Multifunctional Infrastructure for Coastal Bangladesh
Using Roads as Instruments for Flood Resilience

This note sets out the scope for making a strong connection between roads and flood resilience and water management in coastal Bangladesh. At the moment there is already considerable overlap with roads serving as flood embankments and embankments doubling up as roads. Systematically planning and designing integrated multifunctional roads can be a cost effective manner to provide higher flood resilience and improved agricultural productivity and will add to the longevity of the roads themselves.

The coastal area of Bangladesh is one of the most flood prone places globally. Flooding in coastal Bangladesh has many causes. Sea-level rise plays a role as does the occurrence of cyclones but equally important are the dynamic processes of braiding coastal rivers in the active delta. The wide rivers in the coastal delta shift location, eroding and breaching the fragile embankments surrounding the polder areas, resulting in loss of land and livelihoods. In other parts of the delta in Bangladesh the hydrological processes have been disturbed because of the construction of diversion structures upstream. This has caused rivers to silt up with permanent flooding for long periods during the wet season.

In summary flooding takes many shapes:

- floods and waterlogging caused by sedimentation and drainage congestion in silted up rivers
- floods caused by shifting/ braiding rivers and often combined with high tides
- floods caused by cyclones

Whereas the first type of floods leads to a reduction of income opportunities of large populations, the second category of floods play havoc with families whose land is permanently lost to rivers. The third type of floods has dramatic impact in loss of property and lives

It is possible to develop a strong connection between flood resilience, water management and the construction and maintenance/ upgrading of roads. Road development and maintenance is one of the largest investments in the coastal regions. Huge gains can be made and the opportunity for upscaling is large, yet roads are not systematically tailored to water management or flood resilience. Doing so however will also reduce damage and breakage of the roads.

These practices are inspired by the use of roads for resilience and water harvesting in other settings, such as the use of roads fro water harvesting in Ethiopia and Kenya. The current proposal looks at a very relevant angle for the flood affected lowlands – i.e. the functionality of roads for resilience in flood protection and flood relief.

2. Roads for flood resilience

There is a strong connection between roads and water management and flood protection inside and outside the polders of coastal Bangladesh. This connection however is not systematically operationalized at all, which presents both a huge opportunity missed and in several cases, a substantial problem created. There is however much scope for an integrated approach whereby roads can become instruments for water management inside the coastal polders as well as making roads instruments for flood resilience. This can work in three ways:

(1) Roads made instrumental to manage water within the polders
(2) Roads doubling up as improved flood embankments
(3) Roads serving as flood and post-flood shelters.

1. Roads managing water within the polders

Within the polders, roads, bridges, and culverts strongly influence water flow, distribution, and water levels. The network of different types of internal roads, including small village feeder roads and pathways, divides the polder into segments, separating relatively higher and lower lands. This provides a powerful instrument to cope with flooding within the polder areas and the opportunity to better

regulate water levels and create productive opportunities. It makes it possible to create areas with relatively low and high water levels and hence areas that allow three crop a year or areas that are securely geared to fish and paddy cultivation. Roads are however now not constructed on this principle and culverts are too small or too big or wrongly located. Neither are they provided with simple gates that would make it possible to actively manage water levels and to store and release high water between different sections of the polders.

To the contrary, in many cases, due to inconsiderate design, internal roads with inadequate cross-drainage obstruct the flow of water and worsen flooding problems The construction of new roads in the polder areas has in many cases contributed to drainage congestion, as insufficient culverts were provided. Failure to drain excess water and waterlogging hinders farming practices, causes serious damage to crops, and affects accessibility and livelihoods. At the same time, ill-designed roads that do not pay due consideration to flood removal/ drainage patterns are quickly damaged by erosion and subsidence. This problem may be turned around with a multifunctional approach with polder internal roads turned into instruments for polder water management, by considering road alignment and cross drainage as an element of water level management, by providing gates at culverts and by considering additional cross-drainage structures where flooding and water logging occurs. It will reduce flood and high water impact. It will support a more productive agriculture and will reduce damage to the roads.

2. Roads doubling up as improved flood embankments

Secondly, there is also a strong link between roads and polder embankments. The length of embankments in both coastal and inland areas of Bangladesh is unsurpassed. Many of these embankments are also used as roads – the top of the embankment serves as subgrade for the pavement of the road – and many roads also happen to be embankments of rivers, channels and canals. In fact, the majority of the polder embankments double up as roads in coastal areas. There are several mismatches between transport and flood protection functions however. There is a large number of examples, for instance, where the Local Government Engineering Department (LGED) has reduced the height of the embankment to create more space (i.e. a wider road) for the road to improve the transport functions. This jeopardizes the flood protection functions. Another issues is the construction of bridges in the flood embankment that may either weaken or strengthen the flood protection functions. The current mismatches can be turned around by closing aligning the specification of roads and embankment works, including foundation, alignment and dimensions and coming to new joint designs and specifications and innovative multifunctional features.

3. Roads as flood shelters and past flood shelters

The third important nexus between roads and flood resilience is that roads act as flood shelters and as safe heavens during times of inundation but also, after the floods recede, as places where affected people can temporary settle and rehabilitate. In polders affected by inundation, it is especially the poorest that have taken shelter on the roads after the floods. Those who have lost their land often use the roads to rebuild houses and firms. There is a need to systematically develop these linkages – with roads in areas with high risk of inundation providing additional service in temporary shelters to store property and food stocks and house businesses. What is very well possible – especially in high-risk areas - to make 'wide road levees'. Here the embankment road will be higher and wider: such sections can provide decentralized flood shelters and also accommodate flood victims and give them space to rehabilitate. Making such reinforced wide road levees may be a cost effective complement to the typhoon shelters that are currently still limited in number and hence take time for people to reach and which moreover are less suitable to help in the process of rehabilitation of those who lost their land in the floods.

4. Way forward

This all comes down to modified new multifunctional techniques and investments, practices, and also to changed governance (systematic coordination) and more intense local participation (which in road development is generally lacking). Many of the improvements are rather basic and straightforward and require creativity and coordination rather than big changes. As of today, synergy between water and roads in planning and management does not systematically occur despite the great potential in

Bangladesh to optimize both functions: transport and flood protection/water management. This would ensure longevity of roads but also enhance the contribution of roads to improved water management and flood protection.

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