

## Roads for resilience opportunities in Mozambique

### 1. Roads for water

This note describes opportunities for making a much stronger connection between road development and climate change adaptation and water management in Mozambique. It is not more than a first identification of opportunities and is meant to start a discussion on exploring mutual beneficial opportunities to integrate climate change adaptation and water management in road building practice, as may hopefully be captured in newly updated road manuals for instance. The approach it takes to water management and climate change adaptation is to make as much as possible use of roads as instruments for climate resilience and beneficial use of water rather than – defensively - merely making roads stronger and more durable in anticipation of changed weather.

There is a three-fold argument for connecting road development and nwater management is three-fold:

- (1) At present roads and water are often at loggerheads – much damage to roads is caused by water – typically 35-80%, the higher figure for unpaved roads. But this does not need to be and road asset management is much helped by road water management measures.
- (2) This would not only reduce damage to roads but also benefits the area around the roads. Nowadays roads cause much damage to the surrounding landscape – erosion, flooding, water logging and drainage congestion, sedimentation. This does not need to be: In many cases such damage can be avoided and turned around.
- (3) In fact, roads can be instruments for beneficial use of water. This stretches from harvesting water from roads to using roads as instruments for flood resilience. With so much road development going on, roads can – if done well – significantly contribute to better water resources management.

This note tentatively identifies a number of opportunities for making use of roads as instruments for water management in Mozambique. It is useful to distinguish between two areas:

- Upland areas
- Plains

### 2. Win-win combinations of roads and water in the uplands

In upland areas roads can be instruments for water harvesting. Road affect the run-off pattern, obstruct water, concentrate flows, channelli and gussiding them. This is now often destructive, as mentioned, but can be turned around with roads being used to harvest water for direct use or for recharge.

There are several opportunities:

- Taking water from paved surface to the land using water spreaders – adding moisture to land
- On unpaved roads systematically using water bars or rolling dips to take water away from the road surface and as such reducing erosive run-off and instead taking water to the road
- Spreading water from culverts – for productive use: either as supplementary moisture or for filling (recharge) ponds. This will also prevent gully formation
- Systematically converting borrow pits into water storage ponds – for stock water, supplementary irrigation, fishery or recharge (see separate note)

- Similarly, converting road quarries into storage reservoirs
- Developing road side infiltration pits and roads – and guiding road water to such infiltration pits or infiltration trenches
- Combining road crossings (drifts) with sand dams – building up some semi-artificial aquifers

### 3. Win-win combinations of roads and water in the plains

In plains in Mozambique there are two important matches between roads and water. First is to support the water management in the flood plains. Second is to contribute to flood resilience.

With respect to the first link - water management in flood plains, there are a number of elements:

- in flat rice growing areas gated culverts can be used to regulated water levels for instance for rice farming and aquaculture (or weeds)– with potentially large impact on production and also avoiding interference
- in areas with fish migration fish passage can be interrupted creating a potential huge local economic loss – so the location and number of culverts should accommodate
- particularly where the bed material of the road in wetland section of flood plains is impervious, roads will have a huge impact on wetlands – typically drying them up on one side of the road (depending on the direction of high water, flood) and creating new wet areas or overall wetter areas on the other side of the road. This should be managed – by permeability of road bed material,
- In areas with high groundwater tables borrow pits may act as ‘seepage ponds’ – with water seeping in and being permanently available for stockwater, irrigation or fishery if not drinking water. These vital function can be maximized particularly to cover the dry part of the year –

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The second function in flood plain (and also in some of the low-lying coastal areas) is to optimize the functions of roads for flood resilience. There are again a number of elements:

- roads often serve as embankment in flood prone areas, and embankments serve as roads . These two functions benefit from being synchronized – for instance with respect to the height of the roads/embankments
- roads also guide run-off unwittingly and a high road embankment may cause run-off to become uncontrollable and erosive – there may be a cases to develop roads on relatively low embankment and/or with lower section to prevent congestion of run-off becoming a destructive local flood
- for river crossings non-vented drifts may be considered – these spread water gently and avoid rutting of the river bed or uncontrolled flooding . In some of the drier part of the plains they may be combined (raised and extended) with flood water spreading weirs
- roads may also function as a flood shelter – where people and livestock take recourse in times of extreme high water. We may optimize this function by building in elevated levees in road sections close to flood-prone population centres.

There are several other opportunities, such as road side tree planting – that will serve many purposes but one is the mitigation of dust from the roads.

#### 4. Changed processes

There are huge win-win's to be made. The change however is not merely technical but needs to be matched by different processes of coordination and consultation.



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