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Beneficial Roads for Water/Resilience Opportunities along the National Highway in Pakistan

1. Roads for water

This short note argues to make a strong connection between road development and climate change adaptation and water management in Pakistan. It focuses particular on opportunities to do so along the National Highway, where the Pakistan Sustainable National Highway Maintenance Project is under consideration for ADB funding.

The standpoint is that whereas roads now often cause considerable harm to areas around them, they can instead become instruments for climate resilience and beneficial use of water and as such increased agricultural production. This will also contribute to improved road asset management and make roads more resilient to change in climate. The proposed opportunities build on the experience of 'roads for water' projects now on-going in Ethiopia, Kenya, Uganda and Bangladesh.

In summary, there is a three-fold argument for systematically connecting road development and water management:

- (1) At present roads and water are often 'enemies'. Much damage to roads is caused by water – typically 35-80%, the lower figure for highways; the higher figure for unpaved roads. So improved beneficial road water management is an important element of road asset management.
- (2) Systematic road water management would not only reduce damage to roads but also benefit the area around the roads. Nowadays roads cause much damage to the surrounding landscape in the shape of water logging, flooding, erosion and sedimentation. This does not need to be: In many cases such damage can be avoided and turned around. Roads for water can have significant impact on landscape management and agricultural production,
- (3) In fact, roads can be instruments for beneficial use of water. This stretches from harvesting water from roads in dry areas to using roads as instruments for flood resilience and using roads in wetland management. With more than 200,000 kilometres of roads in Pakistan, roads can in principle contribute enormously to better water resources management.

2. Combining roads and water management along sections of the National Highway

There are several opportunities for beneficial road water management along the National Highway. The National Highway traverses Pakistan from Karachi to Torkam over a 1800 kilometre stretch and crosses a variety of landscapes and agricultural production systems. Under the proposed project several degraded road sections would be rehabilitated and re-engineered. This provides an opportunity to manage water better in these road sections,

setting an example for other stretches of roads and making a positive environmental contribution. Here are from South to North a number of opportunities

Reducing waterlogging

Waterlogging and salinity is a main issue in particular in Sindh Province – severely depressing agricultural production. It affects 40% of the canal-irrigated land in Sindh Province through a combination of out-dated irrigation water management strategies and blockage of the natural drainage paths. This impeded drainage is very much caused by road and railway infrastructure curtailing natural run-off and also impeding lateral soil water movement. This can be observed by the severe salinity along many road sections in Upper Sindh. Re-engineering road drainage (probably in combination with road side eucalyptus tree planting) may make a significant contribution to improve agricultural water productivity and will reduce human and livestock diseases, that are associated with standing water and water logged lands.

Avoid road-induced flooding

When the Motorway was build in 1992 there was widespread flooding in Punjab as there was inadequate cross-drainage. This shows the intricate role of roads in water management in the canal irrigated areas of Punjab. A number of opportunities exist:

- in such flat irrigated areas gated culverts can be used to regulated water levels for instance for rice farming and aquaculture– with potentially large impact on production
- 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 such fish movement.

Having roads as post flood shelters

After the epic devastating flood of Pakistan of 2010, flood have been recurrent in Pakistan. Also in 2011, 2012, 2015 and 2016 floods have taken lives and caused displacement. It is often on higher proportion of the metalled roads that people have taken refuge during and after flood, sometimes using road reserves to rebuilt their lives. It may be worth considering in selected hotspot areas along the National Highway to more systematically combine road development with flood protection by combining road development with flood protection functions and creating widened road levees as post-flood shelters. Road embankments can also be used to guide flood water to safe disposal areas, in particular escapes into potential recharge zones.

Using road bodies for water harvesting

In relatively dry areas – along road sections in KPK and Upper Punjab (Salt Range) a series of measures maybe taken to make beneficial use of road water for irrigation and water storage so as to contribute to better water security increased agricultural production. Roads have a major imprint on the entire surface hydrology. Whilst nowadays this often harmful and destructive with roads causing erosion and accelerating sedimentation, this can be turned around with run-off water guided by road infrastructure for beneficial use – recharging aquifers or filling storage ponds (including converted borrow pits). There is a range of road water harvesting techniques that may be deployed for this. In Kenya and Ethiopia this approach has caused a 10-20% increase in farm production in similar semi-arid areas.

3. Combination of roads and water management in other parts of Pakistan

Pakistan is an enormously diversified country and opportunities for beneficial road water management. Here are some examples

Water harvesting from feeder roads in dry upland areas

In all dry upland areas roads can be instruments for water harvesting. Feeder roads in particular offer huge opportunities because of their magnitude and susceptibility to water-induced damage. 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 – this will also strongly reduce the maintenance load
- 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 guiding road water to such infiltration pits or infiltration trenches

Using road crossings (drifts) for local groundwater storage and flood water spreading

In arid and semi-arid areas ‘irish bridge-type’ road crossings can be used to systematically impede the subsurface flows in river beds and increase local groundwater availability. The preference is for non-vented drifts (i.e. without culverts): these are less prone to damage; give less cause for detrimental river bed scouring and have a better effect on local water management, as follows:

- They can back up as a sand dam creating a sand deposit in the river bed that stores water and increases groundwater levels;
- They can be combined with elevated road embankments to serve a flood water spreading weirs
- They will stabilize river beds and avoid rutting and gullying upstream of them. This will make it easier to construct diversion for perennial or for spate irrigation.

Combining roads with wetland management

Where roads traverse wetland areas, they have a huge impact on wetlands. Particularly where road-bed material is impervious, the infrastructure roads will dissect wetlands 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. Such effects can be managed in a beneficial manner too for wetland viability.

4. End statement

Adding water management functions to roads has a large added value and upscaling potential – that will serve both road asset management and the sustainability and productivity

of the landscapes traversed by the roads. Looking at road infrastructure from this multifunctional perspective can add tremendous value.