Aquifer Recharge and Overexploitation: The Need for a New Storyline

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Groundwater

Technical Commentary/

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by François Molle[1]

Groundwater has been the star in 2022, with a UN World Water Development Report and countless other policy documents, reports, conferences and webinars devoted to the "invisible resource." Unsurprisingly, groundwater overexploitation emerged as a central theme; yet, a puzzling—and very damaging—storyline was frequently reiterated. (A storyline is defined by Hajer [2006:69] as "a condensed statement summarizing complex narratives, used by people as 'short hand' in discussions.") It describes overexploitation as occurring when groundwater abstraction exceeds recharge, suggesting first that there is a clear point at which an aquifer becomes "overexploited," or "overabstracted" and second that this threshold can be quantitatively equated with the "recharge" term of the mass balance.

There are many variations of this storyline. In some cases, the statement is just flatly wrong: "If groundwater abstraction exceeds the natural groundwater recharge for extensive areas and long times, overexploitation or persistent groundwater depletion occurs" (Wada et al. 2010). But many formulations, implicitly or explicitly, equate overexploitation—or even the fact that water tables are falling—with abstraction *exceeding* recharge, indirectly suggesting that, as there is no overexploitation when pumping less, this is therefore allowable. In the Arab region "limited renewable groundwater resources continue to be exploited at an unsustainable rate, exceeding natural recharge rates" (ESCWA 2022). "Of Mexico's 653 aquifers 101 are considered to be over-exploited, meaning that their net annual extraction exceeds their natural recharge" (World Bank 2009). "'Overexploitation' of an aquifer is a term applied to a physically unsustainable situation in which the extraction of groundwater exceeds replenishment (recharge) within a given area over a given period of time" (Pahuja et al. 2010). "Exploiting groundwater resources at a faster rate than recharge has led to widespread "overdraft" and falling water tables in many parts of the world" (Jones et al. 2011). "In many places we are extracting groundwater faster than it is being replenished by natural or managed recharge. This overdraft is driving groundwater depletion, or a diminishing volume of water in aquifers" (Richter and Melissa 2022). A perusal of the policy literature, as well as scientific articles, yields innumerable similarly ambiguous statements, such as, "we need to align use with recharge," or to "restore the balance between abstraction and recharge," directly or indirectly suggesting that abstracting less or as much as the aquifer recharge is the right and "safe" thing to do.

Denouncing the flawed nature of these statements reminds us of the debate on the "budget myth" (Bredehoeft 1997, 2002) and associated misconceptions about "safe yield" (Sophocleous 1997). It is well understood by hydrogeologists that any pumping from aquifers induces after some time and some stock depletion (and notwithstanding the possible fluctuations generated by hydrologic variability) a new state of equilibrium where abstraction results in the "capture" of specific portions of both the recharge and the "natural" discharge of the aquifer to recipients like rivers, lakes or the ocean (Pierce and Cook 2020). Abstracting the same volume as the recharge actually draws all outflows to zero over time, with very drastic impacts on surface water and ecosystems and a spatial/social reallocation of the resource. More generally, no continuous abstraction is without effect and its desirability and soundness must be assessed based on a consideration of what these effects are and who is affected and how.

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Just like the commonplace double-accounting that results from considering surface water and groundwater as separate resources (Evans et al. 2011), the "recharge-is-the-limit" fallacy is a convenient misconception that speaks to some managers/policy-makers' interests in believing, or pretending, that there are more resources to be used than actually available. Along with plain misunderstandings and casual ambiguity, this probably contributes to explaining the stickiness of the fallacy. Conversely, revealing the extent and diversity of the externalities attached to groundwater abstraction, and identifying trade-offs and their political implications (e.g., reallocation, restraining access, etc.) is unpalatable to states which, on the contrary, have perverse political incentives to buy time and sweep the problem under the carpet (Molle and Closas 2020).

Although these debates have by now clarified many misconceptions among specialists, it is all too clear that, despite 25-year old calls for better "communication" (Sophocleous 1997), this enhanced understanding has not percolated to practitioners and policy-makers. Flawed and misleading storylines remain ubiquitous. Storylines are simplified truth-sounding statements that often draw on common sense and may as such seem uncontroversial. The unconscious parallel here, is perhaps, "bathtub thinking" (Molle 2011), where aquifers are seen as underground reservoirs to be filled and emptied; or that of a bank account replenished monthly with a total of, say, 100 units and from which withdrawing the same amount on a monthly basis will look like the most natural, "balanced" and "safe" thing to do. Few bother to notice that the groundwater "bank account" was, initially, *already* "seeping" 100 units to other "downstream" users or environments. Language is key and narratives do frame the way we envisage problems and solutions. I argue that to unsettle and displace this ubiquitous misconception we need to promote an alternative storyline with the aim of shifting the starting point of our reasoning. We could, for example, foster the storyline that *any groundwater pumping has an impact on other existing users and environments*, thereby shifting the burden of proof to showing that abstraction has no noticeable impact on other users and environments, if this is the case, or revealing those impacts—and the time they take to manifest, if it is not. Of course, this is where all the contextual factors come into play (aquifer characteristics, location and timing of the abstraction, response time-lag of the aquifer, increased recharge, effect of land use or climate change, etc.) that will spring to the minds of hydrogeologists intent on qualifying the general statement. This burden of proof would appear to be a healthy alternative to the disastrous *carte blanche* given to abstractors "as long as they don't exceed recharge."

Author's Note

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