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Regarding Groundwater and Drinking Water Access through A Human Rights Lens: Self-Supply as A Norm

Jenny Grönwall ^{1,*}  and Kerstin Danert ²

¹ UNDP–SIWI Water Governance Facility, Box 101 87 Stockholm, Sweden

² Skat Foundation, Vadianstr. 42, 9000 St Gallen, Switzerland; kerstin.danert@skat.ch

* Correspondence: jenny.gronwall@siwi.org

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Abstract: Globally, some 2.5 billion people depend solely on groundwater to satisfy their daily drinking water needs. The reliance on this resource and its centrality to realize the human right to ‘safe’ drinking water has increased manifold, but this is yet to be fully acknowledged globally or by governments and political leaders at the national level. This paper analyses the interface of international human rights law, as corresponding to the obligations and responsibilities of different actors, regarding groundwater resources planning, management and protection. Drawing on the literature, we discuss the State’s duties to respect, protect and fulfil this right especially in relation to the freedom of end-users to self-supply from groundwater sources; the training and regulation of non-State service providers including drillers and private vendors; and health and safety concerns. Interpreting the State’s duty to ‘fulfil’ through direct water service provision ‘as a last resort’, this paper suggests that self-provision is the original norm for enjoying the right to water. This has significant implications for the State’s role in raising awareness concerning point source protection and aquifer recharge for water resources management and in decisions concerning water allocation. By ignoring self-provision, which is primarily from groundwater, the State is not only missing a tremendous opportunity but is jeopardizing the water security of future generations.

Keywords: groundwater; human rights; safe drinking water; HRWS; HRBA; self-supply; off-grid; private vendors; borehole drilling; source protection

1. Introduction

Groundwater is central to human development [1], for a range of societal sectors and for environmental flows [2]. Its strategic importance for global water and food security will probably intensify under climate change as more frequent and intense climate extremes (e.g., droughts and floods) increase variability in precipitation, soil moisture and surface water availability [3]. The reliance on water from aquifers has increased manifold over the past half century, supported by ever cheaper and advanced drilling and pumping technology that enables access in situ and ‘just in time’. The values for society—and not least from the perspective of public health—are tremendous, but vastly increased groundwater dependence also has consequences. In some regions, the understanding of the resource is very limited, particularly the quantities available, how much can be abstracted and how groundwater is replenished through recharge. A lack of data means that information on groundwater remains as hidden as the resource itself. Questions also remain about the behaviour and prediction of well-known groundwater pollutants and the interaction between land use categories and groundwater quality, while new concerns around emerging contaminants in drinking water bodies are on the increase [4].

Groundwater has been estimated to provide almost half of all drinking water worldwide with 2.5 billion people depending solely on this resource to satisfy their daily needs for water [5,6]. Thus, it is

vital to comprehend and account for groundwater dependence and the quantity and quality utilized. These figures may well be an underestimation though, as official statistics tend to not capture all sources used at domestic level. What we do know is that nearly 85 percent of the Indian population relies on groundwater for drinking [7], and tubewells serve as the main source of drinking water in rural Bangladesh [8]. In growing sub-Saharan countries, including Burkina Faso, Central African Republic, Chad, Ethiopia, Nigeria, South Sudan, Uganda and Somalia, groundwater is the main drinking water source for between 70 and 90 percent of domestic water users [9–12]. In the USA, 38 percent of the population depends on groundwater for its drinking water supply—be it from either a public source or private well [13] with self-supply wells providing water to approximately 13 percent of the population [14]. In ten studied Southeast Asian and Pacific nations, 79 percent drink groundwater [15]. Besides domestic needs, groundwater is also key for irrigated agriculture and indirectly for food security, as well as for industrial purposes.

Groundwater for household use can be accessed in many ways. It can be drawn or pumped from a single well (i.e., scoop holes, dug wells or shallow or deep boreholes/tubewells) which are one's own or belong to a community, a neighbour or an NGO. The borehole may even be connected to a 'water ATM' (an automated vending machine dispensing drinking water)—or the groundwater is delivered through kiosks, standpipes or informal vendors' carts and tankers. It can be abstracted from well-fields or springs and provided as part of a public or private utility's reticulated (piped, networked) water supply system. Nonetheless, individual groundwater-based water facilities and 'services' are oftentimes regarded as residuals that need to be eliminated by the continued expansion of piped water systems [11]. In some cases, groundwater is used only for other domestic purposes than drinking, because the water quality is/perceived as/sub-standard and adequate point of use-treatment methods are not employed by end-users [16]. Besides the technical aspects of accessing water, there are important legal and human rights distinctions to be made between groundwater that is provided by a public body; by a private (often referred to, and here used interchangeably with, 'informal') vendor or through public–private partnership arrangements; and such that is 'self-supplied'.

Mainstream policy recommendations are yet to treat groundwater as the critical source for households' dependence on water that it is. The importance of groundwater as a resource is not very prominent in the discussion on how the world is to ensure access to safe and affordable drinking water for all by 2030 or meet the Sustainable Development Goals (SDG) as a whole. It is furthermore telling that when the World Bank made a systematic mapping of an under-researched aspect of the ongoing global water crisis in its "Quality Unknown" study in 2019 [17], the very big data gaps with respect to groundwater forced the authors to exclude this resource altogether [18]. This absence of attention to groundwater is reflected also in documents, reports and normative statements from the United Nations (UN), with references only rarely found in reports. The planned UN World Water Development Report for 2022 [19] on groundwater is long overdue.

The international community employs human rights to protect the inherent dignity of every human being, and access to safe drinking water was formally recognized as a human right by the UN General Assembly [20] and the Human Rights Council [21] in 2010. This right contains fundamental freedoms and entitlements, conceptualized in accordance with a given frame for interpreting them. The devil is as always in the details and neither the particular content of the right nor the obligations of governments to respect, protect and fulfil have been discussed in relation to groundwater use and management nor are they adequate with respect to self-supply. Underpinning rights as concept is the central definition of them as *correlating* to duties. This understanding of rights as relational can be credited Wesley Hohfeld [22,23], in whose framework a right can, among other things, require duty-bearers to refrain from performing some action.

This paper sheds light on groundwater for domestic use, with emphasis on self-supply as practice. It analyses the human rights entitlement to be directly supplied with water, on the one hand, and corresponding State obligations and third-party responsibilities on the other. We examine central documents, including case law, and draw from empirical experience of self-supply. We also discuss the

regulation of non-State service providers, including private vendors, as well as quantitative aspects of groundwater resource management and health and safety concerns.

Section 2 gives a brief background to the human rights to water in international human rights law. Section 3 explores the literature on the right to water in relation to groundwater, in particular the General Comment No. 15 and reports from the Special Rapporteur (an individual expert given a mandate by the Human Rights Council to investigate, monitor and recommend solutions to a specific human right, in this case the human right to water and sanitation, HRWS). In Section 4 we zoom in on quality aspects of ‘safe’ drinking water, motivated by how the human right to water is today steadfastly accompanied by this prefix. Section 5 discusses in depth the State obligation ‘to provide’ in relation to groundwater. It also offers perspectives on different actors’ involvement in realizing the right to water, particularly when linked to invisible and sometimes unpredictable groundwater resources. In the final section, we conclude that the State’s role as the duty-bearer to provide water is limited under international human rights law and that end-users are supposedly capable agents who can and must take charge of their water supply.

2. International Law on the Human Right to Drinking Water: Fundamental Concepts

The human right to drinking water is derived from the right to an adequate standard of living and inextricably related to the highest attainable standard of physical and mental health as well as the right to life and human dignity, all of which are covered under the 1966 Covenant on Economic, Social and Cultural Rights (ICESCR). Sanitation, in a broad meaning that interlinks it with water resources quality and health, was recognized as a distinct human right in 2015 [24]. The right to water entitles everyone to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses with a definition that excludes so-called productive uses at household level [25]. Water does not necessarily have to be (made) available free of charge [26].

Notably, the human right to drinking water should not be confused with ‘water rights’; the latter refers to permissions for drilling boreholes that may be required under domestic law.

The main authoritative, albeit not legally binding, statements for interpretations of the right to drinking water are found in the General Comment No. 15 on the right to water, adopted in 2002 by the UN Committee on Economic, Social and Cultural Rights [27]. Each UN member state country (State Party) that has signed and ratified the ICESCR has thereby committed to take steps to implement this treaty with guidance to be taken from general comments and other UN documents including the work of the special rapporteurs. The Covenant allows for progressive realization of human rights where available (financial and similar) resources are limited.

The system imposes on States various core obligations which are of immediate effect. In relation to the right to drinking water, these include to ensure, at the very least, access to the minimum essential amount of water that is sufficient and safe for personal and domestic uses to prevent disease [27] (para. 37). State Parties are expected to modify their domestic legal orders as necessary in order to give effect to their treaty obligations.

3. Groundwater Access and Human Rights

3.1. Self-Supply and HRWS

We define self-supply as the provision of water for oneself without direct support from the government, donors or others. It is driven by user demand and mostly, though not always, by the lack of alternatives. Broadly, there are three self-supply scenarios: (i) rural areas, with population density too low to warrant municipal or externally funded water supply; (ii) rural areas that are difficult or expensive to reach by government or development agencies; (iii) some rapidly expanding cities and their outskirts (peri-urban areas) where individual households and/or communities organize their own drinking water access. Previous studies have also pointed to incapacity among community-based

organisations to guarantee sufficient service, as well as intra-community discrimination or inequitable power relations at village level, as reasons behind self-provision [28].

Groundwater self-supply comprises water points—dug wells, boreholes, tubewells and/or springs—developed and financed by the end-users. It can encompass improvements to water supplies through user investment in drilling or digging a well, pumping technology, storage, water treatment, supply construction and up-grading, solar power water pumps, and rainwater infiltration beds (for groundwater rejuvenation) as part of resource management [11,29,30]. For instance, in India where no ordinary family enjoys 24/7 public supply, households are forced to access water from where it can be found and boreholes have proliferated over the past decades [31]. A more recent phenomenon witnessed in some of the fastest growing cities in Africa and Asia is for upper strata households to turn to an ‘off-grid’ model, taking responsibility for the own water supply through drilling of boreholes in the absence of reliable and convenient public supply [32,33].

Another term used for groundwater self-supply is ‘individual on-site solutions’ which the UN General Assembly observes as widespread [34]. Notably, the practice is described as part of ‘household contributions’ in some UN reports such as the Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS). Reporting from the 2018/19 country survey, the assessment mentions a gap in documentation of funding from household contributions and investments in self-supply solutions [35].

The Special Rapporteur on the human rights to safe drinking water and sanitation recommends “ensuring that public finance and subsidies reach the most marginalized and disadvantaged individuals and communities, who are often not (yet) connected to a formal network, who may live in informal settlements without any formal title or in remote rural areas where self-supply is common, and who are often overlooked or deliberately ignored in current policymaking and planning” [26] (para. 86). Notably, the households that drill their own wells, particularly in peri-urban areas, may not actually be particularly marginalized or disadvantaged [32].

3.1.1. The State’s Obligations to Facilitate, Promote and Provide as ‘Last Resort’

All human rights impose three main obligations on State Parties, designed to complement each other: to respect; to protect; and to fulfil the rights. The obligation to *fulfil* the right to drinking water should be read in light of how the human rights to health, food, education, social security and work are framed. It can be disaggregated into three different tiers: to facilitate; to promote; and to provide.

To *facilitate* means taking necessary steps towards full realization of the right. The State is expected to be proactive and take measures to empower, assist and strengthen people’s access to and use of resources and means of ensuring their livelihoods, including to create the appropriate circumstances in which individuals can successfully pursue their enjoyment of the right. For instance, States can develop agrarian systems, adopt national health policies and programs, improve methods of production and establish effective distribution mechanisms [36]. Facilitation should also take the form of law and regulation, plans and strategies [27] (para. 26, 28).

The obligation to *promote* involves steps to ensure appropriate education and awareness related to the right in question, such as concerning the hygienic use of water, protection of water sources and methods to minimize water wastage.

As a general rule, State Parties are further obliged to fulfil (*provide*) rights when an individual or group is unable, for reasons beyond their control, to realize the right themselves by the means at their disposal. States are thus obliged to *provide* the content of the right (the commodity in question) whenever individuals and communities are unable to realize and enjoy it by their own efforts, on grounds reasonably considered beyond their control (including natural disasters). It follows that only under such circumstances must States fulfil—as in supply—that right directly [27,37,38]. Accordingly, the General Comment No. 15 specifies that as part of the duty ‘to fulfil’, States are to “provide the right [to water] when individuals or a group are unable, for reasons beyond their control, to realize that right themselves by the means at their disposal” (para. 25). The Special Rapporteur clarifies that

‘fulfil’ means “to ensure direct provision as a last resort, when individuals are, for reasons beyond their control, unable to provide for themselves” [39] (para. 19, emphasis added).

For comparison, the realization of the human right to food usually relies on individual sourcing, while States may fix pricing for essential foodstuffs, to ensure that these remain affordable for all [26] (para. 5). In relation to water, this is illustrated by a court case from Argentina where the duty-bearer was ordered to provide direct assistance to those in a situation of extreme need and unable to satisfy their basic needs to safe drinking water and health—here being decided as a minimum of 200 litres per household daily—after the provincial municipality had caused pollution of the groundwater upon which these households depended [40].

The ICESCR rights are primarily to be realized by right-holders themselves. In terms of delivery systems and modalities, General Comment No. 15 and reports from the Special Rapporteur are neutral, and it would seem as if ‘self-supply’ and self-managed water systems are not only accepted but desired as a means for individuals to provide for themselves. Groundwater resources will by necessity be of importance here.

3.1.2. The State’s Obligation to Respect

The State obligations to fulfil the right to water are linked with the negative duty not to undermine existing access to food or other resources needed to provide for oneself. For drinking water, right-holders have a fundamental, correlating freedom to maintain access to existing water supplies necessary for enjoyment of the HRWS. This includes freedom from intrusion, interruption and disturbance where water access is arranged. This, and the right to be free from interference—such as from contamination of one’s water supplies—is correlated with the State’s obligation ‘to respect’. This requires States to refrain from interfering, directly or indirectly, with existing access [27] (para. 10). The State must especially respect traditional and customary arrangements for water allocation that (rural) communities and indigenous peoples rely on. Freedom from interference encompasses quantitative and qualitative dimensions, corresponding to State obligations not to arbitrarily diminish, pollute or contaminate water supplies as well as to prevent third parties from doing so.

Thus, these obligations do not preclude the continued existence of community-based or individual (ground)water access systems. This has been testified by court cases globally, e.g., the obligation to respect was applied when the State sought to prevent a well-established Bushmen community in Botswana from using a borehole, their traditional source of water [41], and when a malfunctioning municipal wastewater treatment plant polluted a river in Argentina and thereby compromised right-holders’ access to safe drinking water from their wells [40].

3.1.3. Self-Supply and the HRWS Normative Criteria

The globally endorsed monitoring framework for measuring the achievement of goal SDG 6.1 is provided by the Joint Monitoring Programme (JMP) of WHO and UNICEF. Data from national censuses and surveys are analysed and presented in the form of service ‘ladders’ which are used to benchmark and compare progress among countries and over time [42]. Indicator 6.1.1 is used to monitor the population that is using so-called safely managed drinking water services. To qualify as ‘safely managed’, water services need to be accessible, available and of specified quality.

Piped water supplies score highly in the JMP service ladder as they tend to provide water that is close to the home and have been considered, by default to provide water that is of high quality, i.e., is ‘safe’. However, the safety of piped water supplies is increasingly being called into question [43,44]. Meanwhile, self-supply sources oftentimes make safe water available close to the home, but cannot readily be identified within the national survey and census data and so remain invisible.

In order to examine whether the human right to water has been achieved at household level, all five normative criteria should ideally be considered. Water supplies, including those that rely on groundwater and self-provided sources, need to be judged against the criteria in their own right. This means considering acceptability (colour, odour, taste, salinity); availability (sufficiency, reliability);

accessibility (distance from the home); quality (including risks of pollution by nearby pit latrines); and affordability (construction costs, running costs, maintenance and management costs).

In many cases, self-supply sources relying on groundwater would score quite highly across all five criteria. For instance, in densely populated (peri-)urban areas water quality may be inadequate, whereas availability may be excellent. In rural areas, groundwater quantity and quality may be affected due to the intense irrigation, use of fertilizers and pesticides or sanitation practices. Using data from a study of communities in Nicaragua, Flores Baquero et al. [28] compared access to water among families that rely on self-provided sources including groundwater with those served by the village community (Committees of Drinking Water and Sanitation, CAPS, in Figure 1) as service provider. The spider diagram in Figure 1 enables each criterion to be considered separately. Water quality or ‘safe’ water is thereby not given more weight than the other four criteria. This more nuanced understanding and visual representation could be used as an incentive to drive improvements to the actual supplies by illustrating that, for example, availability is inadequate. This spider diagram approach is moreover neutral as to whether the water supply is piped or from a self-supply borehole but rather considers the outcomes, i.e., the extent to which the normative criteria are fulfilled.

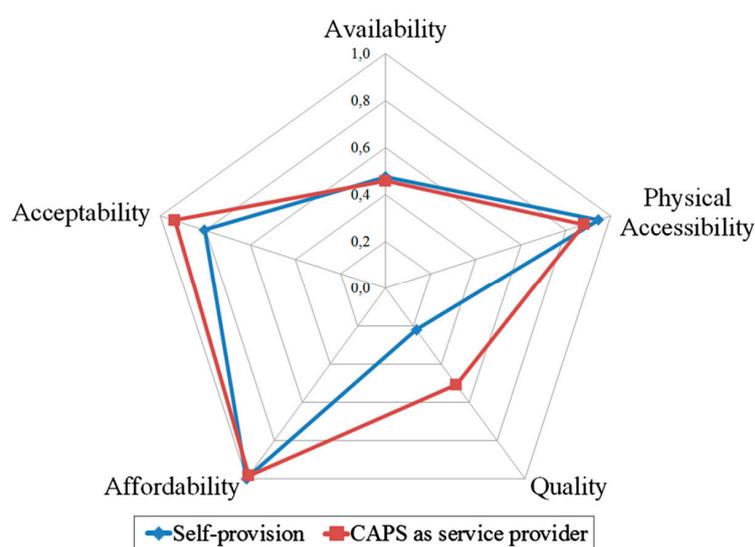


Figure 1. Comparing the extent to which water sources fulfil the normative criteria of the human right to drinking water. From Reference [28].

3.2. Service Delivery and Third Parties/Non-State Actors' Role

In cases where end-users rely on tankers or vendors, they are seldom aware of whether their drinking water is sourced from surface water, groundwater or both. Further, the State rarely has full information about which aquifers are being tapped, how much is being withdrawn or what the sustainable yield may be. This lack of information may be due to the lack of regulatory oversight; groundwater abstraction permits may not be accompanied by data collection. Even if drilling licences are issued, there may not be incentives for the collection of drilling logs, and there may be no (updated) groundwater database. Groundwater monitoring may altogether be very poor or non-existent.

A lack of information may also be because no public service provider is involved. With groundwater, more often non-State actors play a major role. Transnational corporations and agents operating within public–private partnerships; development aid agencies; non-profit community-based or non-governmental organisations (NGOs); charities and faith organisations as well as individuals; and private vendors are all tapping groundwater but are generally neither collecting nor sharing groundwater data.

The Special Rapporteur (then independent expert) presented a report in 2010 to clarify the obligations and responsibilities of non-State water service providers [39]. The report reminds us that

the international human rights framework is neutral as to economic models in general including forms for provision of services [45]. It does not express a preference for private sector engagement, and it also does not prohibit payment for water services.

The report identified three forms of providers. As listed in Table 1, these have different forms of obligations or responsibilities and tend to employ different modes of distribution. Regardless of the modalities of the service provision, the State cannot exempt itself from its human rights obligations by involving non-State actors in service provision. Where piped water networks, water tankers, boreholes and wells, bottle/sachet water or other types of water services are provided, operated or controlled by third parties, State Parties are obliged to *protect* rights-holders. This applies to individuals as well as groups including indigenous peoples. Non-State actors must be prevented from interfering with the enjoyment of human rights by others and from compromising or denying equal, affordable access to adequate water as well as from polluting and unsustainably extracting water resources. This includes water from aquifers. Adoption of targeted social policies (e.g., pro-poor or cross-subsidies) may be needed to ensure attention to those that are, or are at risk of being, left behind and cannot provide for themselves.

Table 1. Different forms of (ground)water services providers.

| Provider Modified from Reference [39] | Obligations or Responsibilities | Mode of Distribution |
|---|--|--------------------------------------|
| The State: Provides services itself, often through its municipalities. | The State, being the primary duty-bearer, is directly accountable. If local representatives step in, the State, as the Party to the ICESCR, retains its binding obligations to realize human rights. | Usually networked. |
| Non-State actors /third parties: Formally delegated service provision, e.g., to State-owned companies, private companies, community-based organisations, NGOs, etc. | Entails a non-binding <i>responsibility</i> to respect the human rights and the corresponding obligations of the State; Must comply with domestic laws on, i.e., protection of natural resources and the conditions of the concession or licence, if any. If Regulator is set up, terms of reference will be dictated by it. | From networked to on-site solutions. |
| Informal, <i>de facto</i> provision: Involves a variety of actors and structures that have evolved over time, ranging from small-scale entrepreneurs to NGOs and community-based organisations responding to need and demand. | Responsibility applies proportionally, to i.e., the size of companies involved. No rights-based accountability for non-corporate actors. Domestic contract law may stipulate conditions for the relationship between provider and customer. | Varies; usually on-site solutions. |

The obligations of the State, on the one hand, and non-State actors' responsibility to respect the human rights, on the other, are complementary. The responsibility of transnational corporations and other business enterprises has been outlined under the auspices of the UN Secretary-General. In 2007, it was laid down that the basic expectation society has of business enterprises is that they will respect human rights and act with due diligence to avoid infringing on the rights of others [46]. As such, this responsibility is affirmed through global voluntary commitments and multi-stakeholder initiatives. These are reinforced through soft law instruments, which do not create legally binding obligations, but "'derive their' normative force through recognition of social expectations by States and other key actors" (ibid, para. 45). The subsequently launched Ruggie Framework for human rights and business consists of three pillars: the States' obligation to protect against human rights abuses by third parties; the responsibility of companies to respect human rights; and the need for access to effective remedies and grievance mechanisms to address alleged human rights violations [47]. The Human

Rights Council endorsed the framework through the UN Guiding Principles on Business and Human Rights (UNGPs) in 2011 [48].

The Ruggie Framework's responsibility concept is designed to be applicable to all enterprises regardless of their size, ownership and structure [48] (Principle 14). However, fundamental differences exist, for instance, between:

- a transnational company contracted by delegation as an industrial supplier of water services, who may have invested in piped distribution from a wellfield;
- the private vendor with a lorry or bullock cart, who may be pumping groundwater from his/her own borehole, selling to households and communities on a more or less regular basis;
- the small drilling enterprise providing on-site solutions to households in peri-urban areas.

Small- and medium-sized enterprises—as well as NGOs and similar organizations—may have less capacity as well as more informal processes and management structures than larger companies. Under the Ruggie Framework, the scale and complexity of the means through which they meet their responsibilities are permitted to vary accordingly.

The responsibility to avoid infringing on the human rights of others applies particularly in extraction from a shared aquifer that may interfere with existing water supply arrangements or when there is risk of contamination of such a water body.

3.3. State Duties to Regulate Third Party Providers

The obligation to fulfil and the role of the State as the primary duty-bearer with accountability requires the creation of an enabling environment including regulation and monitoring of service delivery. A Water Regulator authority to oversee the service provider of a piped supply can, for instance, ensure the affordability of services delivered by the service provider. Human rights standards on the right to information, transparency and participation in decision-making apply when a contract is awarded to a services operator. A State decision to issue a licence for business activities without due consideration of human rights principles can amount to a violation, as can failure to develop and enforce regulation to protect water resources from contamination [49].

Because the realization of the HRWS is influenced by the way in which various types of water 'services' is delivered, the extent to which the State has oversight of informal, small-scale providers also matters. There is practically no regulation of water quality, affordability, or reliability of the boreholes and wells that households, communities and small-scale providers or vendors utilize. Likewise, there is little or no oversight of private drilling to ensure design and construction quality and prevent contamination. In terms of reliability, private wells may not provide a regular or year-round supply of water, with seasonal dry periods being problematic in some regions [34], and boreholes may have been poorly designed or constructed. Effective legislative and other measures to restrain business activities, or enable them to provide high-quality services, are necessary to consider whether and how to integrate informal actors into the formal system [27,39]. However, this assumes that formal regulation is enforced, and that standards and oversight can guide implementation. In situations and environments where, for instance, drillers have poor knowledge of how to construct a sanitary well that protects from faecal coliform contamination, any sort of regulation becomes superfluous.

International human rights law has a fraught relationship with private (informal) water vendors. Over the years, different attitudes have been taken that reveal either a dismissal of these actors' role as service providers, or a recognition of a reality where they fill a key function. In 2017, the Special Rapporteur concluded that "where, due to a lack of regulation, access to water and sanitation facilities is either not available or inadequate '... ' or where people living in informal settlements are left with no option but to resort to *unregulated* informal services, the State is in breach of its obligation to facilitate" [50] (para. 11, emphasis added). This statement should be read in light of how the predecessor observed in 2010 that small-scale water providers "serve more people than the formal private sector" and that "'o'perating unregulated, 'informal, small-scale providers' often provide poor

quality services at exorbitant prices. Yet, many people would be far worse off *without* their services. Any attempt to regulate the activities of such providers first requires an overview of the sector and *the political will to acknowledge their activities*" [39] (para. 24 and 53, emphasis added). Taken together, the lack of operational guidance on regulation as part of the obligation to 'fulfil' does not do justice to the importance of small-scale, informal third parties, and there is not sufficient detail to approach them.

Many calls for regulation of private vendors stress the risks to consumers due to the poor quality control and the lack of testing of the raw water. In Indian cities, urban 'water mafias'—operators who extract and deliver groundwater to scores of formal and informal residential areas—fill a gap where government water supply has failed [51]. As suggested, this practice should be seen as ranging from exploitation to electoral lobbying to social protection to the provision of welfare.

4. The Importance of 'Safe' Drinking Water

4.1. Safety and Quality as Normative Human Rights Criteria

General Comment No. 15 stipulates that water for personal or domestic use must be safe, meaning free from micro-organisms, chemical substances and radiological hazards that constitute a threat to a person's health. Furthermore, water should be of an acceptable colour, odour and taste. Guidelines for drinking water quality from the WHO are intended to be used as a basis for the development of national standards. These promote the elimination or reduction of constituents of water that are known to be hazardous to health to a minimum concentration. States are to ensure that natural water resources are protected from contamination by harmful substances and pathogenic microbes [27] (para. 12 and 8, respectively).

Notably, the term 'drinking water' covers water needed for quenching thirst but also for domestic food preparation, personal sanitation, washing of clothes, and personal and household hygiene. Sanitation is not the focus of this paper, but it is important to bear in mind that inadequate sanitation can involve the rights of other people, whose health, and right to 'safe' drinking water can be negatively impacted when wastewater or human excreta is not appropriately treated, disposed of or reused [52,53].

The General Assembly Secretary-General warns that where a small-scale provider sells water to neighbours, this may be safe in some rural areas, while wells in high-density urban areas are often at great risk of contamination. To ensure water quality, dug (open) wells must be protected from animals and other sources of contamination [34]. Along the same line, the Special Rapporteur has expressed that "'t'he most appropriate water source in terms of water quality, in almost all cases, is a household connection to a networked supply, as it is generally the simplest way to control and regulate water quality" [54] (p. 137). As mentioned above, however, the literature points to how even piped-to-plot drinking water may originate from an unsafe or untreated source, may be supplied only intermittently and, therefore, be susceptible to contamination and may be stored unsafely once collected [43,44].

4.2. Groundwater Quality Aspects and Usage Concerns

Groundwater, at least from deeper layers and /semi-/confined aquifers, is typically of more stable and better microbial quality than surface waters [55], though toxic levels of fluoride and arsenic occur at all depths. Pollutants are, however, present in surface and groundwater alike. Shallow, hand-dug wells are often microbially contaminated due to the insufficient source protection, inadequate wastewater handling and/or solid waste management. There may also be poor awareness about the risks connected with storage at home and with consuming untreated groundwater from such wells [16,56]. It is therefore not surprising that one main concern related to the use of dug wells for drinking water needs is the likelihood of its substandard quality and resulting health issues.

The quality of groundwaters, in their pristine condition, can vary considerably from one aquifer to another due to the particular geology of the area within which the groundwater body exists. For instance, arsenic occurs naturally as a trace component in many rocks and sediments and can be released from these in a number of ways, but also enter into groundwater reserves and water supplies as by-products

from various industrial uses, among others. Salinity, which can give drinking water a salty taste, can be caused by seawater intrusion along coastlines, fossil groundwater, naturally highly mineralized groundwaters due to the geological factors, and/or leaching into aquifers from anthropogenic sources, such as sewage, agricultural use of fertilizers and industrial wastewater discharge.

In China, anthropogenic pollution of deep as well as shallow aquifers, which are the most important drinking water sources, has been proclaimed a major challenge and quality has worsened drastically in the past years with more than 85 percent of the country's groundwater reportedly graded as poor or very poor in 2018 [57,58]. Globally, WHO reports that at least 140 million people in 50 countries are exposed to arsenic through contaminated groundwater at levels above 10 µg/L (0.01 mg/L), a majority of whom in India and Bangladesh [59].

As noted above, the obligation 'to promote' (as part of the duty to fulfil) obliges States to ensure appropriate education concerning the hygienic use of water, protection of water sources and methods to minimize water wastage [27] (para. 25). Studies have pointed to the importance of public health messages for treating drinking water from wells and boreholes in connection with the first major rains after dry seasons and drought [60]. Education of those who are drilling and constructing the wells, as well as those who are commissioning their construction, are equally important.

The WHO lists education and community engagement as key for households to understand the risks of high arsenic exposure and the sources thereof. Affected communities can thereby be informed about the importance of prevention of further exposure by usage of a safe water source for drinking, food preparation and irrigation of food crops. Low-arsenic water can be used for these purposes, whereas high-arsenic water can be used for other purposes such as bathing and washing clothes [59]. Similarly, excessive fluoride intake that occurs through the consumption of groundwater naturally rich in this inorganic chemical may lead to dental and skeletal fluorosis and crippling bone deformities. The WHO recommends that context-specific advice can and should be given for fluoride avoidance and removal and has issued guidance in its report "Protecting Groundwater for Health: Managing the Quality of Drinking-Water Sources" [55] as part of the concept Water Safety Plans.

Microbiological drinking water quality is assessed mainly by measuring *E. coli* as an indicator of faecal coliform bacteria, suggesting the presence of sewage or animal waste contamination that can cause waterborne illness. For this reason, precaution is of essence to ensure groundwater source protection including climate-resilient water safety plans as well as appropriate hand dug well, borehole or protected spring design and construction [61]. Here, UNICEF points to the importance of preventive actions to help stop disease transmission and prevent children from becoming ill. Almost 60 percent of deaths due to diarrhoea worldwide are attributable to unsafe drinking water and poor hygiene and sanitation (WASH factors). Hand washing with soap alone can cut the risk of diarrhoea by at least 40 percent. It would seem, then, as if the quantity of water available in particular to poor households is sometimes more important than its quality, because access to more water enables handwashing and other hygiene measures. This also suggests that provision of pure water in scarce amounts can lead to more disease outbreaks than a plentiful supply of impure water [11]. Water availability, as close to the home as possible, has been shown to be more important than improvements in water quality as increased water supply can improve health status by enabling better hygiene [62]. Appropriate treatment of water, at point-of-use in those cases it is stored at home because supply is intermittent, has been found to be more effective than previously thought [63]. Groundwater supplies that are available directly by the home, as is generally the case with self-supply wells and boreholes, are thus very important as water sources.

The Special Rapporteur notes that pollution and over-abstraction of water resources through industrial activities are among the most commonly identified threats to the realization of the HRWS. For instance, heavy metals mining in mega-projects have, in several cases, caused groundwater pollution and hence impacted negatively on the HRWS [64]. The importance to monitor bacterial contamination has also been stressed [53]. The threat of groundwater pollution from extensive on-site sanitation is, however, notably absent in the reporting.

5. Discussion

5.1. Self-Supply: Freedoms and Entitlements Coupled with Responsibilities

5.1.1. Right-Holders' Ability to Self-Supply and the State's Obligation to Provide

Achieving direct assistance for water facilities or services is not an automatic entitlement for which right-holders can hold the State to account under the obligation to fulfil (provide). Providing water services and assuring access via *facilities* is not a State duty in the first instance. With Hohfeld's reasoning, rights-holder's do not have entitlements unless duty-bearers actually have corresponding duties. If State Parties are only obliged to providing drinking water (services and facilities) as a last resort solution when right-holders are unable to, "for reasons beyond their control", self-provision becomes a norm in realizing the right to water.

Thus, it should not be assumed that end-users of water are always passive recipients of services; rather, they may (need to) be active agents in securing water from available sources. A fundamental element of the human rights-based approach (HRBA) is to assume that rights-holders are capable of actively contributing to their own wellbeing. According to the UN's Common Understanding [65], they are key actors in their own development. The rights/duties system, consequently, does not relieve normal adults of responsibility for self-provision of welfare rights such as for food and drinking water. Rather, direct provision by the State is the ultimate remedy.

James Nickel [66] argues that where people have limited abilities or the circumstances are too harsh for them to gain sufficient access to safe water and adequate food, they have a claim to positive action by the State via the provision of, for example, welfare assistance. The rights-based approach also emphasizes the need for power analyses and a focus on disadvantaged groups. There is a need to promote non-discrimination and equality and to consider that some people may not have the capacities to request the support that they are entitled to. Recent work actually suggests that subsidies are usually only available to people (already) connected to water/sewage networks, whereby people off-grid are left out from public financing benefits [26].

The major question with respect to self-supply under international human rights law is the interpretation of end-users being "unable, for reasons beyond their control, to realize 'the right to water' themselves by the means at their disposal". As laid down in General Comment No. 15, it mirrors general comments on other economic, social and cultural rights. Though general comments are not binding as such, the normative value of the provision in question is strengthened by the similar understanding of the extent of the State duty to fulfil (provide) across the rights to food, health, education, social security and work.

Firstly, as set out in Section 3.1.1, the obligation to fulfil with its three different tiers is foremost to be realized through enabling end-users to pursue their own enjoyment of their rights. This is to be supported by educational measures and capacity development. Direct provision is "the last resort", in the words of the Special Rapporteur. Interlinked with these steps is the negative duty to respect by not interfering with existing access (production or procurement, in the case of food) and not depriving people of the space and resources to do so.

Secondly, is the question as to when right-holders can reasonably be seen, for reasons beyond their control, as without means to provide for themselves. This is the point at which the State's duty to provide sets in. Vulnerable and marginalized groups and un/der/served citizens can be found in both urban and rural environments. A natural disaster qualifies right-holders to be assisted and supplied with an adequate supply of safe and potable water to prevent disease. Given the increase of climate crisis induced floods and droughts, situations when the State must honour its core obligations are likely to increase in frequency and severity. Under regular circumstances, though, 'progressive realization' of international human rights only requires steps to the maximum of the State's available resources. The steps must, however, be deliberate, concrete and targeted and the burden of proof lies on the State to show immediate implementation in terms of a process underway.

The *Grootboom* case before the Constitutional Court of South Africa offers guidance on self-supply as a norm against which the obligation 'to actively provide' is measured [67]. Herein, it is laid down that "for those who can afford to pay for adequate housing, the state's primary obligation lies in unlocking the system, providing access to housing stock and a legislative framework to facilitate self-built houses through planning laws and access to finance. Issues of development and social welfare are raised for those who cannot afford to provide themselves with housing. State policy needs to address both these groups" (id, para. 36). In other words, human rights realization imposes on the State a certain "primary obligation" to facilitate access to the housing market for those with the resources to provide for themselves, but it "does not require the state to do more than its available resources permit" (id, para. 46). For those without the means, concerted efforts are necessary on the part of the State to act positively to ameliorate the conditions of poverty, homelessness or intolerable housing, and their interconnectedness.

Adequate understanding of groundwater levels, flow and heterogeneous characteristics of aquifers is normally far beyond reach of non-professionals. Also in state-of-the-art science, limited knowledge hampers comprehensive source, transport and contaminant identification, even about the behaviour and prediction of well-known groundwater contaminants [4]. It is notoriously difficult to determine variations in recharge magnitudes over time and space and their relationship to climate without direct, long-term observations of groundwater levels [68].

While extreme weather events may be regarded as beyond end-users' reasonable ability to understand, numerous actions and omissions can leave self-supplying households without means to provide for themselves. Changes can have a sudden onset, such as when a neighbour or industry drills a deeper borehole and extracts significant quantities of water, causing the groundwater level to drop, with dried up wells around it as result. Change can also develop slowly, such as when concentrations of nitrogen from fertilizers and wastewater build up to toxic levels. At what point, then, do right-holders become unable to ensure enjoyment of the right to safe drinking water themselves, by the means at their disposal?

These issues cannot be addressed in general ways. Courts and decision makers will by necessity have to consider grounds of reasonableness. Globally, cases of households experiencing difficulties in providing themselves with safe, available, accessible, acceptable, and affordable groundwater will continue to increase. This means that the State will probably have to step in more often to assist by directly supplying water. Likewise, private sector actors will seize opportunities and become even more important. This raises issues about the human rights responsibilities and legal obligations of the private sector, and the State obligation to protect against third parties (see Section 5.1.2).

Thirdly, determining when the shift for the State takes place, from the obligation to respect existing water access, to the obligation to directly provide water services, is reflected in human rights standards of adequate living and health. States are required to proactively strengthen people's access to and use of resources and means of ensuring their livelihoods. It is reasonable to find that the State has a minimum obligation to ensure that no one's human right to the highest attainable standard of health is at risk due to consumption of sub-standard water. However, comparing with the right to food, there are complexities involved in the rights–duties relation. Inga Winkler [69] notes that though a State's primary obligation to fulfil the right to food is to enable people to provide for themselves, it is not obliged to enable people to maintain a specific way of life, such as by subsistence farming. With an equivalent reading of the self-supply norm under General Comment No. 15, there is no entitlement for households to stay off-grid. For instance, under Swedish law the main rule is to pay a mandatory water and sanitation service tariff to the municipality if a property is within zoning plan area. In 2019 a long-anticipated judgement from the Land and Environment Court (*Mark- och Miljödömsstolen*) established that property owners who have arranged their own water supply and sewage treatment can, with due consideration to sustainability, safety and public health aspects, be exempt from this requirement [70].

Access to groundwater for domestic use has become a matter closely linked with climate change adaptation and responses to near Day Zero-predictions in several parts of the world. In Cape Town, 2018, boreholes became a preferred option for property owners who could afford the drilling. Until recently, households voluntarily going off-grid, choosing to rely on a new borehole in the backyard rather than on the already existing utility supply had been unimagined. Among drivers are increased tariffs at the uppermost tiers and/or intermittent, even rationing of, supplies. Some well-owners can earn a decent income from selling on to others. Today, in some cities and peri-urban areas, these practices risk making public service providers irrelevant. Moreover, it risks leading to reduced income streams and, in turn, a difficulty to cross-subsidize low-income customers and to finance future investments in infrastructure etc. [71,72].

Lastly, if the State is only to deliver and distribute water as the last resort, self-supply must be fully acknowledged—it is a norm. Self-supply needs to be captured through relevant indicators which enable:

- monitoring of total water consumption;
- understanding of trends in groundwater extraction and recharge
- measurement of other quantity-related aspects;
- measurements of safety and other quality-related dimensions;
- examination of who is being left behind and the potential need for the State to step in to arrange supply access.

5.1.2. Right-Holders' Obligations and Responsibilities

Self-supply also involves obligations and responsibilities. For instance, under the UN Convention of the Rights of the Child and from the essential health and sustainability perspective, freedom and entitlements of self-supplying households bring obligations on parents as duty-bearers with respect to their children's health. Furthermore, moral responsibilities towards others are becoming increasingly vocalized, with respect to shared aquifers as well as giving due consideration to future generations. In all such instances, there are quantitative as well as qualitative aspects to be considered. The drive for universal sanitation, coupled with increasing population densities in cities and lack of sewerage has led to a proliferation of on-site waste disposal [73]. The effect of burying human excreta and other waste may affect the local groundwater quality and, thus, could lead to abuse of the HRWS if others are negatively impacted by wastewater not being appropriately disposed. At household level there is thus a complex role in the interplay between the right to water and the right to sanitation, and correlating responsibilities. Another aspect that has not received proper attention is how urban sewers, drains and wastewater treatment plants may be under-dimensioned if self-supplied groundwater adds volumes that the infrastructure has not been capacitated for.

Hence, proactive measures would need to be taken by self-supplying users to safeguard that, among other things, wastewater and solid waste is properly managed and treated so as not to infringe on the rights of others. As an example, experience shows that a simple dug well may, originally, not protect adequately from outside contamination. However, with steps taken to upgrade it technically, it can become a reliable and safe source and offer a high degree of convenience and service. Dug wells can be improved with the addition of an impervious cap which keeps out surface water and other contaminants. Because the work is incremental, and community members can combine financial, material and labour resources, shallow, dug wells can be quite affordable per-capita [29].

5.2. Third Party Responsibilities

Groundwater is often the most or only feasible safe drinking water source in remote, low-resource areas. The ubiquitous hand-pump-fitted-borehole is estimated to serve 1.3 billion rural dwellers [74] and may have been self-financed or externally provided. Shortcomings in urban infrastructure expansions and coverage is often overcome by individual on-site solutions in the form of self-supply

from wells and boreholes—but also from private vendors and informal small-scale providers including NGOs and development aid agencies. Third parties' operative solutions are in practice the means to enjoyment of the right to water in unserved and underserved areas.

As noted in Section 3.2 these, and other informal non-State actors fall under the requirements of the Ruggie Framework and the UNGPs. While designed to be proportional to the size and means of the non-State water provider, it is very difficult to apply these guiding principles to small-scale actors, such as neighbours who supply consumers from their own boreholes. Large or small, these groundwater providers are only legally bound by the human right obligations to the extent that the normative criteria are adequately captured in enforceable domestic law.

The Special Rapporteur stresses the need for regulation of small-scale actors in terms of affordability and subsidies, and for institutional reform, development of self-supplying communities' capacity, and increasing financial and human resources to realize the human rights to water and sanitation in rural areas [26]. Clearly, oversight of informal and small-scale providers' services, including quality and safety of the water provided, reliability and accountability, and economic aspects, are central. However, there are many misconceptions in the understanding of private vendors, such as when they are described as “not anonymous companies, but often neighbours, friends or family members” [39] (para. 24); as informal actors that only operate “in areas not covered by formal provision” (ibid, para. 4.c); or that the demand is only seen among those not being served. In practice, demand for informal service-providers—just like self-supply and the evolving off-grid movement—can be witnessed also in *underserved* areas, where intermittent, discontinuous, and generally unreliable supplies drive households to take own measures to provide for their needs. It is yet to be seen how governments will address such tendencies where they are more recent, such as in South Africa's Cape Town, Lagos in Nigeria, or Njamena, Chad.

5.3. State Obligations and Duties

States are expected to adopt comprehensive and integrated strategies and programmes to ensure that there is sufficient and safe water resources for present and future generations. Further, realization of the right to water must be sustainable, ensuring that the right can be realized for present and future generations [27] (para. 11, 28). A major impediment for groundwater is that the resource is generally poorly understood and mapped. This results in both under-development and over-extraction and there is generally abysmal coordination or oversight.

The idea of rights being relational is the foundation of the rights-based approach to development, the UN Common Understanding of which identifies, as its outcome, the development of the capacities of 'duty-bearers' to meet their obligations and of 'rights-holders' to claim their rights [65]. The obligation of the State to facilitate self-supply should comprise various forms of capacity building. It could include, for example, giving robust advice pertaining to well and borehole siting, construction and maintenance [75], and enabling training or the curation of (groundwater) data. Practical advice on water quality testing is available from actors that State governments can easily associate with, such as the UNICEF, or the Rural Water Supply Network [10,12,76]. In the US, binding regulations and standards apply only to public water supply whereas individual well owners must ensure to test the quality of their well water. They are provided ample guidelines by the National Groundwater Association, including a Well Owner's Manual [77].

Education of end-users, contextualized awareness-raising measures, and direct interventions to, for instance, spread information about suitable treatment methods are all ways of facilitating self-provision. For instance, in low-income areas of Lusaka, Zambia, a shallow dug well in the backyard is a preferred way for many households to avail of water for domestic needs at no operational cost. However, the geology coupled with the proximity to pit latrines means that recurrent outbreaks of cholera during the wet season constitute a major concern. Authorities tend to take action by forcibly closing down wells to curb bacteria transmission [11]. This could amount to a violation of the freedom to enjoy existing water arrangements, albeit in the interest of public health.

While the right to water calls for enjoyment of 'safe' water to ensure an adequate standard of living and health, not all 'drinking water' must be of potable standard (fit to drink). The volumes of water needed for quenching thirst and for some food preparation purposes are small relative to other, hygiene related domestic needs. Self-supplied and vendor-obtained groundwater is often accessed and utilized for many different purposes. While it may be used for all the household's needs, it may also be complemented by bottled or sachet water for drinking and sometimes also cooking due to poor quality and/or perceived taste issues.

To realize the human right to the highest attainable standard of physical and mental health, water used for drinking (and some cooking purposes) must be potable. However, health is seldom threatened if water used for washing and similar household use does not meet WHO guidelines or national standards. The WHO itself gives recommendations regarding use of high-concentration arsenic water in Bangladesh and elsewhere, saying it can safely be used for many domestic purposes apart from drinking and cooking. The mental stress and workload that can be taken off the shoulders of women, whose gendered roles put them in charge of the family's water sourcing, should not be ignored for the sake of distant, potable water. A well of one's own serves multiple uses. State initiated training and advice can help households to differentiate between the quality standards of water for potable uses, and for other purposes, respectively.

Given that the demand for groundwater is increasing along an understanding of the risks that the resource faces, it is indisputably the role of the State to invest in research, inform society and translate findings to policy measures and binding regulations. Among other things, the State should raise awareness about best practices and build capacity where needed. Infographics could explain groundwater quality parameters and point of use-treatment methods where end-users are poorly educated or illiterate; radio, including listening groups can provide a good outreach mechanism. This goes hand in hand with creating an enabling environment for groundwater exploitation alongside source protection.

5.4. Emerging Issues

The international human rights framework does not prescribe concrete action for the concerned actors to protect, respect and fulfil the human right to water, and other interlinked rights. This right is in turn blind to what water source is utilized. Yet, ever increasing competition over shared resources, growing demand and the unpredictability of the 'new normal' climate system with ensuing water scarcity has hitherto only highlighted weaknesses of the status quo. Adaptive capacity factors relating to governance, and institutional capacity in particular, are imperative. Using the rights-based approach as a vehicle alongside other mitigation and adaptation measures aims to build the procedural principles of non-discrimination, participation, accountability and transparency into the process. It also addresses inter-generational claims for environment protection.

This study has left several questions outstanding that would benefit from further exploration. For instance, what are the implications of poor data and statistics on the use of groundwater among large-scale water services providers, and indeed for irrigation and in the industrial sector on the realization of the right to drinking water? Future research is needed to discuss how to better recognize groundwater in the SDG targets and indicators, and how the monitoring system (including the national surveys and census that provide data for the JMP and GLAAS) should be improved. There is scope to provide groundwater resource planners, decision makers and the entire groundwater community with much better data. Improved understanding of groundwater resources' vulnerability to climate change is furthermore necessary to identify risks posed and to develop and implement feasible management and adaptation measures.

6. Conclusions

This paper has focused on the human right to safe drinking water as related to groundwater resources, and its correlation with obligations and responsibilities in different actors. The primary

duty-bearer, the State, has many legally binding obligations to: respect by refraining from interfering with existing groundwater access arrangements; protect by preventing the pollution and over-extracting of groundwater; and fulfil by facilitating, promoting and—as last resort, to those without own means—directly providing services that are safe, affordable, and available without discrimination. Our interpretation of ‘to provide’ suggests that the duty to directly supply water is limited. Under international human rights law, self-supply (self-provision) is instead the original norm for enjoying the right to water. As of yet, this limited ambit of the State’s obligations to directly provide drinking water and implications of end-users’ freedom to self-supply from aquifers have not received their due attention either in legal reviews nor in policy analysis.

Under the rights-based approach, end-users are capable agents who can take charge of their water supply. Self-supply has particular implications, for the invisible and poorly understood groundwater resources. We thus argue that the freedom *from* interference with existing water arrangements and *to* self-supply need better recognition. This requires support to ensure that end-users take responsibility to protect the resource, and the rights of others. Importantly, end-users also have lawful claims on the State and its proxies in situations and environments where conditions are or become too dire for self-provision, or where they cannot reasonably be expected to have own means at disposal. Such cases already bring social equity concerns and are likely to proliferate with continued climate change.

As long as the water supply discourse and development of tools, manuals and training, as well as the subject of conferences and donor budgets focus on piped, networked ‘services’, significant ways in which households source drinking water from aquifers remain ignored. The many un/der/served who live in disadvantaged parts of our cities, within rural areas or communities that rely on informal, water access solutions are not considered quite as they should be.

Households in charge of their own water supply range from the poorest without much choice in the matter, to upper strata who are investing in modern technology. However, the increasing number of households who self-supply or go off-grid are essentially blanked out in the current debate. Ignoring the diverse ways in which water access at household level does not do justice to the lived reality of millions of people. Moreover, this turning a blind eye does not adequately support their dignity, life and health, and may even jeopardize the water security of future generations.

Groundwater usage involves many more actors than have been mentioned in this paper and we believe that their relationships, stakes and responsibilities warrant a separate study. Broadly translated our findings indicate that much remains to be done to safeguard groundwater for the sustainable realization of human rights. Work is needed on the right to water but also for protection of the resource for other uses. We encourage policy makers to consider the following:

- Providing significantly more attention on the interlinkages between human rights and groundwater. The enjoyment of safe drinking water as a human right for billions of people is affected by decisions to manage and safeguard the quantity and quality of this resource. In line with one understanding of ‘water governance’ as “who gets what water, when, and how”, we need more data on how much groundwater is used by and supplied to households (and other sectors of society); to and by whom; and for what purposes it is utilized (including when it is needed);
- There is need for a significant increase in the political will to invest in groundwater monitoring, characterization and mapping. Groundwater science needs to be translated into action, providing better baselines for decisions on groundwater protection and groundwater exploitation. Such efforts must go hand in hand with awareness-raising, training and regulation. This requires a significant increase in expenditure coupled with dedicated human resources. Advice and communication channels between UN bodies, governments, research organisations, non-State service providers of different capacities, and end-users in relation to groundwater need to be ramped up;
- Water quality is one of five normative criteria sitting alongside accessibility, availability, acceptability and affordability. The main intrinsic value in regarding safe (non-contaminated) drinking water as a human right lies in how it promotes an adequate standard of living, public

health and dignity. Notwithstanding this health-related intention, not all 'drinking water' must be potable. This should serve to provide a more holistic view on groundwater quality both in terms of self-supplying households and in regulating non-State actors;

- A multitude of different actors use groundwater to realize the right to water. Their different obligations or responsibilities, and the distinctions between public and private groundwater provision need clarification. The actual and potential role of informal vendors and other non-State actors in providing groundwater and in facilitating groundwater access, and the scope and limits to their responsibilities need to be fully explored. Likewise, there is need to examine and address the practical challenges and barriers that may undermine their ability to respect human rights;
- Given the complexity of planning, designing and constructing networked water provisioning, the expense and the level of expertise required to manage and maintain them as well as the economy of scale in shared supply systems, there is a role for the State. The State also has a role where rights-holders do not have the means to provide themselves. However, piped water services per se cannot accurately be described as explicitly called for under international human rights law. In conclusion, the obligation 'to provide' water is far from perfectly framed.

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