

The Rivers' Role in Mitigation of and Adaptation to Climate Change, by Bernd Gundermann

The role of the river in mankind's efforts to both mitigating the impacts of climate change as well as adapting our societies to it cannot be underestimated: it is the role of a mentor. For hundreds of millions of years rivers were nature's fluid connector, collecting, carrying, and mingling sediments and organics and eventually breeding new life within their waters. The river's ever-changing permanence that patiently endured both the evolution of life and the emergence and failure of civilisations currently witnesses humanity's struggle to sustain its existence in the face of the swiftly changing climate. The river's patience will outlast our prevailing short-term, quick-gain culture. Its fluidity will teach us to leave our rivers space to breathe and to fluidify our civilisation. The river waters' capacity to create and nurture life demands us to finally give up assuming a commanding position superior to nature but to blend in and adapt to its delicate transient equilibriums.

Discussing the role of rivers with regards of Climate Change means already to transcend the limitations of pure hydrology. Thus we ought to look at the rivers' entire watersheds and encompass the entirety of effects triggered by the changing climate instead of just focussing on the small surface area of the water itself. Acknowledging the intricate nature of rivers as communicators within their basins will be the only way to come to meaningful conclusions about mitigation of and adaptation to the impacts of climate change.

1. Navigation

The waterways' traditional role as main distribution networks has been diminished in favour of trucking. The replacement of industrial storage with just-in-time production made the highways become moving storage facilities. The economical benefits of this trend are, however, outweighed when considering the environmental impact. Inland barges are by far the least polluting mode of cargo transportation. Therefore, another contribution of rivers to climate change mitigation would be to strengthen freight transport on barges between integrated cargo-hubs, providing a seamless transshipping between various modes of transport at strategic locations in proximity to industrial parks and cities. Evaluations of economic efficiency for cargo transport need to complement costs for environmental harm.

- Why isn't there more barges carrying containers integrating ocean and inland shipping as well as transport by trains and trucks?
- When will the currently abandoned canals of the 19th century be recommissioned serving urban industries with cargo?

2. Hydropower

Hydropower offers GHG emission-free energy generation. However, the increasing criticism of both the cultural and ecological impacts of imposing dams and reservoirs goes deeper. It calls for a paradigm-shift. When in 1935 Hoover Dam was dedicated, the U.S. Interior Secretary Harold Ickes announced: "Pridefully, man acclaims his conquest of nature."ⁱ Today, the revision of this claim asks the industry to supersede dams with newer modes of generation offering reduced footprints such as clusters of in-stream turbines directly linked to communities with self-governed micro-grids.

The decline of power companies offering centralised supply and distribution gives way for decentralised, minimal, and smartly implemented systems that are attuned to both varying

local conditions and environmental optimisation. The direct connection between consumers and the river via their power cables creates ownership and responsibility for both energy security and the healthy river.

- When will there be enough political courage to rigorously phase out the non-renewable energy sources?
- Why cannot landlocked countries skip superseded generation techniques and leapfrog to climate-resilient power supply in their development?
- Is the reassessment of dams under tighter parameters just an excuse for avoiding serious R&D?

3. Flooding

Humanity pursues an urban civilisation, centred predominantly on riverside cities. The cities attempt to protect both their population and assets by fortifying the risk of inundation out through hard embankments. This is the classical approach of civil defence of “holding the line”. The term 'flood control' relates once again to the delusion of mankind assuming control of nature, and hard-engineered levies or sluices express the confrontational character of 'combating floods'. However, the rapidly growing production of cement and steel, which would be even more boosted for additional coastal and riverine hard defences, also accelerates climate change. Paradoxically the protection against the challenge worsens it! Consequently in the long-term, when the water levels will surpass the ability to heighten of the flood barriers, options for river cities without concrete need to be found.

Besides increasing the cities' resilience to inundation the warning systems need to be upgraded to support adequate standards of readiness. Integrated systems use data from satellite, LiDAR (drone) flights, rain radar, and rain/tide gauge information to run local hydrologic modelling, which allows for targeted prevention against the impact of flooding. Eventually the hydrologic models should be complemented with both ground models covering the problem of subsidence/earthquakes and relevant BIM-data representing the built up urban environment in order to gain a comprehensive tool for mitigation and adaptation simulation, planning, and monitoring.

As mankind is unable to fight nature, urban culture needs to align with it through adaptation. The fundamental problem is that our immobile cities are facing an increasingly dynamic nature. Unless buildings learn how to walk, smart adaptive planning needs to safeguard people and assets.

Key objectives would be:

- Cohesive management of excess water, irrigation, and navigation aligned with urban development.
- Catering for resilience as well as liveability.
- Urban planning based upon eco-social networks instead of technical infrastructure.
- Multi-layered approach linked to scientifically monitored timelines projecting climate change impact probabilities onto urban processes.
- Smart sensory city, offering multiple links between population, built up and natural environments in order to optimise flow and function within transient environmental parameters.

- Adaptive urbanism and architecture making static cities responsive to dynamic rivers allowing them space to breathe and grow.
- Softened rivers embedded in grassland as common recreational green, ecological nursery, and buffer zone to flooding.
- Renaturation of currently encroached riverbeds upstream of the cities as temporary flood reservoir and ecological refugium.
- Adaptive architecture, making buildings responsive to expanding rivers (i.e. through sacrificing floor levels).

Initiating a new urban age of climate-resilient cities is at the core of mankind's cultural transition that will spawn innovation throughout the industries. Making this happen requires the perseverance to overcome the resistance of superseded yet lucrative and well-established pathways. Exemplars in the world's diverse urban cultures demonstrating the practicality of change are important to learn about integrated planning and living. This needs both discernment and audacity of all citizens, beginning with questions:

- Paris' transition to Grand Paris would have been the prime European exemplar. Why is the planning still based upon 19th century thinking founding the plan on railway loops instead of ecological (and social) networks such as waterways?
- Will Jakarta implement fluid urbanism by regenerating its riverine core city whilst escaping to the fancy Garuda archipelago mega-investment, or is the Council completely lured into this fatal development nightmare?

4. Pollution

Large parts of river basins are utilised by agriculture or forestry nurtured by the river system. Deforestation and the increasing agro industry are large contributors to the release of GHG emissions. The industrial agriculture, highly depending on irrigation sourced from rivers, is rapidly degrading the soils to the point of leaching out CO₂. The overload of fertilisers in the agro industry further contributes the GHG nitrous oxide on the fields as well as leached into the rivers.

The rapidly growing cities in the developing countries lack of appropriate wastewater purification and have been harming their rivers by discharging vast amounts of sewerage. Moreover, the highly sealed surfaces, including rooftops, collect various pollutants that are washed into the rivers as surface run off. Green roofs and permeable surfaces delay the discharge of stormwater into the sewer system, filtering it in the soil, and therefore release clean discharge as well as they avoid river pollution through sewerage overflow.

- Is there research about the (micro)climatic influence of the discharge of warm cooling water from nuclear power plants into rivers?
 - How does the heat island effect of highly sealed cities affect climate change?
 - Which government will have the courage to halt agro industry and re-develop traditional - organic - agriculture [cultura (Latin) = caring]?
- Oh yes, France is leading the way; thank you Madame la Ministre Royal!

5. Riverine biodiversity

The advantage of ecosystem-based soft embankments and buffer zones contribute largely to replenish the riverine biodiversity. When we allow the river water controlled access to the city, it should be clean.

Once agro industry will be turned back into agriculture and cities discharge purified wastewater, the rivers will reinstate their vitality.

Hydropower pays much attention to de-barricade the flow for migrating fish. In-stream turbines ought to be designed in a way to protect fish As well.

River communities aiming for power self-reliance might also expand urban farming to hydroponic farming. Attentively done it will support the biodiversity in the river.

6. Irrigation

On the way from agro industry to agriculture the amount of necessary irrigation will drop. This will reduce the problem of soil degradation. Even though irrigation may be required, the abandonment of chemicals will avoid harming the rivers' water quality.

7. Deltas and estuaries

An example for applied adaptive urbanism from a current project of Urbia Group

Earthquakes have struck New Zealand's second biggest city Christchurch in 2010/11. Besides both the tragic fatalities and the vast physical destruction a large area along the River Avon estuary subsided by c. 50cm. The river is tidally influenced, which means that the lowered hinterland came under threat of varying magnitudes of flows at ever-increasing sea levels. Consequently it has been declared 'Residential Red Zone' and vacated ever since. The central government bought the cleared the c 500 hectares of land for NZ\$1.5 billion (EUR 900 million) but aims for compensation, which puts pressure on the local council to create an income from the abandoned land that is planned to come from small-scale farming or touristic activities.

For two years Urbia Group has been exploring how its concept of adaptive urbanism could help. In discussions with Christchurch City Council and its planning authorities the suggestion is to initially fully reverse-engineer the remains of human utilisation: clearing roads, power lines, pipe work etc, because the land that will fall back to the estuary at an indefinable point in some decades time shall be purified from human remnants harming the natural environment. At that time a scheduled master plan coupled to geophysical/hydrological modelling will determine the schedule when to retreat from defined areas that will – in turn – become a tidal marsh/wetland protecting the core city. Until then most parts of the Red Zone can be inhabited, but under special conditions: the demountable passive stilt-houses, accessed over elevated boardwalks, shall operate off grid. Power shall be sourced from local wind, solar, and in-stream hydropower. A sophisticated flood warning system will increase security of this exposed site. This pioneering migrating community will touch the earth only lightly, whereby it will become an exemplar for countless others under the threat of inundation due to rising rivers and/or seas.

All of these measures demonstrate that once strategies employ creativity, positive spin-offs occur. Reinstated riparian zones increase cities' liveability by offering leisure and recreation; they replenish urban ecosystems; and – first and foremost – bring both physical and social resilience to levels adjustable to the impacts of climate change. However, a creative adaptation to climate change that goes beyond mitigation requires a fundamental paradigm-shift only comparable with the transition from the mediaeval age to renaissance some 500 years ago. Following our river-mentors attentively, humanity will obtain their inert wisdom and apply it to master its future.

ⁱ Veronica Strong, *Water*, Reaction Books, London, 2015, p. 135