POTENTIAL OF ROADWATER HARVESTING IN AFGHANISTAN

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1. WH History in Afghanistan

Main purposes: Drinking water & Irrigation water

- The actual history is not well documented.
- The oldest RWH structure is located in a Budist Stupa in Northern province of Samangan (Thakht-e Rustam) built in 4th or 5th Centuries AD.
- Also ponds along the silk road shows that WH techniques are used in the country for a long time.

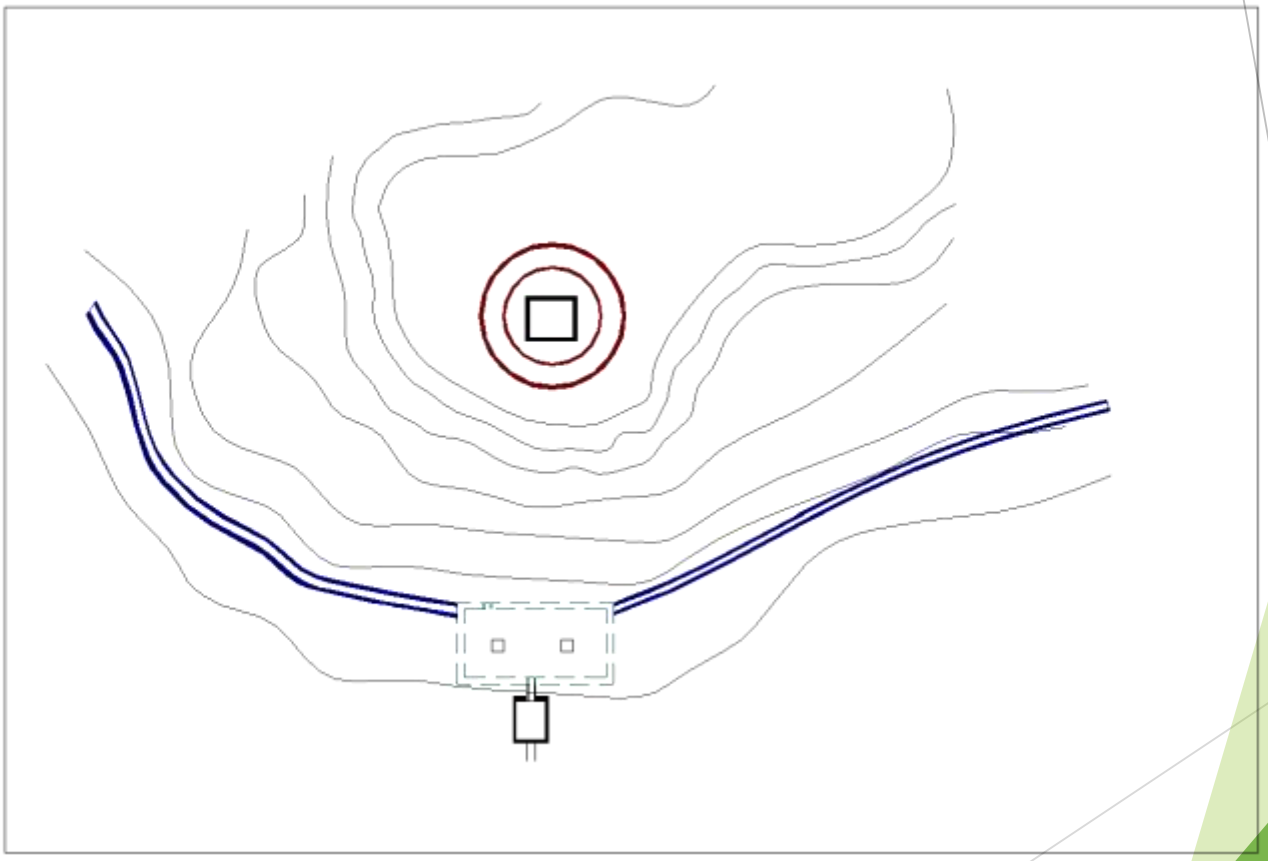
2. WH Techniques in Afghanistan

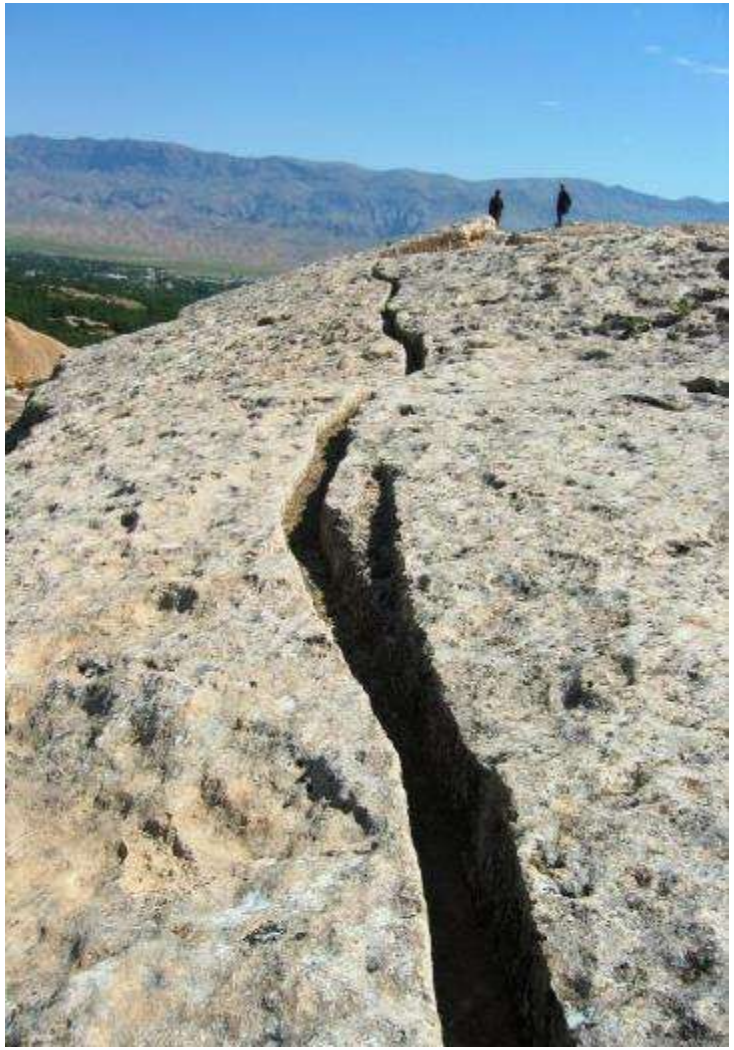
KANDA :

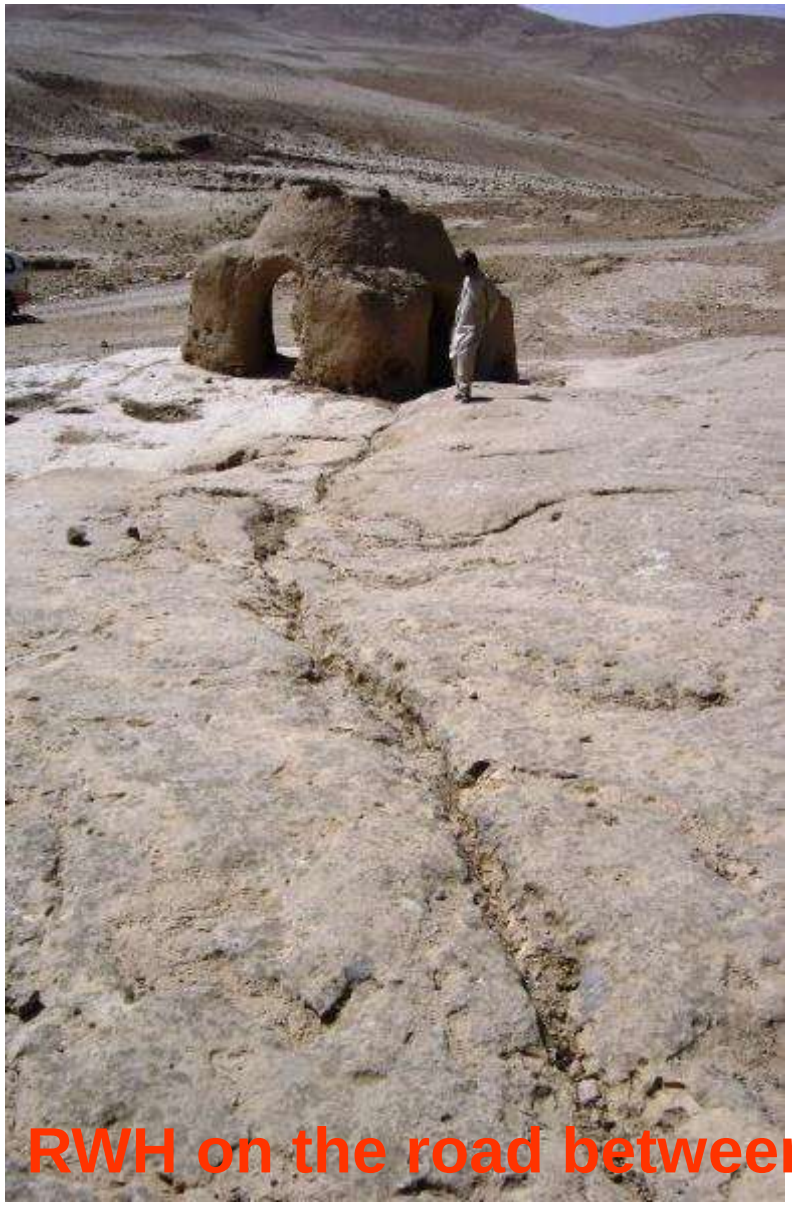
- Northern and Central parts - pastoral area (usually in the mountains consisting of lime stone).
- Round or rectangular underground reservoir with more or less than 10m3 volume
- Micro Catchments
- Rain and snow melt as source of water
- built by the herders and rain-fed farmers: excavating the ponds/reservoirs in the mountain consisting of lime stones.
- Rainwater is harvested automatically
- In summer when there is no flow of water in close by streams but still there is grass for grazing in the pastures
- Animals, herders and travelers, mainly for drinking purpose.

2. WH Techniques in Afghanistan

KANDA :







RWH on the road between Saighan and Kahmard

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2. WH Techniques in Afghanistan ... .

NAWR, NAWOR or Hawz

- Northern, Western and Central parts of the country mainly in the villages and pastoral areas (usually in low land area where the ground water is saline or difficult to get)
- Mainly rectangular pond with different dimensions
- Macro catchment areas
- Rain water as source harvested through water channels during winter and spring seasons
- Mainly built by the community/ farmers/herders.
- Used in summer when there is no flow of water in close by streams or canals, by animals, herders and travelers

Nawr/Hawz after rehab

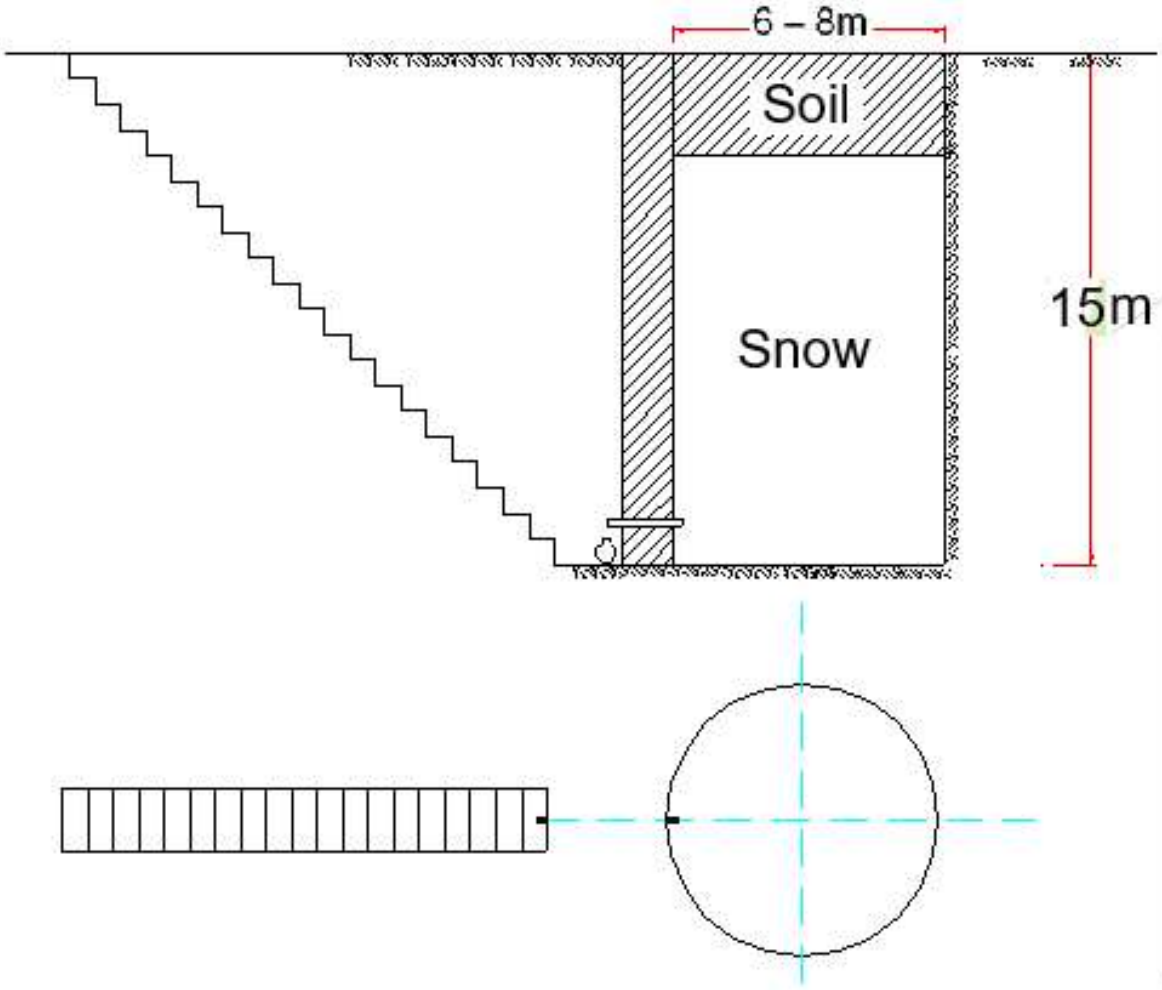
Taile in Bawran village of Pashtoon Zarghoon

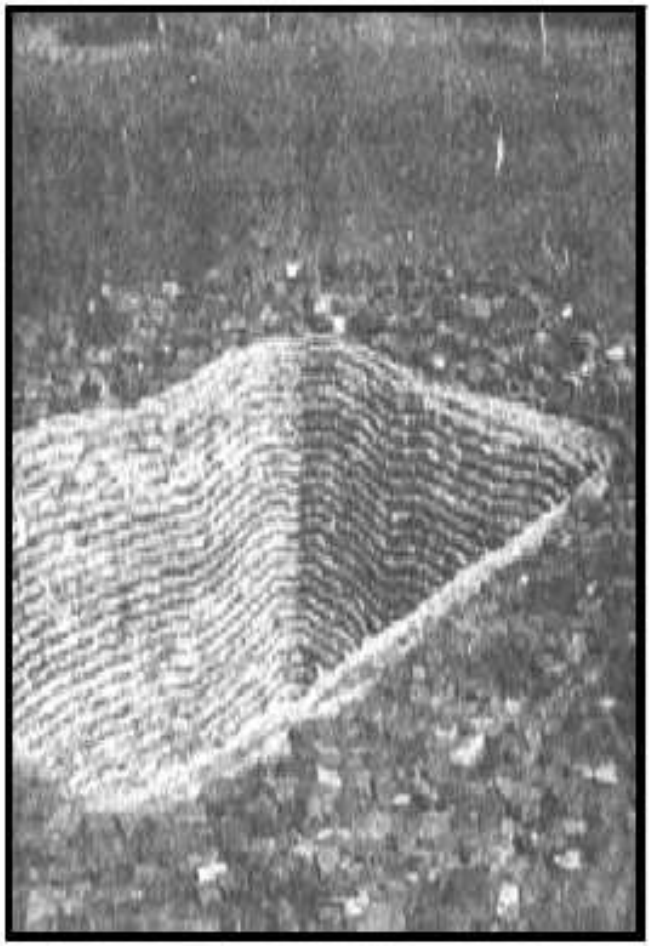
2. WH Techniques in Afghanistan ... .

YAKHDAN/BARFDAN:

- Northern, Western and Central part of the country mainly in hilly areas where it is easy to collect snow
- Shallow well with dia 5-10m and a depths of up to 10m build by the community and individual in Micro catchment areas
- Mainly fed from snow melt, which is collected from the close by area and compacted in layers in the well- snow is covered by rice straw and clay soils; during winter
- The water is used in summer when the weather is hot and there is no flow of water in close by streams or canals.
- Users are villagers for drinking purpose and local Ice Cream makers (old time) Snow Soil 6 – 8m 15m

2. WH Techniques in Afghanistan ... .



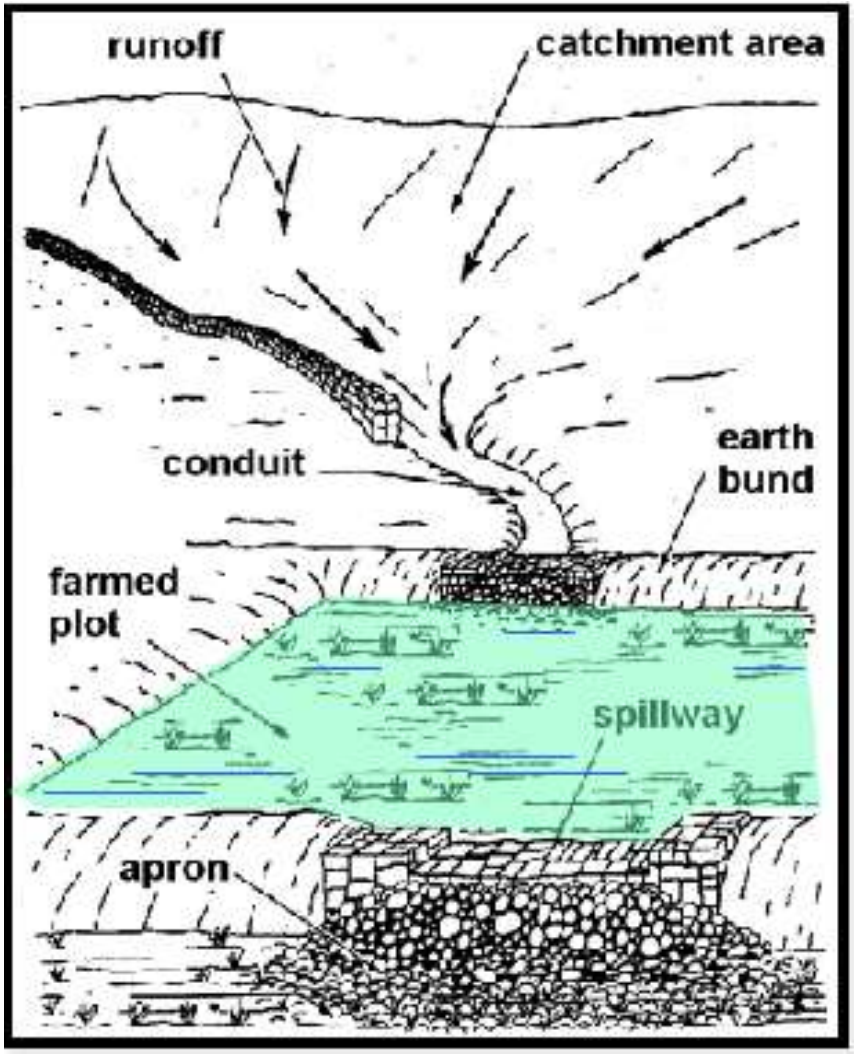


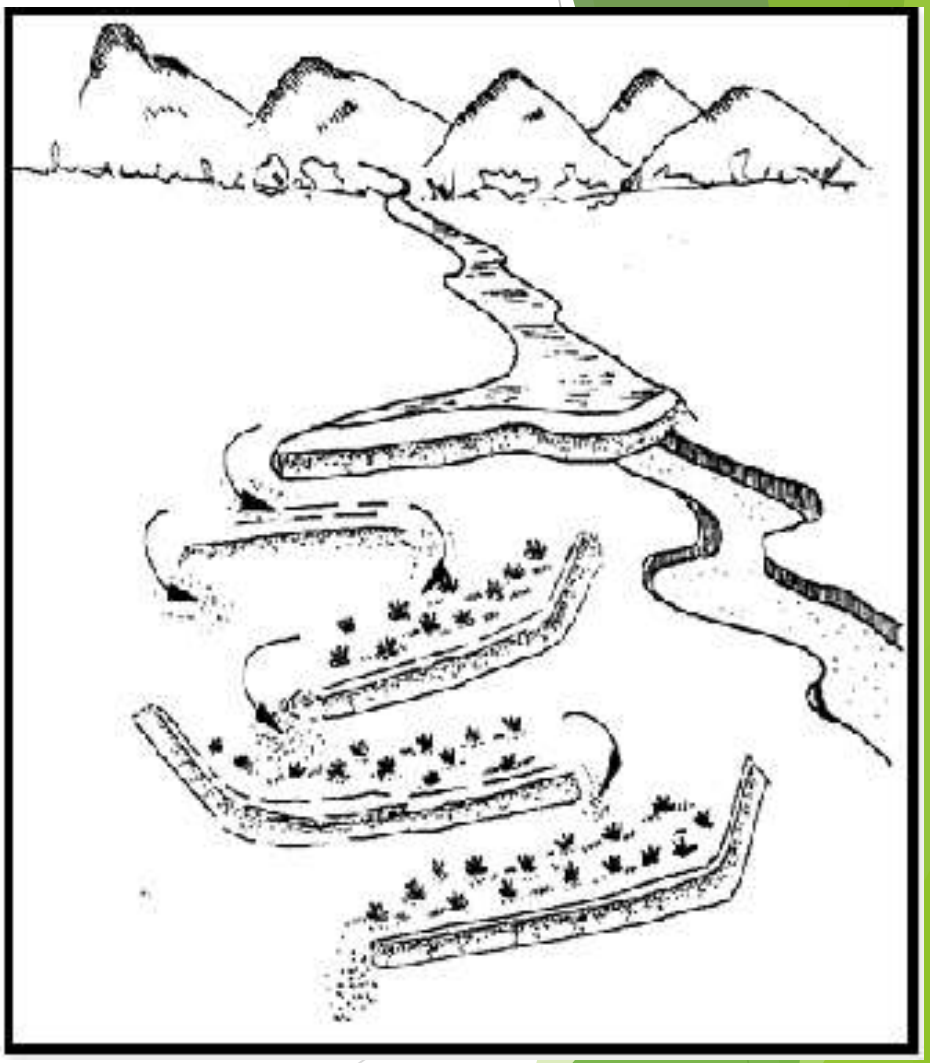
2. WH Techniques in Afghanistan ... .

WASTA:

- Southern part of the country where Monsoon can reach, mainly in low lands
- Pond surrounded by earthen bunds in an area of 1 or 2 ha with 1 to 2m depth
- In Macro Catchments, sourced by flood water
- Built by the farmers, harvested by flood water running in the wash is diverted to the Wasta; during early summer
- The water us used after a few days of harvest when the crops need water
- Used by villagers for agriculture purpose.

2. WH Techniques in Afghanistan ... .





2. WH Techniques in Afghanistan ... .

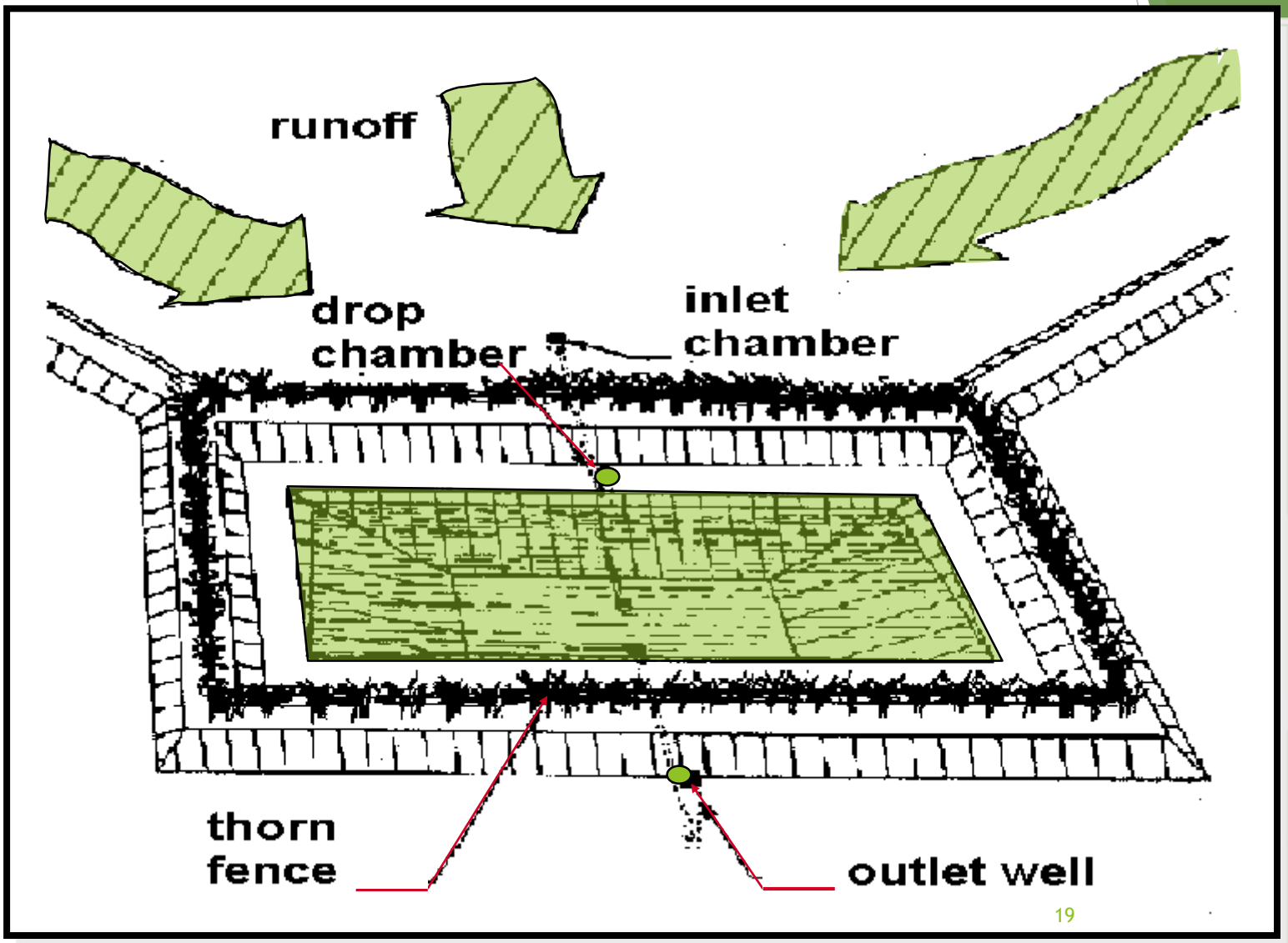
POTENTIAL OF ROADWATER HARVESTING IN AFGHANISTAN

2. WH Techniques in Afghanistan ... .

TAILE /HAWZ/TALABS:

- Western, southern and northern parts of the country, mainly in low lands with no ground water or saline ground water/ along the silk road
- Covered or uncovered reservoir with different sizes, found close to the mosques
- In Macro catchments, fed from canal water
- Built by the community, and canal water is diverted to the taile during winter and spring.
- Used during summer time when the canal is not flowing any more, by the villagers/livestock for drinking purpose.

2. WH Techniques in Afghanistan ... .



2. WH Techniques in Afghanistan ... .

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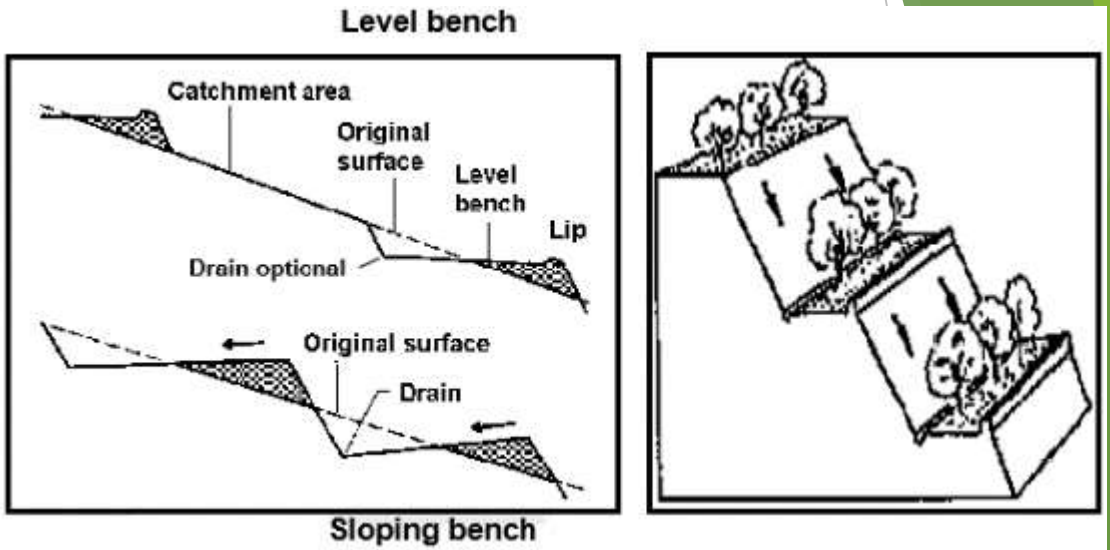
Grapes in Deep Furrows

2. WH Techniques in Afghanistan ... .

Roof rainwater harvesting

2. WH Techniques in Afghanistan ... .

Terraces



3. Why Road for Water? (Dream and Opportunity)

- - To have roads systematically used,
- - To recharge/retention, storage water,
- - To manage water all over the world,

  (Sub Saharan Africa and Asia, such as Afghanistan), and
- - To create win-wins

3. Why Road for Water? (Dream and Opportunity)

- Annual investment 1-2 Trillion USD on Roads
- 40% in developing countries,
- 1 Billion people totally unconnected
- Increased water stress – most poor in water stressed areas (74%)
- MDB's invest USD 17.5 Billion/Yr up to 2022
- **United Nations Secretary-General's High-Level Advisory Group on Sustainable Transport:**

'Transport plays an essential role in countries' economic growth, competitevness, balanced and liveable spatial development, access to water and energy and food saving.

3. Why Road for Water? (Dream and Opportunity)

- Annual increase of roads: f.i. 70,000 km in SSA
- Water is 35% of damage to paved roads, up to 80% to unpaved roads
- Roads change the surface hydrology and have major impacts on run-off
  - now often causing local flooding, water logging and erosion

"This can be turned around in large potential for water harvesting and water management"

3. Why Road for Water? ... .

Some Results of Reconnaissance Studies

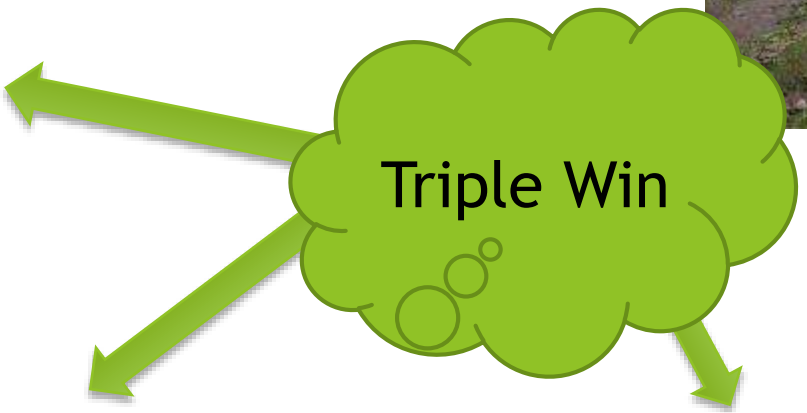
I. In 200 kilometers:
- Erosion and sedimentation: 150 locations
- Flooding of houses and land: 45 locations
- Persistent waterlogging: 65 locations

II. Deficiencies in governance process
- Missing from guidelines,
- No coordination,
- No interaction with road-side communities.

III. Social impacts
- Damage to land and houses, dust
- Poor – most vulnerable least access to potential
- No compensation, indirect litigation

3. Why Road for Water? ... .

- REDUCED WATER DAMAGE TO ROADS (-35%)
+ HIGHER RELIABILITY



- REDUCED DAMAGE FROM ROADS THROUGH FLOODING, EROSION AND SEDIMENT DEPOSITION (-30%)

+ WATER HARVESTED FOR RODUCTIVE USE 400,000 M3 PER KM

+ RISING GROUNDWATER LEVELS 1.9-5.8 MTR

+ INCREASED SOIL MOISTURE 30-100%

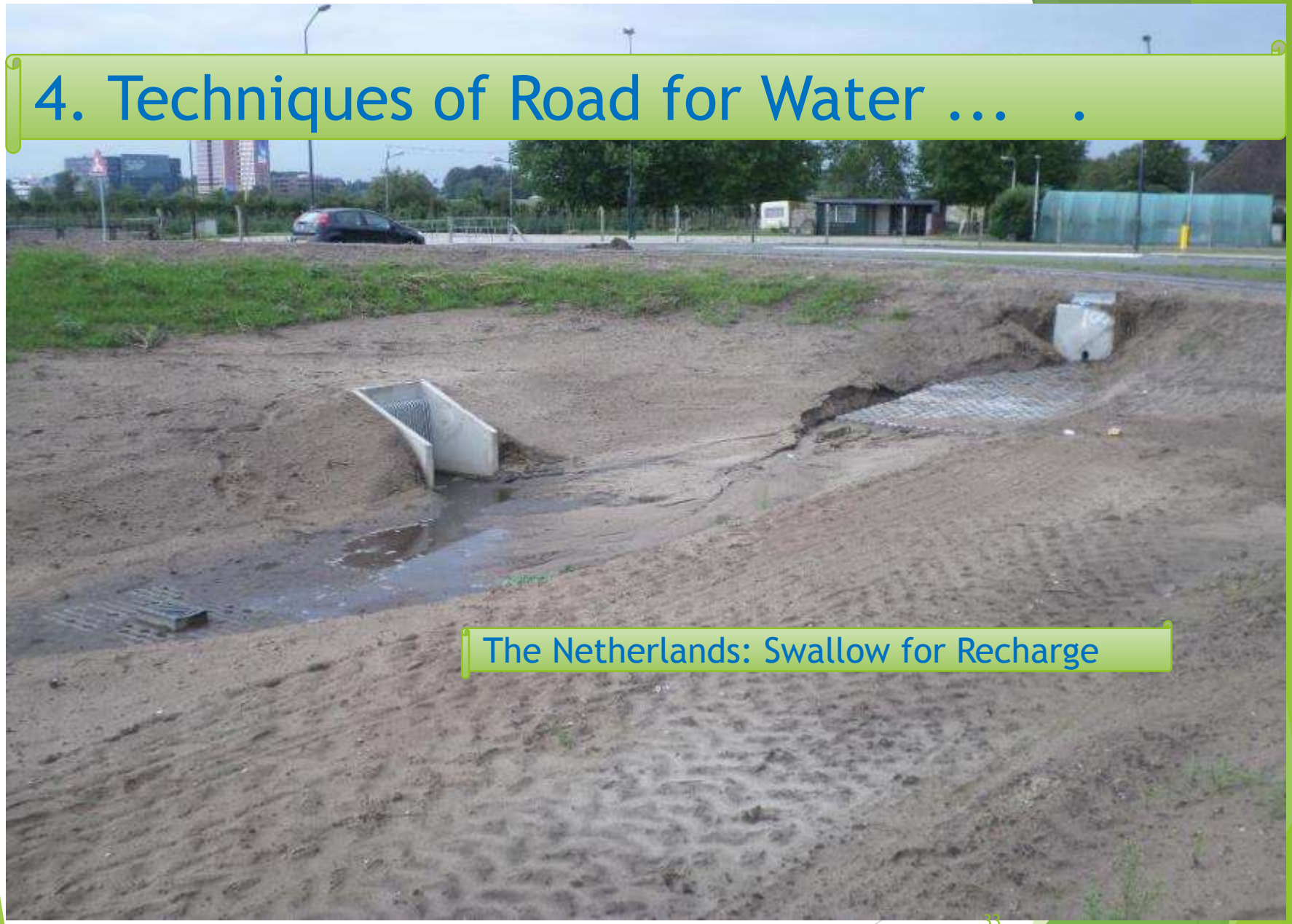
NOW 1.3 PROBLEMSPOT PER KILOMETRE

4. Techniques of Road for Water

Adapting to changed road run-off

1. Spreading water from road surface
2. Harvesting water from culverts, side drains and depressions
   - Converted borrow pits
   - Infiltration ponds
   - Infiltration trenches/ pits
   - Swallows
   - Diversions/cutoffs/trenches to farm
3. Gully plugging for recharge
4. Spring capture

4. Techniques of Road for Water ... .



The Netherlands: Swallow for Recharge

4. Techniques of Road for Water ... .

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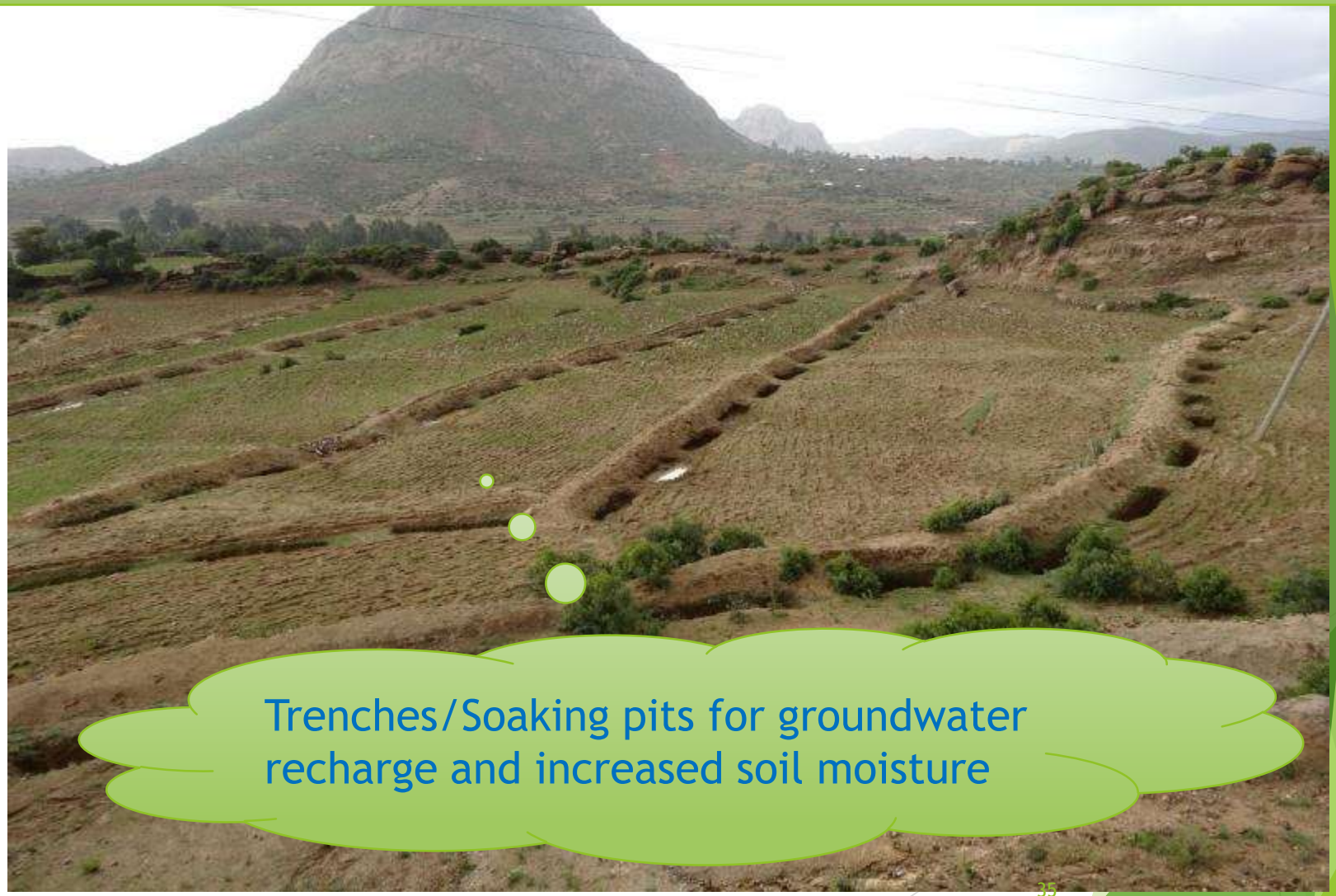
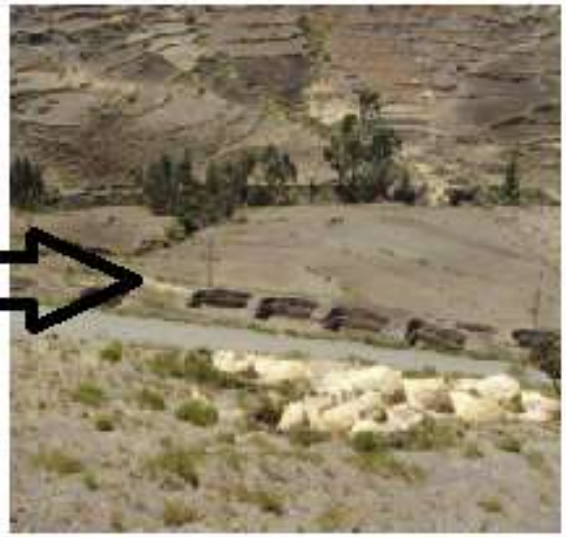


4. Techniques of Road for Water ... .

Embankment Erosion ⇨ **Infiltration ponds, downside drain, mountainous terrain**



4. Techniques of Road for Water ... .

Ponding water on downside of culvert Ethiopia, in flat terrain

4. Techniques of Road for Water ... .

Ponding water on upside of culvert using sluice gates

SE Mali,
flat terrain

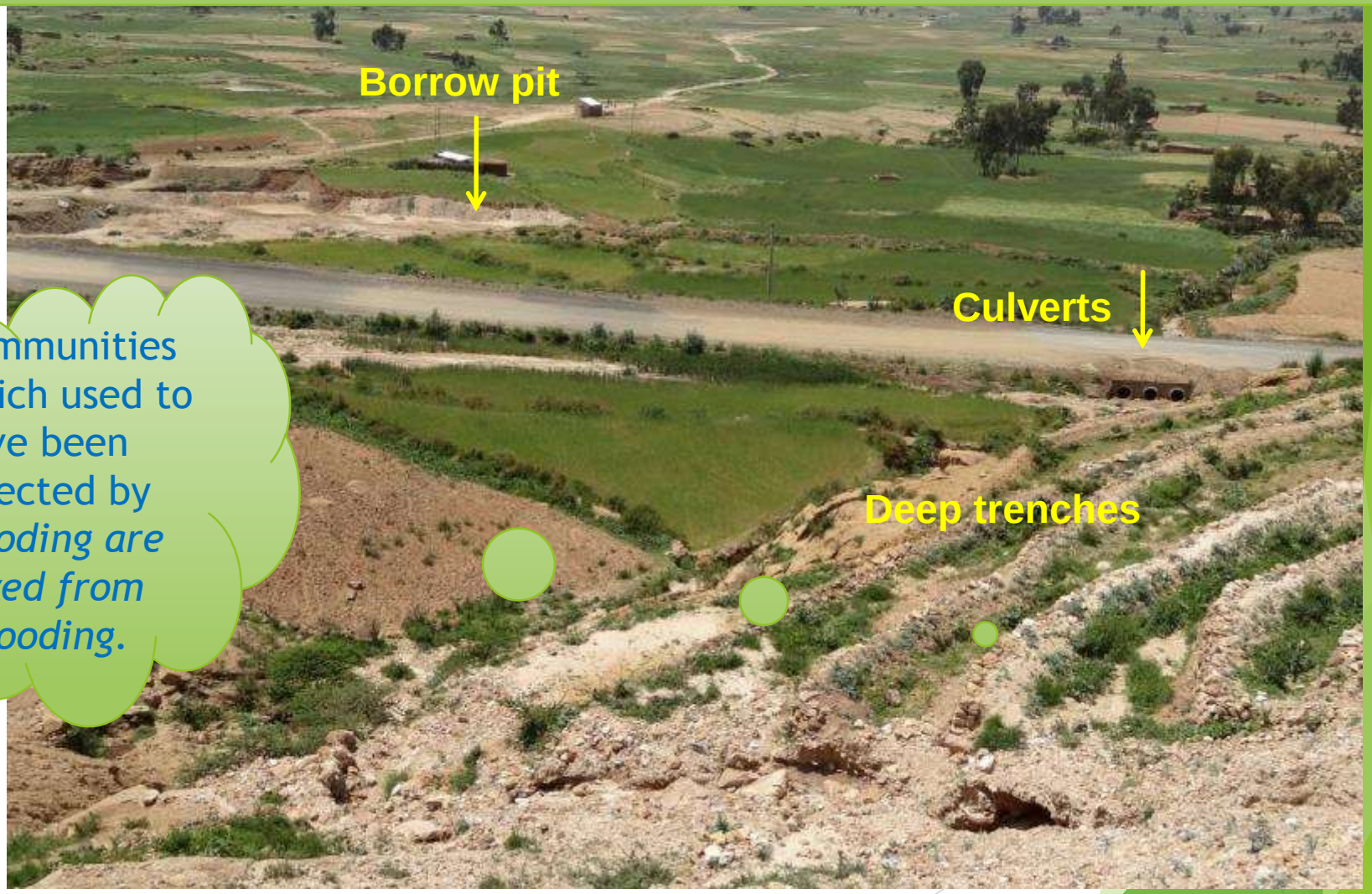
4. Techniques of Road for Water ... .

Roadside pond on downside of culvert Yemen, in flat terrain

4. Techniques of Road for Water ... .

Examples of gabion protection

4. Techniques of Road for Water … .



Communities which used to have been affected by *flooding are saved from dflooding.*

4. Techniques of Road for Water ... .

4. Techniques of Road for Water …

Cascading of soak pits/harvesting ponds along the road

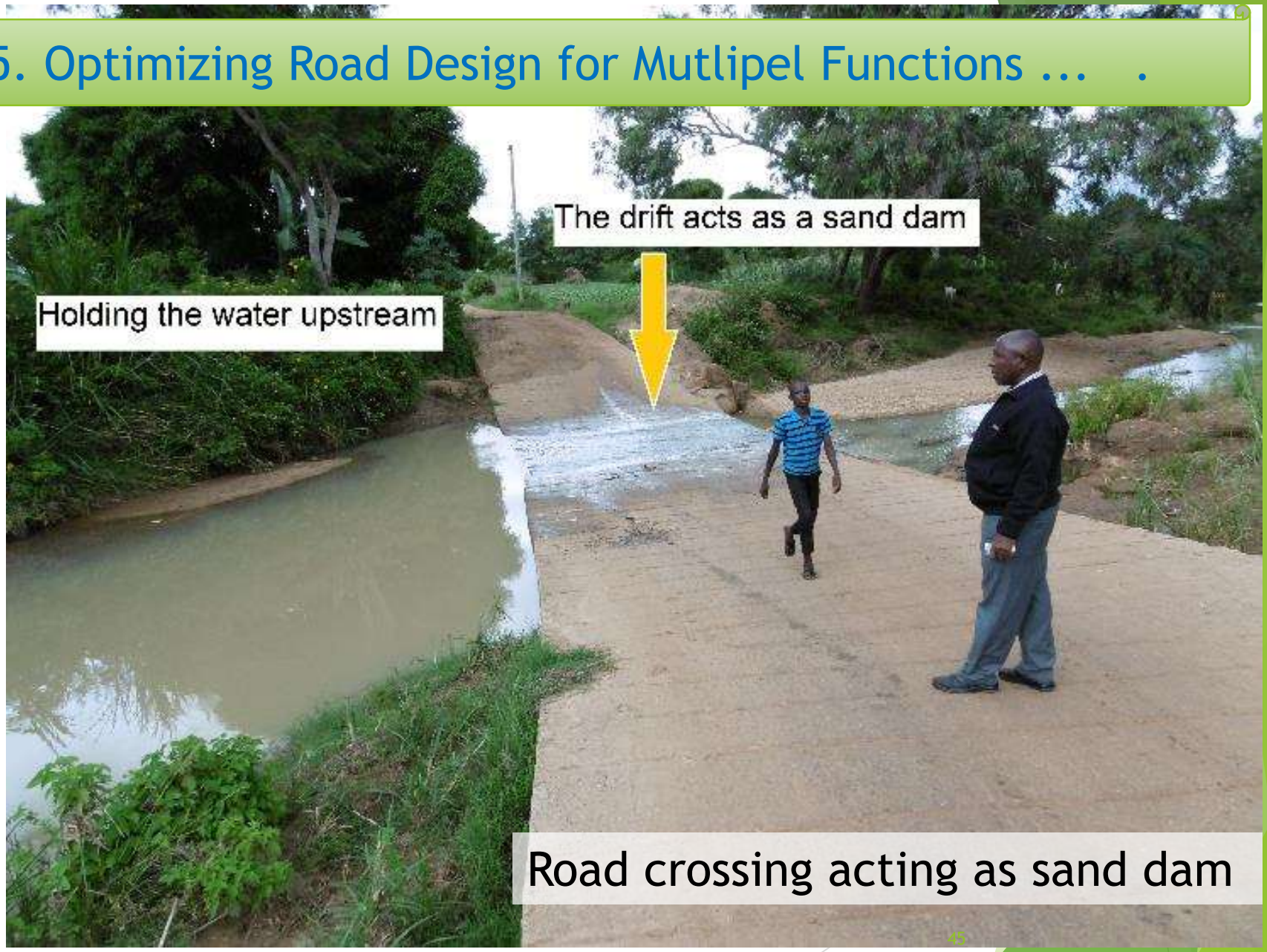
5. Optimizing Road Design for Mutlipel Functions

1. Irish bridges/drifts/low causeways
   - Flood water spreading
   - River bed stabilization
   - Acting as sand dams

2. Changing road alignment to recharge areas

3. Optimize culvert location

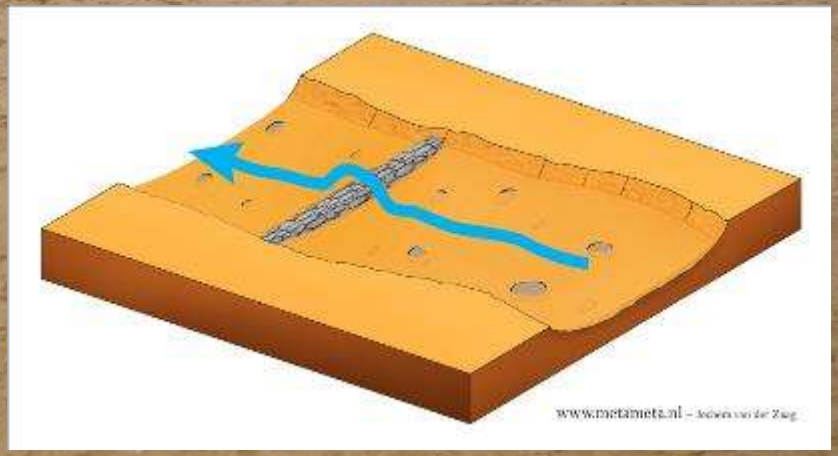
5. Optimizing Road Design for Mutlipel Functions ... .



Road crossing acting as sand dam

5. Optimizing Road Design for Mutlipel Functions ... .

Pakistan: Road = Spate Irrigation Bed Stabili zer



5. Optimizing Road Design for Mutlipel Functions ... .

Road Crossing acting as Sand Dam + Brick Making

5. Optimizing Road Design for Mutlipel Functions ... .

Many additional opportunities to better use roads for water

1. Reuse excavated bed material from roads for soil improvement
2. Controlled sand mining along roads
3. Evacuation in times of floods
4. Road side tree planting
5. Brick making

>> We can turn roads into development reservoirs

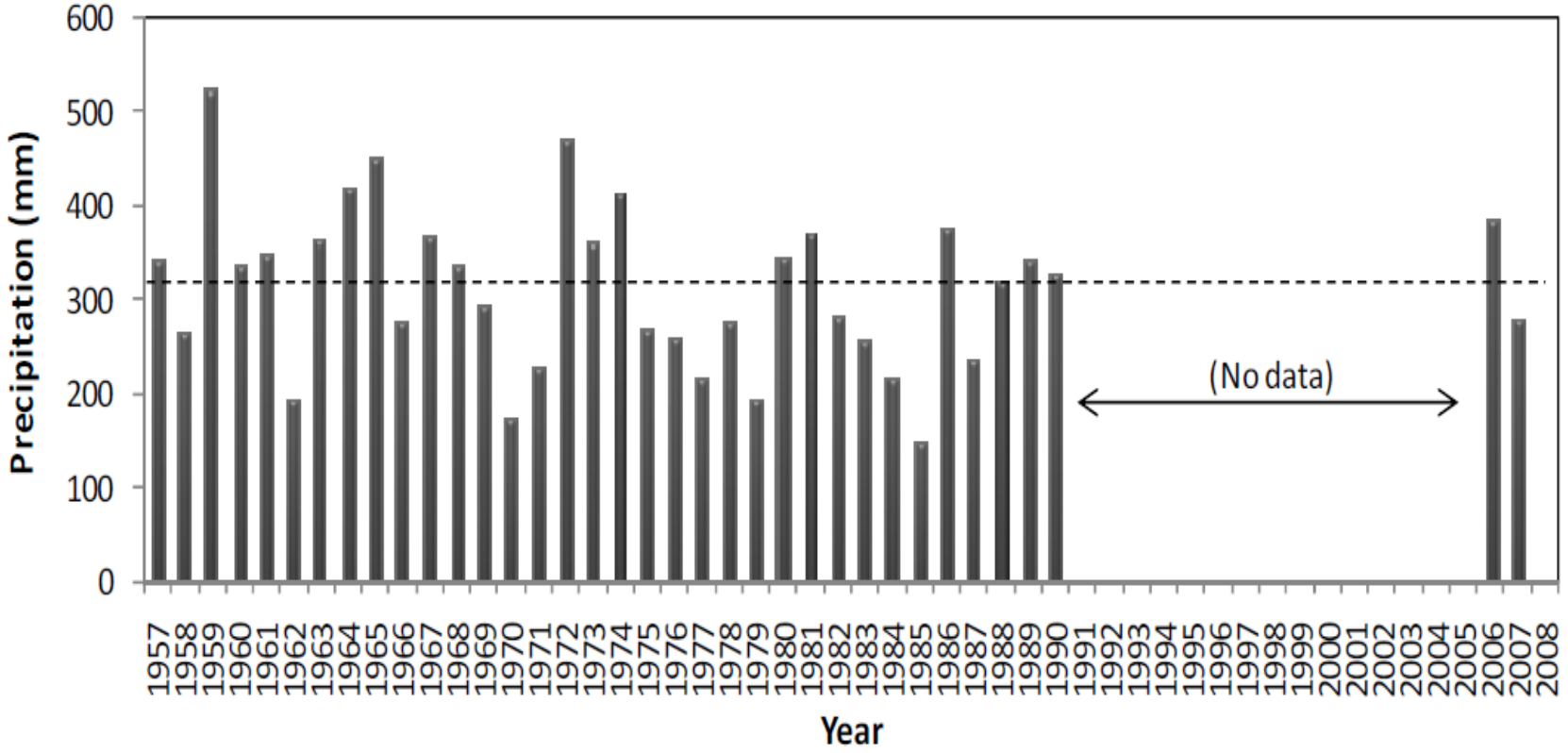
5. Optimizing Road Design for Mutlipel Functions ... .

Brick making along the oad crossing a sandy river bed.

5. Optimizing Road Design for Mutlipel Functions ... .

Road side tree plantation

6. Why Road for Water in Afghanistan? … .



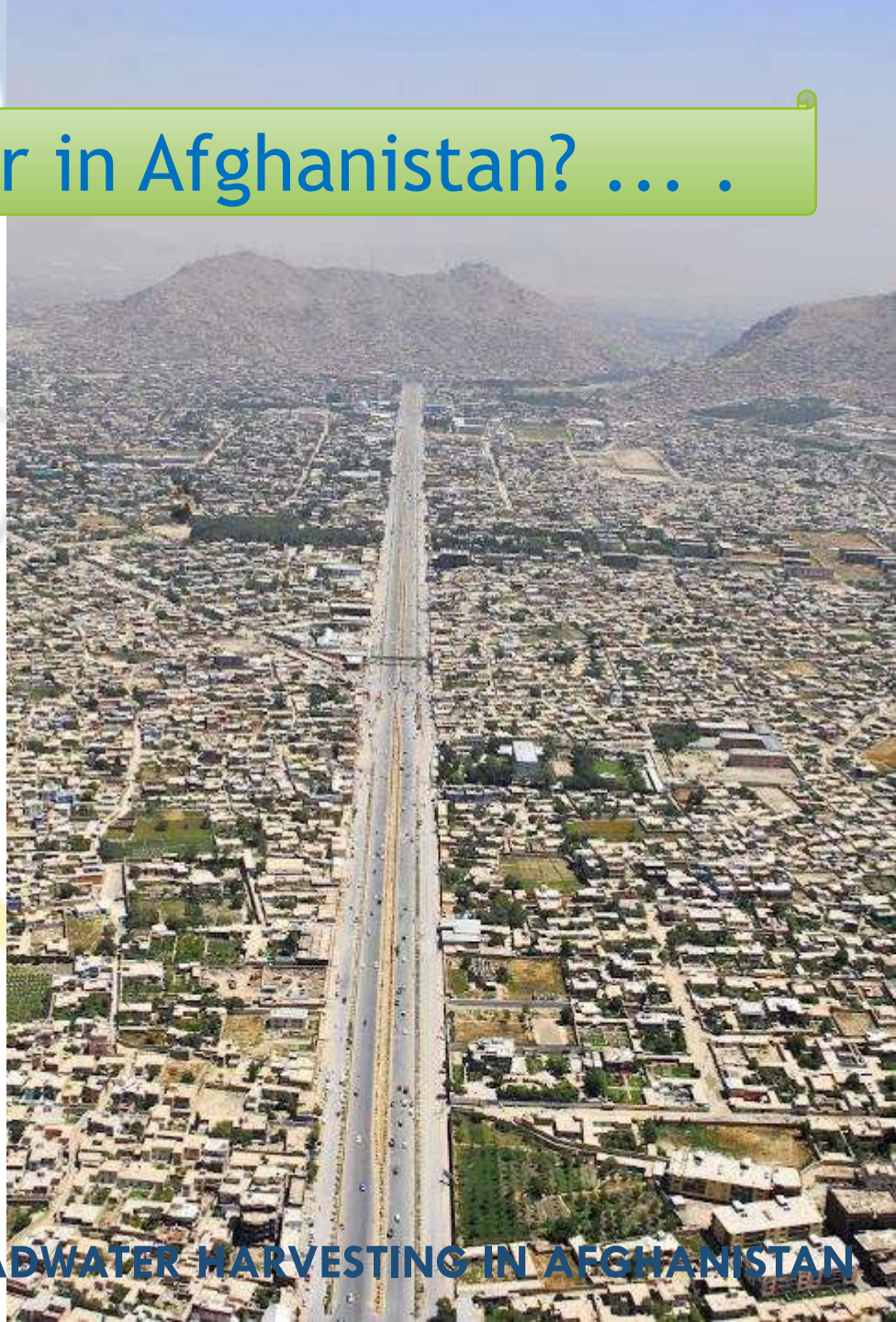
6. Why Road for Water in Afghanistan?

Table – 6 Proposed Land Use of Kabul City by the Third Kabul Master Plan (1978) Source: Japan International Cooperation Agency 2011)

Land Use	Area (ha)	Share (%)
Roads and Street	2,878	8.90%
Public Structures	679	2.10%
Parks and Open Space	3,557	11.00%
Individual Houses	4,222	13.06%
Commercial and Residential Buildings	4,574	14.14%
Mountains & Rivers	16,428	50.80%
Total	32,338	100.00%

Therefore, covering of ground by impermeable paving arise the following problems:

6. Why Road for Water in Afghanistan? ... .



6. Why Road for Water in Afghanistan?

Simple calculation from Kabul (Afghanistan)

- Kabul Average rainfall 300 mm,
- 1mm rainfall = 10 m3 of water in 1 ha
- 300 mm rainfall = 3,000 m3 of water in 1 ha
- Width of Darul-Aman Road say 40 m
- Total length of Road is 5.5 km or 5500m
- Total surface is equal to 5,500 X 40 = 220,000m2 or 22ha
- Total amount of rainfall 3,000 X 22 = 66,000m3
- Say 10m green area, total area 10 X 5,500=55,000 m2 or 5.5 ha.
- For each ha of the green area available water is 66,000/5.5= 12,000 m3.
- Say 60% of rainwater harvesting, 7,000 m3 water for each ha or 700 mm of rain fall; this amount of water will be enough for around 1500 trees (300 trees/ha) or 2 trees/7m; 20 cm irrigation in each 5 days for 5.5 ha green area.

6. WH Techniques in Afghanistan ... .

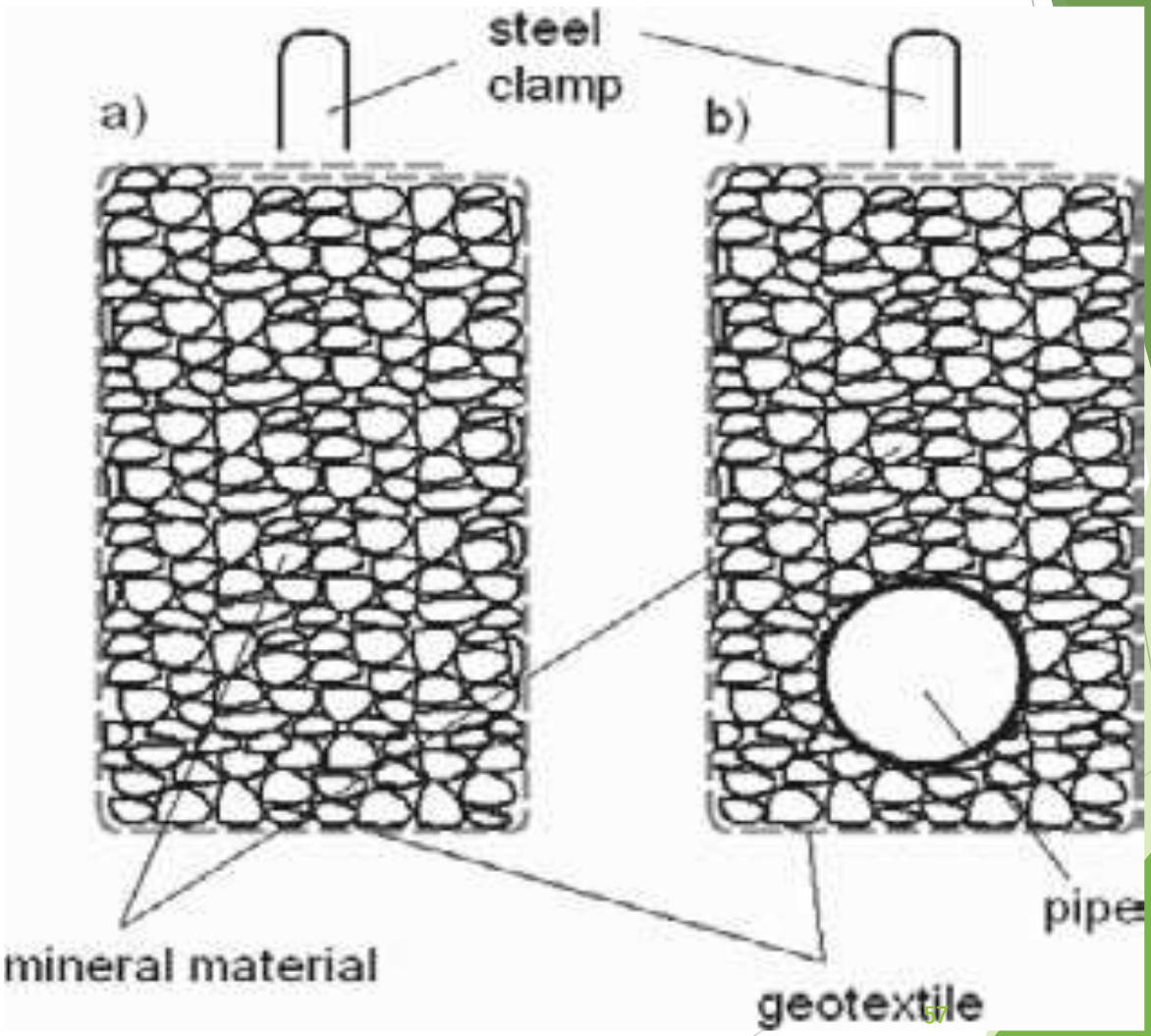
6. WH Techniques in Afghanistan ... .?

7. Suggested Roadwater Harvesting Techniques in the Urban Areas of Afghanistan

French Drain:

(a) without pipe

(b) with pipe,



7. Suggested Roadwater Harvesting Techniques in the Urban Areas of Afghanistan

Kerbs and Gully (inset in to verge)

Side entry gully

7. Suggested Roadwater Harvesting Techniques in the Urban Areas of Afghanistan

Linear Drainage Channel

Combined Kerb and Drainage Block

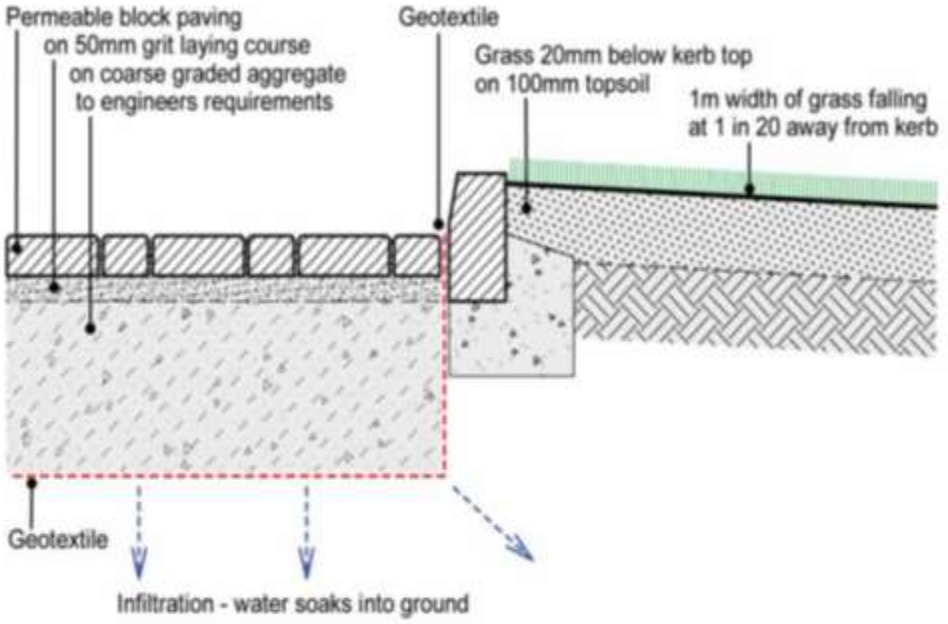
7. Suggested Roadwater Harvesting Techniques in the Urban Areas of Afghanistan

Surface Water Channel

French Drain

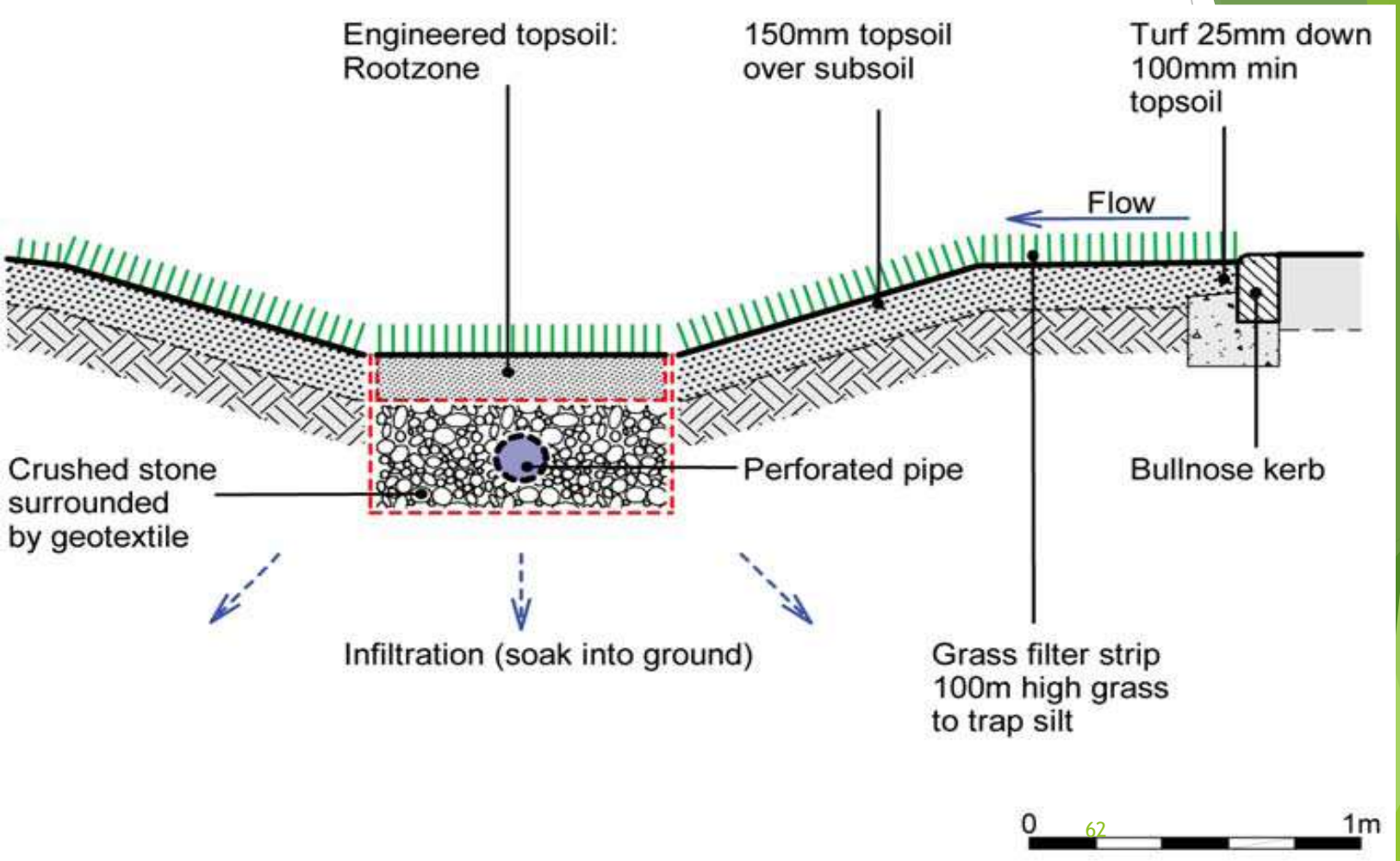
7. Suggested Roadwater Harvesting Techniques in the Urban Areas of Afghanistan

The parking bays at this motorway service area has been built with porous blocks. The rainfall from the tarmac access roads runs onto these bays.



Permeable Block Paving - infiltration system.

7. Suggested Roadwater Harvesting Techniques in the Urban Areas of Afghanistan



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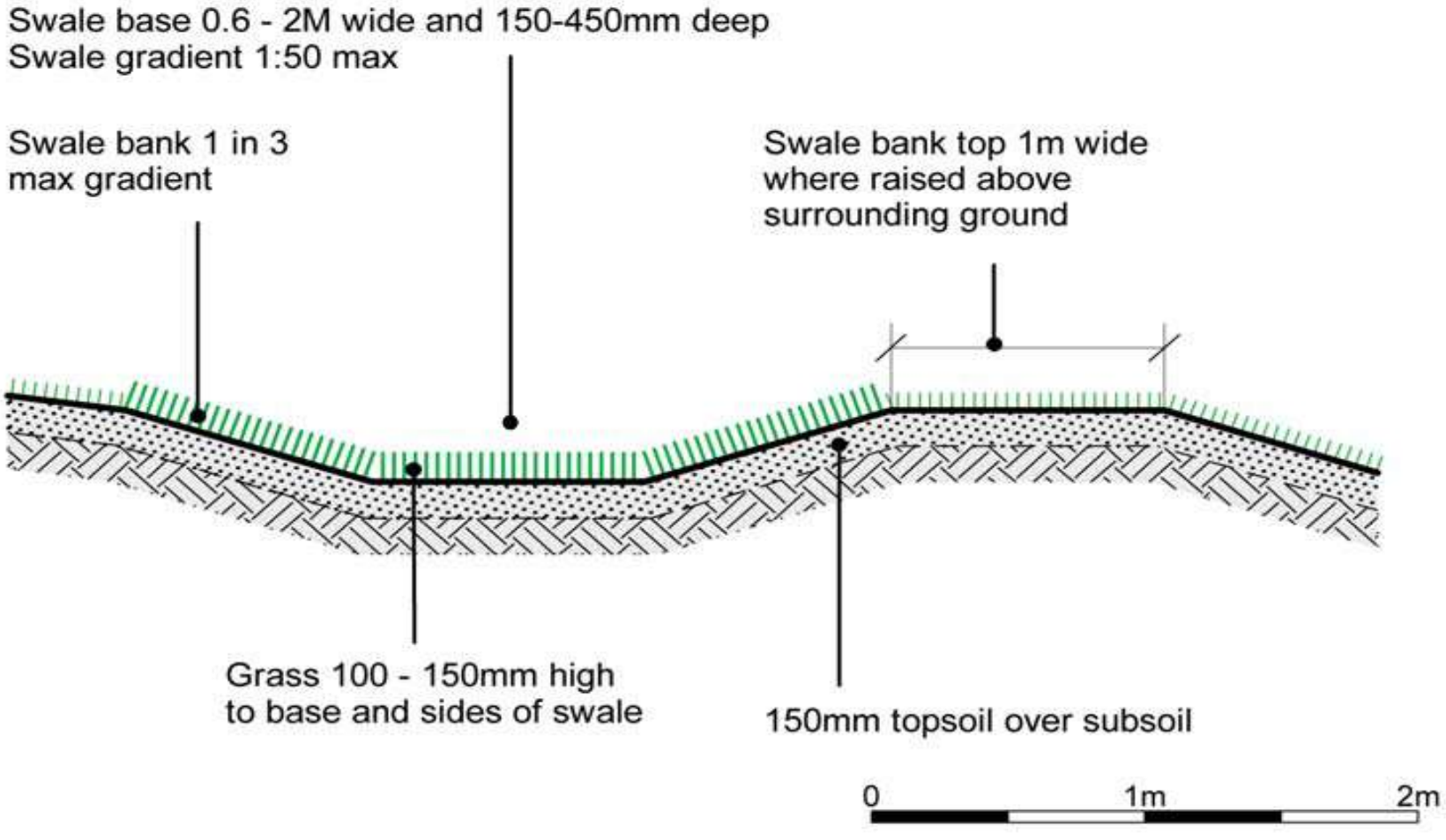
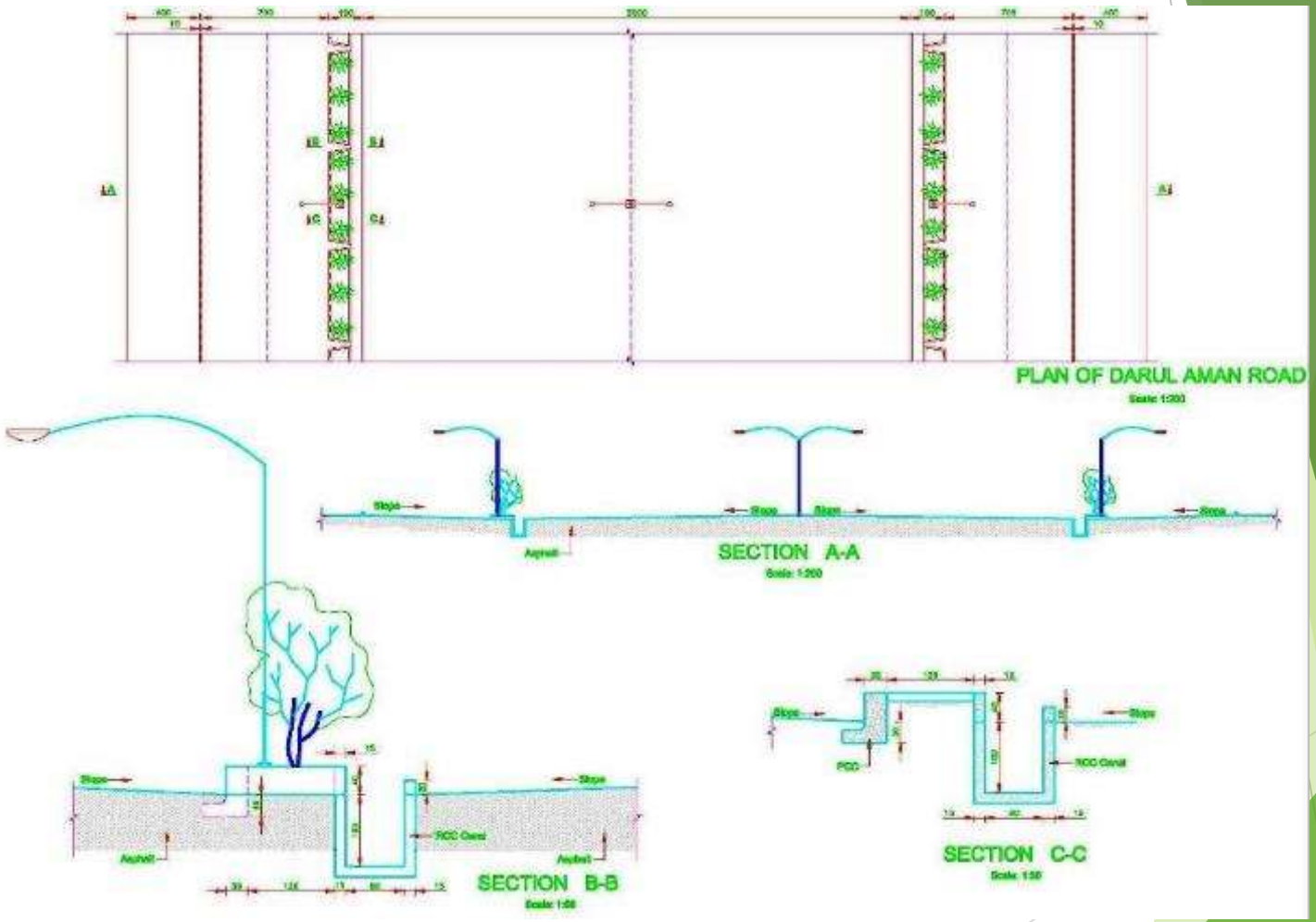


Comparison of Natural and Man Made Plantation

7. Suggested Roadwater Harvesting Techniques in the Urban Areas of Afghanistan



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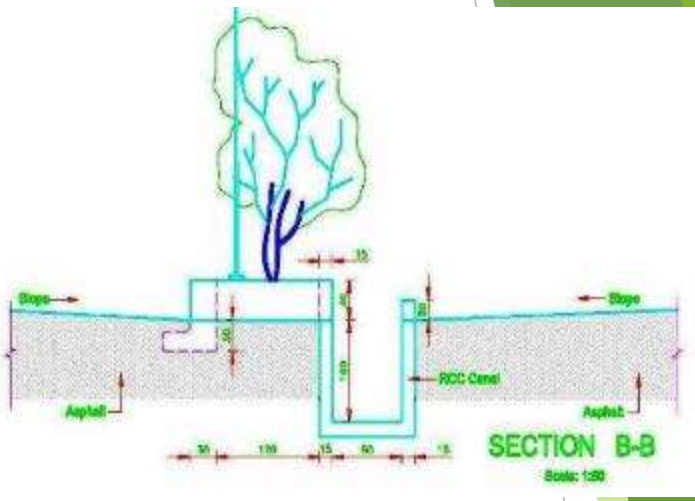
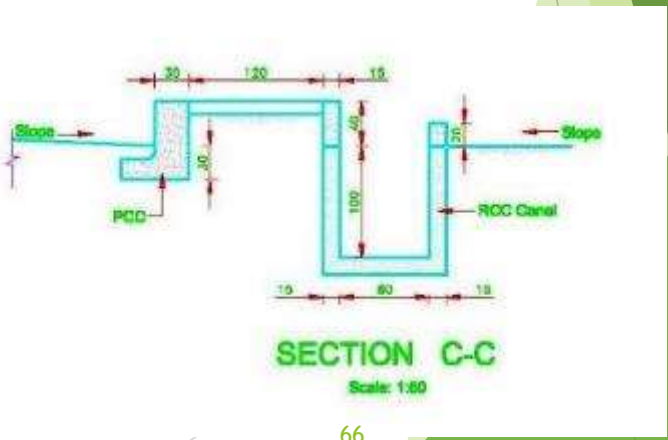
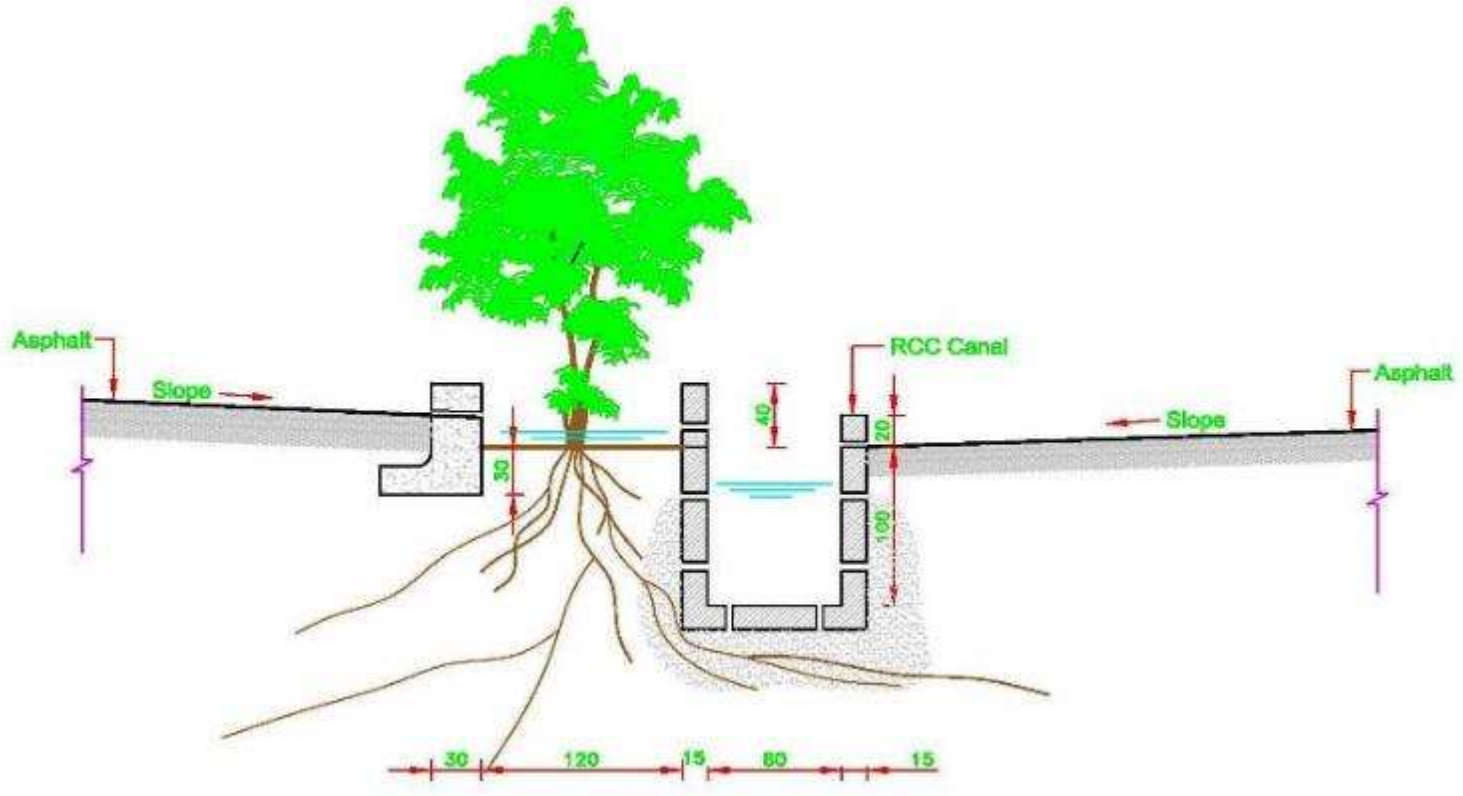




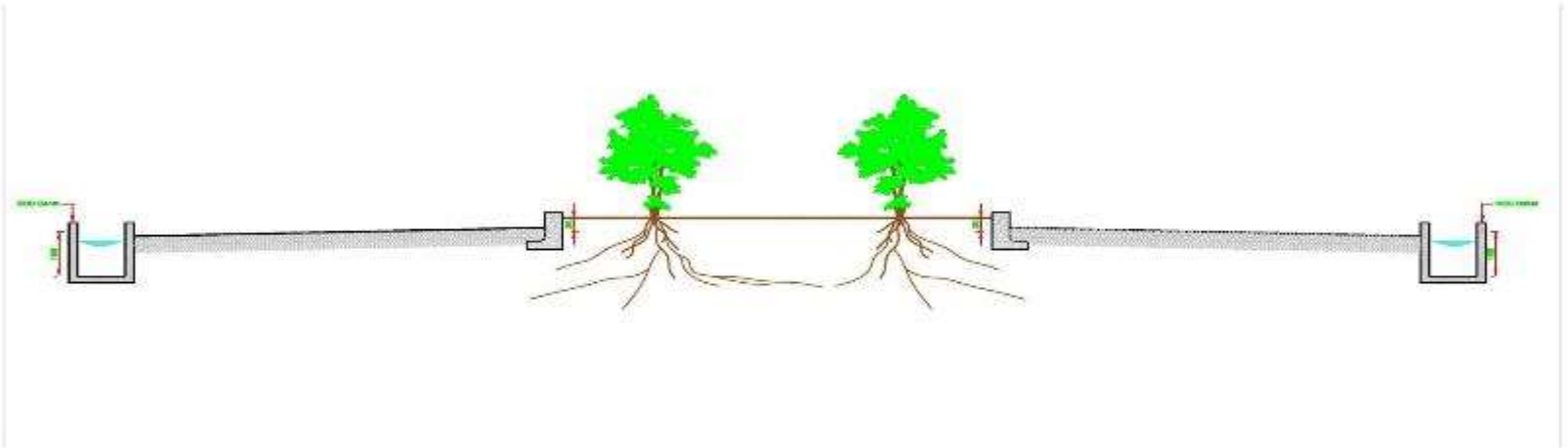
7. Suggested Roadwater Harvesting Techniques in the Urban Areas of Afghanistan

Proposed Section for Darulaman Road



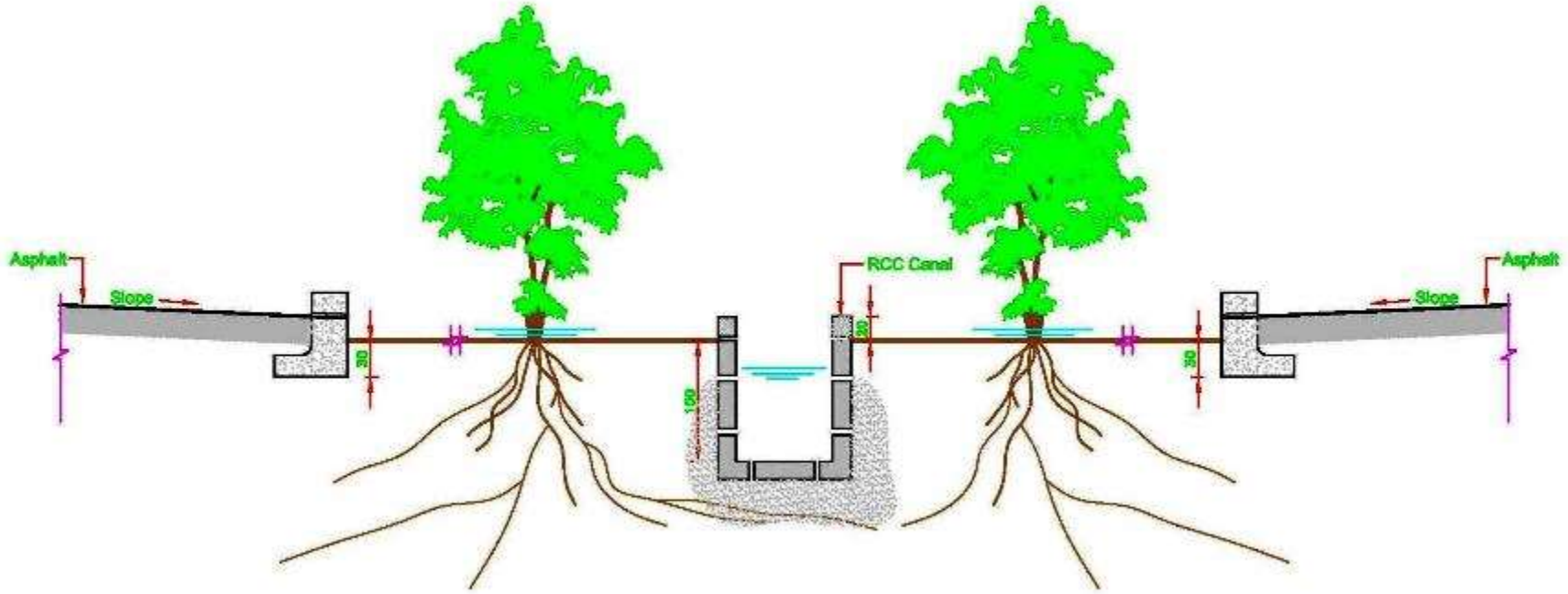
7. Suggested Roadwater Harvesting Techniques in the Urban Areas of Afghanistan

Current section of Khairkhana pass road



7. Suggested Roadwater Harvesting Techniques in the Urban Areas of Afghanistan

Proposed section for Khair Khana Pass Main Road



8. How to Change Governance?

- **1. Integratation of RFW in road and watershed programs**
- **2. Community engagement in the business**
- **3. Change procedures in roads development**
  - Manuals
  - Investment budgets
  - Maintenance budgets
  - Cooperation
- **4. Capacity building**
  - Short courses
  - Tools (run-off models)

9. Learning Topics

- Introduction- Roads for Water, creating resilience
- Culvert and cross drainage design
- Drainage from unpaved roads
- Estimating drainage flows
- Gully assessment and prevention
- Landslide related road failures in Ethiopia
- Rainwater run-off from roads
- Road for water planing and governance
- Roads crossing river beds
- Roads for inclusiveness
- Roads in flood plains
- Roadside planting
- Social engagement processes
- Social impact of roads for water harvesting
- Spate irrigation from road run-off
- Water harvesting from roads: experiences from Tigray
- Water harvesting from seasonal river crossings
- Weather proofing and water harvesting
- Road crossings as sand dams – Kenyan Experience
- GIS and Remote Sensing application in watershed management
- Environmental mitigation of impact from road water harvesting

References

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- World Health Organization: http://www.who.int/roadsafety/
- The International Forum for Rural Transport and Development (IFRTD): http://www.ifrtd.org/new/index.htm
- Commission for Global Road Safety: http://www.fiafoundation.org/commissionforglobalroadsafety/ United States Transportation Research Board: http://www.trb.org/Main/Home.aspx
- Access Exchange International (an NGO promoting accessible public transport for persons with disabilities): http://www.globalride-sf.org
- **Luwieke Bosma**
- **S.Sharif Shobair**

Roads for Water Security
Water for Roads Safety!
Let's travel together ☺