



INDUS BASIN INITIATIVE

# Hydraulic ram pumps for alternative irrigation water supply in cold, arid climate zones

Factsheet on irrigation potential and operational requirements based on a pilot in Gilgit-Baltistan, Pakistan

Agriculture is crucial for the livelihoods of mountain communities in Gilgit-Baltistan, Pakistan. Over 90% of households are primarily dependent on agriculture, and the region holds great potential to produce organic and resilient local varieties of crops, including high-value ones. But climate change is wreaking havoc on traditional farming practices, the landscape is arid, arable land is limited, and much of the cultivated land is irrigated by glacial melt.

With accelerated glacial melting, downwasting of glaciers can lead to the disconnection of the canal intakes from glaciers. As the irrigation canals become dysfunctional, a shortage is created in the supply of irrigation water to cultivated lands. Moreover, a large area of the arable land in Gilgit-Baltistan is located at a higher altitude than rivers. The steep terrain makes it difficult to irrigate the land through canals. Under such conditions, alternative water-lifting (such as the hydraulic ram pump) and efficient irrigation technologies (drip irrigation) are required to extend the agriculture base along the elevated riverbanks.

## Hydraulic ram pumps

We piloted community-led climate-smart water management technologies in Khyber Village, Gilgit-Baltistan, to tackle this problem of overdependence on

gravity-fed open channel irrigation. The hydraulic ram pump lifts river water without using any external source of energy or fuel other than the kinetic energy of the flowing water itself. It is a self-actuating pump that lifts water from a position near the water source to a higher location. And it is particularly suited to Gilgit-Baltistan, where swathes of land are left unirrigated precisely because water sources are downhill.

We worked with the community to pilot the hydraulic ram pump in Khyber. The Gilgit-Baltistan chapter of WWF-Pakistan mobilized the local community, while the Pakistan Council of Research in Water Resources (PCRWR) and the Mountain Agricultural Research Centre (MARC) provided technical support to establish the pilot site. The pump lifts water (at a rate of 10.2 litres/minute) from the Khunjerab River to two storage tanks (2,000 litres each) placed around 45 m uphill. A drip irrigation system efficiently supplies water for alley cropping upland – cultivating apple orchards and vegetables across 1 ha of land. A preliminary but comprehensive cost-benefit analysis based on assumptions has shown that the piloted hydraulic ram pump-fed drip irrigation package has been highly successful: It has a positive net present value of PKR 120,571,860 (USD 1 ≈ PKR 174 as of April 2021) of 15 years with a discount rate of 14%, assuming that plants will be fully laden with fruits in the next three years.

## Pilot details



**Location**  
Khyber Village,  
Upper Hunza, Gilgit  
Baltistan, Pakistan



**Climate**  
Cold, arid



**Rainfall**  
<250 mm  
annually



**Altitude**  
2,000–3,000  
masl

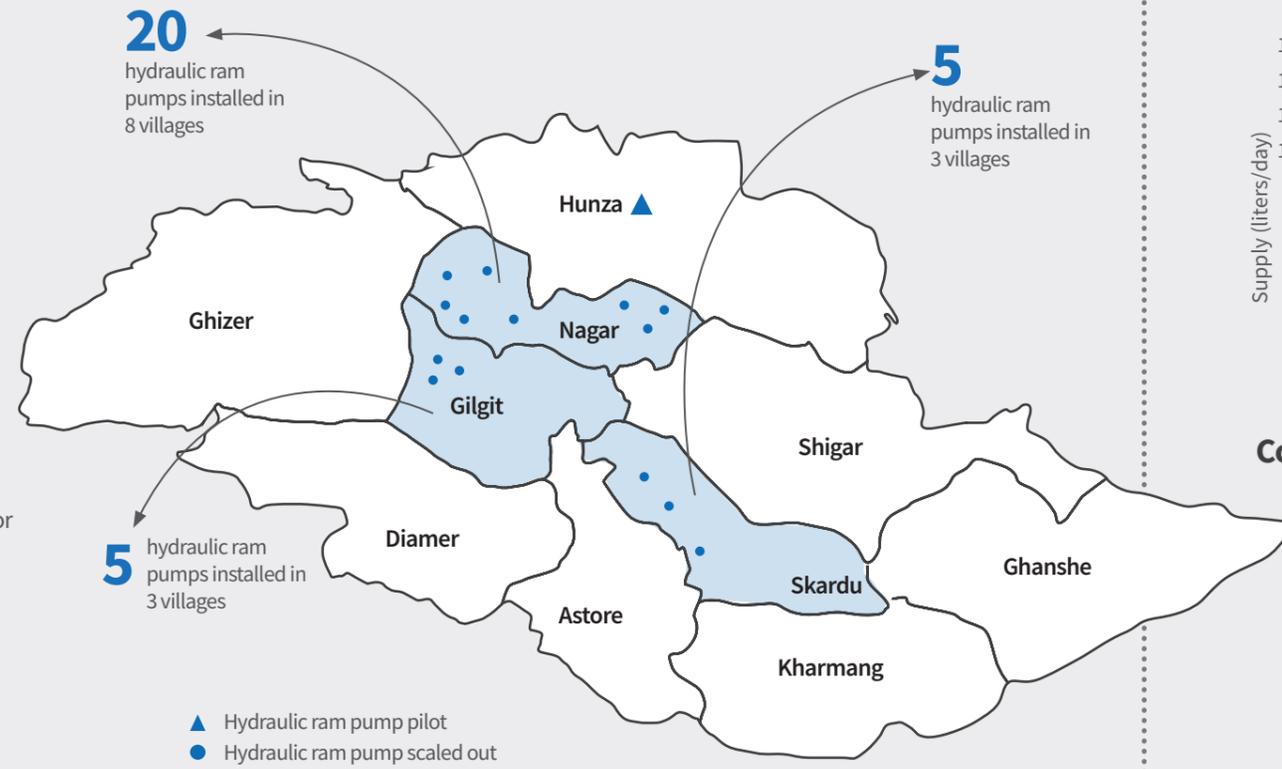
Average landholding: 0.5–1 ha

**Project:** Agricultural Water, Energy, and Hazard Management for Improved Livelihoods in the Upper Indus Basin, Pakistan

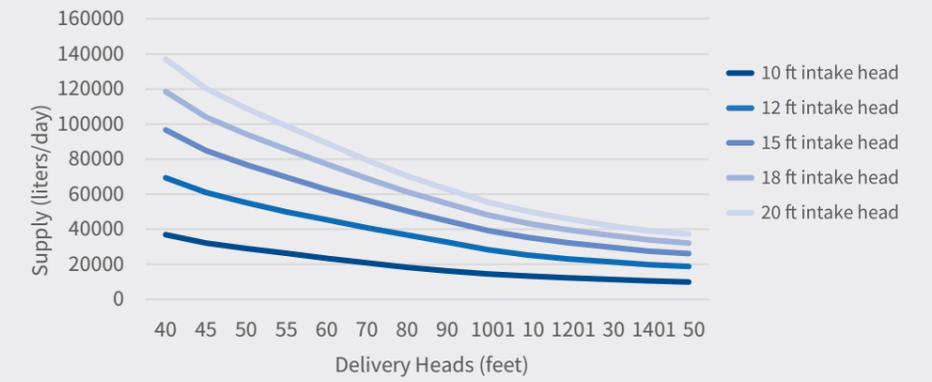
**Stage of intervention:** Piloting

**Implemented by:** Indus Basin Initiative – International Centre for Integrated Mountain Development (ICIMOD), World Wide Fund for Nature -Pakistan (WWF-Pakistan), Pakistan Council of Research in Water Resources (PCRWR), and Mountain Agriculture Research Centre (MARC)

**Implementation year:** 2018

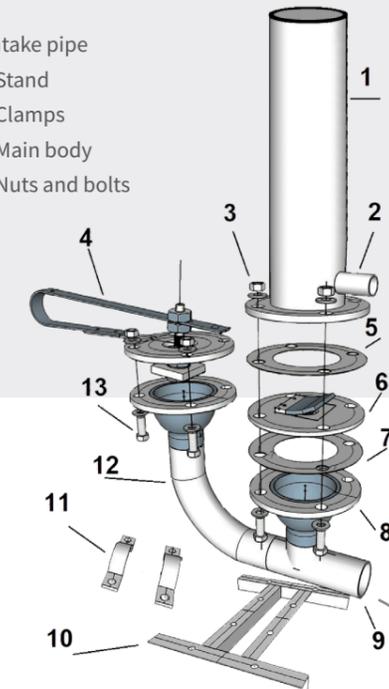


## 2" x 1" hydraulic ram pump performance curve

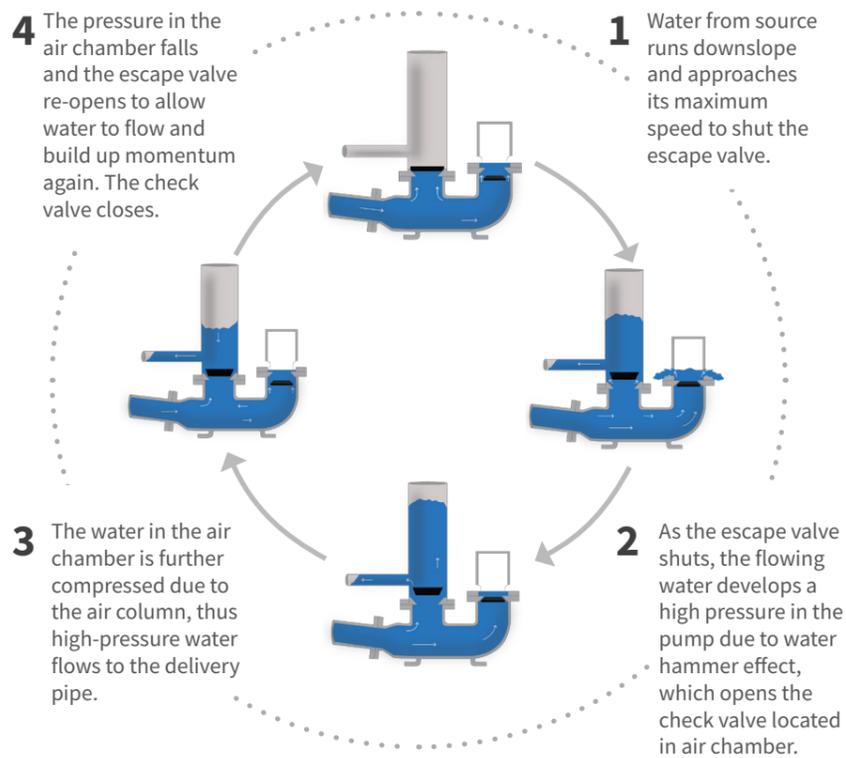


## Components

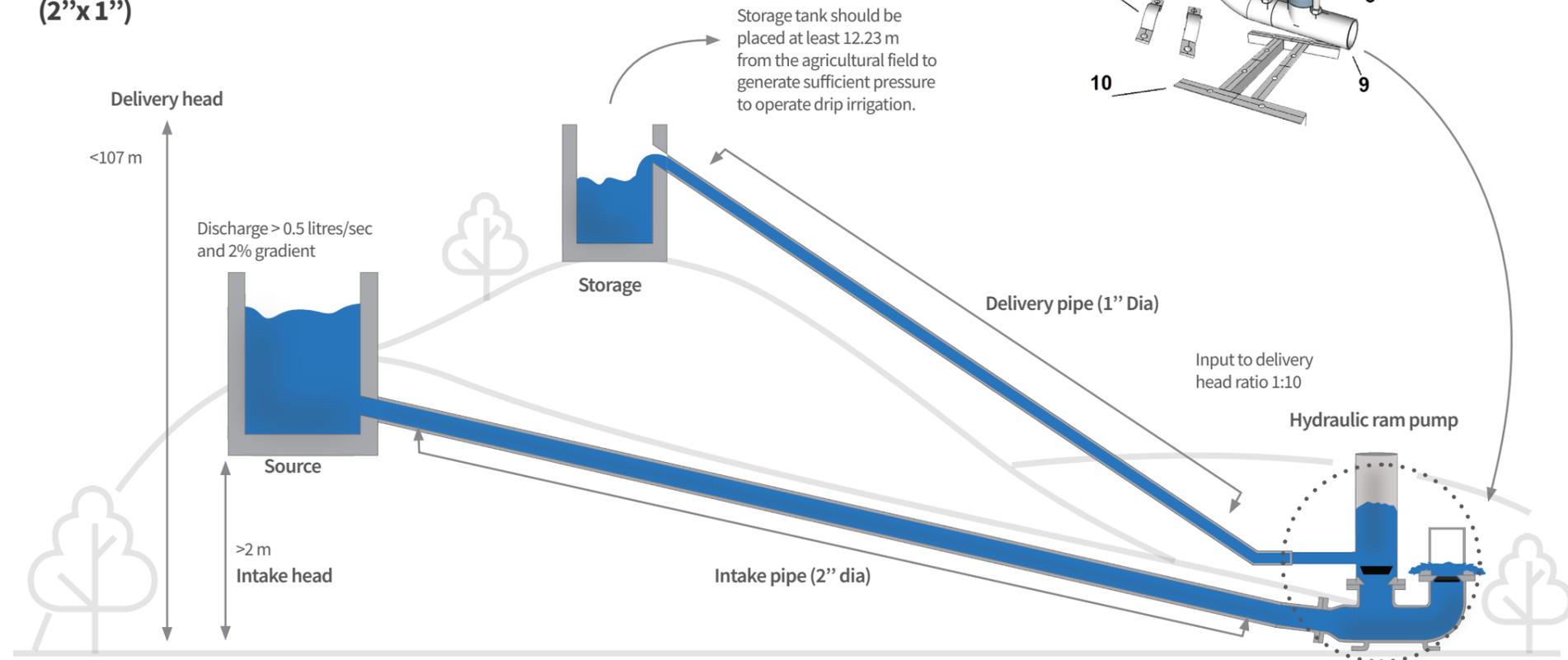
1. Air chamber
2. Out-take pipe
3. Nuts
4. Escape valve
5. Gasket
6. Check valve
7. Gasket
8. Flange
9. Intake pipe
10. Stand
11. Clamps
12. Main body
13. Nuts and bolts



## Working mechanism



## Operational requirements of a hydraulic ram pump (2" x 1")



## Potential applications

- Drinking water supply schemes
- Livestock water feeding systems
- Water lifting for agriculture
- Domestic water supply schemes

## Maintenance

- Frequently visit the site for inspections
- Frequently check and clean the escape valve to remove dirt
- Clear air locks in the delivery pipes
- Tighten bolts at regular intervals
- Change the rubber valve and valve gasket
- Clean the intake screen at the water source to keep clear up the intake debris
- Replace the escape valve spring assembly when broken
- Clean the water storage tank on a bi-monthly basis
- Clean and flush the disc filters on a bi-monthly basis
- Clean and flush the emitters on a bi-monthly basis

## Cost

- PKR 60,000–80,000 PKR for the installation of a 2" × 1" hydraulic ram pump and related equipment, mainly depending on availability of materials
- PKR 40,000–60,000 for the water storage and distribution apparatus
- PKR 70,000–120,000 per acre for the drip irrigation system

## Key benefits

- No electricity or external power source required
- Continual operation

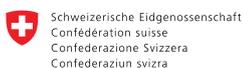
- Easy, low-cost maintenance
- Reliable and fit for long-term use
- Sustainable alternative to motor-driven pumps
- User-friendly and high level of acceptance among the local community
- Fully automated

## Flexibility of design

In Pakistan, hydraulic ram pumps are available in two sizes: 2" × 1" and 4" × 2". In case higher discharges are required, more than two pumps of the above sizes can be attached in parallel to the source while the outtakes of these pumps can be attached to a combined larger delivery pipe. The size of the delivery pipe depends on the discharge of the hydraulic ram pump and hydraulic losses. A typical hydraulic ram pump (2" × 1") requires at least 6 feet intake head and is capable of pumping 5,000 to 15,000 litres to a maximum of 107 m in 24 hours. The source channel must carry water discharge of at least 0.059 cubic feet/second.

## Limitations

- Only useful in terrain with sufficient slope (2%) so that an intake head of 2 m is available
- Requires intake flow of 0.5 litres/sec discharge of intake channel
- The length of the intake pipe should at least be 18.2 m and be made of galvanized iron
- Water that exits the waste valve cannot be re-captured
- Lifts silt-loaded water that requires multiple screenings at storage
- Clogs emitter/drippers if assembled directly with drip irrigation



Schweizerische Eidgenossenschaft  
Confédération suisse  
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Confederaziun svizra

Swiss Agency for Development  
and Cooperation SDC

### For further information

Madhav Dhakal

Muhammad Mudassar Maqsood

madhav.dhakal@icimod.org

mudassar.maqsood@icimod.org

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**International Centre for Integrated Mountain Development**

GPO Box 3226, Kathmandu, Nepal

T +977 1 5275222 | E info@icimod.org | [www.icimod.org](http://www.icimod.org)