WEATHER PROOFING: MANAGING WATER WITH ROADS

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Program

1. Introduction
2. Discussion on designs and guidelines for road water management
3. Discussion on governance
4. Ways forward
Opportunity

- To have roads for systematically used for water management, in different economic and environmental settings
Examples: roads as flood protection
Examples: Roads as spillway

- Escape from main drain
- Road cum spillway
- Overflow and retention area
- Drain
Examples: Groundwater recharge
Because

- Annual investment 700 Million USD
- 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, competitiveness, balanced and liveable spatial development, access to water and energy and food saving’
Continued increasing demands on water

- The demand for food is expected to rise with 60% by 2050
- Caused by rising population (40%) and higher per capita calorie intake (11%) and intake of lower calorie items (especially fruits and vegetables)
- The supermarket revolution particularly effects groundwater:
  - Higher quality standards
  - More uniformity
  - Vegetables
  - Throughout the year
  - Special agronomy

Demand for fibre and bio-energy

- Demand for sawn wood to increase with 45% from 2005-2030, in the same period, demand for roundwood with 47% and for wood panels 120%
- Demand for cotton is to increase with 81% between 2010 and 2050
- Demand for bio-energy = dark horse, depends on 2nd generation bio-fuels among others
Because

Water main source of ((potential) damage to 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
Roads acting as dikes or drains
Example current situation ‘roads and water as enemies’

- On average in 10 kilometer (research in Tigray, Ethiopia on highways)
  - Erosion and sedimentation: 7.5 locations
  - Flooding of houses and land: 2 locations
  - Persistent waterlogging: 4 location
  - Lost opportunity to capture water 4 M m3
  - Unpaved roads main source of sedimentation (>10%)

- Deficiencies in governance process
  - Missing from guidelines
  - No coordination
  - No interaction with road-side stakeholders
Current situation ‘insensitive roads’

- **Social impacts**
  - Damage to land and property
  - Dust: health and loss of production
  - Missed opportunity

- **Impact on roads**
  - Direct damage due to water
  - Added to this: water-related landslides
  - Feeder roads: huge maintenance costs due to inadequate drainage/ water management
  - Common cause of delay are drainage Issues (ERA)
Urgent need to turn things around
Innovative designs and guidelines:
- Road water harvesting
- Sand mining
- Tree planting

Current Road Practice
- Erosion, flooding, water logging
- Dust impact on health
- 35% of road damage by water
- Insecurity and reduced resilience

“Roads for Water”
- Harvest water for productive and social use
- Agriculture, rangeland, fisheries
- Other livelihood opportunities
- Reduce erosion and land loss
- Lower road damage
- Higher ability of people, households, communities to deal and thrive in the face of shocks and stresses

Unif orm guidelines irrespective of different socio-economic systems
(agriculture, pastoralism, fisheries)

Accommodating diverse socio-economic and natural contexts for “roads for resilience”.

No coordination with other stakeholders (agriculture, water)

Multi-sector, multi-actor coordination in development and maintenance

No culture of engagement with roadside population litigation and compounds

Strengthen process of engagement with roadside communities

No coordination with other stakeholders (agriculture, water)

Develop systems of defining access to new benefit streams

Context

Governance

Participation

Designs

Context

Governance

Participation

Designs
Transformation to higher resilience

Positive social impacts

- Positive impact on roads
- Less direct damage due to water
- Less litigation and cost overruns
- Making use of productive opportunities
- Use of affirmative opportunities
- Interactions (gender-sensitive) with road-side communities
- Reduced risk of land and crops property damage
- Reduced negative health impacts from dust
- Less erosion and sedimentation
- More reliable accessibility
- Coordination of road and natural resource development
- Guidelines
- Embedded training
- Changed governance process
Triple Win

REDUCED WATER DAMAGE TO ROADS

HIGHER CLIMATE RESILIENCE

REDUCED DAMAGE FROM ROADS THROUGH FLOODING, EROSION AND SEDIMENT DEPOSITION

NEW EU PROCUREMENT RULES

WATER MANAGED FOR PRODUCTIVE USE

RISING GROUNDWATER LEVELS

INCREASED SOIL MOISTURE

WATER RETENTION

FLOOD MANAGEMENT
Examples of what can be done with watershed and water management programs

1. Using run-off and water flows generated by roads
   1. Spreading water from road surface
   2. Harvesting water from culverts, side drains and depressions
      - Converted borrow pits
      - Infiltration ponds
      - Infiltration trenches/ pits
      - Swallows
      - Dug outs
   3. Gully plugging for recharge
   4. Spring capture
Examples of what can be done with watershed and water management programs

2. Managing water flows with roads

- Water management in polders with controlled culverts
- Steering fish movement
- Roads doubling up as riveraine/coastal flood embankment – synchronized use
- Flood compartmentalization
Other opportunities – by changing road designs

3. Improving road design for multiple functions

1. Irish bridges/fords:
   - for flood water spreading
   - for river bed stabilization
   - acting as sand dams

2. Changing road alignment to recharge areas

3. Change culvert location

4. Permeable road foundations
Many other opportunities to better use of roads for water!

4. Additional

1. Road side tree planting
2. Reuse excavated bed material from roads for soil improvement
3. Sand harvesting along roads
4. Controlling rodents
5. Avoiding sand dune movement
ROAD SIDE PONDS
ROAD SIDE CISTERNS
ROLLING DIPS/ WATER BARS ON UNPAVED ROADS FOR WATER HARVESTING
NON VENTED DRIFTS ACTING AS SAND DAMS
DRIFT AS BED STABILIZER
ROAD BODY = RESERVOIR EMBANKMENT
POLDER MANAGEMENT THROUGH CULVERTS
Optimize
- Ability to harvest
- Flood risk
- Roadside scouring
- Risk of gully initiation/development
- Costs
ON-GOING CAMPAIGNS IN AMHARA AND TIGRAY

- Implemented since 2014
- Engaged 0.75 M and 1.5 M people in 2015 campaigns

Monitoring
- Impact specific to location and specific intervention, compared with base year in different locations
- Soil moisture content increases (30-60%)
- Shallow groundwater levels increases (>1.9 M)
- Control of flood run-off (discharge reduced Surface water storage)
- Water quality (not traceable)
SNAPSHOTS FROM ON-GOING CAMPAIGNS

Spreading water from culverts – avoids gullies and increases soil moisture
Construction of Deep trenches at downstream side of roads to recharge the groundwater and improve moisture conditions of soils.

Road side ponds to recharge groundwater and enhance in-situ moisture in soils.
Road side runoff is channeled into farmlands (used to improve soil moisture and reduce runoff to downstream areas).
Runoff from a town is managed through a number of options:

- Construction of deep trenches to reduce runoff and enhance groundwater recharge.
- Diverting water from culverts into a borrow pit for surface water storage and groundwater recharge.

Communities which used to have been affected by flooding are saved from flooding.
Water from a culvert and roadside drainage channeled into a pond:

- Enhanced the shallow groundwater.

Note: Borrow pit was used as water storage in the month of July 2014.
Yield impacts of road form water in Sinqata

With intervention

During road construction

Yield (qt/ha)

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NEW WATER RESOURCES
Climate resilient roads should not only mean making more costly and weather-proof roads, but (at zero net cost) make the entire area resilient.

Institutionally there is often no link among water, road and land sectors but this should change:
- In modified guidelines and designs
- In budget procedures
- In capacity building and governance

Need to create in different condition close linkages – requires different techniques.
Need to balance

- Road costs
- Road functionality
- Road safety
- Reduced/zero damage to surrounding area
- Optimized water use around roads (depending on the area)
Drainage design and road surfaces

- Location of drains
- Length of drains
- Sand harvesting from drains
Design of culverts and associated structures for beneficial water use

- Culvert placement (concentrated or distributed road drainage)
- Culvert design
- Culvert size
- Fish passage from culverts
- Downstream erosion control
- Water spreading from culverts
- Protected culvert structures (road side safety)
Roads and flood management

- Contribution of roads to flood control
- Roads as embankments and evacuation areas and flood shelters
- Roads in low lying flood plains – managing water retention
Road side water harvesting structures

- Storage ponds (location and dimensions)
- Infiltration ponds (location and dimensions)
- Deep trenches (location and dimensions)
- Urban soak pits
River crossings

- Using drifts and low causeways as sand dams
- Using fords and low causeways as river bed stabilizer or flood water spreaders
- Blocking/ opening the vents
Spring capture and protection

- Spring protection
- Safe channeling
Reusing borrow pits and quarries for water storage

- Location of borrow pits
- Landscaping and protection of borrow pits
- Use of spill ways
- Borrow pits in high water table areas
Landscape management around roads

- Erosion and run-off control
- Avoiding and preventing landslides
- Avoiding sand dune movement
- Using borrow material
Managing road side vegetation

- Dust capture and sediment control by trees and grasses
- Ensuring visibility for road users
- Distance from roads and bends (road safety)
- Selection of trees
- Selection of grasses and other vegetation
- Management of road side tree plantation
Do’s and dont’s

- Reviewing designs
- Ensuring road stability and road safety
- Avoiding damage to surrounding areas
- Optimizing beneficial use of water
Finding the opportunities:

- Roads for harvesting water
- Roads for flood protection
- Roads for controlled drainage and water table control
- Roadside vegetatation
Governance and management

How to integrate?

- In modified guidelines and designs
- In planning and budget procedures
- In capacity building and training
Ideas and experiences?
Roads for Water Initiative
1. Work with road programs
2. Work on optimized practices
   - Guidelines and designs
   - Investment budgets
   - Maintenance practices
   - Social interaction and cooperation
3. Capacity building
   - Short courses
   - Guided learning
   - Tools (models)
   - Research
4. www.roadsforwater.org
Alliance

Please join and contact:

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www.roadsforwater.org