Brief for GSDR – 2016 Update

Groundwater in the Context of the Sustainable Development Goals: Fundamental Policy Considerations

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Introduction

Acknowledging the role of groundwater is paramount to successfully implementing the Sustainable Development Goals (SDGs). Groundwater is the most abstracted raw material on earth (Jarvis 2012). While already crucial to the health of many (aquatic) ecosystems, groundwater has become central to human development over the course of a few decades (Llamas & Martínez-Santos, 2005). Groundwater is often preferred over surface water because of its relative stability in terms of both quality and quantity. It is the primary source of drinking water for half of the world's population, including over 1.5 billion city dwellers. In some areas, groundwater dependence approaches 100 per cent (Howard, 2015).

In providing water for domestic use, enabling food production, and sustaining critical ecosystems function groundwater relates to numerous aspects of human development – including poverty eradication, human dignity and well-being (Moench, 2003). However, using groundwater for sustainable development faces a paradoxical challenge. On the one hand, 1.7 billion people live in areas where groundwater resources are overexploited (Gleeson et al., 2012) and an unknown number are experiencing pollution problems and/or degradation of groundwater dependent ecosystems. On the other, many areas suffer from underdevelopment of groundwater resources because of their remote location and/or unaffordable costs of drilling and maintenance of wells/boreholes.

Water Supply, Sanitation, and Hygiene

Although groundwater resources themselves are pervasive, it is often the poor who are the last to benefit from groundwater-sourced water and sanitation because of the investments needed to access it. Urban and rural settings provide slightly different challenges in this regard. In urban settings, large quantities of private wells complicate equitable use and sustainable management. While low-income households may not have the land rights or capital necessary to install a private well, middle and high-income households can often do so without a permit, resulting in intensive and unregulated use. In Jakarta and Bangkok, these challenges and others have resulted in over-pumping and land subsidence (Foster and Vairavamoorthy, 2013). With regard to quality, concentrated volumes of urban sewerage or waste can contaminate groundwater due to poorly designed collection and treatment systems (IAH, 2015).

In rural settings, groundwater-related challenges for drinking water, sanitation and hygiene take a different form. Given the typically sparse infrastructure and degree of remoteness, groundwater is often the only alternative to scarce or polluted surface water. When accessed through context-appropriate water, sanitation and hygiene infrastructure, groundwater has the potential

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to significantly improve the livelihoods of women, children, the elderly and people with disabilities (CAP-NET and GWA, 2006). It can reduce their burden in water collection and make time available for education, economically productive activities or reduce the burden of physical challenges they may face. Yet achieving equity within and among rural communities remains logistically challenging. Direct connections to water and sanitation services are not always logistically possible or economically viable and distances from central community water points can vary greatly. Thus, community members have a central role in preventing 'indirect discrimination,' wherein infrastructure planning may inadvertently privilege some users over others (Van de Land, 2015) and in ensuring sustainability use of groundwater resources through appropriate allocation and pollution prevention practices.

Food Security

In the coming decades, sustainable utilization of groundwater resources will be critical to achieving global food security. Irrigated lands account for 40% of global food production and productivity of groundwater-irrigated areas exceeds that of irrigation from other sources (Deb Roy and Shah 2003). Groundwater's relative pervasiveness, reliability, and buffering-capacity (drought resistance) reduces sensitivity to rainfall and risk of harvest failure. Increased water availability can also free resources for other investments that can, in combination, substantially increase yields. Given these advantages, groundwater constitutes over 40% of total annual volume of irrigated water (Siebert et al. 2010).

Many regions, particularly Sub-Saharan Africa, underutilize groundwater irrigation and groundwater's buffering capacity (Margat & van der Gun 2012). In contrast, Postel (1999) estimated that 10% of food production could be at risk because of overexploitation of groundwater. Since the 1960s, use of non-renewable groundwater resources in irrigation has increased dramatically, with particularly high proportions in India, Pakistan, the United States, Iran, and China. These locations and others also experience overexploitation due to unregulated or even subsidized groundwater pumping for irrigation. Thus, a key challenge going forward is to sustainably optimize groundwater use in both situations.

Optimization would require appropriate crop selection and development of advantageous food trade regimes. For example, drier regions may choose to grow higher-value, water efficient crops and import staple crops, which are typically low-value and high water intensity. However, the link between food security and groundwater is complex and influence by a great deal of contextual factors such as climate, hydrogeology, demography, socio-cultural dynamics, and economic. As, such a wide range of considerations must be integrated into food policy and decision-making without loosing a focus on equity.

Sustainability, Ecosystems and Climate Change

Anthropogenic activities can pose a significant threat to groundwater resources and their related ecosystems. Agricultural return flows and seepage of wastewater may lead to contamination and salinization of groundwater (Vengosh, 2013), thereby creating human health risks if consumed. Groundwater over-abstraction may also amplify land subsidence and naturally-occurring contamination processes. Consequently, extensive and continuous groundwater monitoring is critical to ensuring groundwater sustainability. It allows for both quantitative and qualitative changes to be evaluated and can provide a sound understanding of spatiotemporal dynamics at various scales. Understanding these dynamics is a prerequisite for the conjunctive management of both supply and demand preventing water shortage. Prevention by means of coordinated monitoring and planning should therefore be established world-wide to systemically facilitate resilience and adaptive actions that ease the effects of water shortages, climatic variability, natural disasters and other emergencies (Vrba and Renaud 2016).

Groundwater planning and management can capitalize on groundwater's natural buffering capacity by employing targeted actions like artificial recharge of groundwater and/or the preservation and protection of natural recharge zones. Artificially recharging aquifers with excess surface water, wastewater, or urban storm could 1) increase storage volumes; 2) rehabilitate salinized aquifers; and 3) naturally contaminated waters (Pyne, 2005; Vanderzalm et al., 2006). Benefits could include augmented supply for drinking water, irrigation, and/or ecosystem function that would contribute to the achieving sustainable development. In addition to artificial recharge, the preservation of natural recharge and drainage areas occurs through the protection of ecosystems such as wetlands, lakes, rivers, springs, and various terrestrial biomes. Protecting these areas, would prevent groundwater contamination and ensure that available groundwater volumes are not reduced over time. In the cases of non-recharging aquifers, planning and management actions need to focus on equitable, inclusive, and inter-generational allocation of groundwater resources as they will inevitably be depleted over time.

Conclusions

Based on the discussion above, it is clear that sustainable and equitable groundwater use plays a critical role in 'ensuring no one is left behind.' In the context of the SDGs, groundwater is most explicitly linked to ensuring availability and sustainable management of water and sanitation for all' (Goal 6). But, groundwater can also directly contribute to poverty eradication (Goal 1); food security (Goal 2); gender equality (Goal 5); sustainability of cities and human settlement (Goal 11); combating climate change (Goal 13) and protecting terrestrial ecosystems (Goal 15). Overall, sustainable groundwater use can only be achieved through proper monitoring, management and governance that uses integrated and precautionary approaches while giving appropriate attention to the potentially transboundary nature of groundwater. These conclusions bring forth the following policy recommendations (see Figure 1).

Figure 1. Policy Recommendations

WASH

- Use integrated planning to reconcile the condition of groundwater resources with planning of water supply, sewerage, sanitation and storm water drainage.
- To avoid polluting groundwater supply, develop well fields in locations least susceptible to contamination (e.g. outside densely-populated areas); create protective perimeters around wells (e.g. prohibit unlined sanitation facilities or livestock grazing); and provide improved sanitation facilities to the extent possible and otherwise site facilities outside groundwater recharge zones.
- To avoid groundwater depletion, establish or enhance groundwater recharge schemes and/or establish equitable allocation regimes that regulate private wells.
- Ensure access for populations with low-income and that are geographical or socially marginalized.

Food Security

- Use agricultural planning to optimize use of groundwater resources, by either reducing over-use or bolstering underdevelopment and also by considering the vulnerability of groundwater resources.
- Taking into account local context, prioritize and weigh the costs and benefits of growing certain crop types based on their potential impacts on groundwater sustainability. Also consider the implications of trading groundwater-irrigated crops internationally – which is effectively exporting groundwater.
- Revaluate the appropriateness of energy or agricultural subsidies that may inadvertently encourage inefficient groundwater use, overexploitation and may reinforce social inequities in terms of access to capital and energy resources.

Sustainability, Ecosystems and Climate Change

- Systematically monitor groundwater to support informed management and decision making, including the role of groundwater in climate change adaptation.
- Complement groundwater resources planning with targeted actions that will enhancing resilience against water shortages, natural disasters, and climate change.
- Preserve natural recharge and discharge areas as a cost-effective measure against climatic and socio-economic pressures and to enhance water services and security.

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