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Solar power installation for emergency maternal and neonatal care, Nepal

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Solar power for maternal and neonatal care after the Jajarkot earthquake, Nepal

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Abstract

Problem A 6.4-magnitude earthquake struck Jajarkot district in Karnali province, Nepal, on 3 November 2023, disrupting electricity supply at essential birthing centres and health posts. The loss of power disabled baby warmers and heating systems, putting mothers and babies at risk.

Approach WHO Nepal conducted rapid facility assessments across eight municipalities and identified three priority birthing centres with critical power deficits. In partnership with the health ministry and local authorities, WHO identified local vendors to install hybrid 5.45 kW photovoltaic systems within 17 days of contract initiation to ensure continuous, off-grid power supply.

Local setting The three facilities, serving over 7500 people, are located in steep, mountainous terrain. One of the facilities had no grid connection and the two others relied on unreliable seasonal hydropower, which fails during the winter dry season.

Relevant changes In end of December 2023, the hybrid photovoltaic systems were operational, providing 24-hour electricity supply. Baby warmers and room heaters were in continuous use, reducing newborn hypothermia risk. Institutional deliveries increased: Pajaru Kha Health Post recorded five deliveries in two weeks following installation compared with none during the preceding winter period (October–December 2023).

Lessons learnt The installation was facilitated by rapid assessment, early engagement of pre-identified local vendors, and use of existing supply chains and technical capacity. Strong coordination among WHO, the health ministry and local governments enabled timely decision-making. Prior health cluster coordination training, clear governance mechanisms, streamlined approvals and access to emergency funding helped maintain momentum and ensure on-schedule procurement and installation.

Introduction

Nepal is highly vulnerable to natural disasters due to its mountainous terrain and seismically active location.¹ On 3 November 2023, during the Himalayan winter, a 6.4 magnitude earthquake struck Jajarkot district in Karnali province, killing 154 people. The effect was immediate and catastrophic,² with dozens of health facilities either destroyed or rendered nonfunctional, and thousands of people displaced to temporary shelters.³ Within days, the Nepal Ministry of Health and Population requested help from the World Health Organization (WHO) to continue essential health services in the affected districts.

Among the most pressing challenges was the disruption of electricity supply to birthing centres and health posts, rendering neonatal warmers used for preventing hypothermia-related neonatal death nonfunctional.⁴ Although these health facilities occasionally experience poor electricity supply, damage to electric lines further worsened the situation. Furthermore, because their houses were destroyed, mothers and their babies who would normally have been discharged needed to stay at the birthing centres, increasing service demand.

In response to the emergency, the WHO Country Office in Nepal prioritized rapid assessment and response in municipalities with considerably affected birthing services. Systemic power shortages in these municipalities highlighted the need for an alternative sustainable power solution to restore vital maternal and child health services. Here, we describe the lessons learnt from implementing hybrid solar–battery systems to ensure uninterrupted power for neonatal care in three selected health facilities.

Local setting

The health-care system in Nepal is based on a decentralized framework, with primary health care provided at rural health posts and birthing centres, particularly in remote and mountainous provinces.⁵ Jajarkot district, which is located in Nepal's mid-western hills, is among the country's most remote and socioeconomically disadvantaged districts.⁶ The hilly terrain, dispersed settlements and limited road connectivity pose obstacles to health service access. The weak health infrastructure relies on small-scale, run-of-river hydropower schemes or grid connections that regularly fail during the dry season.

All three facilities selected for the intervention had unreliable electricity supply even before the earthquake. The Pajaru Kha Health Post in Chhedegad municipality had never been connected to the national grid, and Limsa Basic Hospital in Berekot and Gharkhakot

primary health care in Junichande relied on seasonal micro-hydropower, which was already unreliable and became almost nonfunctional during winter due to decreased water flow. During power outages, essential equipment, such as baby warmers and room heaters, failed to operate, putting mothers and newborns at risk.⁷ Health workers resorted to using hot water bottles and warm clothing to maintain newborn body temperature during these outages.

Approach

The intervention drew on WHO's experience of procuring and installing a 150 kW on-grid photovoltaic system at Province Hospital Surkhet in Karnali province,⁸ where local solar vendors had already been identified and engaged, enabling rapid needs assessment, procurement and installation.

During the second week of November 2023, the WHO Nepal Health Emergency Programme conducted a quick survey (approximately 5–7 days) of Jajarkot's eight municipalities to determine service disruption and infrastructure damage caused by the earthquake. In consultation with the local governments, the assessment team identified three high-priority birthing centres where electricity shortages were a critical bottleneck for maternal and neonatal services. The selected facilities included the Limsa Basic Hospital in Berekot, the Pajaru Kha Health Post in Chhedegad and the Gharkhakot primary health-care centre in Junichande. Based on the assessment and guided by WHO's *Health emergency and disaster risk management framework*,⁹ which promotes sustainable, context-specific and resilient solutions in emergencies, the WHO Country Office prioritized a context-appropriate solar energy solution. The WHO Country Office deemed this solution to be a feasible, sustainable and rapidly deployable option to ensure continuity of essential health-care functions for these three facilities. Through coordination, local, provincial and federal government authorities validated the selected solution.

WHO also facilitated coordination with the Provincial Health Emergency Operations Centre¹⁰ and health cluster partners,¹¹ by supporting a needs communication process. Power shortages identified at health posts were reported to the municipality level and escalated through provincial and federal levels before validated requests were communicated to WHO. This approach ensured validation of priorities, avoided duplication and aligned the intervention with broader earthquake recovery efforts for essential maternal and neonatal services.

The hybrid photovoltaic solar system was jointly selected by the Ministry of Social Development in Karnali province, health ministry and the WHO Country Office, because of its suitability for remote off-grid sites.¹² Each facility received a 5.45-kW system containing battery storage with a capacity of more than 24 hours. Procurement was conducted by the WHO Country Office through a competitive request-for-quotation process involving three local vendors; submitted quotations were evaluated and the most technically compliant and responsive vendor was selected to supply, transport and install the systems. The selected vendor completed all installations within 17 days of contract initiation, in accordance with the timelines specified in the procurement requirements. WHO personnel supervised the installation and verified compliance with safety and performance standards. To simplify facility management and ensure continued system functionality, the WHO Country Office included a three-year, no-cost maintenance arrangement with the selected vendors as a part of the procurement package.

To ensure local ownership, WHO collaborated with municipal authorities, health facility management and the health ministry to conduct staff orientation on system operation, basic energy management, routine maintenance practices and troubleshooting, with emphasis on prioritizing power for essential maternal and neonatal services. Community sensitization activities included informing patients at consultations about the improved availability of reliable electricity, its role in safe deliveries and newborn care and encouraged timely care-seeking and shared responsibility for safeguarding the solar power systems.

Following installation, WHO technical staff conducted monitoring visits to each facility to assess solar system functionality, verify performance through functional testing, and provide supportive supervision. These visits included on-site inspection of the photovoltaic and battery systems, discussions with facility staff members on system use, and reviews of solar power integration into routine service delivery.

Relevant changes

Within days of the solar system installations, previously nonfunctional baby warmers were in full use and provided thermal protection for newborns. Measured voltage output and the uninterrupted operation of essential equipment, including baby warmers, confirmed that power supply was sufficient for the intended purpose. Through regular monitoring, the WHO team confirmed continued system functionality and appropriate use of electricity for priority health services, in line with the staff orientation and without overloading the systems. As of December 2025, the health facilities had not reported any power-related interruptions.

Health workers from all three health facilities reported improved working conditions, more reliable lighting for night deliveries and improved working motivation due to the consistent supply of electricity. They also reported, along with patients, that the information on electricity availability was reinforced during routine patient interactions, helping to raise community awareness of the facility's improved service readiness and its ability to provide uninterrupted maternal and emergency care.

The intervention reached a catchment population of over 7576 people. Pajaru Kha Health Post recorded five deliveries within two weeks post-installation compared with none during the preceding winter period (October–December 2023). By December 2025, the primary health-care centre in Gharkhakot had reported 90 births, Pajaru health post had recorded 89 births and the Basic Hospital at Limsa had reported 278 births since the installation, illustrating continuity of service provision.

Lessons learnt

These experiences show how local and renewable energy solutions can ensure continuity of essential services during emergencies and, in parallel, increase health system resilience in underserved, disaster-prone communities. The main lesson learnt from the intervention is that a stable power supply directly enables the continuous functioning of essential clinical services (Box 1). The off-grid solar and battery system was a rapid, sustainable intervention that operated reliably through the winter and addressed seasonal hydropower outages in a resource-poor, disaster-affected environment.

Key facilitators for a swift implementation were rapid evaluation and involving pre-identified local solar vendors and service providers to support expedited procurement, transportation and installation using existing local supply chains and technical capacity. Close coordination between WHO Country Office, the health ministry and rural municipality governments enabled decision-making and resource mobilization in a timely manner. Previous health cluster coordination training for officials involved in health emergency operations, coordination and response planning, proved valuable, as approvals, procurement and installation were completed according to schedule. Implementation records showed that strong institutional leadership and established governance mechanisms, including streamlined approvals, access to emergency funding and clear technical guidance, helped maintain momentum and ensured that procurement and installation followed the planned timeline.

We encountered some implementation challenges. First, the limited baseline data on equipment load and operating hours, necessitated WHO engineers making on-site

assessments to determine the appropriate capacity of solar panels and battery storage needed to meet facility electricity demand for priority maternal and neonatal services. These assessments required additional technical input but did not significantly delay the project timeline. Second, the remote, mountainous terrain and limited road connectivity delayed transportation of solar equipment, extending installation by approximately 13 days compared with more accessible conditions, where installation could be completed within 3–4 days. These delays were mitigated through close coordination with local vendors and adjusted logistical arrangements.

The total costs for procuring and installing the photovoltaic systems at the three health facilities were 36 568 United States dollars. The South-East Asia Regional Health Emergency Fund provided funding, which enabled expedited procurement and installation under emergency response mechanisms. The relatively low investment in renewable energy to improve health-care services can inform WHO's broader agenda for sustainable health infrastructure.

This project illustrates the potential of renewable energy to strengthen health system resilience, particularly in off-grid and vulnerable settings.¹³ In post-earthquake Jajarkot, the installation of solar power systems directly decreased the risk of power loss in rural health posts. The hybrid photovoltaic systems not only met the immediate clinical needs of mothers and newborns during the winter, but also developed sustainable capacity within the health system. This experience emphasizes renewable energy integration as a viable, high-impact strategy for continuity of care in crisis settings. Furthermore, the implementation model is scalable and generalizable, relying on adaptable components that can be replicated in other off-grid or disaster-prone contexts with similar infrastructure constraints and seasonal power deficits.

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Competing interests:

None declared.

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Box 1. Summary of main lessons learnt

- Installation of off-grid hybrid photovoltaic and battery systems provides a rapid and sustainable solution of restoring essential health services in disaster-affected, resource-poor settings.
- Early site assessment and use of local vendors accelerate implementation in remote areas with limited access.
- Pre-existing coordination mechanisms and prior health cluster training enable faster decision-making and more effective collaboration across government levels and partners.