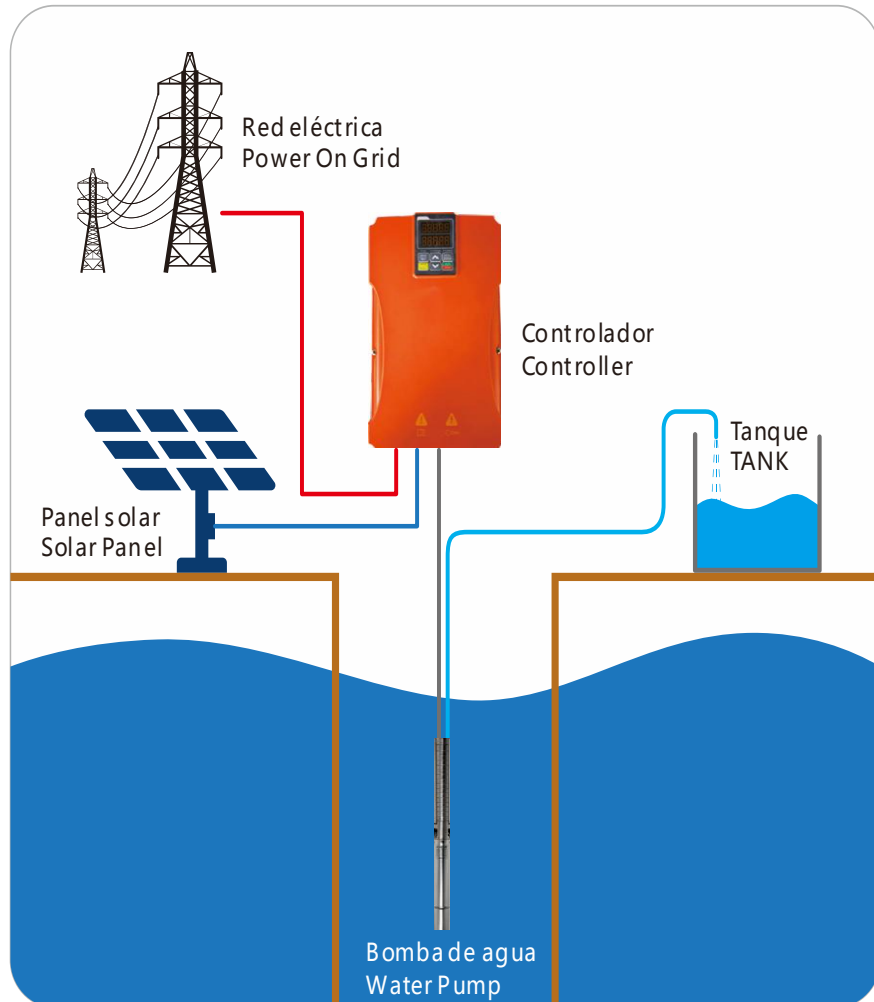
Note: See Annex 1 for the methodology. Numbers in brackets represent the total number of recorded events for each hazard type.
Source: Authors' own elaboration based on data derived from PDNAs.

01 Solar Pump System

- ☀️ Sunlight → DC Power: PV arrays convert sunlight into DC power via the photovoltaic effect
- ⚙️ Power Regulation & Optimization: MPPT controller tracks the maximum power point in real-time, dynamically adapts to light changes, and auto-adjusts voltage/current, boosting efficiency by 10%-30%.
- 💧 Powering the Pump: DC system directly drives brushless pumps (energy-efficient). for large-scale water needs.



01 Solar Pump System



Direct Drive Mode (No Battery Storage: Using Water Storage as Energy Storage)

Features: No battery storage. Pump operation relies entirely on real-time sunlight. Higher light intensity means higher output; low light means shutdown.

Advantages: Low system cost and simple structure.

Applicable Scenarios: Situations with low demand for continuous water supply, such as farmland irrigation.



Energy Storage Buffer Mode (With Energy Storage)

Features: Equipped with batteries to store excess energy generated during the day for use at night or on cloudy days.

Advantages: Enables 24-hour stable water supply with high reliability.

Applicable Scenarios: Situations requiring high reliability, such as domestic water supply and livestock watering.

01 Solar Pump System



15%

Energy Utilization Up
AI-driven
Optimization



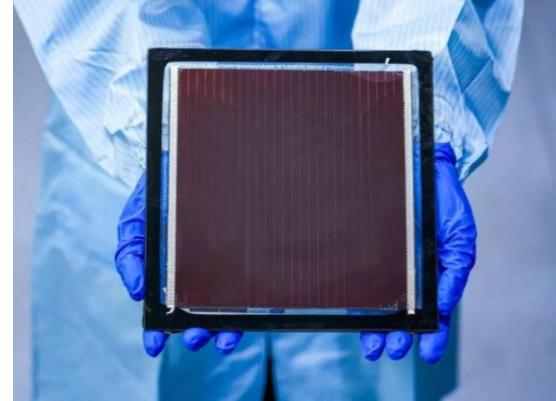
AI-driven Predictive Maintenance: Monitors equipment status via sensors to predict potential failures, reducing failure rates by 40%.



Intelligent Control & Optimization: Develops optimal pumping plans based on weather forecasts and soil moisture, improving energy utilization by 15%.



Remote Monitoring & Management: Enables unmanned operation and refined management via mobile APP or cloud platform.



+25%

Power Generation Jump
New Material
Empowerment



Next-Generation PV Technology: Perovskite solar cells and bifacial PV modules are being gradually applied to improve power generation efficiency.



High-Efficiency Motors & Drives: Permanent Magnet Synchronous Motors (PMSM) and Silicon Carbide (SiC) inverters make systems more efficient and compact.

02 Application Scenarios



Agriculture is the primary application for solar water pumps and irrigation accounts for 58% of the market share.



Cost Reduction & Efficiency

Breaks dependence on diesel and the grid, significantly lowering irrigation costs. A 50-acre vineyard in Spain reduced energy costs by 60% after switching to a 5kW solar pump system.



Increased Yield

Ensures stable water supply during dry seasons, enabling multiple harvests per year and significantly improving crop yield and quality.



Precision Irrigation

Can be combined with drip and sprinkler irrigation for intelligent, precise watering, increasing water use efficiency by over 22.9%.

02 Application Scenarios



Water Supply in Rural and Remote Areas

 Scenarios: Villages, schools, hospitals, border posts, etc.

Value: Provides convenient, clean drinking water, improves livelihoods, reduces waterborne diseases, and enhances public health. A PV water supply project in Chuxiong, Yunnan, China, solved the drinking water problem for 3,433 people in the town.



Livestock Water Supply

 Scenarios: Large ranches, family farms.

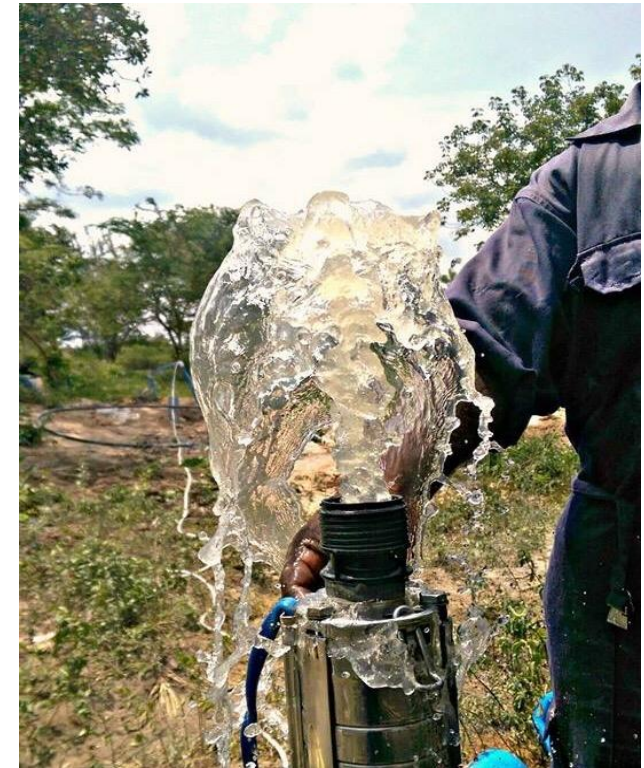
Value: Ensures livestock health; adequate water is key for growth and milk production. In Kenya, Africa, solar pumps have tripled pasture yield and increased livestock survival rates by 40%.

02 Application Conditions

- Site Irradiation Threshold Standard: The annual average peak sunshine hours at the site ≥ 4 h / day, The daily average solar irradiation ≥ 4 kWh/m².
- Groundwater Survey & Drilling Feasibility: Conduct geophysical exploration first to identify aquifers; confirm drillable locations and deploy suitable well drilling equipment. Deep wells in Africa are commonly 50–250 meters deep.
- Matching by Water Source Type:
 - Deep well water intake: Multi-stage stainless steel submersible pumps are adopted (the mainstream solution for rural water supply).
 - Surface water (rivers / lakes): Shallow centrifugal pumps are used. The sediment concentration of water source must be below the threshold; otherwise, pre-filter devices shall be installed.
- PV Array Foundation Requirements: The site shall be leveled and hardened with concrete bases for support brackets to resist sand dust and strong winds.



02 Application Cases



Solar Pump System in UGANDA

PV ARRAY: 330W*4PCS FLOW: 4.0m³/hr

02 Application Cases



Irrigation Solution in Sri Lanka

PV ARRAY: 300W*6PCS FLOW: 3.3m³/hr

02 Application Cases



Livestock Drinking Water in Sri Lanka

PV ARRAY: 350W*4PCS FLOW: 6.0m³/hr

03 Advantages and Significance



Traditional diesel pumps rely on fossil fuels, with rising fuel costs, significant exhaust emissions, noise pollution, and high long-term maintenance costs.

01 Plummeting Operating Costs

Solar: Near-zero lifecycle operating costs (free sunlight)
Diesel: High fuel expenses (continuous diesel purchase)

► 70-90% reduction in operating costs

02 Green & Zero-Carbon Experience

Solar: Zero emissions, quiet operation
Diesel: Air pollution, loud mechanical noise

► Clean & eco-friendly, protects health

03 Long Lifespan & Low Maintenance

Solar: 15-25 years lifespan, only PV cleaning
Diesel: 5-8 years lifespan, frequent oil/filter changes

► Higher asset value, stable long-term returns

04 Smart & Hassle-Free Management

Solar: Auto start/stop, no personnel needed
Diesel: Manual operation, real-time fuel monitoring

► Saves labor, improves management efficiency



Case Study: Indian farmer Rajesh Patel reduced irrigation costs by 82% after switching to solar, freeing himself from fuel costs and achieving low-cost, high-efficiency agriculture.

03 Advantages and Significance



Transforming Water-Scarce Regions



Social Significance

Improving Livelihoods: Ends the hardship of water collection, saves time for women and children, and improves public health. **Promoting Gender Equality:** Frees women from the arduous labor of water collection.



Economic Significance

Activating Local Economy: Empowers agricultural production, develops high-value crops, and increases farmers' income. **Creating Jobs:** Spawns green industries such as installation and maintenance.



Environmental Significance

Promoting Sustainable Development: Replaces diesel generators, reducing carbon emissions and environmental pollution. **Enhancing Climate Resilience:** Provides a buffer against droughts and energy crises.

04 Challenges and Countermeasures



01 Economic & Financial Barriers

- High Initial Investment: The primary barrier.
- Lack of Accessible Financing: Weak financial infrastructure in rural areas.



02 Technical & Perceptual Barriers

- Lack of Technical Awareness: Limited understanding and trust.
- Unprofessional Installation: Leads to inefficiency or malfunctions.
- Lack of Maintenance: Shortage of technicians in remote areas.



03 Environmental & Management Challenges

- The "Paradox of Solar Irrigation": Risk of groundwater over-extraction.
- Environmental Sensitivity: Dust and weather affect lifespan.



04 Policy & Market Barriers

- Unstable Subsidy Policies: Affect market confidence.
- Lack of Unified Standards: Uneven product quality.

04 Challenges and Countermeasures



Innovation in Business Models

Lowering User Barriers

Promote PAYG leasing and "Energy-as-a-Service" models to ease upfront investment pressure. Integrate carbon credit trading and green finance tools to reinvest ecological value into projects, creating a win-win business loop for economy and ecology.



Supply Chain Localization & Synergy

Local Roots, Agile Response

Establish regional assembly centers and smart spare parts warehouses in core markets to shorten delivery and maintenance cycles. Partner with local entities to cultivate technical talent, achieving deep localization from equipment supply to technical empowerment.



Sustainable Water Resource Integration

Eco-Centric, Systematic Governance

Incorporate solar water pumping into the Integrated Water Resource Management (IWRM) framework, linking agricultural irrigation, ecological water replenishment and community water supply. Empower efficient water allocation and recycling with technology for economic and ecological sustainability.

Core Vision: Lower barriers through innovation, ensure delivery via local roots, and achieve long-term value through ecological synergy. Build a sustainable ecosystem in solar water utilities, making green technology truly serve and benefit the people.

Thank You!



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