SPURS AND DYKES

FOR FLOOD WATER PROTECTION

Spurs and dykes are structures that can be made by communities on a small scale from wire and stones. They are used to protect river banks and help the communities in Nepal cope with flood waters.

Introduction

Around 80% of Nepal is mountainous. In these areas heavy rain on the steep slops erodes the soil and leads to landslides resulting in loss of land, damage to property and a threat to life. And in the lower lying areas of the country there is often flooding during the monsoon season that threatens the ravine communities. Much of the flooding is exacerbated by upstream activities such as deforestation and farming. The risk of flooding is also on the increase due to rising riverbed levels and in locations where narrowing down of rivers occurs. Breaches of embankments occur every year in some places.

Figure 1: A small spur showing how bank erosion can be reversed by capturing sediment behind the spur. Photo: Practical Action Nepal.

People most as risk are those living alongside of the river. In many cases these people are the indigenous disadvantaged ethnic communities i.e. fishermen, farmers, pottery makers, blacksmiths, tailors, cobblers, bamboo craft workers and untouchables - the socially excluded. The majority are dependent on the rivers' resources for their livelihoods, therefore the settlements of these communities are almost at river level.

Communities that are at risk can act together to put in place flood management plans and work on preventative measures before flood events occur. Community activities include the use of gabion in the construction spurs and dykes along with a range of other activities to reduce their vulnerability to flooding.

The response to floods

Traditionally communities' responses to floods were often a hastily mobilised reaction to an emerging disaster or people would make separate preparations on a family basis. To improve on this situation Practical Action and ECHO worked together along with local partners Sahamati and CSC on a range of flood risk reduction activities. The approach of Practical Action and its partners was to galvanise the community to act as a whole in their preparation for floods. A significant step in the approach was to establish a Community Flood Management Committee - CFMC that promoted cooperation.

The community based risk reduction programme comprises of a number of elements.

- flood warning - strengthening the capacity of communities to manage early warning systems (EWS)
- flood proof housing
- flood rehabilitation
- income generating activities for families living in areas of risk
- bioengineering. fruit and fodder tree planting to stabilise hillsides
- flood resistant crops

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- evacuation
- relief distribution
- food storage
- immunisation of people and their animals
- spray of insecticides after flood to prevent epidemic waterborne diseases like diarrhoea, dysentery, cholera, typhoid, pneumonia, etc.
- risk mapping – mapping out the flood areas and its effects on those areas
- structural measures for diverting and checking flood water through the use of spurs and dykes

In Nepal, the community, through the CFMC, was able to ask for technical support from the various division or sub-division offices of the Department of Water Induced Disaster Prevention. These offices often also provide material support such as gabion boxes and sand bags. There are many other organisations that may provide technical as well as financial support to carry out these works. Therefore the CFMC needs to be well informed of the options.

The CFMC also coordinates activities during flooding. These include; filling the breaches of the embankment, deflecting river flow, isolating water wells. Preventing provision stores, health centres and other structures from being flooded may become an essential activity. Adequate provision of materials for these tasks should be obtained and stored at convenient places.

Structural Options

Various structural measures can be used depending on the particular requirements of an area. Material like loose stones, bricks, bamboo piles, bamboo mats, stone filled gabions, and sand filled bags are all used. With appropriate support the community can do the bulk of the work including collecting stones, filling the gabions, and earthworks etc.

Dykes run along the side of river rather than protruding into the river. They protect the river bank from erosion but do not redirect the river.

Embankments are constructed along the river bank to raise the bank level and stop the water spilling over. The embankments are made of earth and are sometimes additionally protected with revetments.

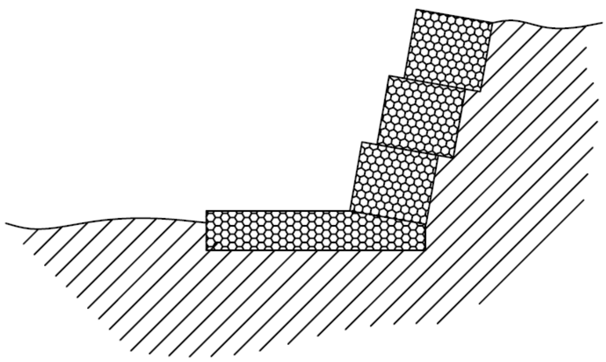

Figure 2: Section through a gabion dyke. Illustration: Practical Action / Neil Noble

Revetments are structures placed on banks in such a way as to absorb the energy within the moving water therefore protecting the land behind them from erosion. In Nepal they are often porous and will allow water to filter through.

Spurs are structures that protrude into the river. Small spurs know as studs help keep the flood water away from venerable banks.

Long spurs, also referred to as groynes, are used to direct the course of the river away from a vulnerable bank. The spurs make permanent changes to the rivers course by capturing sediment. The spurs are often made of gabions as they have to be strong enough to resist the force of the water during periods of flooding. This practice is known as river training.

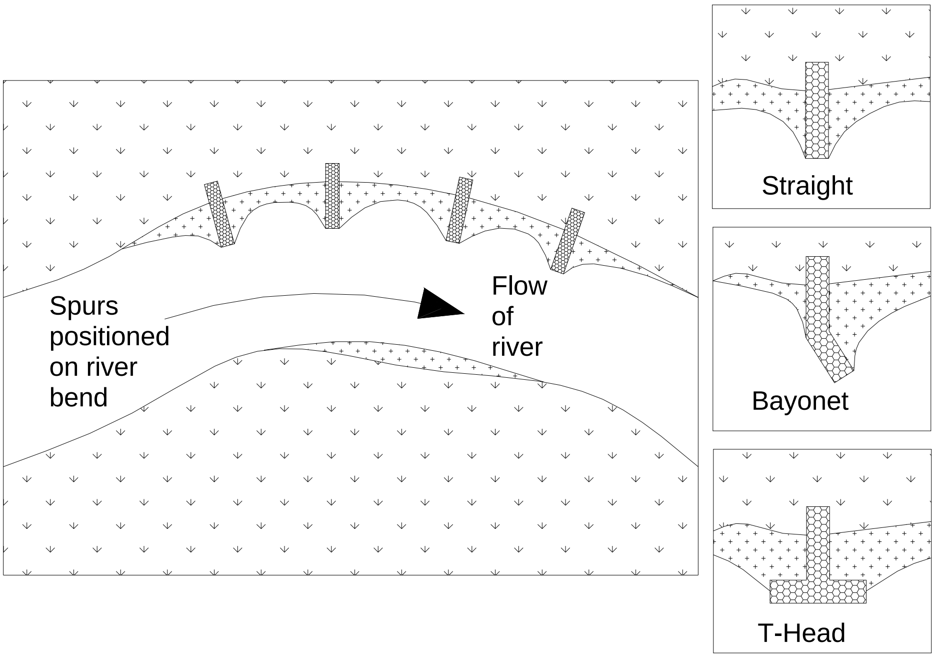

Figure 3: Spurs used for controlling erosion at bends in rivers and spur design options.
Illustration: Practical Action / Neil Noble

Construction Spurs

For spurs to be effective they have to be designed and built in such a way to ensure that they can resist the strongest forces from floodwater. This can be done be using professional expertise in the initial phase of the project. These preliminary stages encompass

- carrying out design work for all structures and producing detailed technical drawings
- assisting communities with quotation and purchasing activities and ensuring standards of inputs and materials
- supervising community construction activities
- liaising with local authorities over standards and legal requirements
- carrying out community training where necessary
- verifying community expenditures and cost estimates

Figure 4: A newly constructed spur shown before the monsoon. The base of the river and the spur apron are clearly visible in the dry season.
Photo: Practical Action Nepal.

The cost of creating the spurs and dykes can be kept low through community participation.

Ideally land is contributed to the project and the labour contribution will vary from between 10 and 100% depending on the type of activity and the need for specialist contributions. Often the majority of materials are also donated to the project.

In the example of the spur constructed at Chitwan specialists were used in the design stage of and engineering drawings produced from which the project requirements in terms of material and labour could be determined. The spur construction is shown in Figure 5. The size and shape will

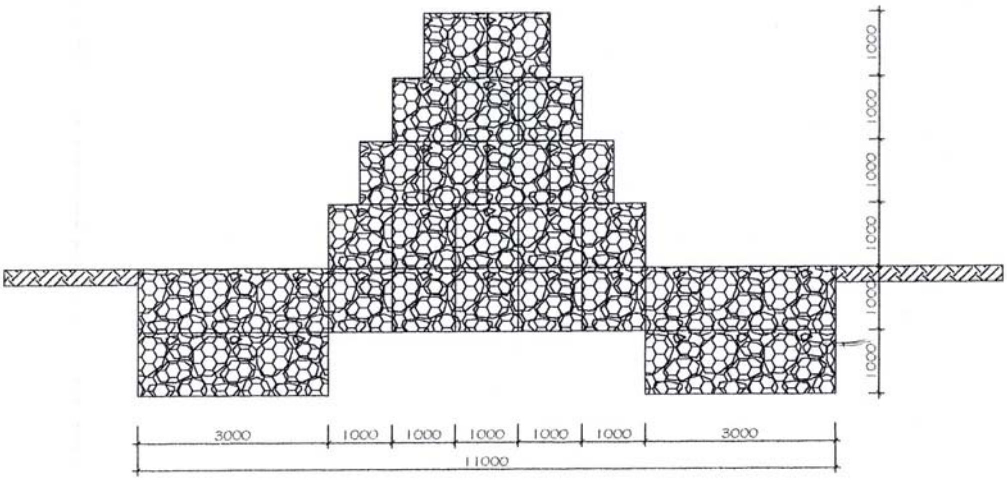

Figure 4: Cross section of a spur design in Chitwan showing substantial groundwork
Illustration: Practical Action Nepal.

change depending on the particular circumstances of each location.

An essential element to constructing a spur is the incorporation of the apron which ensures that the structure is not undermined by the current. The design should ensure that the spur is rooted into the bed of the river and not resting on the river bed (as in the case in figure 4) where the structure is likely be rolled away during heavy flooding.

In general the communities in Nepal have shown a great deal of motivation to carry out mitigation work and have requesting more structural work to be done.

In Meghauli (Chitwan) one spur of 9m ×6m ×7m was completed before the monsoon. The community was particularly highly motivated as their land was threatened by two major rivers. They contributed 400 days of work (40 people a day for ten days on average).

Groundwork is done on the riverbed to build the apron. Gabions can then be placed in position to provide protection for the main structure of the spur. Undermining of the apron may still occur but this will not result in any structural damage as the apron will flop down.

Figure 6: An example of a spur that has not been installed with groundwork or an apron and consequently is likely to be washed away during heavy flooding.
Photo: Practical Action Nepal.

Gabions

Gabions are rectangular wire cages containing rocks or boulders. They are easily constructed units large enough and heavy enough to remain stable in moving water.

These are the basic building blocks for spurs and dykes and can be made locally by hand although this is physically demanding for people doing the work. Either square mesh or hexagonal mesh is used. Hexagonal mesh is intrinsically stronger but more difficult to construct by hand. If a simple rectangular mesh is used then there is a tendency for the mesh to unravel, even if only a single wire is broken, which will result in premature failure of the structure.

Figure 5: Making gabion cages by hand with a square mesh.

Photo: Practical Action Nepal

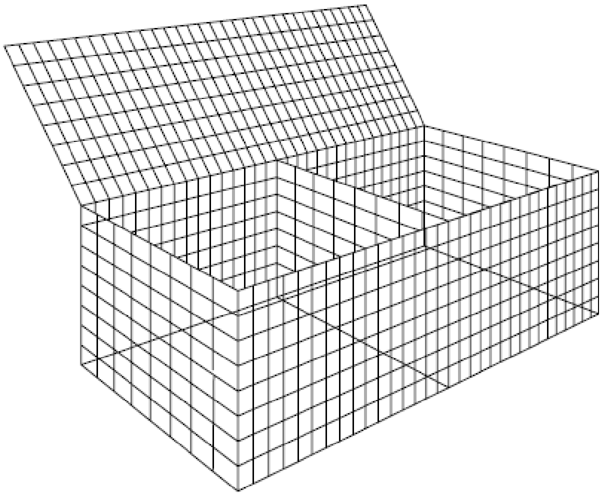

Figure 6: A basic gabion before loading with stones

Illustration: Practical Action / Neil Noble.

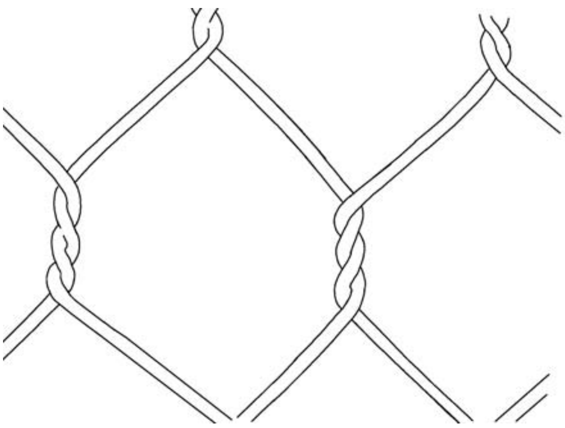

Figure 7: Hexagonal wire mesh with three twists.
Illustration: Practical Action / Neil Noble

Woven double twist or triple twist design is used in commercial gabion construction. The cost of commercial gabions can be prohibitive to many remote communities so alternative approaches have been developed in a number of regions. Hexagonal mesh gabions can be made locally with hand tools.

This hexagonal design can be replicated using galvanised (zinc coated) steel wire with a diameter of 2.7mm and simple tools such as vice grips and jig to help construct them. The hexagonal mesh size should be approximately 10 to 12 cm. Heavier wire can be used along the corners and edges (4mm) to strengthen them.

For example in Sri Lanka a jig was developed to improve local manufacture of hexagonal mesh gabions. The design of the jig used steel pegs positioned on a metal back plate allowing for flexibility in the construction process (Figure 10).

To enhance the strength of the gabion cross wires are incorporated into the overall structure. This transverse wire can be finer than the main wire used (Figure 11).

Overall dimensions of gabions can vary. 3m x1m x 1m and 2m x1m x 1m rectangular structures have been commonly used in Nepal.

Once the gabions cages are made they are placed in their correct position and stones can then be loaded into them by the local community.

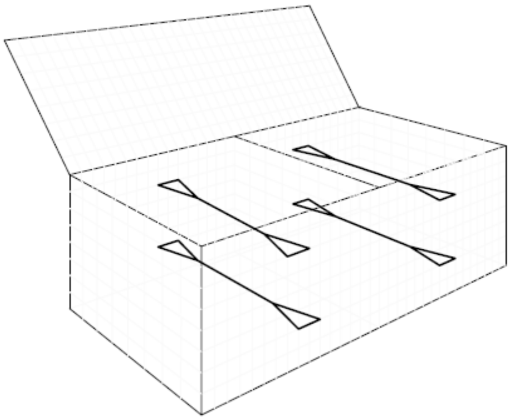

Figure 11: Cross links with wire

Illustration: Practical Action / Neil Noble

Any stones that tends to crumble or are soft and disintegrate with abrasion are not suitable. Stones from the river that have already been worn smooth are most suitable.

When correctly positioned the gabions are then fixed together with wire.

Life of gabions depends on the type of wire used. Galvanised wire protects against rust as long as the surface coating is not damaged.

The amount of water exposure will also affect the life of the gabion and if saltwater is present then corrosion will be more extreme. 20 years is regarded as a safe minimum.

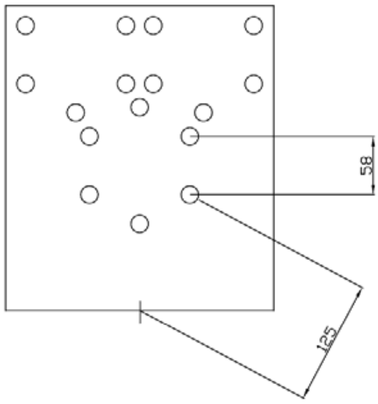

Figure 10: Steel pin jig design for hexagonal gabion construction in Sri Lanka. Illustration: Practical Action / Neil Noble.

Evenly graded stones can be used so that the gabions are well packed. The largest stones should not be more than 2/3 of the minimum dimension of the gabion.

Figure 12: Loading rocks into the gabion cages, a community activity.

Photo: Practical Action Nepal.

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Reference and Further reading

- *Report on Local Manufacture of Gabions, Rural Technology Centre Nuware Eliya District Sri Lanka*
  ITC Intermediate Technology Consultants 1987
- *Labour Intensive Manufacture of Gabions in Haiti*, Appropriate Technology Vol. 8 No. 3
- *Gabions for Hydraulic Structures* Appropriate Technology Vol. 7 No 4 March 1981
- *Design of Gabion Retaining Walls*
  ITC Intermediate Technology Consultants 1987
  This report consists of the following parts: Desk study report which outlines the basic principles employed and assumptions made in the preparation of the simplified methods of designing gabion retaining walls. An instruction manual which deals with the methods necessary for conducting training courses for technical officers in the use of the simplified method of designing gabion retaining walls. Design charts which outline a simplified method for designing gabion retaining walls
- *Small Dams and Weirs in Earth and Gabion Materials* FAO Water Resources Development and Management Service (AGLW)
  http://www.fao.org/ag/agl/aglw/oldocsw.jsp
  A set of practical guidelines and norms for field engineers for the design and building of structures using earth and gabions. The publication will be useful in designing gabion spillways for small hillside dams, intake weirs for gravity irrigation schemes, groynes, river bed training works and for protection against hydraulic erosion.

DIPECHO is the Disaster Preparedness Programme of the European Commisson's Humanitarian Aid department (ECHO), the largest single humanitarian donor in the world. The DIPECHO programme funds pilot projects intended to demonstrate that simple, inexpensive preparatory measures, particularly those implemented by communities themselves, can limit damage, increase resilience and save lives. http://ec.europa.eu/echo/field/dipecho/index_en.htm

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SAHANATI was founded in 2001 as an institution for equitable development. It works with poor, marginalised, and landless ethnic indigenous populations to help establish their rights and improve their living conditions. It does this by promoting indigenous knowledge and practices, rights based advocacy, community empowerment activities and promotion of sustainable livelihoods. www.sahamati.org

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Campaign Service Centre (CSC) was established in 1999 in Nawalparasi with the main objective of ensuring the basic human rights and equitable development of socio-economically marginalised communities who are also vulnerable to conflict and a range of natural hazards. It also conducts regional level work in relation to water issues and is presently involved in campaign work over a proposed border dam between Nepal and India.

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