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Living Customary Water Tenure in Rights-based Water Management in Sub-Saharan Africa

Barbara van Koppen

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Contents

Acronyms and Abbreviations

AU	African Union
DRC	Democratic Republic of the Congo
FAO	Food and Agriculture Organization of the United Nations
lpcd	liters per capita per day
SDG	Sustainable Development Goal
UNGA	United Nations General Assembly
WASH	Water, Sanitation and Hygiene

Summary

Customary water tenure is the most accepted socio-legal system among the large majority of rural people in sub-Saharan Africa. Yet, the lack of awareness by academia, policy makers and statutory lawmakers continues to hamper the realization of intersecting human rights to water, food, adequate standard of living and gender equality, and Sustainable Development Goals (SDGs) 1, 2, 3, 5, 6 and 13. This void affects both statutory water law and infrastructure development. Permit systems which are the dominant form of water law continue to override customary water tenure as intended in colonial times. In many cases, other legislations such as constitutions, land and forest laws, indigenous peoples' law and administrative law recognize customary water tenure better than water law. In contrast, in infrastructure development, which is an important aspect of customary water tenure, the water, sanitation and hygiene (WASH) and irrigation sectors started recognizing communities' customary, age-old and rapidly expanding investments in self supply, and initiated support to self supply as a complementary services model to the conventional development of public infrastructure. However, both sectors focus on pieces of infrastructure, ignore communities as a whole, and remain locked in silos.

Based on literature, this report aims to fill the knowledge gap pertaining to both water resources (as addressed in water law) and infrastructure development (key to access sufficient water when and where needed) by developing a grounded understanding of customary water tenure, with the rural farming or pastoralist community as the unit of analysis. Gender, class and other social hierarchies persist alongside social safety nets, neighborliness and moral economies. Three components shape how rural people meet their domestic and productive water needs on homesteads, distant fields or other sites of use: the fundamental perception of the relation between water resources and humankind, with links to collective customary land; the sharing of finite and contested water resources within and outside communities; and water infrastructure development for self supply. A range of studies illustrate the substance of each component.

The first two components deal with naturally available water resources. Literature suggests that rural communities see water resources as a commons to be shared by all, in which stronger rights to the water resources linked to socially defined territories are vested in the community. Kinship, birth and partially marriage give rights to these resources. For the sharing of water resources, which are manifest as multiple, variable, unpredictable surface water and groundwater sources, rights of way or turns and rotation govern the 'sharing in' of water resources within a community and the 'sharing out' with neighboring customary communities. However, in 'sharing out' water with powerful third parties, communities are highly vulnerable to water grabbing by those outsiders, as they were in colonial times.

Hence, a top-down legal recognition of living customary water tenure in statutory water law is recommended. This would be in better harmony with constitutions and other legislation; ensure due permitting processes to protect rural communities when external high-impact users plan new investments in infrastructure; take existing customary 'sharing in' and 'sharing out' arrangements as legitimate starting points in mediating conflicts; and ensure that the strongest water resource entitlements are not permits anymore, but a core minimum of water resources that meet basic human rights to water and food, so that water resources remain available to flow into water infrastructure (third component) to realize basic rights.

This third component, infrastructure to store and convey water resources, makes more water reliably available where and when needed, strengthening resilience to climate variability and change. Customarily in self supply, community members access multiple water sources to meet their multiple needs, mainly through multi-purpose infrastructure and single-purpose infrastructure as the exception. Homesteads are a preferred site of multiple uses, especially for women.

The bottom-up recommendation for accelerated infrastructure development by the WASH and irrigation sectors is to join forces and take customary water tenure at community level as a starting point for support to self supply and public systems in order to increase basic water supply to everyone's homestead, leaving no one behind. Recognizing people's priority use of these basic supplies, 5 liters per capita per day, not necessarily more, should be safe for drinking, while enhancing the productivity of homestead irrigation and livestock to realize everyone's right to food. Inclusive community-led resource mapping as the basis for participatory planning, design and construction of infrastructure leverages communities' local capital in all three components.

While these findings identify how a recognition of customary water tenure better enables the realization of the rights to water and food and the SDGs, more historical and interdisciplinary research is clearly needed and recommended.

Living Customary Water Tenure in Rights-based Water Management in Sub-Saharan Africa

Barbara van Koppen

Rationale and Aim

Customary Water Tenure

In rural sub-Saharan Africa, customary law "is without doubt the most important of the sources of law, and of water law in particular, as it is the one which is most known and respected by the population" (Caponera 2007, 92). Yet, literature about customary water law in Africa is scarce (Meinzen-Dick and Nkonya 2007; van Koppen et al. 2007; Komakech 2013). Water policy and statutory water laws ignore customary water law as well. Yet, as this report seeks to show, awareness and a better understanding of customary water tenure[1] can significantly contribute to the progressive realization of intersecting water-related human rights to water, food, an adequate standard of living and a sustainable environment (Hellum et al. 2015), as stipulated in General Comment 15 on the Right to Water, of the International Covenant on Economic, Social and Cultural rights (CESCR 2003); and the United Nations General Assembly's declaration of the human right to water for domestic uses (UN 2010), as well as in Sustainable Development Goals (SDGs) 1 (no poverty), 2 (zero hunger), 3 (good health and well-being), 5 (gender equality), 6 (clean water and sanitation) and 13 (climate action), leaving no one behind. Water is also mentioned as part of indigenous peoples' rights (UNGA 2007).

The study follows the Food and Agriculture Organization of the United Nations (FAO) definition of water tenure as 'the relationship, legally or customarily defined, between people, as individuals or groups, with respect to water resources' (FAO 2020). The term 'communities' in customary (community-based, informal, indigenous[2]) water tenure is defined as a "group of rural people (indigenous, Afro-descendants or otherwise) who share a common interest or purpose in a particular territory or natural resource, and who primarily hold rights to those lands and/or resources at the community level" (RRI and ELI 2020). Customary water tenure thus refers to a rural community and its socially defined territories and related water resources as a unit of analysis.

The following three interlinked components come into play in communities' relationships to water resources as customarily defined:

- Community-scale customary perceptions of, and collective claims to nature's fugitive water resources that fall on (as rain on their roofs, fields, pastures, forests), rise from (as springs), flow by (as runoff and streams), wet soils (as soil moisture, wetlands), are stored (in puddles, ponds, lakes) or sit underground (in aquifers) within the socially defined territories of residential areas, fields, grazing land and forests of a settled community; or of pastoralists' routes; or of fishing communities adjacent to water bodies.

- Communities' arrangements to share these variable, finite water resources within the community ('sharing in') and between the community and neighboring customary communities or third parties that share the same surface waters or aquifers ('sharing out') (Knight et al. 2012).

- Water infrastructure development to store and convey water for more secure domestic and productive uses on homesteads, distant fields or other sites of use, daily or intermittently, in the quantities and quality needed, whether as individual households, self-organized sub-groups or as entire communities.

A better understanding of these living customary norms and practices in rural sub-Saharan Africa can inform national and international water policy, laws and programs in two domains in particular: (top-down) statutory water law and other formal legislation and (bottom-up) community-led water services and supported self supply.

Relevance to Statutory Water Law and Other Legislation

This top-down domain pertains to the first two components: perceptions and sharing of naturally available water resources. Customary water tenure is most known and practiced by rural Africans. It comes to them as facilely as 'the blinking of eyes', as a respondent

[1] This study uses the term 'water tenure' as the term 'law' may be misinterpreted and be confined to only state law.
[2] These terms are used interchangeably to indicate the empirical, existing 'living' realities as assessed by researchers. 'Local' or 'informal' conveys the dynamic nature largely outside the ambit of the state while 'customary' better conveys the history and social embeddedness of the rules and norms. This report avoids legal constructs of customary law as interpreted by colonial lawyers, judges and experts, often to legitimize resource grabbing (Hellum et al. 2015).

described (van Koppen et al. 2021a). Nevertheless, statutory permit systems override customary water tenure. Permit systems are the dominant form of formal water law in sub-Saharan Africa, applied in four-fifths of African countries (FAO n.d.). In their current interpretation and operationalization, permit systems impose an immediate conversion of all existing uses into administrative permits of limited duration, irrespective of the customary tenure's oral character and specific perception of natural resources as common goods, and including many other rights rather than just the 'use' right of limited duration, in particular governance, transfer, exclusion and due process rights. Moreover, water authorities lack the logistics to process permit applications by millions of small-scale users. The National Water Resource Strategy second edition in South Africa recognizes this explicitly: "Current processes are often costly, very lengthy, bureaucratic and inaccessible to many South Africans" (DWA 2013). Yet, without a permit, users formally commit offences. This is administrative injustice. The micro-scale *de minimis* water uses for domestic purposes and basic productive uses are exempt from the obligation to apply for a permit. However, this implies a weak legal status or the total invisibility of those users, who include the most vulnerable (van Koppen and Schreiner 2018).

Water laws lag behind other legislation in recognizing customary water tenure. In their groundbreaking analysis of the recognition of customary water tenure in national legislation of 15 countries across the world, RRI and ELI (2020) found that constitutions, land and forest legislation, administrative law and legislation on indigenous peoples' resource rights tend to recognize customary water tenure, integrated in communities' holistic resource tenure, better than water law. In sub-Saharan Africa, the link between customary land tenure and water appurtenant to land appears especially strong (Alden Wily et al. 2017; Troell and Keene 2022), as evident in Ghana (Sarpong 2004), Kenya (RRI and ELI 2020) and in Southern Sudan's Land Act of 2009 which recognizes "any pool, stream, swamp, or secondary river that is traditionally owned and managed by a community" (Southern Sudan 2009). The general administrative right to due processes of free, participatory and informed consent is also stronger in these other laws than in water laws (RRI and ELI 2020).

The invisibility of customary water tenure in current permit systems has colonial roots. As elaborated in van Koppen and Schreiner (2018), in their hydraulic mission, the colonial powers who introduced water law in Africa (and elsewhere) aimed to boost infrastructure development for their minority settler economy. In history's most drastic water grab, at least on legal paper, they claimed ownership of most, if not all, water resources in their colonies and hived off water resources from customary land. This dispossessed communities of their customary claims to water resources appurtenant to their territories and ignored both customary water resource sharing arrangements and age-old infrastructure for self supply. Colonial rulers could then prescribe a meticulous process, only for settlers, to apply for a permit. Any aspiring investor in infrastructure had to share infrastructure plans in a timely fashion in order to ensure free, participatory and informed consent among prior permit holders who might be affected. In the likelihood of infringements, the investor had to compensate them. Africans were at best 'to be informed' when settlers' new infrastructure was going to have 'significant impacts'. By 'granting' a permit to the settler after such due process, the new water departments committed to protect the investor's water rights vis-à-vis any next settler investor. In this way, permit systems became the incentive for settlers' 'orderly' investments in infrastructure on a first-come-first-in-rights basis. Since there were no irrigation departments then, this process provided both water authorities and settlers with prized geo-hydrological knowledge and localized options for infrastructure design in an unknown terrain. The newly built colonial state 'lawfully' overruled all prior and future African water tenure.

Post-independence, the declared ownership of water resources in four-fifths of African countries shifted to custodianship by the new state. However, permits designed to enable new infrastructure investments on a case-by-case basis among a minority suddenly became obligatory in order to 'regularize' all prior and future water uses above the *de minimis* uses. African governments with water laws other than permits were encouraged to shift to custodianship and permits during the northern-financed Integrated Water Resources Management discourses since the 1990s. This expanded and reinforced the formal overriding of customary water tenure. Moreover, with limited capacity to follow due processes, permits have become a relatively easy administrative means to obtain the strongest, and sometimes even tradable, entitlements for the administration-proficient high-impact users and their lawyers. This makes rural communities even more vulnerable to post-colonial 'water grabs' by corporate third parties, and sometimes the state itself, whereas foreign investment contracts can even override the state altogether (Borras et al. 2011; Franco et al. 2013; van Eeden et al. 2016; van Koppen and Schreiner 2018; Bosch and Gupta 2022). Gini coefficients of the distribution of the use of water resources can be as high as 0.96, as found in South Africa (Cullis and van Koppen 2007).

The following case studies confirm this risk is real. The Kenyan state ignored customary rights of way, closing off communities' water sources (Onyango et al. 2007). In Tanzania, the Arusha Urban Water Supply and Sewerage Authority diverts water upstream, depriving downstream communities (Komakech 2013). Large-scale sugar farming in the Awash Basin in Ethiopia deprives downstream pastoralists (Behnke and Kerven 2013). In Uganda, Chinese road builders swiftly got permits and depleted village dams (Debevec 2018). Sugar estate owners in Tanzania divert high volumes of river water, depriving downstream communities (van Eeden et al. 2016).

Water laws to regulate claims to and equitable sharing of water resources from local to transboundary levels will become more important. Competition for water resources is already critical in the continent's arid areas, where they are limited year-round. In many semi-arid areas, water resources dwindle briefly or over long periods in the dry seasons or during dry spells. Moreover, expanding populations, urbanization and industrialization require more water resources. In addition, climate change is exacerbating these challenges, severely hitting vulnerable rural communities who depend most on water resources for their agrarian livelihoods, while their relative contribution to climate change is negligible. Water law shapes the security for investors in infrastructure to augment water supplies through further surface water storage, sustainable groundwater use, or unconventional sources such as expensive seawater desalination. Such security is even more important for the rural poor to encourage them to invest in infrastructure for self supply. When supply augmentation has become impossible and the sharing of available water resources has become a zero-sum game, water law sets the framework for dispute resolution and priorities. In the light of these growing pressures on water resources that are indispensable to realizing human rights, poverty alleviation and inclusive broad-based agriculture-led economic growth, the recognition of customary water tenure in decolonized water law becomes even more urgent and critical.

In exploring the provisions of or amendments to current permit systems, the question arises as to how customary water tenure can be recognized, protected and supported in line with constitutional requirements on the one hand (Burchi 2005, 2012; RRI and ELI 2020), and how permit systems can become effective in regulating the minority of large-scale wealthy foreign and national users on the other hand. One aim of the conceptualization and empirical illustrations of living customary water tenure in this report is to inform legal reforms to decolonize permit systems and to harmonize water law with constitutions and other state laws.

Relevance to Community-led Water Services and Support to Self Supply

A better understanding of the living customary norms and practices in rural sub-Saharan Africa to which this report seeks to contribute, can also inform national and international water policies and programs in the second domain of supported self supply and the potential of community-led infrastructure development anchored in customary tenure. Lack of infrastructure to store and convey water remains a major barrier for the rural poor to access water, also when water resources are abundant. Women still have to go to rivers and directly use water for laundry, bathing or washing; livestock roam to rivers to drink and bathe; and farm households remain totally dependent on unpredictable and variable precipitation and more extreme floods and droughts for their food and income.

Hence, support to the third component of water tenure, infrastructure development to channel water reliably to homesteads, fields or other sites of use, is indispensable to realize intersecting constitutional rights and SDGs.

Accordingly, governmental and non-governmental support agencies in the water, sanitation and hygiene (WASH) sector, as well as in the irrigation, climate adaptation, disaster risk reduction, floods and drought management and other sectors spend significant resources to develop such infrastructure. Conventionally, they focus on public infrastructure for which external support agencies plan, design and finance most or all the capital and major maintenance investments, with varying degrees of user involvement in operations and maintenance. However, both the WASH and irrigation sectors increasingly recognize this third component of customary water tenure: people's initiatives and skills to plan, design, finance, construct, operate and maintain infrastructure either as individual households or as self-organized groups, or sometimes as an entire community, for so called 'self supply' (Butterworth et al. 2013). Self supply has existed since time immemorial and is rapidly expanding as a result of growing populations with higher aspirations to improve convenience, health, food and income; expanding markets of more affordable small-scale infrastructure and spare parts; new energy sources of diesel, electricity and solar power and, in the case of self supply for irrigation, new market opportunities for irrigated produce. Jars, drums, containers, small or large dams and soil moisture retention technologies aid in storing water. Gravity river diversions, canals or pipes and manual, diesel and increasingly electric or solar-powered lifting devices convey water. Through shallow or deep wells and boreholes and groundwater recharge, communities tap or replenish groundwater, the planet's largest natural storage reservoir.

The scale of self supply in customary water tenure in Africa is large. Within their sectoral silos, irrigation researchers have found that the area covered by informal irrigation exceeds that covered by public irrigation systems. The number of households benefitting from self supply is even much higher than beneficiaries of public irrigation (Giordano et al. 2012; Woodhouse et al. 2017; Shah et al. 2020; Izzi et al. 2021). However, farmer-led irrigation can be biased towards the relatively wealthier farmers with more land, as was demonstrated in Ethiopia (Kafle et al. 2022; Lefore et al. 2019). Current irrigation policies include support to 'farmer-led irrigation', as self supply is called in the irrigation sector (Izzi et al. 2021). For example, the African Union (AU) committed to support farmer-led irrigation as one of the pathways to the continent's agriculture-led, broad-based economic growth and the achievement of SDGs 1 (ending poverty), 2 (zero hunger), 3 (good health and well-being), 6 (clean water and sanitation) and 13 (climate action) (AU 2020).

Professionals in the WASH sector (Sutton et al. 2012; Moriarty et al. 2013; Sutton and Butterworth 2021)

also recognize self supply to meet drinking and other domestic water needs. Self supply has been the norm all along and remains the starting point to realize the human right to water for domestic uses, as committed by the United Nations General Assembly (UNGA) in 2010 (UN 2010; Grönwall and Danert 2020). It is an indispensable temporary backup to intermittent or failing public facilities. Across the world, self supply serves as a permanent solution in remote rural areas (Sutton and Butterworth 2021). Support to it has become an alternative or complementary water services model in the WASH sector as well (Butterworth et al. 2013; UNICEF and Skat Foundation 2016; Sutton and Butterworth 2021). However, for the more expensive technologies, a bias similar to that towards wealthier households in the irrigation sector has been observed in the WASH sector (Hofstetter et al. 2021; Sutton and Butterworth 2021).

Within their sectoral silos, the WASH and irrigation sectors see the same advantages of supported self supply compared to public schemes: leveraging their own investments gives substantive value for public money, so more people can be reached. It ensures not just a 'sense' of ownership of infrastructure but real ownership, which is key for sustainability. The infrastructural support provided by both sectors also overlaps: the promotion of similar affordable water and energy technologies with spare parts, whether fully market-led or partially subsidized, or in combinations, and technical training and financing facilities (Minh et al. 2021; Sutton and Butterworth 2021). Also, both sectors have to reckon with whether and how the promotion of self supply will affect the water resources that flow into their infrastructure, even though the volumes for everyone's domestic supply are much less than those taken up by a few irrigators with large tracts of land.

The community as a unit of analysis in holistic customary water tenure that governs self supply is new in both sectors. It requires not only opening up from the single-use silos but also moving up from a focus on specific pieces of infrastructure to the community scale. Yet, a better understanding of all three components of customary water tenure (perceptions and claims to water resources, sharing in and out of water resources, and infrastructure development for self supply) can highlight more effective ways for governments and non-government support agencies to join forces in cross-sectoral collaboration and accelerate the realization of the entire range of mutually enforcing state commitments. This report seeks to explore those options as well.

Structure

The following section on the methodology explains how customary water tenure in sub-Saharan Africa is conceptualized as a people-driven, upside-down (Meinzen-Dick and Pradhan 2001) approach as found in the range of empirical case studies. The bundle of water rights and general features of customary law that also hold for customary water tenure are briefly presented as well. The next section explains the driving force of customary water tenure: poor women's and men's domestic and productive water uses and benefits, and the labor, cash and other efforts to provide water. This is followed by findings on customary rights to water resources, both at community scale as a commons to be shared by all (first component), followed by an exploration of the sharing of water resources within communities and between customary communities (second component). After this, insights into infrastructure development for self supply are presented (the third component), explaining the profound differences between the tenure of water and land or forest tenure, and how owners of infrastructure create 'hydraulic property rights' (Boelens and Vos 2014). The two penultimate sections provide insights into and answers to two questions: (1) How can an understanding and legal recognition of customary water tenure decolonize permit systems and contribute to historical justice in claims to water resources, so that at least a core minimum of water resources continue to be available to flow into infrastructure to realize the human rights to water, food and an adequate standard of living and SDGs? and (2) How can cross-sectoral collaboration in the water sector accelerate the development of sustainable infrastructure to those ends?

Methodology

Conceptual Approach

Surprisingly, no evidence-based conceptualization of water tenure at the community scale could be found in the literature. Excellent studies on living customary water law and the interface with statutory law in Nepal (Ostrom 2005; Pradhan 2010) and Latin America (Boelens and Dávila 1998; Boelens 2008, 2015; Boelens et al. 2016; Vera Delgado and Zwarteveen 2017) focus on communal farmer-led irrigation systems. Less or no attention is paid to domestic and other water uses, or to the ways in which households who are both irrigators and domestic water users combine the use and reuse of multiple surface water and groundwater sources. Linkages between infrastructure development and the allocation of water resources remain unclear. Other in-depth studies on water tenure by indigenous minorities in colonized countries like

Canada, USA, Australia and New Zealand (Jackson 2018) focus on their land-bound water resources (components one and two), but only a few studies (Getches 2005) address the third component of infrastructure development to meet at least basic human rights.

A grounded theory approach was applied to fill this conceptual void, focusing on sub-Saharan Africa (Strauss and Corbin 1990). The literature examined (listed in the section *References*) encompassed a wide range of aspects of water law as defined by Caponera (2007, 49-50), but with less attention to water quality, fisheries and navigation.[3] Moreover, since mainly literature in English was studied, evidence from Francophone and Arabic cases was limited. There is no claim that the over 100 cases cited are in any way exhaustive. Substantive further literature review and field research is required. However, this contribution to more awareness and a better understanding of customary water tenure seeks to already show its high relevance for policy and action.

Bundle of Water Rights

Where literature allowed, the bundle of rights was applied to further refine the conceptualization of the three components of living customary water tenure, based on the categories that RRI and ELI (2020) identified to conceptualize community-based water tenure. These include substantive rights to (temporarily or permanently):

- Use water (for domestic, livelihood, commercial or cultural purposes)
- Govern water resources (set rules, implement, enforce and address conflicts)
- Exclude others
- Transfer rights (for example, by marriage and inheritance, exchange, sale, rental, barter or donation) (Boelens 2008, 55-56)
- Procedural rights to the due process of being informed, participate or consent in decision-making, fair compensation and appeal

We also used the notion of 'sharing' to indicate exclusion and inclusion rights. This refers to a zero-sum situation among competitors in which water used by one is not available for use by the other. Negotiations about the sharing in or sharing out of water are about reducing, rationing or stopping community members and others from tapping into and withdrawing from a common pool. Sharing can refer to either naturally available water resources or water from infrastructure, such as internal water sharing among members of a communal system, or individual households sharing water with other community members from their private infrastructure. While the expression 'sharing' fits the physical features of water and the perception of water resources as a commons, it is rarely equitable. Different uses require different volumes of water. Moreover, as all socioeconomic and political action, it is shaped by power relations within communities along lines of gender, age, wealth, class, mobility and education and other hierarchies such as proficiency with information technology. On the other hand, kinship and neighborliness provide moral sharing and social safety nets. However, deeper inequalities exist between communities and powerful pre- and post-colonial third parties.

As elaborated below in the section *Creation of Hydraulic Property Rights*, it is noted that once water resources have entered infrastructure to be stored and conveyed, the same bundle of rights that RRI and ELI (2020) defined as relevant to a common pool of naturally available water resources remains relevant, but for another action: the concrete handling of infrastructure with the intention to store and convey water. The primary right holders are not necessarily 'a community' anymore, but those who invested skills, labor, funds and other resources in the infrastructure throughout its life cycle of initiation, planning, construction, operations, distribution and water use, maintenance, refurbishment, extension and replacement. As mentioned, investors can be an entire community or initiators with a self-organized sub-group or individual households, depending on, among others, the hydrology, economies of scale, social relations and technologies available. The expression 'infrastructure investors' indicates that the functioning of infrastructure requires continuous efforts to obtain deferred benefits.

General Features of Living Customary Resource Tenure and Its Limitations

Any living customary law has some general features. Assuming that they are also applicable to customary water tenure, some of the features are listed below.

[3] Caponera (2007) identifies the range of issues with which water law deals. With the exception of water resources policy, planning at national and basin levels, hydropower production, industrial and mining uses, this study confirmed that all other aspects also feature in customary water law: [...] inventory of (or information on) water resources laws governing surface water, groundwater and atmospheric water; ownership rights, priorities among the various uses, existing rights, zoning, planning at the [..] local levels; procedures for acquiring ownership rights or use rights, servitudes, i.e., rights of passage for water over land belonging to others, the regulation of all beneficial uses such as domestic uses, municipal supply, irrigation, [..] navigation; control over the harmful effects of water, such as floods, drought, poor drainage and the protection of the banks of water courses; rules governing the financing aspects of water, i.e., taxes, water rates and fees; the safeguarding of water quality and pollution control; provisions regarding the interdependence of water and other natural resources in relation with the environment. However, this study paid less or no attention to water quality, pollution and sanitation issues, the tenure of fisheries (rights on fishing grounds, rules on fishing, seasonality, types of fish and nets, dam building, sale of fish), navigation (access, transport rights, rules on passengers and goods, boat type) and recreation (Ramazzotti 1996).

Firstly, customary norms and principles are localized, dynamic and broad-based. They are continuously negotiated, shaped and adjusted to each rapidly changing local situation (von Benda-Beckmann et al. 1998; Meinzen-Dick and Nkonya 2007; Boelens 2008). Negotiations around general principles allow for different interpretations of what they mean in any concrete situation (Moore 1978, as cited in Benjaminsen and Lund 2003; von Benda-Beckmann et al. 1998; Boelens and Dávila 1998; Boelens 2008; Benjaminsen and Lund 2003; Lund and Eilenberg 2017). Customary systems 'are neither regulated by predictable rules and structures nor characterized by sheer anarchy' (Benjaminsen and Lund 2003). The continuous negotiation and adjustment to local and changing conditions is even more relevant for customary water tenure, which varies both seasonally and annually, and is increasingly extreme and unpredictable under climate change (Juma and Maganga 2005; Boelens 2008).

Secondly, customs, social rules, norms and institutions are unwritten and orally transmitted from generation to generation. Parties may even avoid writing up detailed agreements to prevent conflicts (Lund and Eilenberg 2017). Such flexibility 'provides security that is both possible and needed' (Boelens and Dávila 1998). Moreover, any academic interpretation of poor women's or men's perspectives fails to do justice to the profound meanings as expressed by the women or men themselves, in their own language and culture.

Thirdly, rules and norms derive from the community's historical use and persistence. They are socially embedded (Cleaver 1998; Cleaver and De Koning 2015) and perceived as legitimate and binding. Effective occupancy, a first-come-first-in-right, is an important criterion to make claims to a resource, only breached by violent human or natural forces.

Fourthly, rights are expressed by a code of behavior, by dos and don'ts, rather than proprietary rules of 'mine', 'yours' and 'his' (Pogucki 1955, as cited in Ramazzotti 1996). They often include spiritual or cosmological world views on human beings as integral to their environment and profound social values such as *ubuntu*[4] (Sparks 1990). Any wrongdoing may anger ancestors or invoke evil spirits that seek to punish (Drangert 1993). Ceremonies and references to ancestors play an important role in the continuation and transmission of these normative frameworks to following generations.

Fifthly, even though rules are seen as legitimate and binding, behavior differs in practice. As compliance is embedded in community life, enforcement is complex. On the one hand, people have many identities and interact with each other in multiple spheres (Boelens and Dávila 1998). Multi-faceted interdependencies render good neighborliness vital for mutual assistance in times of need and survival (Komakech 2013). Such multiplicity of mutual dependencies may make punishment and enforcement of compliance difficult. For example, it is difficult to charge fees to or fine kin, neighbors or powerful patrons. High transaction costs of enforcement may further prohibit rule enforcement.

On the other hand, dependency forces compliance. A livestock herder of the WaSukuma ethnic group in Tanzania described this dependency as an incentive to abide by the rule to keep livestock out of cropland: "when your cows are stolen and you whistle for help, people won't come to help search for your cows. They will say you were so proud that you grazed their crops and they won't come to help" (Nkonya 2006, 272). In the past, acceptance by the in-group of one's local community and compliance were a matter of life and death. If anyone was excluded, they had nowhere to go. In spite of many changes in today's life, the threat of being ostracized still underpins punishment through a public apology for wrongdoings (Nkonya 2006).

Sixthly, if conflicts cannot be avoided, conflict resolution is immediate with reconciliation, healing, apologies for mistakes and compensation of the one who lost. A common punishment to close a case (and hence an incentive for others to report) is to bring an animal to slaughter and eat it together, or to feast in another way at the offender's expense. Fines are affordable and may be shared between the victim and the customary court (Nkonya 2006). Direct conflict resolution by the disagreeing parties is encouraged. However, if needed, one can escalate to a higher community authority. Among the WaSukuma in Tanzania, if disputes are escalated to a next higher level, fines double. Fines triple if the village-level local government has to be brought on board (Nkonya 2006).

This dispute resolution sharply contrasts with formal arbitration which takes longer, has higher transaction costs, involves more expensive punishment, or even imprisonment, than the instant judgment and immediate punishment in customary dispute resolution. The

[4] Sparks (1990) relates *ubuntu*, as applied in the Bantu humanist ethics, to the common origins of agro-pastoralist societies of gradual migratory drifts at a generational pace. In the harsh and extremely volatile natural environments of the early migrating Bantu agro-pastoralists, where the year's rain, grass and crops could be followed by years of drought, cattle disease and famine, mutual support was critical for survival. *Ubuntu* cushioned against environmental uncertainties. *Ntu* refers to an ancestor who got human society going while *ubu* refers to the abstract. Together, the word conveys the concept that human realization is essentially being in-community. *Ubuntu* values mutual support and sharing, affection and hospitality. Each individual's humanity is expressed through his or her relationship with others and theirs in turn through the recognition of this humanity. In other words: 'people are people through other people'. However, the other side of the coin of the all-encompassing community is the total rejection of anything that is a threat to that community, notably people accused of witchcraft.

language and formal court settings are alien and intimidating. Ad hoc formal judges are unaware of the long-running disagreements of which a particular conflict is part. Instead of seeking to reconcile and compensate the victim, formal procedures pursue a 'winner takes it all' approach. Communities further lose faith in formal procedures because of corruption and a perception that formal dispute resolution is for 'clever people who can get away with everything' (Nkonya 2006, 290).

Lastly, there is no 'pure' living customary tenure. As one of the plural legal systems, customary (water) tenure is a semi-autonomous social field (Moore 1978, as cited in Benjaminsen and Lund 2003; von Benda-Beckmann et al. 1998). In local 'forum shopping' people invoke rules that serve their interests best as locally negotiated hybrids (von Benda-Beckmann et al. 1998). Interactions with the outside world have been profound and continue to shape contemporary customary tenure, including the substantial differences in rapidly changing variables across the continent, such as demographics, weather and climate, geography, resource endowments, impact of the COVID-19 pandemic, availability of water technologies and energy sources, markets, population increase, mobility, urbanization, voluntary and forced migration, increasing pressure on rural farmland, pastoral land or forests, smaller land sizes and growing rural landlessness.

The interface between communities' customary social fabric and local arms of state institutions, political parties and (elected) representatives is particularly important and complex, contested and diverse within and across countries. It may still carry the colonial divide-and-rule legacy in which the colonial state appointed cronies as their employees in what is described as 'perverted tribalism' (Mamdani 1996). However, the integration of states and tribal authorities can be smooth, as illustrated by the specialized traditional authority who coordinated collective wetland cultivation and water management in Ethiopia, to evolve into a local government (*kebele*) position (Dixon and Wood 2007). More specifically, customary self supply and publicly financed water infrastructure are a continuum: customary arrangements can strongly influence the operation and maintenance of 'public' infrastructure (Cleaver 1998; Cleaver and De Koning 2015; Schnegg 2018). Over time, when external actors move out, for example from irrigation schemes, customary arrangements return (Ferguson and Mulwafu 2007). Without addressing the complex current interface, this report focuses on living customary water tenure, highlighting potential new tangible and concrete implications for policy, law and water interventions for a more inclusive and effective interface.

Multiple Water Uses for Health and Wealth

Drinking, Domestic and Productive Uses

Water needs are important drivers of customary water tenure. Needs cross the administrative sectoral boundaries, as briefly sketched in this section. Most rural women and men use water for both domestic and productive purposes. Everyone drinks water daily and eats food that was washed, prepared and cooked with water. Everyone uses water more or less often to wash hands or body, bathe and for basic sanitation (typically in the absence of flush toilets). Further, each household, predominantly its women, uses water to clean the house, utensils and other objects and for laundry.

A large proportion of rural women and men also use water daily or intermittently for one or more productive uses (Moriarty et al. 2004; van Koppen et al. 2009; Hall et al. 2014; Theis et al. 2018). Depending on the diversity of agriculture-based livelihoods, the range is wide. Households use and reuse water for livestock; to grow vegetables, crops and trees during the dry season or to supplement rainfall during the rainy season; for crafts; for small-scale enterprises such as food preparation for sale; for fisheries; and for incidental events like brickmaking and cultural or ceremonial uses.

The sites of use vary. Irrigation or livestock herding often takes place at distant fields or grazing land. Homesteads are not only the preferred sites of all domestic uses, but often also sites of productive uses to improve nutrition, food security and income. Production at or adjacent to homesteads saves travel time, can easily be combined with other activities and protects against theft (van Koppen et al. 2009; Nigussie et al. 2017). Cropland adjacent to homesteads tends to be more intensively used and better fertilized than distant fields. For the growing number of land-poor or landless families, homesteads are the main or only site where they can engage in water-dependent food production and self-employment.

On homesteads, the use of water for livestock and small-scale irrigation can have a higher priority than relatively 'luxury' domestic uses such as daily bathing or weekly

laundry at home, especially in the dry seasons, as was found and quantified in Ethiopia (Jeths 2006) and several villages in South Africa (van Koppen et al. 2020a, 2021a). Laundry or bathing can be less regular or take place in streams or ponds. Water availability on homesteads augments productive water uses. In South Africa, households with better public water supply were found to undertake more productive activities (de Mendiguren Castresana 2004). The availability of higher volumes of water on the premises after the installation of an own well was shown to improve food security in Zambia, Ethiopia and Malawi (Sutton and Butterworth 2021).

The ultimate benefits of both domestic and productive water uses depend on the overall activity of which water is one input. For example, hand washing is more effective with soap. The benefits of productive uses are even more complex. The range of other costs is wide, such as inputs or the cost of livestock feed. Many factors influence benefits, in particular market channels. Gender and age strongly influence costs and benefits as well, as discussed next.

Intra-household Gendered Division of Costs and Benefits

In intra-household cooperation and conflict, the costs of water provision (labor, time, skills and funds), the broader water-dependent activities and the ultimate benefits are divided along gender and age lines (Theis et al. 2018). All family members benefit from the availability of sufficient water for drinking, cooking, cleaning, hand and body washing, laundry and sanitation. The availability of sufficient water for domestic uses on homesteads ranks high among the priorities not only of women but also of men (Gachenga 2012; Sutton and Butterworth 2021). However, efforts to provide water are gendered and negotiated. Efforts are most strenuous when water must be fetched from distant sources. In dual-adult households, this burden falls disproportionately on women and girls (Fletcher and Schonewille 2015; UN 2015). Among the ethnic Gourounsi in Burkina Faso, women may refuse to marry into husbands' villages if there are no proper wells for domestic uses (van Koppen 2017). However, negotiations can fail, as Drangert (1993) found in Tanzania, where women unsuccessfully tried to incite men to make simple investments in water infrastructure for domestic uses. Men tend to take up more responsibilities to fetch water or pay for water when technologies for conveyance are more advanced, such as carts, bicycles, cars or public yard connections (van Koppen 2017; Sutton and Butterworth 2021).

Intra-household cooperation and conflict pertaining to costs and benefits vary even more for productive water use. Productive uses of water are diverse and depend on livelihood patterns of farmers, pastoralists or fisherfolk, and on wealth, among others. Water is just one of the inputs. In joint activities, the respective contributions to the cost of supplying water and other inputs influence control over the benefits, or 'fructus' rights as Theis et al. (2018) define. This control is skewed: Women contribute more than men but have less control over the benefits.

Various factors play a role in these inequities. Women may prefer less thirsty or dryland crops that give them more control over the produce, even if benefits are few and riskier (Theis et al. 2018). Control over land influences benefits. Women's plots are often smaller than male-controlled plots. Land may even be taken away. Tapela (2015) illustrates this in Makuleke in South Africa, where individual women had taken up irrigation at the riparian strips of a stream in a communal grazing area. This did not require permission from the (male) chief. However, after some years, the chief issued a verdict, which was widely seen as legitimate, that the women could not use the riparian lands anymore, because male livestock owners needed the riparian grazing lands for pasture.

The site of cultivation is related to this control. Although many women irrigate and control produce on own, distant fields (van Koppen 2017), women tend to have better control over the fruits of production on and around homesteads than at distant fields. van Houweling et al. (2012) document how productive water uses from piped supplies generate half of women's incomes in Senegal. Hence, water infrastructure on homesteads for multiple uses serves two goals: It meets the domestic needs of all the family members and generates benefits for water-dependent production, from which women reap benefits as well. Not surprisingly, when the option to install infrastructure emerged in an Ethiopian village, women preferred setting up the infrastructure on homesteads for their own and their families' multiple uses (Nigussie et al. 2017).

Women also tend to have less control over the water infrastructure. In some cases, men may entirely control investments in infrastructure and its benefits. Couples may also decide to share the cost of installing irrigation equipment or adults may use the infrastructure paid for and owned by another adult. Women in female-headed households or women who own plots in Zambia and Ghana (van Koppen et al. 2012) and Kenya and Tanzania (Njuki et al. 2014) were found to adopt and own irrigation infrastructure but used low-cost and more labor-intensive infrastructure such as buckets, while men more often owned mechanized infrastructure. Women often lack the money to invest in water infrastructure or they may be less informed about possibilities and have fewer opportunities to try them out. This reinforces their limited technical

skills (Theis et al. 2018). In sub-Saharan Africa, there is rarely or no real taboo for women to master technology, unlike in Asia or Europe.[5]

Age too has a bearing on the sharing of costs and benefits of water for domestic and productive uses. This is partly related to the experiential knowledge required on climate, geohydrology, technical skills, infrastructure ownership and leadership in collective action, including ceremonies, among others. This indigenous knowledge builds up over generations and comes with age. For example, elders were found to have stronger managerial responsibilities and power in the small village of Ga-Moela, South Africa, where scattered natural shallow springs provide water. Only elder men and women who could no longer bear children were allowed to dig and maintain shallow hand-dug wells, although this was not strictly implemented (van Koppen et al. 2021a). The Gadaa system among the Boran in Ethiopia and Kenya is also age-based (Edossa et al. 2007; Dahl and Megerssa 1990, as cited in Ramazzotti 1996). On the other hand, youth may be more familiar with modern technology and energy sources, and information technology and be more enterprising.

With these gendered drivers behind water use and governance, we now turn to the empirical answers to the question of how needs are met in the three components of customary water tenure.

Vesting Customary Socio-territorial Rights to Water Resources

Literature is unanimous in that women and men in rural sub-Saharan Africa customarily see water resources as given by a god or a higher force and creator, for the benefit of all. Nobody can own water resources, which corresponds to a *res communis omnium* in terms of statutory water law (cf. cases in Ramazzotti 1996; Drangert 1993; Sokile 2005; Malzbender et al. 2005; Nkonya 2006; Derman et al. 2007; Kapfudzaruwa and Sowman 2009; Komakech 2013; Hellum et al. 2015; Debevec 2018). However, this does not mean open access. As with many customary claims to natural resources, effective use over a long period is probably the most important criterion to lay customary claims to water resources. Generally, in customary tenure 'natural resources belong to living, the deceased and the yet-to-be born' (Tapela 2015). In this relationship between humankind and nature, rights result from the status of a person in a certain community. Being born or married in a community entitles to its resources. Invoking ancestors buried in the land consolidates the passing on of resource rights to the next generations (Tapela 2015). The rights of in-groups so based on kinship, co-habitation and sharing an interest in a territory and its resources are stronger than those of out-groups, but in-groups cannot categorically exclude out-groups. As the pastoralist Boran say: "Water is either a source that you 'share in' as a member of a descent-based collectivity, or one that you 'share out' to signify respect" (Dahl and Megerssa 1990, as cited in Ramazzotti 1996). Edossa et al. (2007) found that pastoralists' consciousness of clan territory becomes more intense as their proximity to water sources increases.

The perception of water as a shared resource is not necessarily a matter of generosity. It is a resource jealously guarded by all. No member of the community can claim sole ownership of a source of water supply because 'that would forestall an individual holding the whole community to ransom', as Andu (n.d., as cited in Ramazzotti 1996) found in Nigeria. The need for such vigilance and rules and regulations is highest during droughts, when there is not enough water for all. Drought becomes a common enemy that can only be fought together. Collaboration through shared rules is indispensable to build peace. As the Boran emphasize, peace is not the absence of war, but proper relationships within the localities and with God, Waaqa (Edossa et al. 2007).

Age-old settlement or transhumance and marriage shape these socially defined claims to land and naturally available water resources physically bound to that land. Precipitation and the availability of water resources were drivers of settlement, besides land fertility, safety, accessibility, roads and trade routes, absence of disease and other factors. Thus, communities were vested with socio-territorial claims to these water resources. Even though violent conquest considerably weakened rights to land and water, the expertise of earlier occupants was respected, and their ceremonial functions continued to some extent. For example, when the Yao invaded the land

[5] In Europe and Asia, male control over technology is more pronounced than in most parts of Africa (Alesina et al. 2013). Boserup (1970) traces this to the plough, the most important agrarian technology since over 2000 years in Eurasia. In the emerging 'plough culture', men's monopolization of the plough evolved into an elite class of landed rulers whose spouses were increasingly relegated to the status of assetless housewives. Among the new landless, both women and men worked for mere survival. Gradually, poorer women were also disproportionately burdened with domestic chores. However, in most parts of Africa, soils and crops are less suitable for ploughing. This is one of the reasons why the hoe remains the main technology for both women and men. In this 'hoe culture', both women and men produce for both food and income, although productivity is low.

of the Nyanja, north of the Zambezi River, they appealed to the dead Nyanja chief for rain (Tew 1950). The Rain Queen of the Balobedus in South Africa is another example of a ceremonial role of 'rain makers' that is still respected across their former territories (Malzbender et al. 2005).

Pastoralists established flexible routes along pastures and water points (Edossa et al. 2007). Water points are often seen as open to all and owned by no one within the clan and their territories. Solidarity is maintained through efficient communication channels and dispute resolution procedures. Similarly, fishing communities were vested with socio-territorial rights to water bodies and their shores.

The precise roles of hereditary and tiered traditional authorities and their councils in customary water tenure are still unclear. They embody the clan as oral cadastres who pass on the history of the clan, its settlement and related resource claims and other relevant knowledge to the next generations. As custodians of customary land and its spatial allocation, they indirectly influence households' proximity to the community's multiple, land-bound water sources. Moreover, conflicts or anticipated conflicts around water can be escalated to them.

The social definitions of territory, in-group and out-group are further shaped by marriage, which in turn shapes women's and men's access to and control over land, water resources, livestock and other resources. Diversity is huge. In matrilineal and matrilocal societies as they prevail, for example, in significant parts of Burkina Faso, Ghana, Mali, Sudan, Madagascar, Tanzania, Malawi, Zambia, Democratic Republic of the Congo (DRC) and Mozambique, men move to the village of their new wives without having to pay a bridewealth. Women inherit land with appurtenant water resources, strengthening their say over the produce from joint cultivation. Moreover, without bridewealth and with a secure place to stay, women have a stronger fallback position, and hence negotiation power (Peters 2010; Meinzen-Dick et al. 2011; Lowes 2019). In contrast, in patrilineal societies, sons inherit resource rights or cattle from their fathers. A wife often moves to the husband's place. A bridewealth given to the wife's parents serves as a 'compensation' for the family's loss of labor power and offspring. However, it renders divorce more difficult for the wife. Women's water resource rights in their husbands' clans seem limited. In the case of single women, they may stay and access water resources in their father's clan. There are multiple, ever-changing combinations in between.

An illustration of how marriage patterns shape socio-territorial rights to water resources was found in Tshakhuma, South Africa. Various streams flow through the hamlets of this large village. One of the hamlets wanted to install a gravity piped system fed by a distant stream in the mountains in a distant hamlet. They sought permission from the lowest-level traditional authority of the hamlet with the source. In readily according that access, an important argument put forth was that their daughters were married in the requesting hamlet (van Koppen et al. 2021a).

Customary Sharing of Water Resources

Intra-community Sharing

Safeguarding Water Quality

Amidst this complexity, one of the most ancient and widespread customary norms about a community's water resources is safeguarding its quality. Among the ethnic Pedi in South Africa, pollution was a serious offence punishable severely. Anybody witnessing the poisoning of water resources was obliged to report it to the chief. There have been cases of animal cadavers having to be removed from water bodies (Mönnig 1967).

Rules to access zones around groundwater wells can include strict conditions to keep water clean, especially when used for domestic purposes, like in public wells (Nkonya 2006; Malzbender et al. 2005; Tapela 2015). Feet should be cleaned, or shoes taken off when approaching such water points. Children below a certain age are forbidden to enter without an adult. Washing and bathing, urinating and defecating near wells are strictly forbidden. The use of clean lifting tools and practices and carrying and storing water are equally important for water quality (Sutton and Butterworth 2021). According to Nkonya (2006), the WaSukuma in Tanzania say that with a dirty vessel one risks scooping out a snake.

Concerns about water quality underpin the widely observed division of streams in stretches, each for a specific use by members of the community. The upstream part is reserved for drinking water whereas the downstream part is for other domestic uses (washing, bathing, cleaning of hides), as noted in a Tanzanian village (Nkonja 2006) and in Kenya (Onyango et al. 2007). Women's bathing at a protected site provides privacy. Kapfudzaruwa and Sowman (2009) report the division of streams by communities in Eastern Cape, South Africa, into the upstream section for drinking, the middle section for laundry and bathing and the downstream section for cattle. Similarly, the ethnic Iteso in Kenya ruled that

domestic uses should be upstream and livestock should drink and bathe downstream. Here, local authorities defined such places and imposed fines on those watering livestock at human watering places (Lawrance 1970). In contrast, pastoralists may prioritize the health of their animals; in that case, no person or any infected animal is allowed to bathe in standing water from which cattle drink (Cerulli 1956, as cited in Ramazzotti 1996).

Further research will clarify whether and how these early customary norms and practices and their enforcement evolve and may be fading; this should also be examined in the light of increasing plastic and other waste.

Multiple Sources

As above, we conceptualize customary claims to naturally available water resources as linked to communities' socially defined territories. Links between land and water shape the sharing of water resources within a community (water sharing with out-groups is elaborated later). Physical proximity, shaped by the intra-village spatial layout during settlement, can create customary claims. For instance, Juma and Maganga (2005, 3-5) reported this in Tanzania, where many villagers 'find it unacceptable not to utilize water passing near their premises'.

This land-water nexus further depends on the way in which nature's water resources are dispersed as multiple sources at diverse locations in the spatial layout of residential land, cropland with distant fields, forests, grazing areas or other sites of water uses. Water availability at each source varies. In the rainy season, flooding may occur at certain sites, even in arid areas. Perennial sources never dry up. Water quality also influences the use of sources, as van Krieken (2017) observed among a community in the Uluguru mountains in Tanzania that reserved a small source of trickling water, but of a high quality, for drinking and cooking.

Many households have access to multiple water sources, especially to meet daily and year-round multiple uses on homesteads. As documented in Zimbabwe (Cleaver 1998) and South Africa (van Koppen et al. 2020b), most households have access to second or third sources of water which serve as backup during intermittent supply from preferred sources and mitigate seasonal variability and droughts. Where support agencies' new water points for domestic uses are hardly used, the reason may well be that households prefer their usual closer alternatives, even though more polluted (Sutton and Butterworth 2021).

Negotiations to share limited water, say during the dry season, can be about access to preferred sources, with or without certain alternatives, or about water from a specific source, or both. Power easily rules in negotiations about preferred sources. This was the case in a Zambian village where a wealthy livestock keeper monopolized a new public well with first rights for his cattle. Poorer women decided not to contest it and instead fell back on their alternative and returned to other sources of lesser quality water and at a greater distance (Funder et al. 2012).

Rights of Way

Claims to a water source are often mediated as rights of way that govern the last mile of paths or roads to water sources, such as the riparian zones of perennial or ephemeral springs, streams, ponds or lakes, or rights to land above the groundwater, or wetlands or riverbeds for recession agriculture. Riparian zones or other land can be hotspots of claims, rules and contests, especially under competition. Rights of way can be oral agreements or materialize through fencing. Rights of way and conservation can go together, as in forbidding the cutting of trees on riparian strips to prevent soil erosion (Nkonya 2006).

Rights of way apply to direct uses of such sources, such as washing, bathing and laundry, or livestock watering, fisheries, or digging sand and accessing boats or ferries. They also apply to laying pipes or constructing intakes or wells to abstract water for infrastructure. In Tshakhuma, South Africa, community members maintain a few meters' distance to springs and streams before any abstraction or building of weirs, possibly reflecting both hydrological considerations and respect for overlapping claims (van Koppen et al. 2021a).

Rights of way to access water sources often restrict the rights of land holders. Those who seek to enter others' land towards a water source emphasize that water resources are a common good for all. Gods (*mulungu*) can be invoked, as Penwill (1951, as cited in Ramazzotti 1996) found in Tanzania that 'Mulungu made the water for the benefit of all', or the common good of the ethnic group can be invoked, as Lawrance (1970) found in Kenya that 'water resources are for the Iteso'. Similarly, Nkonya (2006) notes how someone who had received land from the WaSukuma chief had to allow people to cross the land to reach a water source. In Uganda, people may privatize their claims to land, for example, by buying it. However, if others use that land to access a water source, the latter can invoke first-come-first-served rights to the wells situated on the piece of land and ask the pertinent question to the new land title holder: 'What are we going to do'?

On the opposite side are strong land rights that limit others' access to water. A clear case where land rights dominate over access to water comes from Tanzania, where Nkonya (2006) found how a person had dug a well on land of another title holder. The title holder reclaimed the land and the well. Strong land rights also give power to exclude those who fail to comply with rules in joint investments in communal systems for self supply. While free riders can easily use street taps, it is less easy or not possible at all for them to access yard taps placed in homesteads with well-defined land rights (van Koppen et al. 2021a).

Rights to land that is temporarily inundated are also shaped by available water resources, as in wetland cultivation or recession agriculture along rivers. The latter has been practiced since ancient times along the Senegal River and many other African rivers and valley bottoms.

Water and Livestock

A very common conflict within a community or between pastoralists and settlers pertains to livestock that compete for the same water source and risk polluting water and eating crops on their way. In the above mentioned village of Ga-Moela, South Africa, both people and livestock depend on shallow springs and hand-dug wells. In the past, some wells were reserved for domestic uses, and others for roaming livestock. Other wells were diligently constructed and monitored for multiple uses: water from a higher, covered section was used for domestic purposes while animals drank from a separate lower, open section (van Koppen et al. 2021a). In other situations, cattle troughs separate livestock.

Owners of livestock are held accountable for cattle that roam around and make their way to water sources. However, enforcement requires a strong communal authority. In Ga Mokgotho, South Africa, livestock keepers used to effectively prevent cattle from accessing water sources in irrigated fields, but this customary rule got eroded under weakening community cohesion and centralized authority. Most customary irrigation was abandoned as a result (van Koppen et al. 2021a).

Planning Infrastructure Development

Infrastructure development affects intra-community sharing of water resources. As elaborated later, infrastructure brings major improvements in health, livelihoods and wealth, but also impacts water resource availability more strongly than direct water uses. Infrastructure development also widens inequalities which may be related to technology, for example along gender lines, or to class in terms of the means required to invest, or to the type of livelihood, as in the irrigation of thirsty crops.

Geohydrology and infrastructure type impact water resources and sharing arrangements. Water resource availability increases when excess water and flood waters are stored in ponds or sand dams or recharge aquifers. Similarly, 'idle' surface water resources in mountainous streams under high pressure and which must flow down may be channelled and become available where and when needed, without major impacts on further downstream availability.

However, at some stage, increasing water abstraction from shared surface water or groundwater bodies limits its availability to others. This may initially be limited to a few days in the dry season and be swiftly replenished with the first rains. However, with expanding infrastructure development and increased abstraction, competition increases. The right time to regulate water sharing is during the planning and design of new infrastructure, when plans can be adjusted or cancelled altogether. It is also the time for the investor to assess whether there is sufficient assurance that water will keep flowing into the investments made, or to negotiate such an assurance. Once infrastructure is in place, scarce water resources flowing into it are to be better shared with other upstream or downstream users or those sharing the same aquifer, for example through rotation, or curtailed, or designs may have to be retrofitted.

Hence, the literature examined suggests that when water resources are available or even abundant, investments in infrastructure for self supply are a 'democratic' bottom-up initiative by anyone willing and able to make the effort. The role of traditional authorities as community custodians in infrastructure development seems limited, other than implicitly approving that their 'subjects' invest and incrementally improve their well-being. (Like others, traditional authorities can also invest in infrastructure for their families' self supply). The principle that also holds for clearing land, livestock breeding or intensifying cropping, holds for water as well: 'If you have the energy to clear the land and work the land, do it', was the expression that Sithole (2011) observed in a South African community. Or, as community members in Zimbabwe commented on others' new uptake of irrigation: "water is life, so one cannot deny someone water" (Derman and Hellum 2002).

A similar limited role of the wider community and its authorities in household self supply was noted among the WaSangu in the Usangu plains in Tanzania. Here, individuals can tap a stream for their own uses without first consulting the chief, even though the chiefs could, in principle, prohibit such construction. However, if a canal is abandoned, it goes to the chief (Juma and Maganga 2005). Whenever conflicts arise, escalation to higher authorities is possible. As in many customary arrangements, just the possibility to reach out to traditional authorities as potential mediators when rules are breached boosts compliance.

When competition for finite water resources increases, first-come-first-in-right claims can be invoked. This even applies to runoff. Nkonya (2006) describes how runoff used to flow naturally into the paddy fields of a WaSukuma farmer. When somebody upstream diverted the flow, the farmer contested it, invoking the first-come-first-in-right principle.

For surface water over longer distances, investors in infrastructure start a 'race to the top', while communities located upstream are already privileged. Anticipating future competition, aspiring investors may choose to consolidate first-come-first-in-right claims to better guaranteed access to water resources after making efforts in infrastructure installation. In Tshakhuma, South Africa, initiators of 10 of the 11

communal gravity systems orally informed the headman of their plans to construct a system from a certain stream. The exception was in a neighborhood without a respected headman, where initiators just went ahead. The authorities approved and recorded the planned infrastructure in writing. Later, that written recording served as evidence of prior rights when others started tapping higher upstream (Hofstetter et al. 2021). Elsewhere, oral procedures may serve a similar goal in customary authorities' living memories.

In other cases, solutions are directly retrofitted, even just among the parties involved. For example, in Khalavha, South Africa, a man had constructed the intake of a pipe to his household upstream of a communal self supply system that benefitted many more households. The high number of beneficiaries served as justification to instruct him to rebuild his intake downstream. In Tshakhuma, where two collective systems used the same weak resource, the communities, the local water specialists and their headmen agreed that the stream should be shared equally (van Koppen et al. 2021a).

However, In Ga Mokgotho, South Africa, this 'race to the top' turned anarchic and led to tampering and destroying intakes of other investors (van Koppen et al. 2020a). Without strong traditional authority structures to mitigate conflicts and enforce solutions, there was no real solution. Conflict mediating arrangements would have helped forge rotations or other win-win solutions for all past investors, and potentially even future investors.

The sharing of groundwater resources is more complex, as the impacts of its abstraction are much less visible and depend on locally diverse geohydrology. Also, groundwater development is often of recent origin. In Arusha, Tanzania, and its suburbs, a 'race to the bottom' evolved, in which large-scale facilities and wealthy pump owners drilled deepest and 'won' to the detriment of users with shallow wells, including wells used for basic domestic purposes (Komakech and De Bont 2018).

From the viewpoint of prior investors, the most effective way to avoid any competition is to forbid new investments in infrastructure. Ethiopian pastoralists apply that rule when aquifers in arid areas risk being overused. If new construction starts near an existing well, guardians categorically halt any further digging (Ramazzotti 1996). Rules for zoning of new wells at sufficient distance avoid future competition, but may be difficult to enforce. Moving to less water demanding crops is another common strategy used (Bruns 2021).

In sum, in these water resource sharing arrangements, the community regulates the sharing of its commonly held water resources internally. As needed, rights of way are further specified to regulate access. When water resources are limited, as is increasingly the case with greater water uptake, efforts are made to strike a balance between the improved well-being of members and managing infrastructure development and its resulting uses. However, the common first-come-first-in-right principle rewards investors in self supply.

Inter-community Sharing

Rights of Way

In the sharing-out of water resources with neighboring customary communities, community members share a collective interest in protecting their land-related water resource rights when water risks becoming scarce or in negotiating benefits from those neighbors even when water resources are sufficient. Literature provides the following illustrations.

When a water source is located within a community, outsiders can only access it for direct uses or to abstract water for infrastructure by passing through the community's territory. They need to seek permission to access water sources and obtain rights of way within other communities' territories, even if hardly ever refused. However, it can be refused, certainly when the requesters have alternatives. Among the Adchema Melga in Eritrea, villagers who sought water for their livestock in a neighboring village were refused such access, citing a legitimate reason: 'you have water'. Elsewhere, clear conditions can be set to such rights of way. For example, external herders and their livestock should take the shortest route to the water source, perpendicular to the riverine stream. Grazing enroute is strictly forbidden. Also, since long, some form of compensation, however small, may be required in exchange (Regional Commissary of Addi Ugra 1946, as cited in Ramazzotti 1996). When the needs are urgent, solidarity comes into play. In Ethiopia, the 'devastating consequences of the village remaining without water even for a few days' was the argument to allow another village to enter the village to access a stream (Ambrosi 1941, as cited in Ramazzotti 1996). In some cases, the factual impact of specific uses by the neighboring community plays a role. If the impact is limited, such uses are easily accepted. For example, some sand digging by neighbors within the community's territory is easily allowed (Knight et al. 2012).

Infrastructure Development

When fugitive water bodies are shared between two or more customary communities, their respective abstractions need to be negotiated. We could not find literature about aquifers shared by several rural communities, which would have been even more complicated than sharing the aquifer within communities. However, there is literature on the sharing of gravity streams, which reveals how downstream users who feel the impact of expanding upstream uses take the initiative to talk with upstream users (Sokile 2005; Lankford and Mwaruvanda 2007; Komakech 2013). Downstream users in Sekororo area in South Africa took such an initiative when they started suffering the consequences of upstream

water diversions (Sithole 2011). Moore and Puritt (1977) document how the leaders of water infrastructure among the WaChagga repeatedly negotiated with upstream users. Over time, communities expanded uphill. Water leaders gained stronger authority in the community than the traditional tribal authorities.

Negotiations can focus on continuous volumetric shares. These can be hardwired in visible, flexible and proportionate diversion structures (Lankford and Mwaruvanda 2007) or rotations can be agreed upon. In the Mkoji sub-catchment, the rotation (or *zamu*) follows days of the week. Sokile (2005) documents how the reaching of such an agreement was celebrated with the slaughter of a cow.

Komakech (2013) analyzes similar processes in the Pangani Basin. Downstream users approached the Masaai who had settled upstream and defended their prior claims. With growing competition for water, weirs that diverted water upstream were destroyed. One conflict became fatal. To avoid extreme violence, river committees were formed to negotiate the settlement of sharing rules primarily through rotation. Guards were appointed to enforce the rules, paid from collected fees. However, the study showed that downstream users paid the fee and respected the appointed water guards more faithfully than upstream users.

An early example of rotation in the Pangani Basin is the river committee in the Temi sub-catchment formed in 1945, wherein a 70-cm-long bamboo stick with white markings has been used since then to measure the water flow. Each marking indicates the level below which the stream's flow is to be diverted to another part of the nine furrows that take water from that stream. Yet, with expanding uses, hardly any water reached the most downstream large-scale plantation owner. He was part of the river committee and tried to collaborate with the communities that provided the wage labor he needed. In the end, he gave up negotiations and shifted to the more expensive alternative of groundwater pumping. The maximum distance over which cooperation among smallholders was forged is 15 km. Komakech (2013) hypothesizes that 'the larger the spatial extent between upstream and downstream users, the more difficult it is for such institutional arrangements to emerge from bottom-up'.

Downstream users may be able to share benefits of increased upstream uses. Malzbender et al. (2005) describe how an upstream community in the mountainous area in Limpopo province, South Africa, initiated and managed a communal gravity piped system from a stream that was shared with a downstream community. The latter community invoked a riparian principle that the resource that passed their lands should be equally shared by all. The solution that two chiefs and their councils came to was that the downstream village could qualify as equal beneficiaries of the resource on the condition that they contributed equally to the finances required to maintain the water scheme. The Magistrate's court and other officials had been unable to solve this conflict.

These examples illustrate how conflict resolution in customary water tenure between communities is 'a gradual negotiation process that recognizes the slow maturation of institution building, is technically tested and socially sanctioned, and prone to redefinition when circumstances change' (Molle 2004).

This section focused on the customary 'sharing in' and 'sharing out' of naturally available water resources, highlighting the bundle of rights to use, govern and transfer internally, without excluding neighboring communities. The bundle of rights changes once water resources flow into storage and conveyance infrastructure, the third component of customary water tenure.

Customary Water Infrastructure Development

Tenure of Infrastructure

Water Security in a New Land-Water Nexus

Water tenure is more complex than land or forest tenures, whether customary or statutory. This is not only because water resources are variable, unpredictable and fugitive, but also because infrastructure profoundly changes it, including the land-water nexus, with far-reaching implications. Storage infrastructure stops water resources from being fugitive and mitigates or even ends the variability and unpredictability of its availability. Instead of the land-bound nature of the multiple sources with rights of way to regulate access, conveyance infrastructure opens up many more possibilities. Conveyance infrastructure drastically alleviates the time and physical efforts required to provide enough water at a site of use when and where needed. Except in the case of fisheries, navigation, recreation and environmental flows for ecological sustainability, infrastructure creates considerably more

value to water resources appurtenant to communities' territories that would have otherwise flowed by or remained underground. Benefits are derived at homesteads, distant fields or other sites of use. The term 'distant fields' implies the likelihood of infrastructure serving homesteads, differing from that serving these fields. 'Other sites of use' include streams for direct uses but also, for example, cattle dams in grazing land. When water becomes available at a site, the site appreciates in value. For example, land where water can be made available for irrigation can be newly leased, even if just for one season or one year, as reported in Mozambique (Nkoka et al. 2014), Tanzania (Komakech 2013) and Malawi (Mapedza et al. 2017).

The land-water nexus for infrastructure not only pertains to the point of abstraction and the site of use but also for land on which the infrastructure is built. The required land rights can vary from straightforward servitudes (for example, for pipes) to land dispossession and reallocation in the case of public irrigation schemes, or even displacement for inundation in the case of large dams. In the earlier mentioned example of the new piped gravity system in Tshakhuma, South Africa, the traditional authority of the hamlet lying between the distant hamlet with the source and the initiators' hamlet, readily approved the request for the right for the pipe to pass through.

Creation of Hydraulic Property Rights

Once naturally available surface water or groundwater sources enter the infrastructure, the investors in it can not only technically and practically move and allocate water around but also vest strong claims to water stored and conveyed in a process of creating hydraulic property rights (Coward 1986; Boelens and Vos 2014). Skills, labor and other costs of maintaining, repairing and rehabilitating infrastructure recreate these claims. Infrastructure owners transfer these rights to the heirs. They can exclude others from using that water. For example, the hydraulic property rights of water vendors allow them to sell only to those who pay, while they have at best use rights to fill their tanks from water resources. Water sale can be permanent in water-scarce residential areas; temporary during dry seasons or when other sources fail or for short-term projects such as brickmaking or for special occasions. The vendor's scope for mark-ups over actual costs incurred depends on the clients' alternative sources and broader relationships with clients (van Koppen et al. 2020a).

Hydrology- and Infrastructure-based Self-organization

Investors who initiate, design, construct, operate, maintain, repair and rehabilitate infrastructure can be individuals, self-organized sub-groups or entire communities. This depends, among other factors, on the hydrology at stake. An entire community can engage in inland fisheries in natural lakes and floodplain pans (e.g., ox-bow lakes) as in South Africa (Tapela 2015). Here, traditional authorities and local water specialists facilitate collective action for seasonal collective basket fishing, such as the *imfonya* among the ethnic Tembe-Thonga of northeastern KwaZulu-Natal and *xirongo* among the Tsonga-speaking Makuleke of northeastern Limpopo province. In the Eastern Cape in South Africa, the chief delegates on a rotation basis among households the removal of mud in a community pond (locally called *u kapa*) and the maintenance of branch fencing to keep cattle out (Kapfudzaruwa and Sowman 2009). In Zambia, traditional authorities lead the ceremonial shift of the community out of the Barotse floodplains to the uplands following the yearly inundation. They are warned about the start of upstream flooding through long-distance communication with the upstream communities (Mapedza et al. 2017).

Wetland cultivation requires communal action to store or drain flood waters with bunds around farmers' plots. In southwest Burkina Faso, women dominate wetland rice cultivation in valleys. Plots are 'the precious gift of a mother to her daughter' or obtained from in-laws. Men, who dominate rainfed agriculture in the uplands, may not even know where their sisters' or wives' rice plots are. Male land chiefs are even forbidden to enter the valleys, as this is said to 'cause inundations'. A rule that promotes immediate problem solving by contesting parties pertains to the bunds between plots to regulate water. Bunds take up space, so neighboring farmers are tempted to extend their own field at the expense of the joint bund. The rule is that if they cannot come to an agreement, both plots are taken away and returned to the (female) land chief (van Koppen 2009).

A well-documented example of hydrology requiring extensive collective action is spate irrigation in Ethiopia, involving the ad hoc channelling of mountainous floods caused by unpredictable rains leading to unpredictable groundwater saturation. The flood waters are stored in ponds for domestic uses and diverted to farmlands for irrigation (Mehari et al. 2007).

Channelling mountainous streams through earthen canals (furrows) to homesteads, fields and other sites of use has also been practiced since long and keeps increasing. One or two households can start and gradually include other households. An early example are the furrows that the WaChagga built on the slopes of the Kilimanjaro in Tanzania. They were initially built to supply water to homesteads and later expanded for supplementary irrigation of coffee, banana and vegetables. One such scheme is the Musa Mwijanga, which now serves approximately 600 families and irrigates a total of 600 ha (Maganga et al. 2004).

Gravity systems with night reservoirs (*ndivas*) across Tanzania were designed for domestic uses and expanded to include irrigation of distant fields. High density polyethylene pipes have become widely available to replace earthen furrows for domestic, irrigation and any

other uses. Compared to furrows, pipes prevent seepage and can overcome undulating terrain to reach more sites. Collective piped gravity systems derive significant economies of scale. The complex collective deep wells in pastoralists' arid areas, as elaborated later in this report, are another example of cooperation to create specialist knowledge over generations (Edossa et al. 2007; Dahl and Megerssa 1990, as cited in Ramazzotti 1996). Investors in infrastructure can be individual households or groups; the bundle of their use, governance, transfer and exclusion rights varies accordingly.

Individual Household Infrastructure

A higher proportion of relatively wealthy households than poor households invest in self supply to homesteads (Sutton and Butterworth 2021) or primarily for irrigation (Lefore et al. 2019). However, since there were more poor households, even with a lower proportion of infrastructure owners, they constituted the majority (Sutton and Butterworth 2021). When households invest in infrastructure for self supply they often share this water. Usually, this is a matter of neighborliness in moral economies, especially for domestic uses. The top priority of water for drinking, as in the Islamic 'right of thirst' (*chafa*) followed by the right to drink by one's animals, is widely reported in any form of sharing. Sharing water from one's well avoids being seen as 'selfish'. Moreover, the owner is safe as others have no reason to poison or bewitch the water (Derman et al. 2007; Sutton and Butterworth 2021). When sharing of water for any purpose becomes regular, payment is common. This compensates at least partially for the investor's cost of diesel or electricity for operations, or also for the capital investment in infrastructure. Sharing is also common for irrigation. Besides using water on their own small plot, owners of portable motorized pumps share or rent out the pump itself. This is another advantage of sharing as the renting out makes the purchase more affordable, as widely found in areas with shallow groundwater in Zambia and Tanzania (Giordano et al. 2012) and elsewhere in Africa (Shah et al. 2020).

Sharing water from one's own equipment becomes morally imperative when supplies decline and less fortunate neighbors lack alternatives. In such cases, relations between the giver and the taker of water are not necessarily friendly, even with monetary compensation. For instance, after electrification in Ha-Gumbu, South Africa, many households invested in boreholes on their homesteads for domestic uses and commercial homestead irrigation, selling to urban markets 500 km away. This self supply became an important alternative source of water for neighboring households. When the municipal system broke down, these private boreholes became their only source of water. All the households without boreholes obtained water from individual borehole owners, either by carrying water or by connecting a pipe from the borehole owner's household to one's own yard. However, some water buyers commented, ''one gets tired of always asking for water'' and "sometimes the man in the house talks in a bad manner." Water buyers were at the lowest steps of the intra-village water ladder of perceived service levels, and most keen for the municipal system to resume functioning (van Koppen et al. 2021a).

Collective Infrastructure

Initiators, Local Artisans and Operators

In collective infrastructure, ownership of the infrastructure and the bundle of rights to the water stored and conveyed are jointly created during the planning, design and construction process, and recreated by participation in maintenance and repairs. Broadly, three parties come together: initiators, technicians or artisans and users joining as members (or technicians are also the initiators). The initiators design the system that suits their needs best. They and their heirs usually continue in the decision-making governance structure or 'committee'. They have stronger inheritable property rights to the infrastructure hardware than operators and members. Even though collective systems change and grow over generations, they can still be named after the founders or locality of the founders, as in the case of the gravity earthen canal (furrows) systems in the Pangani Basin, Tanzania. While the election of committees through secret ballot in these systems may have seemed 'democratic', the elected committee continued to consist of members of the founding families (Komakech 2013).

Technical expertise is developed over time, often by trial and error. This expertise is dominated by (elder) men. For instance, experienced ethnic groups such as the Hawsa well-diggers in Niger sell wells to new proprietors (Tufts University 1984, as cited in Ramazzotti 1996). In Malawi, male technicians may claim that tasks are too hard for women by going up into snake-infested bushes around water sources high up in the mountains to cut rocks or perform other risky tasks to channel water downwards (Mapedza et al. 2017). Affordable and more user-friendly infrastructure and energy sources open up unprecedented opportunities for women and men to own water infrastructure.

Membership

While women who wield influence can encourage men to join in initiating infrastructure construction, most women join these initiatives only as members. This was observed among the matrilineal Wa-Luguru in Tanzania, where women and men jointly cultivate women's lands and dig earthen furrows. One would expect that women would have as strong an incentive as men to invest in irrigation, if not more. Some collective furrows were jointly initiated and managed (van Krieken 2017). However, other furrows were initiated by some well-off men.

The process of including or excluding other community members upfront or later depends on hydrological and technical requirements and neighborliness, among others. Women leaders can actively recruit members. The woman leader who initiated a communal piped gravity system to homesteads in Tshakhuma in South Africa clarified how she went about creating a group. She had walked to the sources in the surrounding mountains, sought the advice of experienced local specialists and artisans and talked with neighbors about her plan to bring water to her house. They warned her: "You better include us in your plan. Otherwise, you will come home in the late afternoon to find that all the upstream neighbors of your pipe already stole water from it." Not all households joined her initiative from the start. Some were satisfied with their access to the old municipal system. Others were sceptical about the plan. Once they saw it worked, they joined under stringent conditions set by the initiators, in this case a higher joining fee. Some of the poorest households lacked the money to pay for the initial investment or the late joining fee. Newcomers were accommodated by expanding the system. However, in similar systems elsewhere in the village, where the water availability limit within the system had been reached, no new members were accepted. Any newcomers had to start their own system (Hofstetter et al. 2021; van Koppen et al. 2021a).

There is a thin line dividing the leadership of a collective system and individual ownership of a piped gravity system selling water. One of the local specialists in Tshakhuma had initiated his own system for his fields and homesteads. After many negotiations, he found only a few neighbors willing to join and share in the investment. However, he later extended the system to others at his own cost, but now for sale. Non-payers were promptly disconnected, solving the problem of free riders. However, other villagers anxiously watched the price he was charging. Making profits from water was unacceptable (van Koppen et al. 2021a).

This and other literature suggest that both women and men can become members. Members have user rights to the water and can co-decide on water distribution rules and their implementation, provided they comply with obligations to contribute cash, labor or otherwise to the construction. Contributions to operation and maintenance confirm their share in the hydraulic property rights. Children inherit members' rights.

Money towards repairs may be collected regularly or, as happens more often, when needed (Komakech 2013). In joint works to construct and maintain infrastructure, tasks can be gender-differentiated. Women's contribution may consist of feeding male workers. As reported among the WaSukuma, this should consist of special and good food 'to provide the energy and motivation for men to dig'. This may even require women to find temporary farm work to raise money to buy special food. As Nkonya (2006) observed, it is embarrassing if men refuse to eat; 'the whole village will know'.

These governance, inclusion, exclusion and transferability rights to water infrastructure and water stored and conveyed are oral, loosely defined and principles are flexible. Membership too is fluid because of variable weather and hydrological conditions. In systems that are also used for irrigation, the total irrigated area expands or contracts. In the Usangu sub-catchment, Tanzania, Lankford and Beale (2007) found that only 20% of the potential command area of gravity furrows is always irrigated. The maximum is only reached in exceptionally wet years. As widely found in Tanzania (Sokile 2005; Komakech 2013) and Malawi (Mapedza et al. 2017), smallholders have several scattered plots across the command area. In dry periods, the best situated plots can be borrowed or leased. Giving out such favorable land can strengthen patronage relationships. This further underlines the fluidity of membership.

Water Distribution within Collective Systems

Principles

Committees hold regular meetings with operators and members to plan the repair, maintenance and cleaning of furrows after the rainy season and members' other contributions, and to set water distribution rules which are flexible. In the gravity systems in the Pangani Basin, not all members who dig furrows and claim access to water may attend those meetings (Komakech 2013).

As it is rare for water to be sufficient for everyone all year-round, seasonal or ad hoc rotation of turns is required. Water use rights are defined as distribution rules with the required operation of the intakes and valves within the collective system, i.e., 'who gets how much water when, where, for which purpose and with what certainty' (Boelens 2015). As weather and inflows of water vary, rules are flexible. Moreover, rules are not necessarily implemented. Non-members may even take (or steal) water passing through their lands when the transaction costs of strict enforcement are too high in proportion to the results achieved (Komakech 2013). Operators, guards, water masters or overseers who are in principle accountable to the committee and the members may be under pressure or enticed to change turns in the scheduled rotation (Komakech 2013). If there is no functional committee to hold operators accountable, they may be tempted to generate some personal income by installing illegal connections, as was observed in Ga Mokgotho, South Africa (van Koppen et al. 2020a).

The distribution principles vary widely. In gravity systems or shared taps, this can be a rotation of water turns. In furrow systems, it means opening and closing one's own and other's intakes, either for fixed periods or as long as needed (Sokile 2005; van Krieken 2017; Komakech 2013). When furrow systems adopt a first-come-first-in-right rotation, everyone can open one's intake any time. When water quantity is equal for all, time slots are equal, so irrigators who have the next turn after a certain time

slot can stop the preceding irrigator, even if he or she hasn't irrigated as much as needed (Sokile 2005). Water quantity may also be proportionate to plot size and crop water requirements. The transfer of water turns (or 'water trade') by irrigators not needing a turn at a particular time is common, as was found by both Komakech (2013) and Sokile (2005). Plot location also matters. An upstream location is often most favorable. To mitigate inequity in the Mkoji Basin, the rule in some furrows is to provide water to the most downstream user first, and then move upstream. In other furrows, the turns start at the top. However, the downstream location of a plot can also be advantageous. In the Pangani Basin, Tanzania, some upstream locations can get flooded, whereas downstream alluvial soils are more fertile, with better water-holding capacity for irrigation (Komakech 2013).

Similar rotation principles govern the distribution of water from wells or shared taps among many people. Turns can mean 'first-come-first-in-right', for example, through queuing up at a well, either in person or by placing one's containers in the queue. Quantities can be controlled by the number of containers one can fill (Nkonya 2006; van Koppen et al. 2020a). Among the WaSukuma, Tanzania, well water is distributed as an equal number of buckets per household. Large households that need more water must join more than one well user group. This shows the importance of alternatives in negotiations (Nkonya 2006). Elsewhere, quantities can be proportionate to needs, such as family size, for domestic uses (van Koppen et al. 2020a). Further, quantities can also depend on labor or cash contributions.

When water becomes really scarce, farmers with more plots are allowed to irrigate only one plot. This was the case in both the Pangani (Komakech 2013) and Mkoji basins (Sokile 2005). In collective multi-purpose systems, the priority is for domestic water uses, livestock watering or water to schools and other public buildings. In the driest months, the night household storage structures (*ndivas*) continue to be filled and a base flow is maintained that also serves fish in the furrows and streams. Irrigation is temporarily forbidden during such periods of scarcity (Komakech 2013).

Gender Discrimination

Gender inequities in the composition of committees, compounded by male domination in technical expertise and leadership are reflected in water distribution. Komakech (2013) describes the fierce protests by women irrigators who constituted 34% of the active farmers in a gravity system when male farmers took a second turn while women had not received even one turn. The next morning, the women woke up at 3 a.m. to irrigate during other men's turns, refusing to compensate them in any way (Komakech 2013). Sokile (2005) found similar discrimination in the Mkoji Basin, where rules prioritize water turns in this order: widows, the poor, disabled, female heads of households, married women cultivating on their own and men. In reality, though, male irrigators dressed up as magicians scared women irrigators and vulnerable men during the night so that they could take water first. In these fights for water, women had to hire men to scramble for water.

Men were also found to intimidate women who seek to abide by the strict rules that govern the area surrounding the wells. Nkonya (2006) noted that among the WaSukuma, no one is allowed to fight, argue or use abusive language within those areas. Water guards and peer monitoring enforce implementation. However, when men came to draw water, they started quarrelling with the many women using the well, infringing the rules. Women gave in to avoid open conflict. In all these cases of conflict, women have less recourse than men to male-dominated traditional authority structures.

Moral Economies in Water Sharing

Communities' moral economies and social safety nets shape obligations and benefits. In Zambia, neighbors help elder women by fetching water for them (Mwale 2016). Among the WaSukuma in Tanzania, it was agreed in meetings as to which households were vulnerable because of age, poverty or disability, and, therefore, deserved waivers for the payment of fees, and could make in-kind contributions instead (Nkonya 2006). Among the Songo in Tanzania, water theft because of dire necessity was observed to hardly lead to moral stigma (Gray 1963). Similarly, water thefts by underprivileged irrigators attract small punishments, if any at all in the Pangani Basin. For the community, it would be a more serious problem if these people were to lose their crops due to the lack of water (Komakech 2013).

Pastoralists' Well Complexes

Since ancient times, nomadic pastoralists and their livestock have survived thanks to the wells along the routes through their pastures. In the male-dominated, age-based gadaa authority system of the Boran pastoralists in Ethiopia and Kenya, political, socio-territorial and water management authorities overlap (Edossa et al. 2007). All wells are seen to represent the Boran people, with their multiple clans dispersed across Ethiopia and Kenya. No clan is barred from using the wells. Sharing, cooperation and solidarity are vital for survival and reproducing livestock (Dahl and Megerssa 1990, as cited in Ramazzotti 1996).

Specialized guardians hold technical and hydrological knowledge. The construction of deep wells and drawing water requires men connecting to each other in long chains. Contributions to the cost are not only through labor but also through the slaughtering of oxen. The latter provides both food during the work and regulates over-stocking. In line with seniority, those entitled to slaughter the animal first get to access water first, and so on. The maintenance of shared water holes is equally regulated. If

wells fall into disuse and are abandoned, those who wish to revive it need to seek the permission of the owning clan (Dahl and Megerssa 1990, as cited in Ramazzotti 1996).

Rules about water distribution are strict and manifest in access rights to the area around wells. For Ethiopia's Boran pastoralists, the wider circle of land around a well is controlled by 'customs', but the inner circle adjacent to the well is governed by stricter 'law' (Dahl and Megerssa 1990, as cited in Ramazzotti 1996). The rules order time slots for all local livestock to be watered. During scarcity, cattle can only drink every other day or in extreme cases, once in three days. One's turn depends on the number of animals contributed to food during the work, or the volume-based price that one is paying. Volumes can be expressed in terms of the drum that a camel can drink from. Among various species, camels are often the last priority. Even wildlife such as the hyena is equally entitled to drink (cf. Ramazzotti 1996; Meinzen-Dick and Nkonya 2007).

Nomads on the move may be able to access such service immediately. However, among pastoralists in Niger, free drinking water for humans or livestock is provided on a one-off basis and can be extended only once; other solutions are needed for regular uses (Tufts University 1984, as cited in Ramazzotti 1996).

Similar principles apply in the Jando system of the Masaai in Tanzania (Komakech 2013). Sources of standing water become the property of those who dug them, if it is a well, or of the one who first discovered the source if it is a spring (Juma and Maganga 2005). Similar principles exist among the Turkana and Jie in Kenya (Gulliver 1955, as cited in Ramazzotti 1996). Those who dig a well become the owners with primary rights to the water. Others may use the water hole only with the permission of and at the convenience of the owners. Not seeking permission is a breach of manners. However, it is wrong to refuse water requests unreasonably based on the overall perception that water and pasturage are free to all and that every man has the right to water for his animals. When such requests become more frequent, one must join and pay or contribute an entrance fee to the communal system. There is also a strong obligation to participate in the maintenance (Gulliver 1955, as cited in Ramazzotti 1996).

The voluntary sharing of surplus water establishes patron-client relationships. For well owners among pastoralists in Niger, their wells become both 'tools for the management of social relations' and tools to manage water (Tufts University 1984, as cited in Ramazzotti 1996). Such sharing can even be a main goal. Among the Iteso in Kenya, it is reported that an individual constructed a dam, for which he slaughtered 108 heads of cattle and paid for labor, and the dam is used by all (Lawrance 1970).

This section illustrated the third component of customary water tenure: communities' infrastructure development of the multiple surface water or groundwater sources across residential areas, forests, fields and grazing land on their territories, possibly in parallel to, or partly supported by external agencies. More storage and conveyance of water resources meet the needs of growing populations on more intensively cultivated land, with growing aspirations for less laborious water fetching and more convenience, hygiene, nutrition and income from the sale of irrigated produce or livestock. These are virtuous circles out of poverty.

The foregoing sections provided insights into living customary tenure. More research for a much better understanding is clearly needed. Nevertheless, even these insights already have important policy and legal implications for the realization of human rights and SDGs, both for top-down water resource allocation and bottom-up community-led water services and support to self supply.

Policy and Legal Implications for Rights-based Water Resource Allocation

States as the Legitimate Custodian of the African Commons

A legal recognition of living customary water tenure finally ends its colonial marginalization and the post-colonial expectation that it is possible to suddenly convert existing customary arrangements that are seen as legitimate by the large majority, into an entirely new legal system that was designed for new water uptake by a minority. Such recognition solves many problems, both for water authorities and communities. It solves the administrative injustices as a result of the logistic inability of resource-constrained water authorities to process permit applications by hundreds of thousands small-scale users. It also solves the injustice that *de minimis* users, who are exempted from the obligation to apply for a permit and typically include the most vulnerable, become legally invisible.

In practice, the large majority of rural water users know and practice customary tenure and have not been informed, so are not even aware of a parallel state permit

system. However, in the few cases in which the state tried to implement permitting, they faced fierce protests. Communities saw permitting as a taxation measure (De Jong 2010; van Koppen et al. 2005). Maganga et al. (2004) cite how smallholders see permitting as "a way of organizing them for the purpose of making them pay water fees, which they do not believe in." Indeed, it is a contradiction that national agriculture, irrigation and water services policies subsidize rural communities, whereas taxation through permits takes back benefits from their own efforts towards self supply. This harms state legitimacy. Permitting even causes a loss to the state itself, as Maganga et al. (2004) further observe: "Rather than trying to charge large numbers of smallholders for small quantities of the water they use, it is suggested that the government should target the few high volume users who make considerable benefits from water (e.g., Tanzania Electricity Company)." Studies in South Africa confirm how the cost of collecting revenue among many small-scale users below a certain threshold outstrips the revenue collected, even without calculating the cost of awareness raising and enforcing compliance (Schreiner and van Koppen 2020).

Evidence of efforts to grant individual permits has further demonstrated that it erodes customary water sharing arrangements, and even creates new problems. For instance, permitting instilled an 'each for oneself' mentality in the Mkoji Basin, where customary irrigators sought to obtain a permit faster than others in order to strengthen their entitlement vis-à-vis fellow water users – precisely in the ways in which colonial powers pursued their formal first-come-first-in-right claims that legitimized overriding any prior users (Sokile 2005). Permitting creates further problems when more administration-proficient upstream users are the first to apply (Komakech 2013) or hope to carve out personal benefits (Juma and Maganga 2005). Juma and Maganga (2005) observe: "It seems the policy makers in the water sector have been inspired by the neo-liberal principles that prevailed in the 1990s, which link everything to the individual rather than the community".

Expectedly, the notion that water resources can be owned, in this case by the state, has been met with stiff criticism. The literature examined on this issue in Tanzania and South Africa is unanimous: rural communities invoke the customary notion that water is given by god and is to be shared by all (Sokile 2005; Komakech 2013; Malzbender et al. 2005; Kapfudzaruwa and Sowman 2009). In these power relations between communities and states (Benjaminsen and Lund 2003; Lund and Eilenberg 2017), states can embrace this notion of water resources as the African commons. This would undo the colonial dispossession of all Africans when foreign powers hived off water resources from African land but still maintain the state as the legitimate custodian of the nation's water resources in the public interest. This allows the state to harmonize water laws and their constitutions that recognize customary law, and also with land and forest legislation and with indigenous peoples' rights that already align with the customary notions that water resources are appurtenant to land in the ways that this report tried to unravel.

The right holder will be a community that stewards its land, water and other resources in an integrated manner. 'The community' would include women, otherwise marginalized people and all *de minimis* users who are currently exempt from the obligation to apply for a permit. It would also include existing relationships with other communities that share the same fugitive surface water bodies or aquifers. Formalization of oral arrangements pertaining to collectively held resources is likely to create more problems than it solves. For example, hydrology-based top-down organization into new water user associations was contested in Tanzania (Sumuni 2015). Any codification of water rights would at best freeze dynamic living arrangements. The worst scenario is that formalization of new structures in an alien, written language would continue to exclude the most vulnerable.

This does not deny water authorities' legitimate need for information. One cannot manage what one does not know. For the first colonial settlers, permitting processes provided useful information. However, today's surveys and information technologies with internet and remote sensing are much more effective than cumbersome legal processes. For conflict mediation, a demand-driven and issue-based approach is proposed.

Mediating in Customary Sharing In and Out of Water Resources

Water authorities can play important roles in conflict mediation in customary settings. Existing water resource sharing arrangements within a community and between customary communities are the legitimate starting point. Conflict resolution arrangements to protect and stimulate communities' own efforts to enhance their constitutional rights are especially welcomed in demand-driven state mediation towards common developmental goals. For example, in the Pangani Basin, water authorities assisted by putting oral river sharing arrangements on paper (Komakech 2013). Networks of researchers and support agencies can assist communities in managing their commons, especially in unknown areas such as rapidly expanding groundwater development (Meinzen-Dick et al. 2020; Falk et al. 2021).

At larger scales where customary networks increasingly fail to reach, water authorities can certainly assist. This was illustrated when Kenyan water authorities mediated in competition over finite water among water facilities for expanding urbanization, smallholder farm households and downstream pastoralists (Mwaniki 2020).

Two principles further lead to rights-based statutory water resource allocation: firstly, shunning a widening

of inequalities by targeting strict regulation from the top down, and secondly, from the bottom up ensuring that water resources remain available to flow into infrastructure to meet human rights to water or other constitutional provisions to meet multi-faceted basic human needs.

Protecting Against Powerful Third Parties

In current permit systems, administration-proficient, high-impact users derive major benefits from administrative permit applications for new water uptake because permits are the strongest entitlements. As Schreiner and van Koppen (2018) propose, instead of strongest entitlements, permitting should serve as a tool for the government to enforce conditions targeted at these relatively few high-impact users, whose strict regulation contributes most to sustainable and equitable sharing of water resources. In colonial times, the process of permitting required settlers just to 'inform' the majority of rural communities of any 'significant impact'. Even today, water authorities may only have to 'consider' community water uses as one criterion in the granting of permits, if such community uses are mentioned at all. However, a recognition of customary water tenure implies that permitting becomes a diligent process during the planning of new investments in infrastructure that seeks free, participatory and informed consent from *all* existing water users who might be affected, especially those governed by customary law. Foreign investment contracts should abide by national law. This ends customary communities' vulnerability in 'sharing out' water resources with powerful third parties.

In respecting and protecting customary water tenure, aspiring investors and states bear the burden of proof to ensure that communities are timely and well informed and can invoke customary socio-territorial rights and existing water resource sharing arrangements, in order to ensure, at least, that water keeps flowing into all prior infrastructure for self supply. Anticipated infringements are either compensated, or benefits are shared, or new investors are rejected and told to explore alternative technical designs elsewhere. Finally, communities' indigenous knowledge and deep dependency on their environment will contribute to safeguarding environmental sustainability.

Targeted permitting focuses limited state resources for regulatory efforts where most needed, so on planning of the highest and most disproportionate impacts (also in terms of water quality). Kenya has already done this by categorizing its users from A (small users who just might have to register with local water authorities) to D (high-impact national and transboundary users for national regulation). Once state authorities have more capacity, thresholds can be adapted. However, any threshold should avoid administrative injustices when the cost and efforts of permitting requirements are disproportionate to the volumes at stake.

In short, permits stop being the strongest formal entitlement, but become time-bound and frequently revised legal tools to regulate and enforce conditions on water users, where needed most. Age-old vibrant rural realities are protected against the risk of further encroachment by powerful third parties. Mediation continues, depending on thorny issues at stake. However, we are not romanticizing customary arrangements, and note that self supply is biased towards the wealthy, even though the most vulnerable may benefit partially too. Other inequalities along gender, class, ethnicity and migration status are rife. This raises the question: which principles should steer water resource allocation when states mediate in customary settings or even country-wide?

Prioritizing Core Minimum Flows for All

Prioritization under competition for water resources reflects the strength of water resource entitlements. Many water laws prioritize water resources to meet any domestic needs (Grönwall and Danert 2020). The World Health Organization (WHO) sets 100 liters per capita per day (lpcd) as standard. Standard volumes set by urban facilities, for example, are usually well above 200 lpcd. The human right to affordable water infrastructure services (the third component in water tenure) 24/7 and sufficiently close to homesteads supposes that the water resources to flow into the infrastructure will be available (the other two components).

Water laws in Mozambique and Zimbabwe prioritize *de minimis* uses. This goes beyond domestic uses and includes water for subsistence irrigation and livestock, as some or many people use water through self supply. These priority allocations are indispensable to realize the human right to food and an adequate standard of living, whether users themselves take care of the infrastructure, or external support agencies do (HLPE 2015; Morgera et al. 2020).

States are the duty bearers to enforce priority allocations for such core minimum resource flows for all. The challenge is a lack of implementation and enforcement, especially of the strongest water entitlement to meet basic human needs to water and food (van Koppen et al. 2021b). With low coverage levels in public water services, the most marginalized are often excluded, making them even more dependent on direct access to water resources for self supply.

Customary social safety nets reflect a similar prioritization of water resource allocation to meet basic water needs of everyone, and also livestock and fish, before a few can take the remaining water resources.

Awareness raising and proactive enforcement of core minimum volumes for everyone according to existing or redefined definitions of multi-faceted basic human needs and corresponding thresholds will ensure that water resources keep flowing into infrastructure.

Policy Implications for Rights-based Infrastructure Development: Supported Self Supply to Homesteads

Cross-sectoral Collaboration to Accelerate Water Services for Multiple Uses on Homesteads

In the second domain of policy implications of recognition of customary water tenure, both the WASH and irrigation sectors have remained in their sectoral silos when engaging in supporting self supply. Yet, they seek to support the same neutral infrastructure that taps into the same water resources. Both sectors recognize a bias in self supply towards the wealthier (Lefore et al. 2019; Kafle et al. 2022).

The two differences between the WASH and irrigation sectors are the site of use and the commitment to equity. The WASH sector (cf. Moriarty et al. 2013) targets homesteads as the site of use and is inclusive, leaving no one behind. Everyone has a homestead, even the landless and land-poor households. In contrast, the irrigation sector remains vague about the type of farmers who irrigate. Most public irrigation systems have well defined command areas, usually at some distance from homesteads. In supporting farmer-led irrigation, the huge diversity in the spatial dispersion of fields receives little attention as yet. Irrigated homestead cultivation is often still called 'kitchen gardens', supposedly for own consumption and *a priori*, hardly productive.

Paradoxically, the WASH sector's strong commitment to inclusion and leaving no one behind strengthens the divide between both sectors in that public collective systems installed by the WASH sector cannot be used for any productive uses, as it might affect households that still lack access to water for basic domestic uses. Productive water uses require larger volumes and are not necessarily taken up by everyone. This encourages the irrigation sector to leave the responsibility of meeting constitutional water rights (and required water resources) to the WASH sector and ignore homesteads as potential inclusive sites of use.

In customary water tenure, households use water to meet both domestic and productive needs. Even below basic service levels, livestock and the use and reuse of water for cultivation may have a higher priority than regular home bathing. Accordingly, self supply infrastructure is often multipurpose, especially around homesteads, where households access a combination of water sources (Moriarty et al. 2013; Sutton et al. 2012). Women tend to have a stronger say in production on homesteads than in distant fields controlled by their male kin. Households with own infrastructure share water with neighbors, contributing to the realization of everybody's constitutional rights. Lastly, communities do not think in silos and realize that benefits derived from water uses mutually reinforce each other: health, hygiene and alleviation of domestic chores with better water supplies on premises support higher productivity for food security and improved nutrition and income among women and men. Food security, nutrition and income enable higher productivity. More incomes or other benefits incentivize and enable reinvestments in water infrastructure for self supply.

Support agencies in both sectors can build on these merits of customary water tenure by shifting focus from a piece of infrastructure designed for a single use at a pre-determined site to the community scale with multiple sources and sites of use. Both sectors can join forces to realize rights to water and food by accelerating water infrastructure development for domestic uses for all and multiple uses for every household that wants it. Depending on local conditions, supporting self supply may well appear to be a powerful service model to develop affordable technologies along the ladder of incremental improvements, i.e., from open wells to robust hand pumps to rope pumps to motorized means and affordable energy sources. Realizing both the domestic and productive water needs of both women and men overcomes a 'housewivization' of women as primarily responsible for unpaid domestic chores (Rogers 1981; van der Grift 1993; van Koppen 2017). Men want water too, and already contribute to some extent to water provision. Gender equity involves better sharing of efforts and benefits for both domestic and productive uses. Women's technical knowledge and control as owners of individual or collective infrastructure is encouraged, besides narrowing other inequalities, as in land rights or capital.

By joining efforts in multi-purpose infrastructure development, low incremental costs incurred on ongoing efforts will generate high incremental benefits with favorable benefit-cost ratios (Renwick 2007).

Community-led Planning of Water Services

By moving up from a piece of infrastructure and specific site of use to community scale, the high local diversity of communities' multiple sources of water to meet their various needs through multi-purpose infrastructure as a rule and single-purpose infrastructure as the exception becomes visible. It also indicates the extent of self supply versus public infrastructure, its many combinations, water sharing arrangements as neighbors and in social safety nets, and where and when water resources become the limiting factor. Experience has shown that communities need only a few hours to map on the ground or on paper their customary water tenure, including public infrastructure and support by external agencies (Knight et al. 2012; van Koppen et al. 2020c). Communities have managed this highly localized complexity since long, as a matter of daily life and survival. An in-depth participatory diagnosis of this wisdom is an excellent start to an inclusive participatory planning, design and construction process because it allows the most marginalized to indicate their priorities for next incremental improvements. It is likely that more water going more reliably to homesteads remains the priority of most community members. Water for livestock, feed, irrigation, or fisheries will also come up importantly; such a holistic planning process anchored in customary water tenure will naturally raise issues around the sharing in and out of water resources.

Sectoral Expertise

Joining forces for integrated water infrastructure development means that sector-specific expertise becomes more widely applicable. Water is only one input in an overall activity leading to health and wealth. Ultimate health and wealth require expertise to turn water use into well-being. Such expertise in safeguarding the quality of water for drinking and promoting hygiene and sanitation or improving productivity through agronomic training, seeds and other inputs, markets for sale, veterinary care and feed (agricultural water management) is currently locked in silos and needs to be unlocked to be applied more broadly.

The concept of 'drinking water', also explicitly mentioned as goal SDG 6.1,[6] is most puzzling. It suggests that all water used on premises in low-income settings should be 'potable', so of drinking water quality (WHO and UNICEF 2017). Not surprisingly, irrigation officials were found to avoid even reporting about people's real-life uses of irrigation canals or other water infrastructure for laundry, bathing, cleaning and sometimes even drinking. They feared being accused of accepting or even encouraging people to drink such water. This strengthened irrigation professionals' outlook that providing water for domestic uses was not their job (van Koppen et al. 2014). However, bringing higher volumes of water near or on premises is important for health as well. Sutton and Butterworth (2021) confirmed that such higher volumes tend to be more effective for infant health than higher water quality per se. The quality of water for drinking 'should not be viewed in isolation but be balanced with the benefits of convenience'.[7] In a shared responsibility to meet basic rights, the expertise of the WASH sector on water, health and hygiene is also important for agricultural and other sectors. Both sectors can promote realistic and acceptable solutions to point-of-use treatment through clean lifting of water from household wells, or filtration of, or adding chemicals to, the 5 lpcd needed for drinking only.

The agricultural water management sector has expertise on seeds, inputs, fertilization, agronomy and market development. Outcomes of irrigation development will be significantly more inclusive and gender equitable if this expertise is provided to render homestead cultivation more productive.

In sum, building on integrated customary water tenure opens up cost-effective opportunities for the water sector to accelerate infrastructure development, leaving no one behind.

[6] In the definitions of the Joint Monitoring Programme (JMP) for Water Supply, Sanitation and Hygiene, a "basic drinking water service" means an improved drinking water source at 30 minutes or less for a round trip. "Safely managed water" as the indicator of SDG Target 6.1 is an improved water source located on premises, available when needed, and free from fecal and priority chemical contamination" (WHO and UNICEF 2017).

[7] Howard et al. (2020) differentiate between drinking water and other domestic uses, and set basic drinking water volumes at 5.3 lpcd; basic access at 20 lpcd within 30 minutes of a roundtrip; intermediate access at 50 lpcd within 5 minutes of a roundtrip or on premises and optimal access at 100 lpcd on premises.

Conclusion

This report explored how a better recognition of customary water tenure can accelerate the realization of the human right to water for domestic purposes and the human right to food and an adequate standard of living, depending on water, as well as SDGs 1, 2, 3, 5, 6 and 13 in sub-Saharan Africa.

The literature that illustrated each of the three components of water tenure, as we conceptualized, highlighted such potential.

Regarding the first component, in customary tenure, water resources are perceived as a commons to be shared by all, in which community members have rights by birth or marriage to the water resources linked to their socially defined territories, whereas neighboring communities hold certain rights to shared water resources as well. This perception can well align with the role of the state as a custodian of the nation's water resources in public interest. However, it sharply contrasts with the ways in which states currently operationalize their custodianship through permitting. These systems continue to hive off water resources from customary land and even declare the millions of small-scale users without a permit as unlawful water users, and marginalize the *de minimis* users exempted from the obligation to apply for a permit by rendering them invisible. A recognition of customary water tenure will also avoid the problems that already arose from state efforts to implement permitting, in particular communities' protests and erosion of existing water sharing arrangements. Recognition of customary tenure also aligns better with constitutions, land and forest laws and indigenous peoples' legislation.

For the second component, the practical water resource sharing, customary arrangements within and between communities are a sound starting point for state action. Building on these arrangements helps states to mediate in conflicts in customary settings, as needed. Further, state's recognition of customary water tenure protects communities vis-à-vis colonial and post-colonial powerful third parties. Permits can be useful tools that can end the enabling of such water grabbing if they are targeted at the relatively few high-impact users and if they end being the strongest top-down entitlement as the colonial powers envisaged. Instead, states should use permit applications for new water uptake to impose due process that prevents any infringements on customary water uses. A last implication of customary water tenure, in particular its social safety nets, for state action in water resource sharing is bottom-up: the enforcement of the highest, priority entitlements to core minimum volumes of water resources that contribute to the realization of human and constitutional rights to water and food.

These water resource sharing actions ensure that water resources keep flowing into communities' infrastructure, the third component.

As the literature shows, since time immemorial, infrastructure development for self supply has been part and parcel of customary water tenure to mitigate climate variability and enhance benefits all year round. Self supply keeps expanding. Multi-purpose infrastructure is common, especially near and on homesteads, to meet domestic and productive water needs. Both the WASH and irrigation sectors increasingly recognize and support self supply. By joining forces, the sectors can accelerate infrastructure development, leaving no one behind. Community-scale participatory planning and design have been shown to leverage the assets embedded in all three components, as locally relevant.

Further research on customary water tenure and its interface with statutory policies and laws and external support to infrastructure development is recommended. As reflected in the literature reviewed, this requires more interdisciplinary exchange between historians, social scientists, engineers, human rights, water, environmental and other lawyers across WASH, irrigation, livestock, forestry, fishery and other sectors. Poor women and men best oversee the complexities of customary tenure and priorities for support, rightfully claiming: 'nothing about us without us'.

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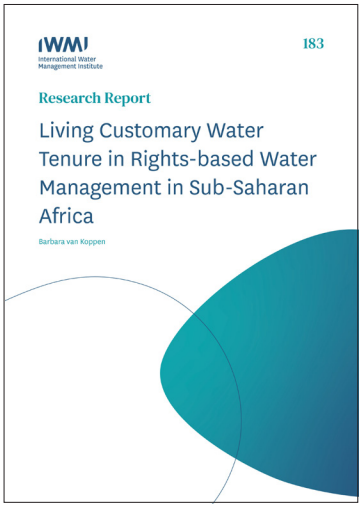

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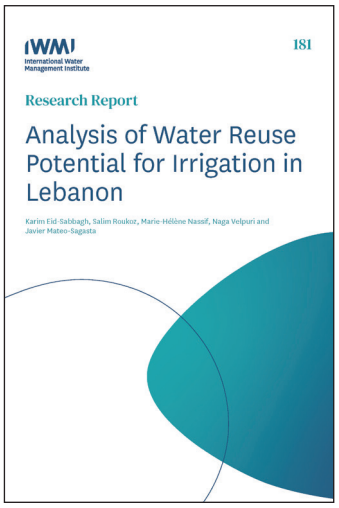

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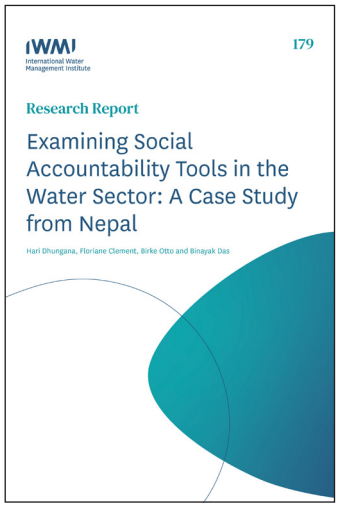

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