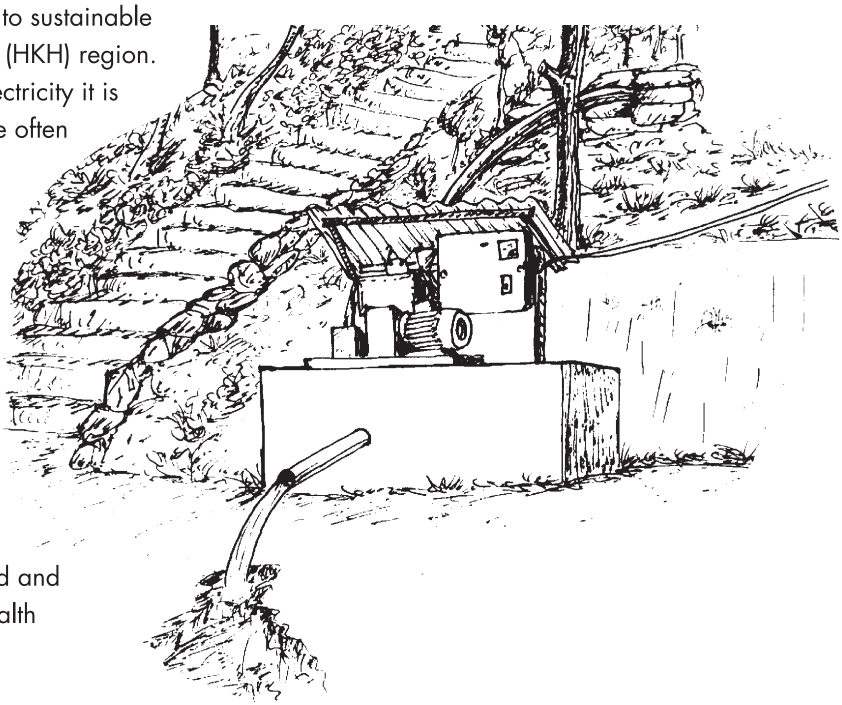
ICIMOD
FOR MOUNTAINS AND PEOPLE

Renewable Energy Technology



Access to sources of energy is still a major limiting factor to sustainable development in many parts of the Hindu Kush-Himalayan (HKH) region. Large areas are still not electrified, and where there is electricity it is often unreliable or prohibitively expensive. Fossil fuels are often not easily available or are too expensive for daily use. Mountain people have always relied on renewable energies like wood, animal dung, and draught power for survival – be they for cooking food, keeping the house warm, milling grain, ploughing fields, or transporting goods; but the traditional energy sources are no longer sufficient to meet people's needs, and there is increasing concern about the negative impacts associated with their use. Wood is becoming scarce increasing the time spent on collection; deforestation is leading to land degradation and loss of groundwater recharge amongst others; and indoor pollution from wood and dung smoke is a major cause of respiratory and other health problems.

However, mountain areas have vast untapped sources of potential energy in the form of running water and long hours of sunshine. Recent developments in technologies for renewable energy, offer possibilities for using this energy on a small-scale at low cost to reduce household drudgery, provide electricity for domestic use, and support and sustain income-generating activities. Overall, the potential for sustainable use of renewable energy resources in the Hindu Kush-Himalayas (HKH) exceeds by far the total energy consumption in the region.

The activities at the Godavari site focus on the demonstration of simple low-cost renewable energy technologies that can be used by farmers to support agricultural, domestic, or small-scale income generation activities. Most of the demonstrations are provided in partnership with different local NGOs. We welcome other groups to use the site for demonstration of appropriate technologies that complement the ongoing demonstration and training activities.

Solar Energy (Map Sites 8.1 a-e))

Solar energy has been used for centuries for drying crops, clothes, wood, and crop residues, and heating buildings. But now methods have been developed to make these activities more efficient, and to use solar energy in different ways. There are two main types of solar energy technology: passive solar (heat) and photovoltaic. Selected examples of both are demonstrated at the site.

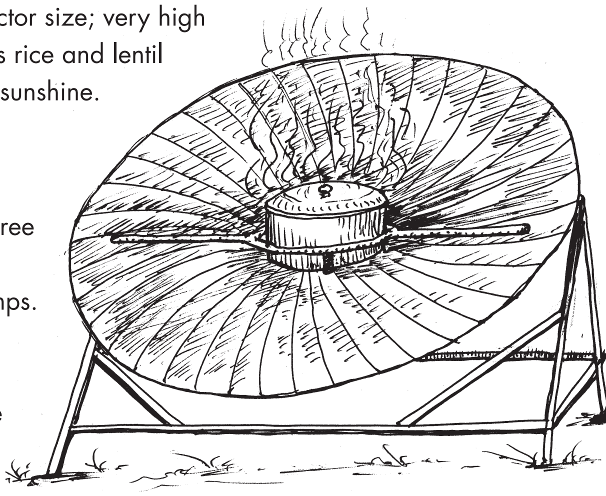
Solar drier (Map Site 8.1a)

This is a method for increasing the efficiency and cleanliness of solar drying. Fruit and vegetables are dried on racks in a small chamber with a solid earth back wall and plastic film covering. The drier is constructed from available stone, mud, bamboo and white plastic sheet and built facing south to maximise the sunshine it receives. The design ensures a constant airflow.

Solar cooker (Map Site 8.1b)

The solar parabolic cooker is a reflecting surface in the form of a parabolic dish which concentrates the solar rays at a focal point on which the cooking pot is placed. The reflector is mounted in such a way that it can be easily adjusted to face the sun.

The quantity of heat delivered to the cooking pot is proportionate to the reflector size; very high temperatures can be attained sufficient for most conventional cooking such as rice and lentil soup (dal). The net power of the cooker is approximately 700 watts in good sunshine.



Solar lamp (Map Site 8.1c)

The Tukimara solar lamp consists of a small solar photovoltaic module and three tiny semiconductor devices called white light emitting diodes (WLEDs) that convert electricity into white light more efficiently than traditional filament lamps. The three WLEDs together use only about 0.5 Watt of power, much less than the approximately 10 Watt consumption of the conventional solar DC lamps used in Nepal. Solar lamps have strong advantages for rural kitchens, where they provide bright, smoke-free light, with no danger of fire, unlike kerosene lamps. Solar lamps can be used like a torch, and are safe when handled by children. Development of lights using WLEDs has great potential and a big scope for mass use in low cost home lighting systems in rural areas in the Himalayan region.

Solaqua solar still (Map Site 8.1d)

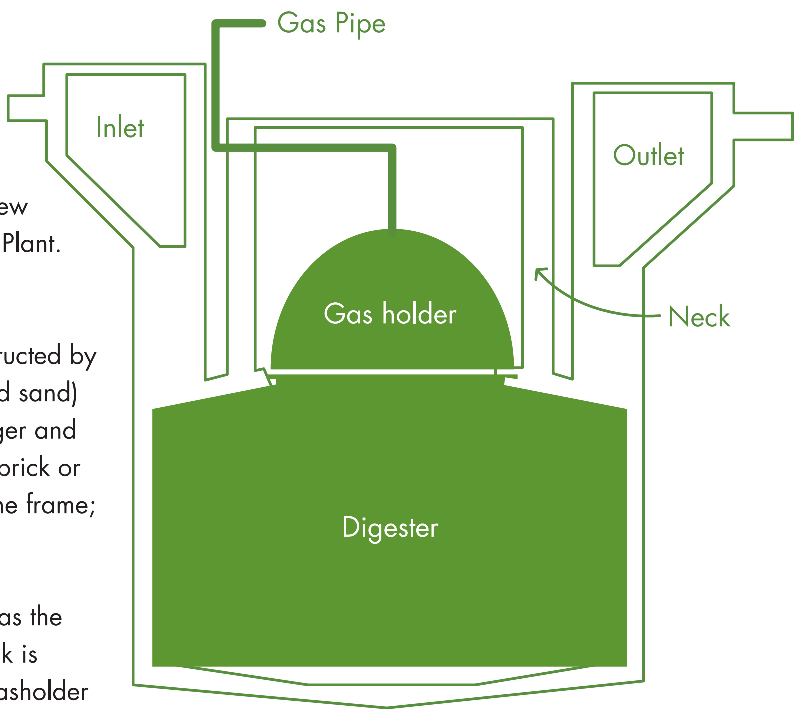
The Solaqua Solar Still uses natural evaporation and condensation to give pure water using solar energy. It removes impurities such as salts, heavy metals, arsenic, and nitrates, and eliminates microbiological organisms and the taste and odour of chlorine to give pure water. This simple technology is appropriate for mountain communities and can be used under harsh mountain conditions. The equipment can produce 6 litres of purified water per day under sunny conditions. The advantages are the very simple operation and maintenance and cost effectiveness, since only solar energy is required. It is suitable for both rural and urban areas.

Photovoltaic Electricity (Map Site 8.1e)

Solar photovoltaic technology directly converts radiation from the sun into electricity using a physical process with no moving parts. It requires special solar voltaic panels, which are mounted on rooftops or poles to face the sun. Solar photovoltaic systems allow power to be stored and then used as required. They are ideal systems for small-scale end uses such as lighting, pumping water, and low temperature storage of medicine. This can be a viable alternative in remote mountainous locations where the normal grid is difficult to reach. At the Godavari site, solar voltaic panels are used to supply power for lighting and for charging the battery used in the automatic meteorological data logger belonging to the on-site weather station.

Puxin Biogas Plant (Map Site 8.3a)

Biogas is potentially one of the most economical sources of energy for mountain farmers. In China, the Shenzhen Puxin Science and Technology Co., Ltd carried out many years' study to develop the traditional biogas plant and produce a new generation hydraulic biogas system named the PUXIN Biogas Plant. The Puxin biogas plant has three major parts.



Concrete digester: The stomach (digester) of the plant is constructed by casting concrete (1:3:3 mixture of cement, smashed stone, and sand) with the help of 'scaffolding' (a steel mould). Hence it is stronger and more earthquake resistant than the traditional plants made of brick or stone mortar. The volume of the digester varies according to the frame; the two basic sizes are 6 and 10 cu m.

Neck and cover: The round part above the digester is known as the neck. This is also made with the help of a steel frame. The neck is essential for fixing the gasholder. The water level above the gasholder in the neck determines the gas pressure. The neck is covered with five concrete covers (slabs), which make the plant attractive and help utilise the plant area.

Gasholder: The gasholder is made of reinforced glassfibre which is 100% air and water tight. The diameter of the gas holder is 1.6 m; the volume varies with the height.

The Puxin biogas plant has more advantages than the traditional fixed dome plant:

- It is easier and quicker to build.
- It is environmentally friendly, durable and easy to repair.
- Any solid biodegradable materials can be used including grass and straw so that it is not necessary for the farmer to have a large number of cattle.
- If used as a batch plant, there is regular discharge of gas over a long time (5-6 months), but the materials have to be replaced after 5-6 months.
- The slurry from the plant is perfectly digested and consists of 90% water. The plant is a very effective producer of bio-fertiliser to replace chemical fertiliser.

Hydropower and Water Pumps (Map Sites 8.2 a-c)

Hydropower is one of the most promising potential sources of energy in the HKH region. The possibilities range from large-scale hydroelectric stations to the small water-powered wheels used across the region to grind grain. At Godavari, we focus on low-cost small-scale technologies for farm households.

Picohydropower: peltric set technology (Map Site 8.2a)

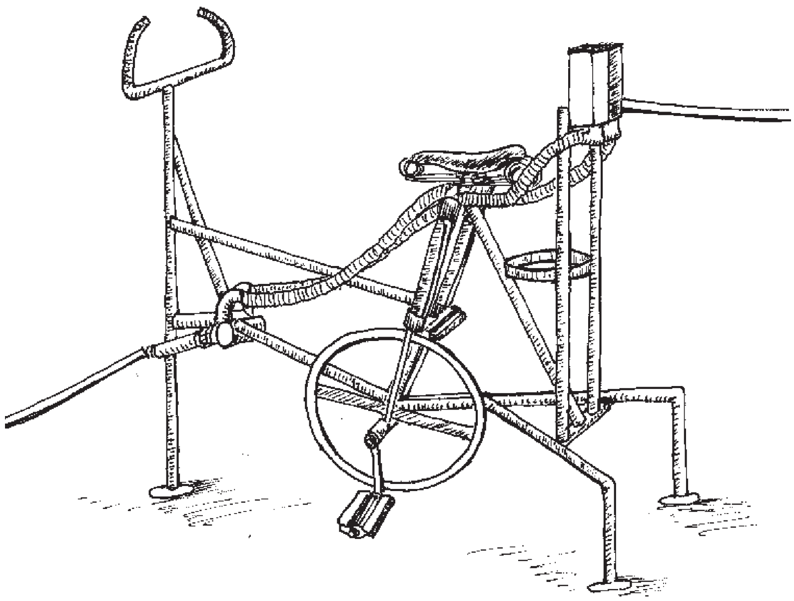
Peltric set technology is a means of generating electric power from a small quantity of water dropped from a large height. The device consists of an induction generator that runs with a peltron turbine. A high velocity water jet strikes the bucket to run the impeller, which in turn rotates the shaft of the induction generator. The basic principle used is that 'an induction motor tends to generate electricity after it runs faster than the synchronous speed'. An induction generator controller (IGC) is used with a ballast heater for regular power supply and to protect the generator, The IGC diverts electric power to the ballast heater when the electric power is not being consumed to produce hot water. The device is simple to operate and requires little maintenance. The generated electric power can be used to provide electricity in rural and remote mountainous areas and is highly suited for use in the HKH region which is full of small streams and rivulets with small discharge flows on sloping land that provides height for the water to drop down. The demonstrated set provides 200W of electricity, sufficient to light 18 light bulbs of 11 Watts each (shown using energy-saving fluorescent bulbs, each with a light energy output equivalent to that from a normal 60 Watt bulb).

Hydro ram water pump (Map Site 8.2b)

The hydro-ram water pump is a self-actuating pump operating on the principle of a water hammer that is used to lift water from a position near the water source to a higher location. If correctly installed and properly maintained, it is a dependable and useful device that can lift water to a great height without the use of any source of energy or fuel other than the water itself. The pump uses the momentum of a relatively large amount of moving water to pump a relatively small amount of water uphill. This type of pump is useful for providing irrigation water to fields at a higher level than the water source, or water to a house higher up a slope.

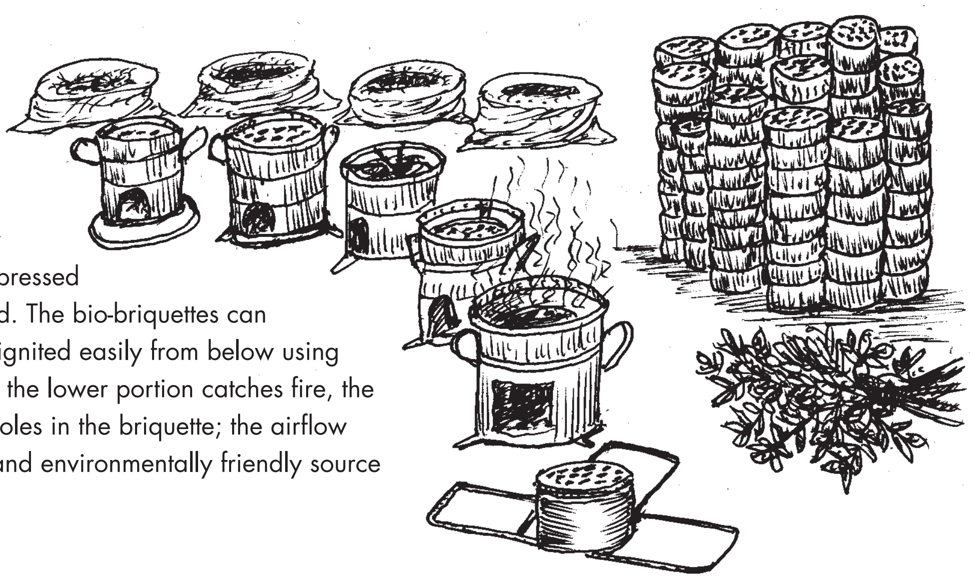
Cycle water pump (Map Site 8.2c)

Mr. Yuwak K.C. of Nepal developed this pump as an adaptation of the traditional reciprocating pump applying tangent projection technology. Water is pumped manually from a water source 25 feet below the pump to a position 50 feet above the pump, or up to 200 feet in a sloping area, by pedalling an adapted bicycle. The water is pumped at a rate of 13 litres per minute. The main use is for providing water for irrigation.



Other Techniques

Beehive briquetting technology (Map Site 8.4a)



This technique is an adaptation of methods used to produce charcoal for fuel. Unwanted biomass, in this case from the forest weed 'banmara' (*Eupatorium adenophorum*), is converted into charcoal in a charring drum and then turned into solid fuel bio-briquettes. The charcoal powder is mixed with bentonite clay at a ratio of 3:I, pressed into honeycomb-shaped moulds, and sun-dried. The bio-briquettes can be used for cooking or heating. They can be ignited easily from below using waste paper or dried leaves and twigs. Once the lower portion catches fire, the flames start coming up through the nineteen holes in the briquette; the airflow ensures smokeless burning – a pollution free and environmentally friendly source of energy.

Cool chamber (Map Site 8.4b)

This cool chamber uses the principle of evaporation to maintain a temperature that is 10-15°C less than the outside temperature, with a relative humidity of about 90 per cent. It can be constructed with locally available material like bricks, stones, sand, bamboo, straw, and gunny-bags and a small water supply. It can be used to keep produce fresh before transport to market, or for personal household use. It is suitable for remote mountain areas where there are no refrigerated cold storage facilities.

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