

Harnessing the Sun: Mobile Solar Trailers for Resilient Farming Communities

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The Agricultural Research Council – Natural Resources and Engineering is continuously exploring and promoting sustainable technologies to enhance climate resilience and support smallholder farmers. For many small-scale and emerging farmers, especially in remote or grid-unreliable areas, powering water pumps remains a significant challenge. Limited access to reliable electricity, rising fuel costs, and dependence on diesel-powered systems often constrain irrigation, livestock watering, and daily farming operations. As a result, productivity may decline, operational costs

may increase, and farming communities can become more vulnerable to drought and climate-related disruptions.

Mobile solar power trailers present an innovative, off-grid solution to this enduring problem. Support from the Department of Agriculture LandCare Programme, which focuses on the sustainable management and rehabilitation of natural resources, drives implementation of technologies like the mobile solar trailer. These trailers align with the LandCare programme's core objectives by enabling off-grid, solar-powered



Figure 1 A mobile solar-powered system that supports on-farm water abstraction.

water abstraction for irrigation and livestock without degrading the environment. Using the trailers to replace diesel-powered pumps eliminates greenhouse gas emissions, noise pollution, and soil contamination from fuel spills, contributing to cleaner air and healthier ecosystems.

Understanding Mobile Solar Trailers

A mobile solar trailer is a compact, towable unit that integrates solar panels, energy storage, pumping equipment, and water delivery into a single system. The units are designed to be rugged and easily movable around a farm. A typical system, as illustrated in Figure 1, features a single-axle trailer equipped with multiple solar panels, a submersible pump, a controller, batteries for energy storage, and connected water pipes. One of the main advantages of the system is the quick on-site setup, which requires no complex installation or connection to the national grid.

How Mobile Solar Trailers Support Farm Operations

The primary application of these trailers is to provide a self-sufficient water supply for:

- **Groundwater-fed irrigation:** They provide power to submersible pumps that draw water from boreholes for irrigating crops or backyard gardens. This is particularly helpful for maintaining food production during dry spells.
- **Livestock watering:** For livestock farmers, the trailers provide consistent access to clean water, which is vital for animal health and productivity. Because the system is mounted on a trailer, it can be used at different watering points across the farm.
- **Supplemental water supply:** The system can also function as a backup during power outages or as a power source in areas that are not connected to the grid at all.

Mobile solar-powered trailers have a diverse range of applications around the farm. They are especially useful for farmers with multiple boreholes or those who intend to increase their borehole count in future, since their mobility eliminates the need for multiple power sources.

Why Mobile Solar Trailers Matter for Small-Scale Farmers

Challenges such as water shortages highlight the vulnerability of small-scale operations. Mobile solar trailers address several constraints that are specific to small-holder farmers:

- **Energy independence:** The systems reduce and can even eliminate reliance on the unstable national grid or expensive diesel generators for water pumping, which leads to improved energy security. Because South Africa experiences elevated levels of solar radiation, it is a well-suited solution for farms in the country.
- **Affordability in the long term:** After the initial investment, the operating costs are near-zero because sunlight is the fuel source. This not only protects farmers from volatile fuel and electricity prices, but it also eliminates the need for refueling, leading to daily energy savings.
- **Low maintenance and operational simplicity:** Designed for durability and equipped with minimal moving parts, these systems require less technical expertise to operate than maintaining a diesel generator. However, users should still receive sufficient training to ensure appropriate hitching and correct travelling speeds under different on- and off-road conditions.
- **Flexibility and mobility:** The trailer can be hitched to a vehicle and moved to where water is needed most, making it a versatile asset for different plots or community shared-use models. It does not need large vehicles like tractors; an adequately powered bakkie should suffice for moving the trailer around the farm. This has the added advantage of not disrupting other farming activities that require use of tractors.

Key Benefits and Practical Considerations

Using solar-powered mobile trailers for farm water abstraction offers several advantages, as they:

- are clean and renewable – use of solar energy reduces the carbon footprint and air pollution associated with other fossil fuel-powered water abstraction methods.

- promote water security – farmers have reliable access to groundwater, an important adaptation to climate variability
- are scalable – the systems can be designed for different needs, from a 500W system for smaller tasks to 1.2kW for more demanding continuous operation.
- provide power storage flexibility – in areas where farms receive sufficient sunlight all year round or on farms that have water storage tanks, the batteries may be omitted from the design. This can reduce the capital cost of the system. Furthermore, the system is flexible enough for the batteries to be added at a later stage, as long as their weight and integration is taken into consideration in the design phases of the trailer.
- are quiet and safe – the systems operate silently with no fire risk from fuel storage. However, caution should be taken to ensure the batteries and wires are properly placed and adequately protected to prevent explosions and fires.



Figure 2 A mobile solar-powered trailer equipped with a submersible pump and piping system for portable water abstraction and irrigation support.

Although there are several advantages associated with mobile solar trailers, there are important factors that need to be taken into consideration as well, such as:

- Initial capital cost – the upfront cost for the trailer, panels, batteries, and pump can be a barrier, which may necessitate supportive financing or grant mechanisms.
- Weather dependence – in some areas, sufficient battery storage will be necessary for continuity since pumping capacity is reduced during cloudy or rainy periods
- Maintenance awareness – while low, components like batteries have a finite lifespan and need eventual replacement. Users require training on system use and care.
- Theft security – as with any valuable farm asset, properly securing the panels and equipment is necessary.

Mobile solar trailers form part of a broader integrated approach to improving agricultural resilience and sustainability. By providing reliable and clean energy for water abstraction, these systems can support agricultural productivity, strengthen livestock management, and improve

household resilience against climate and economic pressures. Their ability to operate independently of the national grid also makes them particularly valuable in remote or underserved farming areas where access to reliable electricity remains limited. In addition, the mobility and flexibility of these systems allow farmers to use a single unit across various locations and applications on the farm, reducing infrastructure requirements and operational costs.

As climate variability and energy challenges continue to affect agricultural production, mobile solar trailers offer a practical and sustainable solution for small-scale and emerging farmers looking for improved water access and greater long-term farming resilience. They are more than a technical innovation — they represent a pathway to resilience, sustainability, and independence for South Africa’s farmers.

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