APPENDIX I. CASE STUDY DETAILS

Further information regarding the South African case study detailed in the article can be found below, separated into the four components of the governance solutionscape.

Locating the Doringlaagte

The 'Doringlaagte' is the local name for a small sub-catchment of the Hout Catchment within the Limpopo River Basin in South Africa. The Hout Catchment is located 60 km northwest of Polokwane city and has an area of 2,478 km^2. The climate is semi-arid, with an annual long-term mean precipitation of 407 mm/year (see Ebrahim et al. 2019 for detailed hydrogeological and climatological information).

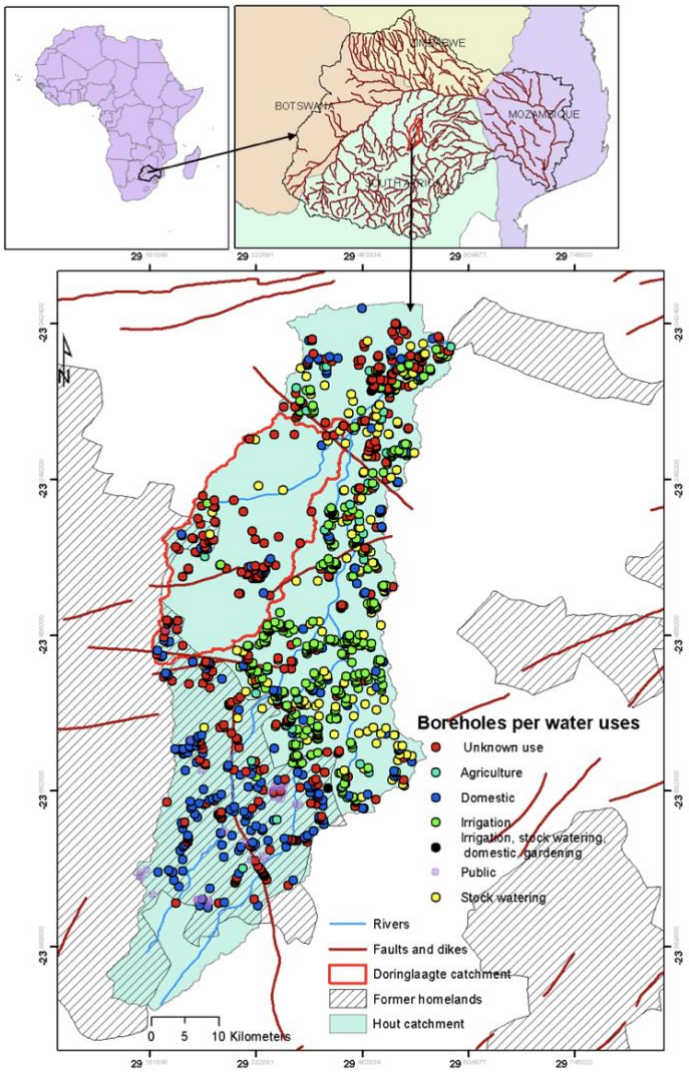

Fig. A1.1. The study area's location within the Limpopo basin. The area lined in red denotes the Doringlaagte, where the majority of the case study research was carried out (source: Fallon et al. 2019).

The following sections describe in more detail the different solutionscape dimensions pertaining to the case study, as well as more contextual information for South Africa.

Science and research

Research regarding the groundwater status of the catchment has been carried out on and off for the past few decades, although there is little evidence of significant change in groundwater-use due to these studies. More recent research has been focused on groundwater modelling (by the International Water

Management Institute) due to low groundwater data availability (most groundwater level recordings do not go back far enough to provide a clear picture of the aquifer's status) (Ebrahim et al. 2019). This work has been carried out alongside contact with some commercial farmers, with interest paid to local knowledge of the environment. However, gaining access to boreholes for monitoring data has been a continued issue. Gaps in monitoring and regulation have resulted in the production of misinformation, both consciously and unconsciously. For example, several commercial farmers externalized liability for groundwater exploitation to nearby towns and (unverified) government-built dams upstream, while legitimizing their own water use with narratives of family farming legacies and providing food security for the country. However, the high interest in Limpopo-wide groundwater status reports indicated that these perceptions are not infallible, and better data could go a long way in changing the practices currently undertaken in the catchment.

Policy, policymakers and partnerships

South Africa's 1998 National Water Act (Act 36) was deemed an archetype of water legislation around the world, hailed for its progressive inclusion of IWRM principles and fundamental reformation of the previous apartheid-era Water Act of 1956, which was racially discriminatory and based on European legislation (typically made for water-rich countries, unlike the water-scarce South Africa). However, implementation has been weak, and has been criticised for the protection of pre-1994 licenses as 'existing lawful use' which accommodates users with entitlements from the earlier system based on riparian rights and perpetuates racial inequalities (van Koppen and Schreiner, 2014).

Decentralization of water management responsibilities to Catchment Management Agencies (CMAs) was central in the water reform process in post-Apartheid South Africa (Kemerink et al. 2013). However, as described by Schreiner (2013), there was widespread failure in the ambitious target of establishing 19 CMAs, due to poor target-setting and accountability, underestimation of the complexities of both departmental and sectoral transformation, lack of capacity in regional offices of the Department of Water Affairs (now Department of Water and Sanitation, DWS), and the illegitimacy of decisions made regarding such institutional policy and process. This manifested across the country in multiple policy adjustments, non-existent stakeholder engagement, limited progress in establishing CMAs, alongside the continuation of apartheid-era Irrigation Boards (consisting predominantly of white male commercial farmers). Unfortunately, successive Ministers have come and gone, each with a different view of policy and strategy leaving the broader water sector with uncertain intent and an inability to unlock what are deeply complex issues.

Almost all interviewed commercial farmers in the catchment reported very weak formal governance by the government (in terms of monitoring and regulation of water use), and trust between the farming community and the regional DWS office is low due to stagnating communication regarding the approval of a new Water User Association (WUA), which is desired by the farming community as a way to have more authority and coordination over water use in the catchment (Fallon et al. 2019).

Water licenses are weakly implemented in the study area, leading to concerns of some commercial farms exceeding licenses, illegal borehole drilling and illegal dam-building along the river. Issues with the 'Blue Scorpions' – the government's Environmental Management Inspectorate responsible for verifying commercial water use – were reported by two game farmers during interviews, who had unsuccessfully reported illegal drilling in the area to them. Licensing data obtained from DWS showed that 91% of water licenses in the area were 'yet to be verified' (as of 2017). Water licenses are approved based on farmer's declared needs and satellite imagery of irrigatable land. Groundwater monitoring by DWS is also inadequate; a hydrogeologist from DWS reported severe deterioration in monitoring infrastructure across the catchment (and in the wider Limpopo River Basin) and rapid loss of skilled personnel within the department, with a high staff turnover rate. This was perceived to be undercutting

efforts to produce quarterly groundwater status reports for the basin, as well as deteriorating trust between DWS and farmers, who became fatigued with having to re-establish communication and relationships every time existing staff left.

Water user associations, where they have been established, play an important role in compliance monitoring within their areas of operation, and as such these associations are understood to be a key local actor in supporting the DWS in ensuring users comply with license conditions. It is effectively in the best interest of both the association and the DWS for this type of local regulation to support improved water resource management. As such, the frustration of the agricultural sector at the poor pace of institutional reform is palpable.

Communication facilitated by researchers (Fallon et al. 2019) helped establish trust between a few hydrologists within DWS and local farmers, and led to the distribution of quarterly groundwater status reports through a mailing list (although this has since been halted due to the retirement of the author of the report, and lack of a replacement). The emergence of this process helped circumnavigate failing official channels of communication and promote knowledge-sharing.

There was little coordination observed between DWS and related governmental bodies, such as the Department of Land Reform and Rural Affairs, regarding the linkages between groundwater use and land acquisitions. A country-wide attempt has been long underway to retract historical dispossession of black communities from land and water rights appropriated by the Land Acts of 1913 and 1936, and the 1912 Irrigation Act, under the apartheid era (van Koppen and Schreiner 2014). However, water remains predominantly in the hands of white South Africans, and groundwater is still intrinsically linked to land ownership due to prior riparian rights, largely condoned by the 'existing lawful use' section of the 1998 National Water Act (NWA). Several farmers interviewed in the Doringlaagte regarded the water abstracted within their farm boundaries as belonging to them, despite water rights in South Africa shifting from riparian rights to public trust with the NWA. However, younger farmers were more supportive of the Public Trust Doctrine, suggesting a generational shift in perspectives on water rights.

Practice and technology

In the Doringlaagte, most groundwater management remains predominantly within socially-embedded institutions, with individual day-to-day actions and some 'gentlemen's agreements' between farmers (Fallon et al. 2018). Relations between white and black farmers remain detached, with white commercial farmers constituting the primary resource users. These weak relationships and significant power asymmetries are primarily due to the historical racial legacies that prevail across South Africa more broadly, though racial prejudices seemed to be slowly changing amongst some farmers. A few commercial farmers in the area have been involved in government-led mentorship programs, aimed at training black emerging farmers on how to run a farm, and helping them establish a livelihood. The scheme was generally well-received, and one farmer interviewed felt that despite 'teething issues', it was an important step towards equality. However, one interviewee did not see this as a good programme, alleging nepotism within the government regarding who received this training (some of whom had little interest in farming), and an associated increase in mistrust between the government, commercial farmers, and emerging farmers. There was also a discreet concern that some emerging farmers were not interested in long-term groundwater management, and one commercial farmer felt that they were better equipped at managing groundwater due to a more intimate, generational knowledge of the local environment. It therefore seems that existing practices, including practical knowledge and cultural norms, dominate the groundwater governance arrangement within the Doringlaagte, which have proven difficult to change (particularly with poor policy implementation and unequal participation in decision-making processes).

Participation and engagement

As shown so far within this case study, there are power asymmetries occurring in the study area. While a WUA is yet to be officially established, the local Agricultural Union has been gaining legitimacy as an authoritative power regarding groundwater management, partly due to its endurance (its ancestral institution being the Irrigation Board). This decentralization of power to the local level may seem appealing in terms of 'good governance' principles. However, without official support from the government there is no requirement for an inclusive association, which means no black emerging farmers are included in meetings (Fallon et al. 2019). Thus, without support, existing power asymmetries are perpetuated and water management decisions remain with the most powerful players in an 'echo-chamber' whereby few new ideas are circulated. When stakeholder participation is inadequate, it is easy for powerful actors to perpetuate their own narratives. For example, the dominance of the agricultural union by white commercial farmers was legitimized by their much higher consumption of water (thus they could make the biggest impact, positively or negatively). However, having no alternative perspectives, values or needs present in meetings meant the same narratives and decisions were maintained. Uncritical participation that is unsupported by appropriately implemented land and water policies cannot therefore address this deeply embedded legacy. In this sense, participation in the Doringlaagte remains an instrument for efficiency and a display of inclusion, rather than one of transformation and empowerment (as per White 1996). Thus, existing practices endure.

Additional references

Kemerink, J.S., Méndez, L.E., Ahlers, R., Wester, P., Van Der Zaag, P., 2013. The question of inclusion and representation in rural South Africa: Challenging the concept of water user associations as a vehicle for transformation. *Water Policy* 15: 243–257. DOI: 10.2166/wp.2012.127