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Chapter 10

Groundwater policy and planning

UNDP

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Groundwater policy defines objectives, ambitions and priorities for managing groundwater resources, for the benefit of society. Planning translates policy into programmes of action. Both are often part of a wider water resource policy and planning framework, but the specific challenges pertaining to groundwater have traditionally received less attention than surface water.

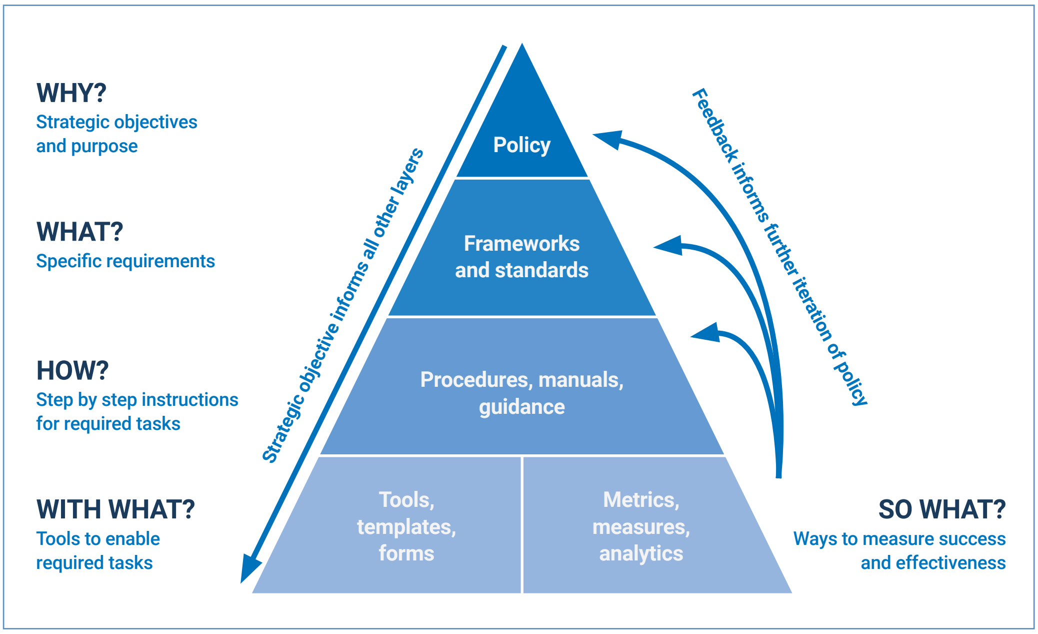
The terms 'policy,' 'strategy' and 'plans' are used interchangeably in many countries and contexts.

10.1 Groundwater policy

Policy seeks to represent values and ideas deemed to be in the public interest. Through broadly formulated statements, a policy document sets strategic objectives, establishes why they are important, and sets specific requirements to guide the course of action for present and future decisions (Torjman, 2005; De Sousa and Berrocal Capdevila, 2019). Figure 10.1 indicates how policy relates to specific requirements (What?); procedures, manuals and guidance (How?); and enabling tools (With what?), illustrating how to translate the policy into action (De Sousa and Berrocal Capdevila, 2019; Smith, 2003).

Figure 10.1

What is Policy? A model from the State of New South Wales (Australia)



Source: De Sousa and Berrocal Capdevila (2019).

In a national context, 'policy-makers' are normally a publicly elected or designated body with mandate to frame the policy and its scope. Federal states often have groundwater policies at the national and at the state level. The policy can be intended primarily for, and relate to the mandates of, authorities, organizations, jurisdictions and non-governmental organizations.

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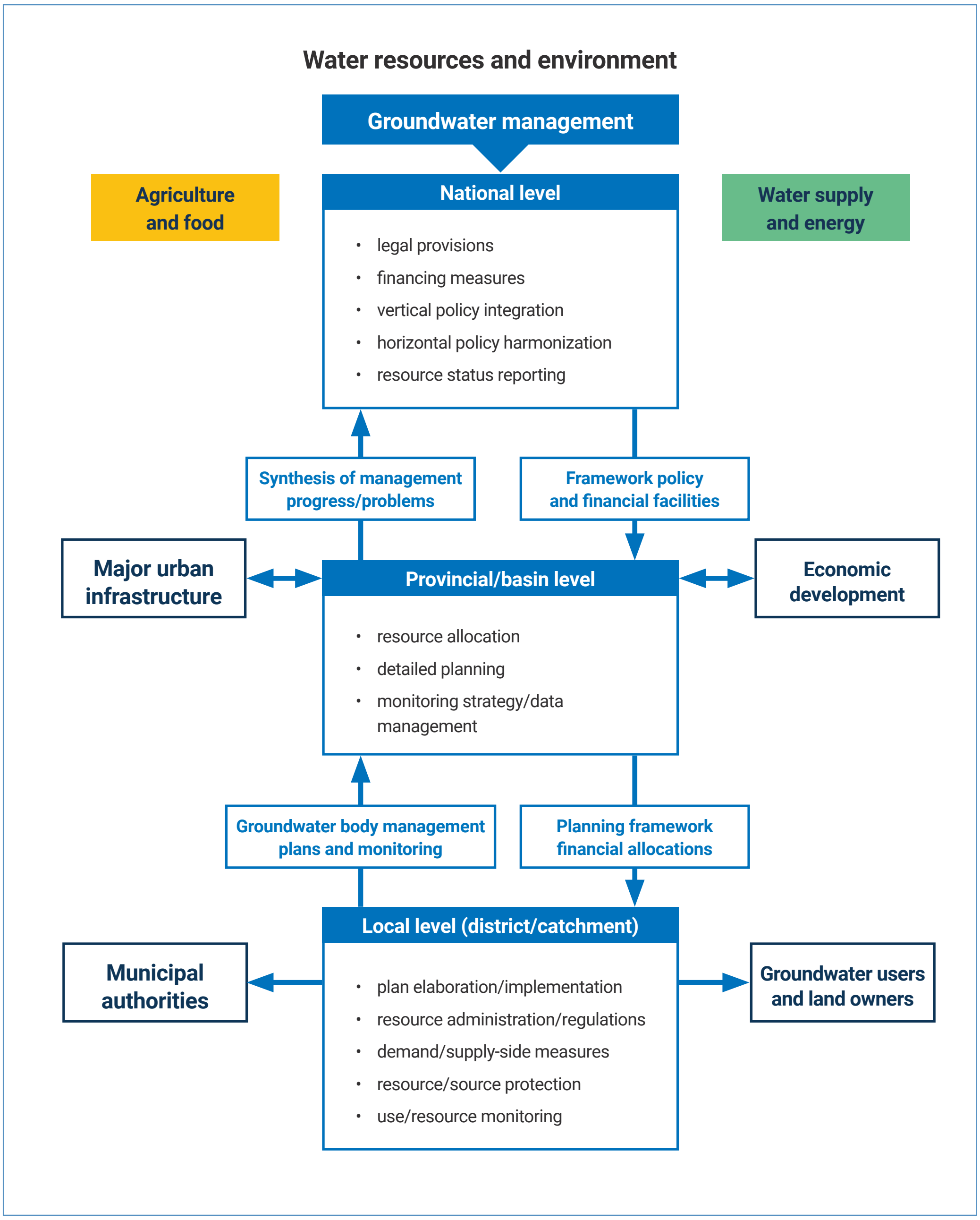
Developing policy requires making choices about the most appropriate means to a desired end. Economic principles (see Figure 13.1) can be used to guide choices, assigning value to groundwater resources (Smith et al., 2016). Instrumental, intrinsic and relational values and principles are also of essence to uphold environmental ethics, human needs, and cultural and historical values (see Figure 2.1 and United Nations, 2021).

The first step is to determine a national 'groundwater management vision' that is embedded within a national vision for water resources, in dialogue with actors ranging from local groundwater users and technicians to scientists, policy-makers and investors, for catalysing and managing the changes needed (Smith et al., 2016) – such as in South Africa (Republic of South Africa, 2010). Groundwater policy should be contingent on the legal status and nature of ownership of groundwater (public or private), of the water users, the interrelated surface water features, and land use in aquifer recharge areas (Foster and Chilton, 2018). It also should provide for integrated decision-making for groundwater resources and aquifer systems, and connect to other sectors and domains of society beyond the water sector – such as socio-economic development, gender equality and poverty alleviation, food and energy, ecosystems, climate change, and human health.

Figure 10.2 illustrates a generic institutional structure, showing how policy-making can enable vertical and horizontal integration and linkages to related sectors. The choices and the structure sit in a wider policy context where international guidelines and treaties can set outer frames. Recommendations of the Groundwater Governance Project (2016c), rules laid down in the European Union Groundwater Directive (European Parliament/Council, 2006), as well as the Model Provisions on Transboundary Groundwaters (UNECE, 2014) under the UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (UNECE, 1992) and the Draft Articles on the Law of Transboundary Aquifers (ILC, 2008; see Chapter 12) can also guide and influence policy-setting.

Figure 10.2

Institutional structure for groundwater policy development



Source: Foster and Chilton (2018, fig. 4.4, p. 87).

A (ground)water policy includes fundamental standards and basic guiding principles. Sustainability, efficiency, equity, the precautionary principle, the polluter pays principle, conjunctive management, demand and supply and maintenance management, and integrated water resource management (IWRM) are critical to inform future decisions (Smith et al., 2016). To ensure that indigenous communities' interests are addressed, for instance when concessions are given to groundwater resource developers, the principle of free, prior and informed consent – a component of the United Nations Declaration on the Rights of Indigenous Peoples (UNGA, 2007) – is also essential. Procedural elements may call for participation, transparency, accountability, non-discrimination and universality, the rule of law, anti-corruption, and subsidiarity. The participatory approach emphasizes that women play a central part in the provision, management and safeguarding of water, as stressed in the Dublin Principles (ICWE, 1992). An updated set of principles for valuing water has been proposed by the High-Level Panel on Water (2018), and these principles have been further elaborated in the *World Water Development Report 2021: Valuing Water* (United Nations, 2021). Procedural principles are also fundamental for the human rights-based approach.

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The General Comment No. 15 on the right to water recommends that priority in the allocation of water must be given to personal and domestic uses (CESCR, 2002). Drinking water is therefore prioritized over other sectors, for instance in South Africa (Republic of South Africa, 2010). Following policy-making, it may be useful to frame such policy in law, based on human rights terms, thereby elevating drinking water from 'needs' to 'rights' (Mechlem, 2016).

All too often, the adoption of a groundwater policy is primarily focused on the utilization of groundwater after abstraction. This is far removed from sound management of *the aquifer*, which requires attention to land use, replenishment, protection, and implementation of measures that aim at preserving the multiple groundwater system services and functions (see Chapter 1). The aquifers, acting as the 'hosts' of the groundwater, and the very sources of various (ground) waters are distinct but interconnected, and need to be managed by targeted, yet complementary measures that provide for conjunctive use (Eckstein, 2017; Puri and Villholt, 2021).

10.2 Examples of groundwater policies

The Indian National Water Policy of 2012 states that groundwater "*needs to be managed as a community resource held, by the state, under public trust doctrine to achieve food security, livelihood, and equitable and sustainable development for all.*" (Ministry of Water Resources of India, 2012, p. 4). Regardless, the extraction of groundwater generally continues without strict regulation or enforcement (Pandit and Biswas, 2019), where powerful interests scarcely affected by the imposed government disincentives are reluctant to reduce their profitable groundwater use. Many states and union territories cover groundwater in their water policies; for instance, in Karnataka – a State that faces severe agrarian distress and acute shortage of domestic water – the over-exploitation of aquifers is now widely recognized, as is the interlinked groundwater–energy nexus (Kelkar Khambete, 2020). A stumbling block to realizing policy ambitions is the data bias in official statistics. Dry wells, for example, carry critical information about groundwater stress that is missed when data are filtered. This gap undermines policy interventions and resource allocation, as noted in the neighbouring State of Tamil Nadu (Hora et al., 2019).

In Australia, after decades of focusing primarily on surface water, the federal government as well as the States, territories and river basin authorities now pay more attention to groundwater. An example is the updated New South Wales (NSW) government's 20-year strategy (NSW Government, 2021). This document shows a high degree of horizontal integration, with groundwater linked to all the sectors depending on, and impacting, the resource.

10.3 Groundwater management planning

A groundwater (management) plan translates policy into a budgeted/financed programme of action and can provide a blueprint for its implementation.

Strategic planning identifies and defines actions that are likely to contribute to achieving the stipulated policy ambitions and goals, in particular for priority aquifer systems (Box 10.1). It can also serve to involve stakeholders in the process. Strategic plans are developed to promote rational, effective and fair water management and decision-making in relation to the resources and users of main concern. Planning considers uncertainty in a changing environment to address known future problems as well as those that cannot be predicted. This requires IWRM and linkages to all relevant policy sectors.

Box 10.1 Action points for the process of planning priority aquifers

Elaborating and implementing groundwater management plans for priority aquifers is the ultimate test of adequacy for governance provisions, and involves the following stepwise sequence of actions in each adaptive management cycle:

- identification and characterization of groundwater management units;
- assessment of resource status, opportunities and risks;
- reaching consensus on required aquifer services and plan objectives;
- drawing up the management strategy (including specific measures, monitoring needs and associated finance); and
- planning implementation over a specified period, with systematic monitoring, review of effectiveness, and adjustment of the next cycle.

Source: Groundwater Governance Project (2016c, p. 86).

A groundwater (management) plan translates policy into a budgeted/financed programme of action and can provide a blueprint for its implementation

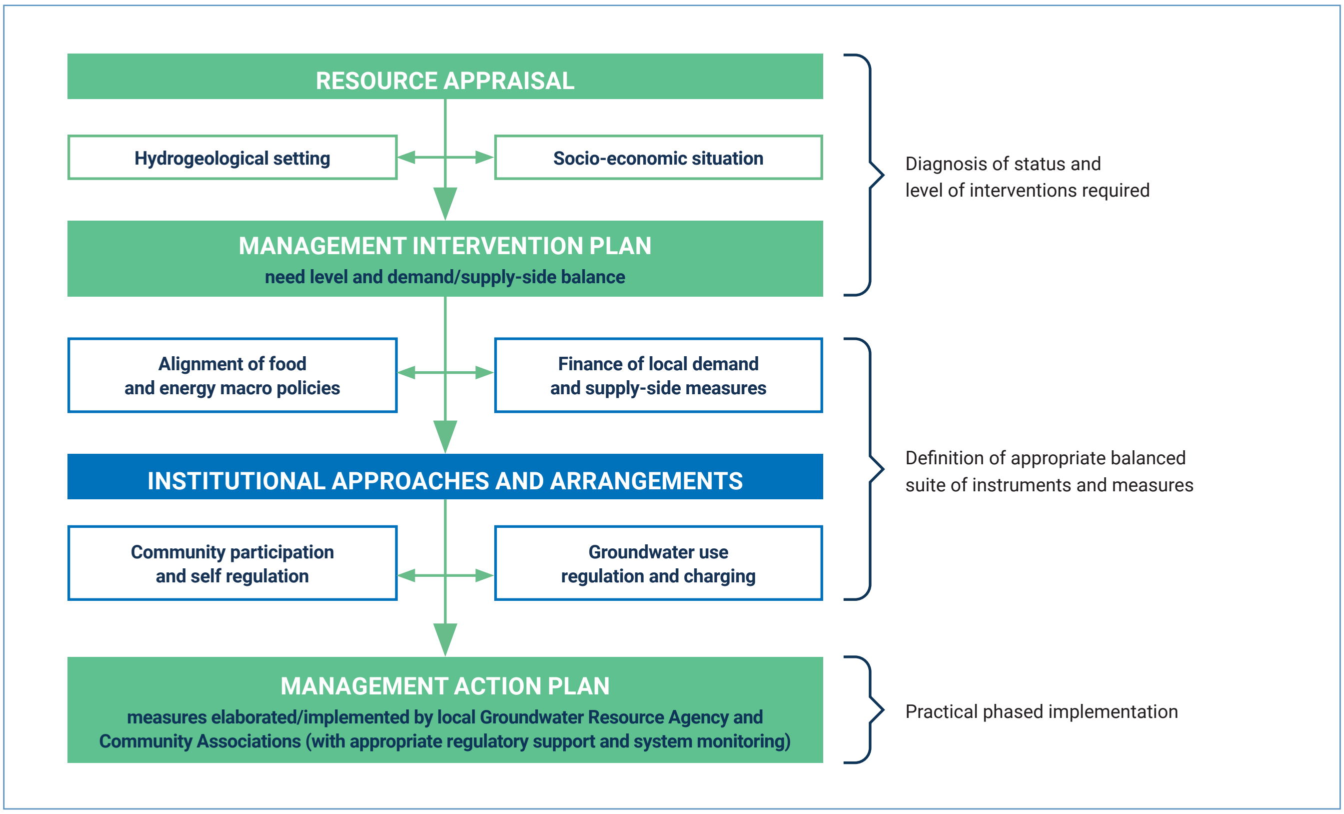
Operational management planning specifies the interventions and other activities to be carried out at field level, including their timing. It deals with subjects such as water supply infrastructure, reforestation projects and artificial aquifer recharge, as well as non-technical measures linked to legal and policy requirements, guidelines and related matters including who should be involved and at what phase. Operational plans go more into detail than strategic ones and usually cover only one policy sector, or only part of a sector, but acknowledge where they need to liaise.

In groundwater systems with little development stress, plans designed to monitor the aquifers for impacts without specific control mechanism would be appropriate. In contrast, in regions with intense usage competition or with historical or anticipated water shortages, plans detailing control measures would be important for preventing and managing risks of overexploitation (White et al., 2016).

Plans can be developed to specifically address issues such as flood risks caused by raised groundwater levels, typically following prolonged rain. Alternatively, the focus may be on avoiding depletion, seawater intrusion and land subsidence, and/or on protecting vulnerable groundwater-related ecosystems. Digitalization – including technologies for monitoring groundwater quality and aquifer systems in real time – offers efficiency gains and optimization through data collection and analysis, of importance at each stage of groundwater management planning (ITU, 2010). For instance, in arid regions, where a unified methodology for evaluation and decision-making is often restricted, a strategic approach for aquifer management planning may have to be based on a risk model (Şen et al., 2013).

The main components of groundwater plans include: inventorying, diagnosing and characterizing the aquifer systems or parts thereof (the 'management units'); evaluating and prioritizing the importance of the system to socio-economic development and ecosystems; assessing pressures on the system; and involving and consulting stakeholders (Foster and Chilton, 2018). Additional components include the specification of interventions and other management measures, and the expected impacts of such measures. All of these are central to 'adaptive management', which is needed to confront the joint challenges of global change and scientific uncertainty around complex groundwater resources and aquifers. Planning for conjunctive management of surface water and groundwater is critical to diversify water sourcing and to increase resilience (Grönwall and Oduro-Kwarteng, 2018). Additional aspects are shown in Figure 10.3.

Figure 10.3 Stages and factors in the elaboration of a groundwater management plan



Source: Foster and Shah (2012, fig. 4, p. 10).

Importantly, UN Member States are expected to realize the human rights to safe drinking water and sanitation through action plans or strategies, thereby actively promoting awareness and capacity concerning groundwater source protection, the need for treatment before consumption, and aquifer recharge (CESCR, 2002; Grönwall and Danert, 2020).

Plans can be prepared as a cooperative effort between national ministries, provincial and local agencies, and relevant stakeholders, based on dialogue and inclusive technical support (e.g. participatory mapping) to enable co-ownership of the process and the outcome. The process produces a formal document that can be validated, with time-bound actions and indicators that can be monitored, and outputs and impacts/outcomes that can be evaluated. The process includes a budget, linked to outputs that can be subject to review as performance is tracked and conditions change (Groundwater Governance Project, 2016c).

Open and participatory groundwater planning processes can generate greater public support and acceptance of the resulting plan and, by extension, operational management. Such planning involves scientists, resource management specialists, stakeholders and decision-makers, and should be accessible to non-specialists, inviting users to participate (Quevauviller et al., 2016). Planning of groundwater resources is as much a matter for government bodies as for the end users, collectively or individually. At the local scale, data gathering and information analysis will by necessity be limited; yet, all levels can benefit from capacity-building and awareness-raising. Likewise, sex-aggregated data, and ensuring the participation of women in data generation (a usually male-dominated topic), are vital in order to acquire a gendered dimension.

Policies, strategies and plans should be tailored to the local context, based on the priorities and aspirations of the local population, and informed by sound scientific evidence

While a groundwater and aquifer management plan could be part of a national IWRM plan (GWP, 2017), basin-level planning needs to consider the systems as a whole. Indeed, surface water and shallow groundwater are usually closely interconnected. However, it needs to be observed that groundwater basin boundaries do not always coincide with those of surface drainage areas. Moreover, as not all aquifers are linked hydrologically to rivers or lakes, the upstream–downstream relationships and power dynamics that influence the use of surface waters and groundwater may be very different (Smith et al., 2016).

National goals and local development objectives, priorities, approaches and levels of activity that are area-specific give guidance to optimal development, use, management and protection of the groundwater resource and the connected environment and ecosystems (Groundwater Governance Project, 2016c). Policies, strategies and plans should be tailored to the local context, based on the priorities and aspirations of the local population, and informed by sound scientific evidence.

A plan should set goals for groundwater management and serve as a roadmap to guide implementation of policy and diagnostic resource assessments. The management plan should set out the actions needed to address specific problems or pressures on groundwater for specific contexts, for instance as shown in Table 10.1.

Table 10.1 Examples of actions that can be specified in groundwater management plans

Types of measures	Purpose	Examples
Source-directed	Minimization and prevention of impacts at source; mitigation	• Authorization and licensing requirements; enforcement • Quality standards for wastewater discharge; control of injection wells • Requirements for on-site and landscape management approaches to control non-point, diffuse pollution • Economic incentives to reduce pollution • Development of low-waste and no-waste technologies • Application of source-to-sea/catchment-to-coast/ridge-to-reef approaches to address flows of water, biota, sediment, pollution, materials and ecosystem services • Mandatory and voluntary demand management to avoid over-abstraction
Resource-directed	Management of the resource; maintenance and operation	• National classification system for groundwater • Assignment of groundwater management classes • Setting quality objectives according to management classes • Establishment of drinking water protection zones • Application of adequate drinking water treatment methods • Setting of a volume-based reserve to meet basic human needs and an ecological reserve to protect ecosystems • Land subsidence control through pumping limits and managed aquifer recharge
Remediation	Restoration of groundwater quality and quantity, and/or aquifer storage	• Clean-up of abandoned sites • Emergency response to spills • Reduced abstraction to re-establish the reserve • Managed aquifer recharge, rainwater harvesting and enhanced infiltration • Development of a physically based model of land subsidence to plan for remedy strategies

Source: Adapted from Smith et al. (2016, table 3.1, p. 53).

10.4 Examples of groundwater management planning

The European Union's *Water Framework Directive* (European Parliament/Council, 2000) stipulates River Basin Management Plans as the main tool for presenting water status and analyses of impacts and responses, and for reporting to the European Commission. The Parties implementing the *Paris Agreement* under the UN Framework Convention on Climate Change highlight their climate actions in nationally determined contributions plans (NDCs). To date, groundwater features in 20 countries' submitted plans and is mentioned in 8, out of a total of 75 Parties to the Agreement (UNFCCC, 2021). These plans include references to the need for investments in aquifer buffering to increase adaptation capacities, enhancement of groundwater recharge, protection and management of groundwater and wetlands, and risk mapping. The NDCs mention nature-based and technology-driven mitigation as well as adaptation-directed measures.

In Tonga, there is a risk of groundwater depletion given the urgent need for economic development, for instance through agricultural intensification (Kingdom of Tonga/World Bank Group/IFAD/UNDP, 2016). The island's second NDC (Kingdom of Tonga, 2020) identifies salinization of groundwater as a potential impact of sea level rise, which threatens to reduce availability of freshwater resources. Means to address the situation include provisions of the Tonga Agriculture Sector Plan, which suggests assessing groundwater resources and their current exploitation, and identifying the potential areas for protection. The plan also suggests that, following previous drought years, there is an increased interest in using groundwater for irrigation.

In California (USA), the Sustainable Groundwater Management Act of 2014 tasks local agencies with regulating pumping in relation to aquifer recharge. These agencies have mandates to track and monitor abstraction and are required to map aquifer recharge areas. The Act requires planning of land use to achieve sustainability with transparency and stakeholder engagement, and learning within and between basins (Kiparsky et al., 2017).

China's take on groundwater policy and planning shows how the two are sometimes indistinguishable. The 1988 Water Law (People's Republic of China, 1988) lists planning in an independent chapter to emphasize its importance and legal status. It states that integrated water planning should be centred on watersheds rather than on administrative boundaries, with the regional planning complying with watershed planning, and based on a comprehensive scientific survey, investigation and assessment at relevant administrative levels. However, the stipulated segmentation in managing water quantity and quality inevitably hinders effective integration (Liu and Zheng, 2016). A Plan of Groundwater Pollution Control and Remediation, and a National Plan for Land Subsidence Prevention and Control provided official directives for groundwater management up to 2020 (Liao and Ming, 2019). These and other plans apply in parallel with the 'Three Red Lines' policy of 2012, which sets targets on total water use, efficiency improvement and water quality improvement. Further scientific planning should protect soils and groundwater to meet the 14th Five-Year Plan. Moreover, the Water Pollution Prevention and Control Action Plan (also known as the "Water Ten Plan") aims to control groundwater quality (Xinhua, 2020; China Water Risk, 2015).

Australia's National Groundwater Strategic Framework followed on a National Groundwater Action Plan. In New South Wales, planning and resource allocation builds on Water Sharing Plans, and the Water Reform Action Plan outlines how the government will deliver on its goals (NSW Government, n.d.a, n.d.b). The state employs a Bulk Access Regime to determine how much water will be available for extraction by all licensed water users within a Water Sharing Plan (see also Box 2.3). For instance, the Great Artesian Basin Shallow Groundwater Sources Order 2020 establishes rules according to which water allocations are to be adjusted, recognizing *inter alia* the effect of climatic variability on the availability of water (NSW Government, 2020).

Lessons on participatory planning can also be drawn from Gujarat and Rajasthan (India). Here, researchers engaged villagers to create ownership and behavioural change around groundwater overdraft. End users learned to monitor rainwater, operate automatic weather stations and put data into a repository app. This enabled calculations of the water balance recharge and assessing how much irrigation could be allowed (Maheshwari et al., 2014).