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SMALL WATER CYCLES:
WHAT THEY ARE, THEIR IMPORTANCE, THEIR RESTORATION

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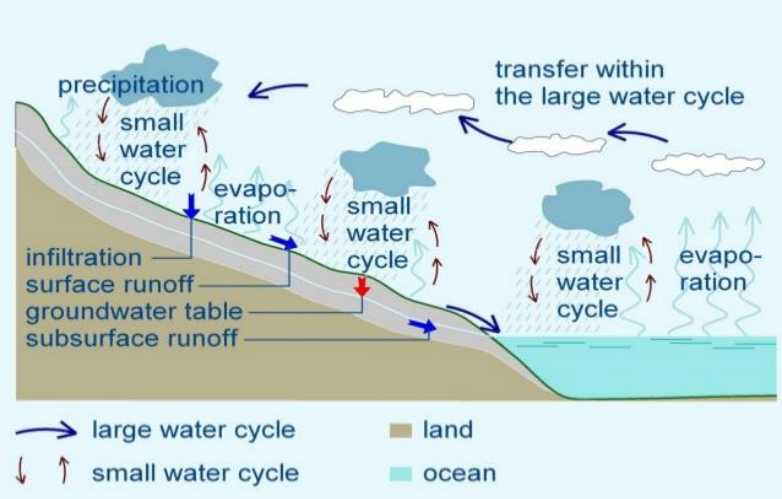

The large and small water cycles (Kravčík 2015)

Small water cycles and the consequences of degrading them

The small water cycle over land is a closed circulation in which water evaporated from land falls in the form of precipitation over the same terrestrial environment. Humanity, through its activities (deforestation, agriculture, urbanisation), accelerates the runoff of rainwater and causes draining of the transformed land. Distortion of the small water cycle impacts the large water cycle (Kravčík *et al* 2009).

The small water cycle is more important to local precipitation patterns than the large water cycle. It is estimated that mean global precipitation overland is 720 mm, of which only 310 mm is from the large water cycle and 410 mm comes from the repeated evaporation-precipitation process of the small water cycle (Widows 2016).

In mismanaged landscapes with little vegetative ground cover, the small water cycles are degraded or destroyed - soil absorbency is destroyed; more heat and carbon dioxide is radiated; and there is little transpiration to nucleate local mists, fogs and rain. In the large water cycle, temperatures increase and rains become both more irregular and often occur as large events – causing increasing damage to a simplified and less resilient landscape.(Massy 2019).

If there is insufficient water in the land, immense flows of solar energy cannot be transformed into the latent heat of water evaporation but are instead changed into sensible heat. Warmer air over hot and dry urban and agricultural expanses pushes precipitation activities into cooler environments formed by woods and bodies of water, or to places of higher latitude or altitude (Kravčík *et al* 2009).

The leaching of fresh water from land into the oceans is one of the most significant factors not only in global desertification, but also in climate change. Human activities, such as deforestation, agriculture and urbanisation, have gradually reduced soil moisture, ground water, and vegetation, which in turn have reduced on-land evaporation, completely interrupting the small water cycle (Widows 2016). The share of global climate change caused by human drainage of water from the land can be stopped or moderated through a comprehensive program of conservation of rainwater on the land, its infiltration and evaporation (Kravčík *et al* 2009). See Conclusion 5.

The need to restore small water cycles

Half of Australia's annual rainfall is evaporated into the atmosphere, largely because it can't infiltrate a carbon-deficient, compacted soil. We must ensure that more of that water soaks into the soil to the root zone of the plants, not only to help them grow but to be transpired by these plants through their leaves back into the atmosphere, where about two-thirds of it fall again as mostly local rain. A healthy, carbon-rich soil enhances the small water cycle, which in turn retains more water in a cooler soil, generates greater local rainfall, reduces fire intensity and, importantly, and helps to create essential cloud cover. (Jeffery 2015). See Conclusion 1.

In urban areas, we need to recycle storm water, domestic waste water and the effluent from sewerage systems. Maximising coverage of our landscape (including our cities) with green will increase the small water cycle, while bare landscapes will reduce it. There are many ways to restore the small water cycle, including slowing the movement of water, repairing the riparian zone (the interface between river and land), restoring wetlands and flood plains, revegetation, managing grazing and adopting limited-till and pasture cropping We need a nationally coordinated water and evaporation management plan (Jeffery 2015). See Conclusion 2.

Perhaps not a wicked problem, but instead a powerful driver of beneficial change

When the Murray Darling Basin plan was formulated, there was almost no discussion about the water cycle and how human activity might be influencing it (Widows 2016). See Conclusion 3.

Evaporation needs to be viewed, not as a loss to the system to be avoided at all costs, but understood and respected as the source of all precipitation and managed accordingly (Widows 2016). See Conclusion 4.

Conclusions

1. If we restore a degraded or broken local small water cycle, the temperature and rainfall benefits of that restoration will be *seen* locally and also benefit the wider climate. For instance, cropping and grazing practices need to be re-designed, with the express aim of repairing degraded small water cycles, to the mutual benefit of both farmers/graziers and the natural environment.
2. Queensland needs to create and implement a state-wide coordinated water and evaporation management plan. This plan could later act as a template for a nation-wide coordinated plan.
3. We are fighting over the water that's presently in the rivers, wetlands, lakes and irrigator storage ponds. However, a major water source is that of the transpiration-evaporation-precipitation process - and we can *increase* that.
4. With a healthy local water cycle, there would be far less evaporation from those local rivers, wetlands, lakes and irrigator storage ponds and more of that evaporated water would return as rainfall.
5. Because restoration of local small water cycles can be *demonstrated* to benefit local climates, we can honestly, effectively sell this message, locally, regionally and nationally, thus:

   > 'Restore your local small water cycle and you *will* improve your local climate - local summers will be cooler, local winters will be warmer, local droughts will be less severe, local rainfall events will be less extreme. You will see the results in your lifetime. And, oh yes, as a by-product, you will also improve the world's climate'.

Bio: The author, now retired, worked as a Principal Research Adviser in the Department of Lands (later Department of Natural Resources) in the Queensland public service in multiple fields, including applied research and land planning.

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