Check Dam Erosion Control

Purpose

Small check dams made of stone can reduce erosion and slow water flow in gullies, thereby reducing stream and river bank erosion downstream.

A series of small check dams in Ghor province slow water flow on this hillside

Partners

GIRoA District Agriculture Extension Agents, Village Leadership, Farmers' Shura.

Potential Stakeholders

Local farmers, herders, local village leadership, people with property rights to the affected hillside and downstream areas.

Advantages/Benefits

Benefits. The purpose of check dams is to 1) prevent soil erosion, 2) to slow the flow of water downstream and 3) help re-establish vegetation for grazing.

Affordable. Check dams are a cheap and effective way to improve watershed conditions. Water flowing quickly down a hillside that lacks vegetation will remove soil, accelerating erosion and rangeland degradation. If water continues to flow unrestricted down hillside gullies, it can overburden streams and rivers downstream and lead to river bank erosion, flashfloods, and sediment buildup – clogging downstream water infrastructure like dams and irrigation canals. Check dams also encourage water to percolate through the soil, recharging groundwater resources and helps re-establish vegetation.

Water trapped behind check dams will either enter the soil or evaporate. Note the accumulation of finer soil behind the dams, which would have washed away without the dams.

Local Materials. Check dams can be constructed from locally available materials, so funds are exclusively dedicated to planning and labor. Little training is required to build check dams, and they can be maintained and recreated without printed diagrams.

Note. If stream and river bank erosion are problems, the problem is likely upstream. Although river bank stabilization may be necessary, building check dams higher upstream first may be a more sustainable solution, but one that lacks the immediate impact of stream stabilization

Limitations

Cause and Effect Understanding. Stakeholders may not understand the impact of check dams upstream as a solution to problems downstream. In some regions of Afghanistan, people believe that hillside erosion is a good thing as it replenishes the farmland. However, the damage caused by heavy erosion outweighs these benefits. One must clearly explain the strategy of managing water and soil upstream in order to improve conditions downstream. Pictures and diagrams may be required to explain these concepts.

Erosion control

In some areas, there has been considerable emphasis on stabilizing riverbanks using physical structures (e.g., Gabion Baskets). Such work often tends to accelerate water flow and increase erosion on land immediately downstream. Thus, such riverbank stabilization should mainly be used to protect small, high value sites, like houses or schools.

Integrated effort. Check dams are not a onetime solution to watershed and erosion issues. Check dams need to be built in groups, i.e., one check dam on a hillside will not suffice. Many small check dams properly placed across a hillside provide more benefits than a few large

checksums at the bottom of a hill. Check dam construction is most useful in coordination with other watershed management activities such as hillside terracing, improved grazing animal management, tree planting, etc.

Materials Required

Rocks. Check dams can be built using rocks collected from the local area. The rocks should be small enough that a single person can easily maneuver them, but large enough that they will not be dislodged by flowing water. The rocks should be a hard material that will not easily wear with water flow (i.e., shale and sandstone should be avoided).

Use only rocks that are available on site to reduce costs and the risk of removal.

Check dams can be constructed with local materials. This image shows roughly built check dams, which require little labor and maintenance. .

Other materials. Materials such as wood, straw bales, fiber rolls and metal can be used to construct check dams. These materials are not recommended for Afghanistan, as they often have other, more valuable uses for the local population. Even rocks shaped by a mason should be avoided since these are likely to be taken and used for other purposes.

Action Plan

1. **Assessment.** Determine if runoff and erosion are issues affecting the local area.
    a. Locals may not acknowledge this as a problem, but there are visual clues in the landscape indicating problems resulting from high runoff flow and hillside erosion (**Appendix I**). Signs include:
        i. Gullies at the base of slopes leading up to narrow channels on hillsides that are accessible to potential check dam builders. Focus check dam building in upslope areas where gullies are just now forming and are small enough to step across.
        ii. Exposed soil on hillsides that have been subjected to grazing.
2. **Monitoring.** Monitor water runoff and hillside erosion patterns during the spring (if possible).
        i. If streams that originate from these hillsides cause flooding problems, such as sediment deposits in *wadis*, flash flooding, or stream bank erosion following rainfall or snow melt, consider check dam construction.
        ii. Beware that floodwaters are not originating from elsewhere, otherwise check dams will not have the impact expected by stakeholders
        iii. Be sure that the greatest flows of water and sediment will not overwhelm potential check dams. **Western engineers have often failed to grasp the strength and destructive power of floodwater flow in Afghanistan**. These problems are best avoided by concentrating building projects far up on hillsides where gullies are very small or just beginning to form and where water flow will not overwhelm check dams.
3. **Stakeholders and Partners.** If runoff and erosion are issues, identify potential partners and stakeholders.
    a. Partners may include:
        i. GIRoA district agriculture extension agents
        ii. Local village leadership
        iii. Farmers' Shura
        iv. Farmers or herders that use or have property rights to the affected area
    b. Stakeholders may include:
        i. Local farmers and herders

   ii. Local water agents
   iii. District leadership
4. **Buy-in.** Meet with local partners and stakeholders to discuss the reason for the project, its potential impact and benefits, materials, and labor required.
5. **Strategy.** Develop an implementation strategy that fulfills the project's requirements, but respects local power dynamics and needs.
   a. The implementation plan should include:
      i. Training
         1. Training could consist of determining where to locate check dams and building a model check dam
      ii. Construction (could be a series of work days)
      iii. Follow-up training on how to monitor the check dams and repair as necessary
6. **Engage DAIL.** If using the "train-the-trainer" methodology, schedule the DAIL staff training session prior to the larger training event, with sufficient time for the DAIL staff to run a practice session.
7. **Integrate.** If possible, consider additional watershed management strategies such as terracing on the same slopes where the check dams were built.

Technical Instructions

Construction Timing. Check dams are meant to reduce the impact of melting snow and spring rains. Check dam projects can be done whenever labor is available and hillsides are accessible. If possible, keep an eye on water flow conditions and erosion during the spring when water flow is greatest.

Material and Porosity. Loose rock check dams should be made of durable loose stones, between 15-60 cm in circumference; bigger rocks are better where water flow is stronger. It is critical that the check dams are porous and allow water to flow through – the purpose of check dams is to reduce water flow speed, not to retain water. Local partners might ask to use concrete or mortar to build the dams, but this should be avoided as concrete and mortar contradicts the porous design of the dams and their intended purpose and reduces focus on maximizing the number of small dams built.

Key in. Check dams should be "keyed" into the sides of the gully. Dig lateral trenches into the sides of the gully, extend the check dam into the sides, and back fill so as to prevent water flow from gouging soil out from the sides of the check dams (see Figure 1, Image 2).

Shape. The check dams should have a notched, "V" or "U" shape at the top so as to channel water towards the center of the dam and prevent water flowing around the edges of the check dam. (see Figure 1, Images 1 & 2). Check dam height is often about ¼ of the base width (see Figure 1, Image 3), but this depends on building material.

Foundation. The check dam should extend below the soil surface to bedrock or for at least 30-50 cm to prevent water from undercutting the check dam structure (see Figure 1, Image 2).

Dam Spacing. Check dams should be built in sequence. If possible, the distance between subsequent check dams should be so that the base of the previous dam is at the same height as the top of the second dam (see Figure 2). This may not be possible in steeper settings, but a general rule to follow is that the space between check dams will decrease as the slope of the hillside increases.

Reducing downhill erosion. Large stones should be placed on the downhill side of the check dam to reduce the impact of spill over from gouging out soil behind the check dam.

Technical schematics can be found in **Appendix II** of this Project Action Plan.

Figure 1: *Check Dam Profile*

Image 1: *Dam center should be lower than the sides.*

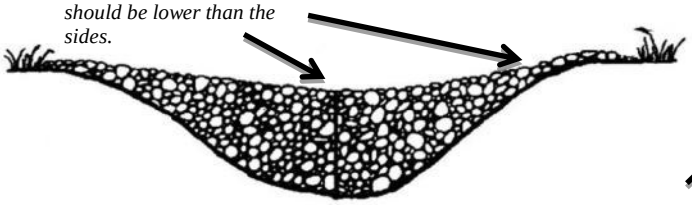

Image 2: *Check dam sides and foundation extend into gully banks.*

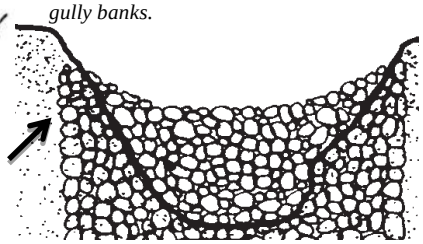

Image 3: *Check dams should have a 2:1 slope, approximately a 45° angle. The result will be sides twice the height.*

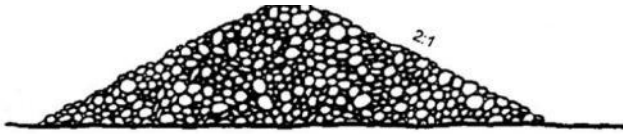

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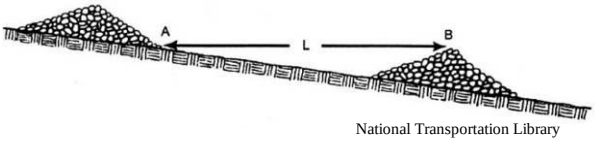
Image 1: *Front view of check dam in gully.*
Image 2: *Front view of check dam showing the structure's extension into the gully's sides and bottom.*
Image 3: *Side view of check dam, detailing check dam slope construction slope.*

Figure 2: *Distance between check dams*



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Training Resources

Minneapolis and St. Paul Metropolitan Council Environmental Services:
http://www.metrocouncil.org/environment/water/bmp/CH3_RPPSedCheckdam.pdf

California Stormwater Quality Association:
http://www.cabmphandbooks.com/Documents/Construction/SE-4.pdf

e-Afghan Ag Forestry and Watershed Management Page:
http://eafghanag.ucdavis.edu/forest-watershed-man

Extension Opportunity

Check dams are easily constructed and, if properly installed in the correct location, their impacts are clearly seen by others who may benefit from this practice. Once a community has received basic check dam training, successful projects can be easily expanded or repeated in other locations without further outside input. Alternately, work with local leaders to facilitate inviting DAIL personnel from other locations for field demonstrations and training. This will help them spread proper check dam installation to their work areas. Do not be afraid to point out how future projects could be improved to prevent mistakes from being repeated unnecessarily.

Projects constructed in locations where people from other villages will be able to see the benefits of the check dams increases the likelihood of project expansion.

Effects/Outcomes

- **Mitigate Damage.** Reducing the speed and amount of water flowing from hillsides decreases flooding and its impacts on downstream areas.

- **Increase Awareness.** Working on hillsides increases community awareness that abusive land management in these less appreciated areas damages the irrigation systems and farmland that villagers consider very valuable.
- **Improve Rangeland.** Check dam construction can increase vegetation development and grazing land recovery, especially when this practice is combined with terracing and range management.
- **Strengthen Community.** Cooperative projects are difficult in Afghanistan, but encouraging people to work together to solve common problems can help rebuild or strengthen community institutions.

Appendix I: Visual Indicators of Erosion

Rill erosion is evident, consider terracing

Only minor erosion has occurred, improved range management would increase productivity and prevent further problems

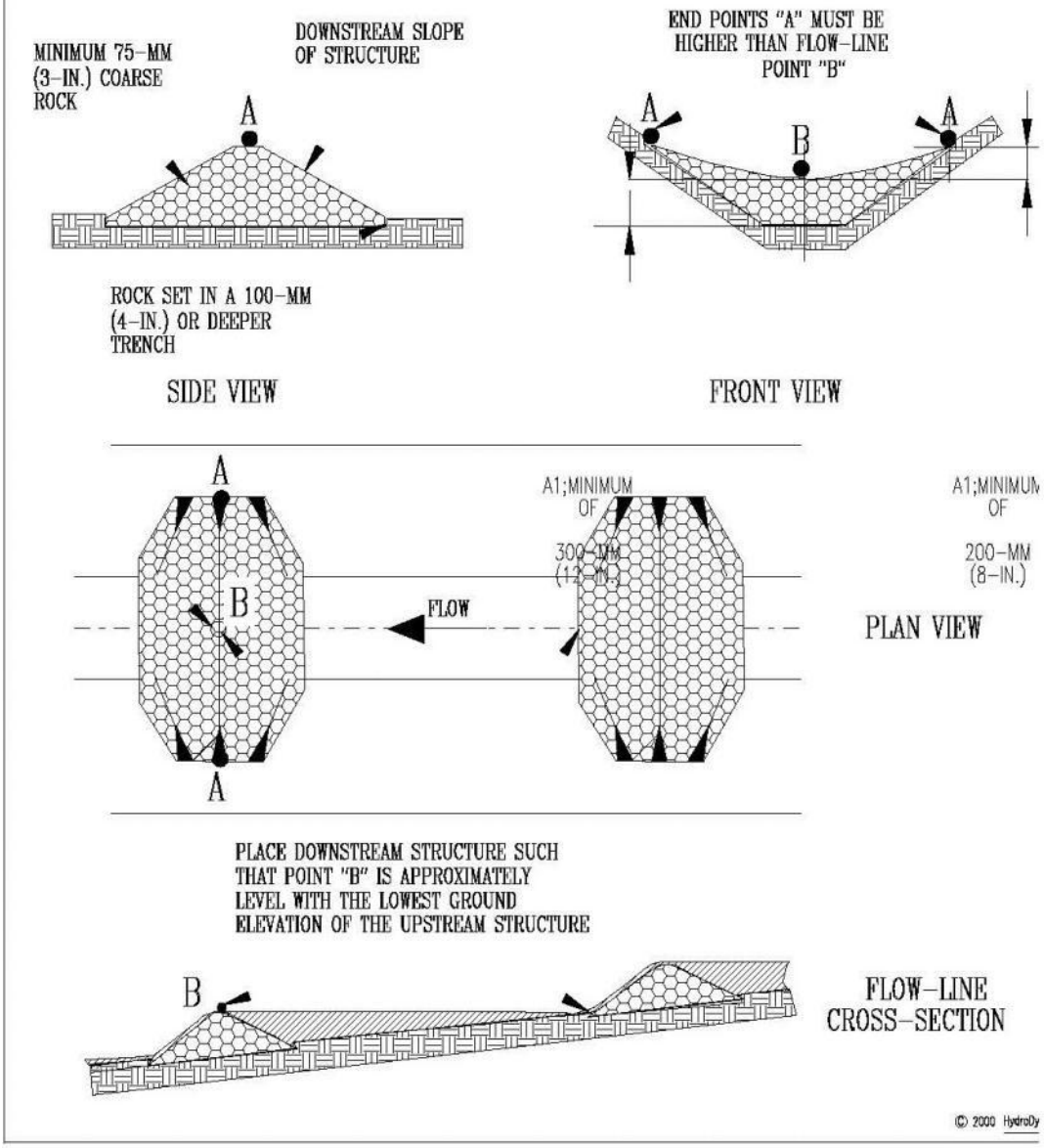
A gully has formed; small, loose stone check dams in the upper hillsides may be considered

This small gully can be leveled and terraces installed

Appendix II: Detailed Schematics of Loose Stone Check Dam Design

D_{50} OF ROCK (MM)	DOWNSTREAM SLOPE OF STRUCTURE 35 % 30 % 25 % 20 % 15 % 10 % MAXIMUM FLOW DEPTH ON ROCK (MM)					
75	15	18	20	25	33	50
150	30	36	40	50	66	100

SUGGESTED ROCK DIAMETER & FLOW DEPTHS



Source: HydroDynamics, Inc., 1999