# Construction of Bamboo Gabions

By Ingemar Saevfors, December 20, 2011

Guide lines based on experiences from a Disaster Risk Reduction mission for ECHO/Concern Worldwide in Timor Leste 2009:

## Erosion

Erosion problems are found almost everywhere and in most cases *man made*:

- Road drainage systems are cutting vegetation carpets and concentrating storm water flows with too few deviation ditches and without all necessary cross evacuation culverts.
- Semi urban population densities have been formed in the settlements, often due to migration after conflicts, and have resulted in increased strain on the environment with the escalated needs for cattle pasture and wood for fuel.
- Another reason may be contractors who are buying cheap stone materials from the village neighborhoods. Obviously these stones are collected on slopes close to the road which further aggravates the erosion.

Effects of the climate change are also noticed: The patterns of erosion are unprecedented according to elders we talked to. There are now frequent landslides, flooding hazards, collapsing roads and bridges. Depressed chunks of land, looking like golf court sand bunkers and other signs of landslides have developed in open spaces.

One could summarize the disaster risks as mainly affecting public works related utilities; access roads and bridges, drainage system collapsed, etc... Directly they affect all the people in a settlement and in a longer term individual houses and agriculture.

## Finding local materials for structural mitigation

Finding local materials is *easier said and recommended than done*. At the end of the day, most governments and NGOs prefer to play it safe and *rather employ known, no matter much more expensive solutions*, to avoid the blame of an unsuccessful attempt. Unfortunately, with such defensive thinking no development process will take place. In a scale up endeavor one would think that economy and thereby quantity must be of prime importance.

Another issue is that contractors and *corrupt officials are not interested in low-cost* solutions and not much in management by local people either.

There has to be a tradeoff between an expensive and perhaps safe outcome, and the considerable cost savings combined with the employment opportunities that local materials can offer. The

maintenance challenges will have to be met with *a community awareness of the problem and ownership of the solution.*

Steel gabions against erosion may be the answer where high vertical loads have to be supported in limited space, like under culvert outlets. Riverbanks on the other hand, have mainly to sustain horizontal erosion from flooding and the protections needs are different. As an option to the rather expensive, imported steel wire gabions now in use, bamboo gabions can be manufactured locally. Combined with retainers and a new design they require much less stone volumes than the steel gabions which have to be built on a double gabion foundation base just to bear their own weight.

Bamboo, which grows in abundance in many tropical and temperate regions, has an outstanding tensile strength to offer if the construction design is right. Unconditionally bamboo has to be treated against insects and decay. Mostly boron derivatives are used such as boric acid, borax etc. These chemicals provide an inexpensive, low toxic treatment, not harmful to people or domestic animals and with very limited effect on plants. [1]

The treatment process can be made quite simple with a soak in a dip ditch. One problem though, is the leaching of the boron in rains; hence the potential loss of the protection. An option is therefore a second dip in waste motor oil which provides a water repellent coat. Another issue could then be oil leaking into the river; however, the released quantities observed during the mission were minimal.

Ultimately this protection will also wear off over time; therefore the simultaneous planting of protective grass species is one of the most important steps in this eco-gabion concept.

We opted for a spool-shaped gabion design which easier should resist violent storm water impact. In addition a retainer bar system anchors the gabions into the river bank. The stack of gabions leans at 80˚ against the river banks and creates by its weight a certain pressure to hold the soil in place.

[1] Dr Berhan Ahmed, School of Forest & Ecosystem Science, Faculty of Land and Food Resources, University of Melbourne.

## Construction details

In a regular 6-7 cm diameter bamboo pole 2 to 3 cm wide slats are cut leaving both end nodes intact.

Then the entire pole is compressed from both ends and a spool shaped basket is automatically created. The noses at both ends should be reinforced with some 3 mm steel wire against splitting.

Bracing slats at 45 degrees are then tied in with similar steel wire.

Windows can later be cut anywhere to fill the gabion with stones and then closed again with more wiring.

Normally, the gabions will stay much longer in place if they are anchored with retainers made of 6 mm steel reinforcement bars. For this purpose 10-12 cm wide holes are horizontally bored 1 meter into the riverbank or the hill slope with a hand auger. This tool can easily be manufactured in a local metal workshop from a 10 cm wide regular steel tube.

The fastener of the retainer device is a bamboo eccentric claw fixed to the reinforcement bar and inserted into the bore hole. When pulled, it opens and acts like an expander bolt; the more it is yanked, the better it is fixed in the bore hole. Afterwards the borehole is stuffed with clay or rags to prevent water from soaking the earth and weakening the fixture.

Protection by gabion stone cages can be further improved with geotextile tissue which lets water flow through but retains the soil particles. This will no doubt help to avoid soil being eroded behind the stone filled gabions.

Geotextiles will have to be imported though, but innovative techniques for using local materials may sometimes require new components. Totally this combination could still be economic and at the same time create substantial income for rural people.

During field work the fibers from certain palm trees were identified as a possible substitute for geotextiles. These fibers could be stuffed behind the gabion when packing the stones.

Most important though, is the planting of trees and grass, such as *vetiver* wich can develop roots 3 m into the ground and is capable of sustaining extended dry seasons. These species should be planted consistently in combination with the construction of bamboo gabions or lining works. When one day the bamboo breaks down these plants will continue to protect the soil from erosion.
Actually, bamboo itself, in its growing stage, has by nature an extensive and protective root system, as often seen at riverbanks.

## Ownership of mitigation assets

These gabions are very easy to produce for local people who live in bamboo regions, but require a lot more than just filling them with stones. The community has to be sufficiently motivated to treat the bamboo against insects, maintain the structures on a periodic schedule and nurture the rooting grass.

All these prerequisites must be accomplished; otherwise an erosion mitigation project like this will backfire. Bamboo is not known as a permanent construction material to local people, and this “poor man’s” stigma is the worst problem to overcome.