

Earthquake Reconstruction: Building Back Better



Photo: Kafle Ghatta/ Helambu-6, by Padam Gurung

Improved water mills: Energy efficient and women-friendly

Water mills to grind food (or process other materials) have been used for centuries in many parts of the world, harnessing the force of running water to turn a wheel or turbine – thus producing mechanical energy. In Nepal, water mills are an important means of reducing the drudgery of women's work in grinding rice, wheat, maize, spices and in some cases oil. Nepal's Centre for Rural Technology (CRT) estimates that there are over 25,000 traditional water mills operating throughout rural parts of the country, with a power output mostly ranging from 200 to 500 Watts. Generally, one mill serves 10 to 20 families, but their use is limited by their poor efficiency. In the areas badly affected by the 2015 earthquake, many water mills were destroyed. This provided an opportunity to "build back better" by introducing improved water mills which both grind more rapidly and efficiently and have additional user-friendly features. With funding from Swiss Solidarity, Helvetas has worked with local people in the municipalities of Melamchi and Helambu to construct 31 improved water mills. Key aspects in addition to the technological improvement are adequate, earthquake resilient structures housing the mill, the provision of a toilet for mill users, and rules of use that include reduced rates for disadvantaged individuals.

Improving on traditional water mills

The design of traditional water mills has resulted, over generations, from a combination of indigenous knowledge and the availability of local materials. Improved water mills build on this knowledge, with the main improvement being in the use of modern materials. Thus, the efficiency of energy conversion is increased through replacing the wooden parts – notably the rotor, shaft and chute - with metallic parts. This not only increases operational efficiency, but also makes it easier to fix additional machines for hulling, electricity generation and other uses. The rotations per minute (rpm) of the shaft average 200-300 rpm while the power output ranges from 500 Watts to 3,000 Watts. The grinding capacity ranges from 20-50 kg maize per hour, compared with up to 20 kg per hour for traditional mills. The frequency of repair and maintenance of improved mills is considerably less than traditional ones, while the life span, of some 10 years, is generally greater.

Technical details

Improved water mills now exist in two versions, distinguished by the length of the shaft – as measured from the pivot (*takkar*) to the key (*phali*) of the system. Short shaft water mills have a shaft of 1.3m (4 feet) and are used only for grinding grain. Long shaft water mills, in which the shaft is nearly 2m long (6 feet), have more diverse uses as they can be coupled to a variety of machines. Although long shaft water mills are more expensive to install, they provide the investor with the opportunity to diversify his or her business. However, they also require a greater source of water and thus cannot be installed everywhere.

A range of potential end uses of long shaft water mills have been tested and promoted. They include huller, husker/ polisher, flattened rice beater, oil expeller, saw milling, paper making (beating the fibre of *Daphne* spp, known locally as *lokta*), water pumping, spice grinding, electrification, and battery charging.

A Climate-friendly technology

The Alternative Energy Promotion Centre (AEPIC), which works under the Ministry of Environment and Forests is the national focal point for developing and promoting renewable and/or

alternative low carbon energy technologies in Nepal. It has registered the construction of improved water mills as a Programme of Activity (PoA) under the eighth Clean Development Mechanism (CDM), as supported under the United Nations Framework Convention on Climate Change (UNFCCC). Thus, since 2011, it has been possible to register improved water mills in Nepal as a technology eligible for carbon credits - that is, tradable emission reduction units. The average annual emission reduction from a long shaft improved water mill installed under the PoA is calculated as 9.36 tonnes of carbon dioxide equivalents; the corresponding value for the short shaft improved water mill is 3.92 tonnes. Nepal has registered 2,200 water mills for an overall reduction of some 9,962 tonnes carbon dioxide per annum under the CDM executive board of UNFCCC. All the improved water mills supported by Helvetas have been registered under the CDM. Given the interest in improved water mills, there has been considerable support for their promotion by a variety of government and non-government agencies. However, this support has invariably focused on improving energy efficiency, and has largely ignored other aspects.

Helvetas engagement

In the aftermath of the devastating 2015 earthquake, most recovery and rehabilitation support focused on shelters, schools and water and sanitation facilities. A rapid assessment conducted by Helvetas in December 2015 in the areas of Melamchi and Helambu showed that there were additional needs for restoring and improving livelihoods. The rehabilitation of water mills was one of these needs – and one that was generally ignored by other agencies.

Over August 2016 to July 2018, the Recovery of Agricultural Livelihoods project supported the restoration of 25 destroyed or badly damaged traditional water mills in Helambu Rural Municipality and Melamchi Municipality – with a further six being added later, to total 31. Most of these mills were and are privately owned, but effectively serve a public function due to the lack of good alternatives. In the absence of water mills, families must either resort to domestic hand mills, or travel long distances to an urban setting in which an electrical or diesel mill is available. Domestic hand mills, as already noted, require long hours of strenuous labour, normally

conducted by women. Diesel or electrical mills are considered to produce inferior flour - and travelling to reach them takes times and money; furthermore, the grinding fee must be paid in cash rather than kind.

Following the earthquake, most water mill owners were reluctant or unable to conduct repair and rehabilitation operations themselves. This has a clear economic logic, as the amount charged for grinding is low, and the investment required for safe construction is not recoverable within 10 to 12 years, which is the usual life of a mill.

Two water mill ownership models

Privately owned: most water mills in Nepal are established by an individual through their own investment. The owner is responsible for overall operation and maintenance, and clients pay a service charge for grinding. This model was the usual one followed for Helvetas-supported water mills, but the support was conditional on certain social requirements (see later box).

Community owned: three of the Helvetas-supported water mills were established through the joint investment of numbers of households. The operation and maintenance responsibility are with member households and maintenance costs are shared equally. Member households depute one operator and each member provides payment to that person in kind (grains) annually. Other households can obtain grinding services on payment.

The most vulnerable component of water mills, from a disaster perspective, is the shelter in which they are housed. However, this is generally given little consideration during mill establishment; thus, most shelters collapsed during the earthquake. Helvetas rehabilitation efforts included the construction of earthquake-resilient water mill sheds, as well as improving the efficiency of the water conveyance system (both fore bay and tail race), and mill functioning (using an improved, piped intake system, and metal turbines). This enabled all season operation, more efficient grinding, and proper storage of grains and flour.

The project provided materials and technical support, whilst the mill owners contributed the labour and any appropriate salvaged local

materials. In addition, the support package also included a toilet for the use of mill clients, and entrepreneurship training for the mill owner/operator. Capacity building further included the regular repair and maintenance of water mills, sanitation and hygiene, and social responsibility as related to the criteria mentioned below.

Collaborating with local authorities and the community

From the beginning, the ReAL project worked closely with the local authorities – initially the relevant Village Development Committees and the Sindhupalchowk District Development Committee, and subsequently, after the elections of 2017, the relevant municipalities. Thus, the criteria used for selecting the water mills for rehabilitation and improvement were those set by the local

A social commitment

All water mill owners supported by Helvetas have signed a social commitment and installed an information board setting out their eight rules of use, and seven social commitments. These include giving priority to pregnant, elderly, differently abled people, as well as a 50% discount for extremely poor households. The owners also guarantee to maintain sanitation and hygiene standards through a clean water supply and toilet.

government, and the final selection of mills was endorsed by them. A local service provider was contracted to facilitate the construction process, with a tri-partite agreement being signed between Helvetas, the owner, and the service provider. The owner was required to sign a social commitment (see box) and develop a business plan for the mill (facilitated as necessary by the service provider).

Water mill selection criteria

The prioritisation and selection of water mills for the rehabilitation was based on technical, logistical and regulatory, and social criteria.

Technical considerations included a safe location (with low risk of flooding and landslides, and in alignment with safe water transmission); adequate all-year water availability; feasibility of cost-effective instalment; and potential for further use of tail water (eg for irrigation).

Logistical and regulatory considerations included approval from the concerned government

authority; clear permission to build (no land ownership problems); interest and willingness on the part of the mill owner; convenient, accessible location for beneficiary households; long distance from alternative mills

Social considerations included high number of potential beneficiaries, especially economically poor and socially discriminated households or those with differently-abled members. Preference was also given to women-owned mills, with the project team encouraging successful women as role models.

Key pointers to success

All the Helvetas-supported mills are currently operating effectively, and to date have minimal maintenance requirements. Amongst the lessons learned from this experience, some of the key ones are as follows.



- Water mills are generally run most efficiently by a single operator, either the owner or a nominated individual paid for the task (in cash or kind).
- Private water mill operators working in partnership with an external agency can be persuaded to follow a code of social responsibility.
- Improved water mills are relatively easy to install and result in major efficiency gains.
- Engaging all concerned – local authorities, private investors and community members - in water mill planning and construction generally pre-empts and avoids any later disputes.
- Improved water mills are a renewable based climate-friendly technology, eligible for registering into carbon credits system of the UNFCCC via national focal point i.e. the Alternative Energy Promotion Centre (AEPCC).

<< With the support we received, we were able to rebuild the water mill shed - which is earthquake resilient too - and we can provide the service to beneficiaries more efficiently. This has supported our livelihood and the education of our children. In future, we plan to sell the ground products in the nearby market. >>

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