Training
Two-day design training on solar water pumps

4-5 August 2025, Thimphu Deluxe, Thimphu, Bhutan

Context
Bhutan's irrigation sector is vital for its largely agrarian population, with over 56% employed in the agriculture sector. However, irrigation development faces several challenges, including rugged terrain, limited arable land, and vulnerability to climate change. Traditional irrigation systems suffer from poor maintenance, water losses, and limited reach, especially during dry seasons. Additionally, rural-urban migration is reducing the labour force needed to manage these systems. Yet, there are significant opportunities for modernisation. Bhutan's abundant water resources offer potential for expanding and upgrading irrigation infrastructure. Integration of climate-resilient technologies, such as solar-powered pumps, can enhance water efficiency. Strengthening community-based water management initiatives can ensure sustainable, inclusive development in the sector.

Bhutan's irrigation sector is severely hindered by a shortage of skilled professionals, where engineering capacity is lacking at all administrative levels, undermining feasibility studies, design, construction oversight, and maintenance. This deficit in trained resources (engineers, technicians and operators) limits modernisation, smart irrigation uptake, and long-term system resilience.

Objective
Bhutan Ecological Society and the International Centre for Integrated Mountain Development (ICIMOD) are organising a two-day training on designing a solar-powered lift irrigation system. The training is targeted at the engineer level.
The objective of the training is to impart knowledge on the fundamentals of solar lift irrigation systems, working principles and sizing of the major system components.

Tentative agenda
Day 1

Time	Topic	Duration
09:00–09:30	Opening session, introduction, training overview and pre-training survey	0.5 hr
09:30–10:30	**Fundamentals of solar energy and solar water pumping systems** (Background and opportunities in the irrigation sector of Bhutan, crop water requirement, irradiation, photovoltaic (PV) effect, solar insolation, applications, types of pumps, AC (Alternating current)/DC (Direct current) pumps, submersible vs surface)	1 hr
10:30–10:45	Tea break	—

10:45–12:15	**Major components of a solar pumping system** (PV modules, inverter/controller, pump, pipe, tank, types of intake structures)	1.5 hrs
12:15–13:00	Lunch	—
13:00–14:30	**Pump selection and hydraulics** (total dynamic head, flow rate, pump curve, friction losses) *Quick exercise 1 and 2: Theoretical pump size estimation, choosing pump based on manufacturer datasheet*	1.5 hrs
14:00 – 14:30	Controller Sizing *Quick exercise 3: Controller sizing based on the pump size*	0.5 hr
14:30–15:15	**Solar PV Array sizing** (Energy matching, losses, array-to-load ratio, design considerations) *Quick exercise 4: Determine solar array size considering losses and pump capacity*	0.75 hrs
15:15–15:30	**Q&A and recap**	0.25 hr

Day 2

Time	Topic	Duration
09:00–10:30	**Design exercise 1** (Individual work: calculate system size for a simulated design case: theoretical calculation, sizing of major components such as pump, controller and solar array using datasheets)	1.5 hr
10:30–10:45	Tea break	—
10:45 – 11:15	**Design exercise 1 continued** (Discussion of results)	0.5 hr
11:15–12:15	**Design exercise 2** (Individual work: prepare a balance of systems such as DC cables, AC cables, protection equipment, etc.)	1 hr
12:15–13:00	Lunch	—
13:00–14:30	**Installation considerations** (Panel tilt, shadow, wiring, grounding, pump location)	1.5 hrs
14:30 – 15:00	**Productive Use of Renewable Energy (PURE) tool and site survey** (Brief of PURE tool, walkthrough of survey form, key aspects to look out for)	0.5 hr
15:00 – 15:30	**Wrap-up: review, Q&A, certification, feedback, post-training survey**	0.5 hr