

Key Informants' Perspectives on Rural Water Sustainability Governance in the Shoalhaven Region of Australia

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Abstract

Rural landscapes are central to ecology and agriculture, yet they remain under-recognised in water policy. This study examined rural water sustainability in the Shoalhaven region, New South Wales, Australia. The overall aims were to explore how key informants conceptualise water sustainability; to examine their perceptions of the current state of water sustainability conditions and governance; and to identify priority reforms for strengthening rural water governance in alignment with Sustainable Development Goals (SDGs) targets. Fifteen semi-structured key informant interviews were conducted with government representatives, water utilities, community groups, industry representatives, and academic researchers. The data were analysed using reflexive thematic analysis across 19 thematic domains. Informants articulated water sustainability through seven distinct conceptual lenses, reflecting a spectrum from ecological non-deterioration to practical resource sufficiency. Notably, no participant gave an unqualified assessment that current actions were sufficient, highlighting widespread concern about the adequacy of current governance arrangements.

Three main governance problems were identified specific to rural areas. First, a crisis-management funding model in which episodic disaster funds substitute for sustained preventive investment. Second, a perceived rural prioritisation deficit, whereby informants considered rural water sustainability to receive less sustained governance attention and investment than urban water systems, despite the catchment's contribution to metropolitan water security. Third, a landscape-specific governance gap in which intersecting agricultural, estuarine, and metropolitan pressures demand coordinated catchment-scale management that no existing institution is configured to deliver. Six interdependent governance reforms are proposed, grounded in practitioner knowledge and directed at structural rather than program-level changes. The findings offer transferable insights for rural water sustainability governance in other coastal catchments facing intersecting agricultural, ecological, and metropolitan water demands.

1. Introduction

Water is a primary resource supporting essential functions in rural landscapes, such as livelihoods, food security, and a sustainable rural economy (International Labour Office 2019). Rural water sustainability is defined here as the capacity of rural water systems to meet current and future needs, which includes water quality, availability, continuous supply, ecosystem health, infrastructure, governance, community participation, and institutional capacity (Muthukumaran 2026). Rural regions are generally characterised by remoteness, low population densities, dispersed settlements, agricultural systems, woodlands, and limited resources. This pattern varies from region to region (OECD 2018). However, the issues and challenges faced by rural landscapes remain broadly consistent. More specifically, access to safe drinking water and an adequate supply for agriculture are the primary priorities, but the availability, quality, and supply of water are deteriorating due to several interconnected factors (Evans et al. 2019; Mekonnen and Hoekstra 2016; Rautanen et al. 2014). These include agricultural impacts (including livestock), water quality issues, contamination risks, infrastructure gaps, tourism activities, urban-rural extraction, geographic isolation, climate change, drought, flood and seasonal variability, poor governance and

institutional support, and financial resource constraints (Crispim et al. 2021; Herrera 2019; Hommes et al. 2019; Nelson-Nuñez and Pizzi 2018). These challenges are interconnected, highlighting the need to understand rural water sustainability beyond the physical availability and quality of water.

Water sustainability in rural Australia depends on both environmental pressures and how well communities and institutions capacity can respond to them. Research from regional Victoria shows that drought adaptation is shaped by rural communities' circumstances and their relationships with water (Kiem 2013). Environmental pressures can also interact: for example, in the Manning River catchment in New South Wales, it is evident that drought, bushfires and subsequent rainfall and flooding formed a hazard cascade that increased erosion and degraded river water quality (Kemter et al. 2021; Wilderer 2005). These catchment-scale disturbances extend beyond rural areas and also create risks to urban drinking-water supplies and food production (Kemter et al. 2021). Water allocation and trading introduce further challenges for climate adaptation and rural water management (Kiem 2013; Pigram 2007). As a result, understanding long-term water sustainability requires attention to governance, social values, economic objectives and ecological sustainability, rather than technical assessment alone (Alexandra 2018; Curtis et al. 2008; Ragusa 2021). This multidimensional perspective provides a basis for examining how sustainability is assessed and governed in rural landscapes (Sherval et al. 2014).

Rural water governance is understood in this study as the institutions, policies, stakeholder relationships and decision-making processes through which water resources and services are managed in rural settings. This working definition draws on broader conceptualisations of water governance and multilevel institutional arrangements (OECD 2015; Pahl-Wostl 2015). Effective water governance requires clearly allocated responsibilities, coordination across institutional and spatial scales, and capacity appropriate to the challenges being addressed (OECD 2015). This study examines these requirements by exploring how practitioners in a rural landscape perceive the present status of distributed responsibilities and catchment-scale coordination. This study also explored practitioners' awareness and understanding of SDG 6 (Clean Water and Sanitation), SDG 11 (Sustainable Cities and Communities) and SDG 15 (Life on Land), including how they interpret the relevance of these global commitments and their associated targets to local rural water governance.

Assessing water sustainability from the perspective of rural landscapes is one of the most pressing yet underexamined dimensions of the global water crisis. To effectively assess water sustainability, it is important to have an in-depth understanding of the current state. Without understanding the current state, there is no way to understand what needs to be focused on and managed (Bhatta et al. 2024). To assess this, understanding how environmental stakeholders perceive and govern is crucial, particularly for translating global commitments into local action (Campos et al. 2011; Wu 2013; Xi et al. 2024). To date, few studies have systematically captured the issues in rural landscapes from key environmental practitioners and community organisations. This approach shifts the analytical focus from purely technical hydrological modelling to an integrated, human-centric evaluation of water resource management. Therefore, this study addresses the above gaps by using a key-informant interview approach to capture the diverse perceptions of water sustainability in the Shoalhaven region, a rural

landscape within the Sydney Basin, New South Wales, Australia. Overall, this study aims to: (1) explore how key informants understand water sustainability in a rural context; (2) assess the current status of water sustainability conditions and governance; and (3) identify priority actions and reform pathways for strengthening rural water governance in alignment with SDGs. Consequently, the findings contribute to understanding the status of water sustainability in rural landscapes, which helps prioritise rural water policy in rapidly changing climatic and institutional environments.

2. Research Methodology

This study adopts a qualitative research design guided by an interpretivist approach because water sustainability is a multidimensional concept; therefore, capturing these perspectives requires this approach. Interpretivism acknowledges that knowledge is socially constructed through lived experience and context, seeking to understand how diverse actors make sense in this domain (Creswell and Poth 2016). The Key Informant Interview (KII) method was selected as the primary data collection tool because it is specifically designed to capture expert and practitioner knowledge from people with direct experience in the domain under study (Kumar 2014). This approach has been widely used in water governance, environmental management, and sustainability research to access knowledge that surveys and quantitative methods simply cannot reach (Holland et al. 2023).

2.1 Study area

The study was conducted in the Shoalhaven Local Government Area (LGA), located on the South Coast and in the Southern Tablelands of New South Wales, Australia, as shown in Fig. 1. This LGA, with a population of approximately 111,755 based on the 2025 census, comprises 49 small towns and villages (ID Community 2026). This region is the traditional Country of the Yuin Nation, whose custodial connections to the river and its associated water bodies carry deep cultural, spiritual, and ecological significance, connections that have historically been marginalised from formal water planning and governance processes (Jackson 2018). This region is a predominantly rural landscape shaped by livestock, horticulture, conservation reserves, and coastal ecosystems (Ji et al. 2025). The entire catchment is covered by almost 70% natural vegetation, 27% rural land, and 3% urban land (Growns et al. 2009). Agriculture added about \$70 million to the local economy, mainly from dairy, nursery, seed, and flower products. The region also has several wine producers. The fishing industry also brings in about \$25 million (DPI NSW 2020). The Shoalhaven River is almost 340 km long, and it covers an area of 7151 km² (Ji et al. 2025). Also, both the Shoalhaven River and its tributaries form the backbone of the region's water system, which provides local water supply (via Shoalhaven City Council's utility) and acts as an inter-basin source for Sydney's water supply during drought. This dual supply function creates a unique and often underacknowledged interdependency between rural water users and the urban demand system. The region was selected as the rural study site because of its agricultural water dependency, governance complexity, and its position at the rural–coastal interface. These all make it a contextually rich and policy-relevant setting for examining rural water sustainability.

2.2 Participant selection and recruitment

Participants were selected through the following systematic strategies, which deliberately identified and targeted individuals with direct knowledge of or responsibility for water sustainability in the Shoalhaven region (Patton 2014). The goal was to achieve meaningful sectoral representation across government, agriculture, water utilities, environmental management, community organisations, and research. Therefore, Initial participant identification was carried out through the website searches of relevant agencies and organisations operating in the Shoalhaven region. To avoid potential researcher bias, the invitation was sent to the organisational email address rather than to a specific individual. Then, snowball sampling was also used during the recruitment process, where initial participants recommended additional contacts with relevant knowledge or institutional roles. This is a commonly used and well-accepted technique in qualitative research, particularly in professional and governance contexts where relevant actors are not always publicly visible (Noy 2008). From these processes, 35 potential participants were identified and approached to participate in an interview. Following initial contact, a screening process was applied: individuals with limited relevant experience, whose roles did not directly relate to water sustainability, or who did not respond to attempts to contact them, were excluded. This criterion-based screening resulted in a final sample of 15 key informants, as shown in both Table 1 and Supplementary Table S1. Their occupations were also well represented across different water-related sectors, including environmental and technical professionals, local and regional government planners, water utility managers, natural resource managers, community volunteers, and academic researchers. This profile lends significant depth and contextual authority to the qualitative insights gathered, with professional experience ranging from 3 to 41 years and the majority (53.3%) having more than two decades of direct engagement with water-related issues in the Shoalhaven region.

The final sample of 15 participants is consistent with accepted norms for qualitative KII research, where informational depth and sectoral diversity are prioritised over statistical sample size. Thematic saturation was assessed iteratively during the analysis, with the final interviews primarily confirming and enriching themes already identified rather than generating new thematic categories (Guest et al. 2006).

Table 1
Demographic and professional background of key informants participating in the study (*n* = 15)

Age Range	Number of Participants	Male	Female	Education Level	Occupational Category	Experience Range (Years)	Share (%)
20s – 30s	2	1	1	Undergraduate; Undergraduate & Postgraduate Certificate	Environmental / Technical Professionals	3–4 years	13.3%
30s – 40s	1	1	0	Undergraduate	Environmental / Technical Professionals	8 years	6.7%
40s – 50s	1	1	0	Undergraduate	Environmental / Technical Professionals	27 years	6.7%
50s – 60s	6	4	2	Postgraduate Master's by Research, Masters, Honours, PhD)	Environmental / Technical Professionals; Managerial / Leadership Roles; Academic / Research	3–35 years	33.3%
60s – 70s	3	2	1	Postgraduate (Master's); Undergraduate; Postgraduate Diploma	Environmental / Technical Professionals; Community Advocates / Volunteers; Managerial / Leadership Roles	10–41 years	20.0%
70s +	2	2	0	Undergraduate; Diploma	Community Advocates / Volunteers	10–39 years	20.0%
Total (<i>n</i>) =	15	11	4				100%

2.3 Data collection

This exploratory study aimed to collect data through semi-structured interviews conducted over a year (September 2024 to September 2025). Semi-structured interviews are particularly appropriate for KII research as they provide a consistent thematic framework while allowing participants the flexibility to

elaborate on their experiences and perspectives in their own terms (Qu and Dumay 2011). The instrument covered a range of water sustainability dimensions, including definitions and conceptualisations of water sustainability, perceptions of current conditions, governance arrangements and institutional roles, monitoring frameworks, Indigenous and traditional ecological knowledge, ecosystem health, awareness of the SDGs, and priority actions for reform. Most of the interviews (13) were conducted in person, and the remaining 2 were conducted via Zoom, based on participant preference and accessibility within the Shoalhaven region. The interviews lasted 40 to 80 minutes, averaging 55 minutes. All interviews were audio-recorded with participants' informed consent using recording software, and transcripts were subsequently downloaded as raw text files for analysis. This study received ethics approval from the Western Sydney University Human Research Ethics Committee (Protocol: H16103).

2.4 Data analysis and visualisation

After collecting the transcripts, the analysis followed a systematic multi-stage process. First, all transcripts were reviewed and de-identified to protect anonymity while maintaining contextual meaning. Responses were then organised into 19 thematic data matrices in Microsoft Excel, with each row representing a participant and each column representing a thematic question from the interview instrument. This framework matrix approach was originally developed by Ritchie and Spencer (2002), which allowed the researcher to view and compare all participants' responses to each question side by side, an important foundation for systematic qualitative analysis.

The next stage involved coding each response, with short descriptive labels assigned to capture the key ideas expressed by participants. Related codes were then grouped into broader thematic patterns across the dataset. The analysis was informed by Braun and Clarke's (2022) six-phase reflexive thematic analysis approach and was undertaken within the framework matrices developed for the 19 interview domains. To further strengthen analytical rigour and transparency, a reflexivity log was maintained throughout the analysis. The researcher then reviewed the emerging themes and shared them with the supervisory team to assess interpretive consistency (Nowell et al. 2017). Finally, frequencies were used descriptively to show how widely particular coded themes occurred across participants. These counts were used to indicate the relative prominence of themes rather than as statistical measures of significance.

3. Results

3.1 Conceptualising Water Sustainability in a Rural Context

Seven dominant thematic lenses emerged from informants' definitions of water sustainability in the rural Shoalhaven context, as presented in Supplementary Table S2 and Fig. 2. The most common framing centred on ecological protection and non-deterioration. Human-ecological balance was the second most common theme with informants emphasising that sustainability requires balancing human consumption with ecological integrity. Several participants took a landscape or catchment-scale view, emphasising that sustainability is about what happens across systems and land–water interactions, not isolated practices.

Participants from water utility and community sectors tended toward more practical, service-oriented definitions, including cost-effectiveness, supply and delivery. These diverse definitions reveal the rural practitioners' conceptualisations about water sustainability across a spectrum from ecological non-deterioration to practical resource sufficiency.

Informants offered mixed reflections on the current state of water sustainability, as shown in Supplementary Figure S1. Slightly less than half of the respondents held a broadly positive view of current water sustainability. Exactly one-third expressed mixed perspectives, recognising genuine improvement in some areas while highlighting ongoing concerns about erosion, runoff, patchy governance, and uneven outcomes, *"Upper catchment areas still pristine, water quality declining toward the coast"*. A minority shared negative assessments, noting multiple interconnected threats from agricultural and floodplain mismanagement. A cautionary neutral view also emerged, with current status described as relatively good given full dam levels, but with concern about *"long-term planning for future drought scenarios under population growth"*. Informants characterised the current situation as one of crisis management rather than genuine governance, as one senior expert stated that *"Water sustainability is very poor. I think that we are still in a state of crisis management, water sharing plans are based on volumetrics, the size of the pie. The environment gets this much; humans get this much. We've basically just broken all of that landscape resilience down. When we get floods, they surge through catchments and take everything with it, and then the water's gone. And then you go into the next drought, and there's no water held in the system to buffer against those droughts"*.

Key informants identified multiple linked signs of declining water sustainability in the Shoalhaven region, as illustrated in Supplementary Figure S2. Almost all informants cited physical degradation and erosion, along with sediment and bank instability, as major issues at the study region. Water quality-related events are the second most common sign observed by most informants. One participant further echoed, *"increased algal blooms are probably the main one. Another one is that a reduction in environmental flows results in higher salinity; essentially, it's seawater now instead of being a brackish estuarine system"*. Informants also observed industrial & point-Source contamination as the major sign. They recalled the lasting effects of industrial discharges from the Manildra plant and paper mill and Per- and polyfluoroalkyl substances (PFAS) contamination from the Fleet Air Arm naval base at Albatross, all of which affected water quality and the historical loss of oyster reefs. Informants reported changes in estuarine dynamics, with ecosystem regime shifts as the primary indicators. One informant further echoed that during the 2019 drought, *"we have witnessed the loss of seagrass, mangroves and increasing jellyfish, and traditionally those jellyfish would be held further lower down in the river by the freshwater flows"*. Further, one informant raised a distinct concern: *"With high amounts of rainfall, people would say that water sustainability is as good as it has ever been because the dams are full"*.

3.2 Indicators, Frameworks and Assessment Approaches

Key informants identified four indicator categories for assessing water sustainability in the Shoalhaven region, as shown in Supplementary Figure S3. Biophysical indicators were the most mentioned and currently used across all participant groups, spanning physicochemical water quality parameters,

hydrological measurements, ecological health assessments, and landscape function indicators. Riparian edge condition and oyster health were highlighted as accessible field-level biophysical indicators. Furthermore, they specifically mentioned that the Estuary health card is an important indicator, but further limitations were added by the informants: *“Unfortunately, it happens once every ten years because of the amount of funds and other resources involved and catchment-wide analysis requires close to \$200,000 per year”*.

Institutional and technical indicators were the second most emphasised category. The SCADA (Supervisory Control and Data Acquisition) network monitoring system used by Shoalhaven Water was identified as a critical technical indicator, providing real-time alarms for abnormal usage and enabling activation of the drought management plan. Further, they discussed the Australian and New Zealand Guidelines for Fresh and Marine Water Quality and the annual government audit indicators. One senior informant emphasised the adequacy of existing data infrastructure, such as household metering, dam records, and river gauges. However, they argued that sufficient technical measurement capacity already exists, but the system requires better integration and utilisation. Council informants advocated reinstating the NSW State of Environment Report and its pressure-state-response model as a structured institutional monitoring framework. They further insisted that *“environmental reporting no longer happens and understanding what the pressures are is very important. We can measure the state very well. Measuring the response is much more difficult”*.

Socio-cultural indicators such as household behaviour (recycling, tank use), community surveys, and capacity-building are the main indicators currently used in the region. Participants also highlighted economic indicators relevant to measuring water sustainability, primarily from utility management, industrial, and agricultural perspectives. Utility-based informants described water consumption levels, reservoir capacity utilisation, energy efficiency in pumping operations, and seasonal demand fluctuation as core economic measures used by Shoalhaven Water. Also, informants noted that industrial water use, especially at the Manildra starch facility, which consumes about 13–14 megalitres daily, is a key economic indicator of the local economy's reliance on water.

The informants highlighted the current assessment frameworks, as illustrated in Supplementary Figure S4. Community and ecological monitoring approaches were highlighted by most of the informants. Further, they stated that *“these approaches are largely informal, practitioner-led, and grounded in long-term local observation rather than prescribed methodological frameworks”*. Regulatory and compliance frameworks were emphasised by half of the informants. Council informants stated that *“Shoalhaven Water long-term water quality monitoring program (Aquadata), operating continuously since the early 1990s, is the foundational assessment framework for the region”*. They further described Shoalhaven City Council's Coastal Management Programs (CMPs) and the NSW Marine Estate Management Strategy as the primary formal planning instruments addressing water quality in the region. Informants also highlighted the two planning and development assessment tools used specifically in drinking water catchment contexts: the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) and the Neutral or Beneficial Effect on Water Quality (NorBE) assessment tool. Despite these better approaches,

almost all informants acknowledged that there are currently no frameworks or approaches in place to assess water sustainability in the Shoalhaven region.

Key informant recommendations for improving water sustainability assessment are shown in Supplementary Figure S5. One informant echoed that *“attitudinal and cultural change, driven by community leadership and local champions, is at the heart of any meaningful assessment improvement”*. Nearly half of the informants suggested that integrated catchment and systems-based approaches were the best way to assess sustainability. Furthermore, they added that, *“Some collaboration with research organisations has happened haphazardly over time, but they don't often translate into a change of practice, and that's a real challenge”*.

A few informants highlighted the most technologically innovative pathways, specifically the use of satellite imagery, digital elevation data, and the Catchment Rehydration Selection Tool (CReST Tool) for geomorphological catchment assessment. Furthermore, informants emphasised that simply monitoring state conditions is inadequate without understanding the underlying pressures driving change. An industry informant provided a unique perspective on economic incentives, water pricing, and sustainability practices. Further, they expressed, *“There's no real incentive at this point or disincentive to reduce water usage. The only thing is around cost; for greenhouse gas emissions there's a price per tonne of emissions, for water, there's no disincentive for water use. So that's hard to convince a business to invest in something that doesn't have a return”*.

3.3 Communication, Indigenous Knowledge and Community Engagement

Key informants highlighted a broad and diverse range of communication channels for conveying the status of water sustainability to different audiences. They consistently emphasised that *“no single channel was universally effective; instead, audience-specific, multi-channel strategies that combine traditional, digital, educational, and demonstrative approaches were needed”*. Community education and school engagement were the most frequently cited effective communication channels among the informants. They stressed that understanding water sustainability requires investment in younger generations and community capacity through education and awareness, rather than relying solely on institutional communication. Full participant quotes by channel and audience group are presented in Supplementary Table S3.

Digital and social media platforms were the second most commonly cited approach, mentioned by almost half of the respondents. However, several informants raised concerns about digital communication in the Shoalhaven rural context, as one informant stated, *“I reckon 85% of landcare and community advocates are retired; a lot of them don't even want to be on social media. I can tell you that. I get in trouble if I don't send stuff through an email network, not just Facebook”*. This observation emphasises the complexity of digital communication in rural communities with high proportions of older volunteers who remain more reachable through email and print. Another informant reinforced this: *“While*

social media represents a theoretically useful communication channel, the lack of consistent usage in the environmental sector disconnects it from its intended purpose”.

Field demonstration and visual communication were identified by informants as the most powerful approaches for communicating the status of water sustainability, particularly with landholders and community members. One academic informant highlighted the most philosophically grounded communication approach, arguing for a fundamental shift toward visual storytelling and narrative, as further stated, *“We need to move away from colonial ways of viewing water as a resource we own and control; communicating about the interconnectedness of systems is what we need to focus on”*. Informants also highlighted the role of traditional and print media, including local radio, press releases, flyers, and newsletters, as effective channels particularly suited to the Shoalhaven's rural and older demographic. Despite these communication channels, more than half of informants expressed the view that *“as of now, water is not a front-line issue for the people”*. Overall, these findings show that communication on water sustainability must be practical, visible, and audience-specific to keep water on the public agenda and support long-term sustainability.

A related dimension concerned informants' views on how First Nations knowledge might be more appropriately recognised and engaged within rural water governance and communication frameworks in the Shoalhaven. Informants highlighted that recognising Indigenous custodianship and trust-based engagement is the essential first step toward incorporating First Nations knowledge into rural water sustainability governance. The key pathways identified by informants are shown in Supplementary Figure S6. The most philosophically distinctive framing came from one informant, *“You look after your land and your land will look after you, and we're a long way off. Aboriginal people used to manage for abundance. That was part of the culture, part of the law. In a sense, in Western culture, we manage for the opposite. We manage for rarity because the rarer something is, the more valuable it is. But when you're thinking about survival and sustainability, you need to manage for abundance, don't you?”* Half of the informants noted a specific fire-water knowledge gap; further, they stated that *“there are practices for cultural burning and it is successfully implemented, but not so much in the water management area. I think there's potential to include indigenous knowledge in that area”*. Informants also highlighted integrating historical and ecological knowledge into the curriculum and structural engagement as possible ways. A few informants addressed the rights of rivers and reciprocity framing as a philosophical and legal pathway for embedding Indigenous water ontology into governance.

Informants also stated the current complexity of engagement and the incorporation of knowledge practices. They revealed systemic non-incorporation, usually in water management practice: *“our engagement stops within the space of connection to country, and other forms of incorporation are not a mandatory priority for many of us”*. One informant offered a straightforward view of practical reality, *“We're not at this point incorporating anything from any traditional knowledge, nor am I aware of anything that actually could affect water supply”*. Informants explicated their views on the limitations, particularly knowledge loss through colonisation, which was raised as a structural barrier, alongside the reality that

landscape change over generations has made some traditional practices difficult to apply in current contexts.

3.4 Ecosystem Health and Consequences of Deterioration

Perceptions of the current state of water-related ecosystems in the Shoalhaven region varied considerably among informants, as shown in Fig. 3. More than half of the participants (53.3%) described a mixed condition, acknowledging both positive and negative pressures. A further 26.7% described ecosystems as degraded or in poor condition, while 20.0% assessed the overall condition as healthy or good.

Almost half of the respondents acknowledged genuine restoration efforts by government, community groups, and landholder extension programs, alongside persistent structural vulnerabilities. One informant described the current condition as, *“I don't think it's getting worse, but it's not getting better; things have probably deteriorated, and it seems like a lot of it has stabilised. In the last 30 years, a lot of improvements have been made to the river systems”*. This observation captures a critical dynamic in which reductions in point-source pollution have led to real improvements, while land-use pressures remain largely unchanged. Almost half of the informants raised concerns about changes in seawater intrusion, which could alter the nature of the estuary and river ecosystems. Informants also highlighted a lack of information about groundwater use in the region; none had clear information on it.

Participants who assessed the ecosystem condition as good highlighted various outcomes. As they stated, the Shoalhaven water catchment is in good condition due to its regulatory frameworks and the conduct of substantive health assessments at regular intervals. One informant echoed, *“Overall in the Shoalhaven, our water ecosystems are in good condition; they're valuable to the community and to our economy through tourism and fisheries”*.

Participants were asked to reflect on the consequences of ecosystem conditions if they continued to worsen. Consequences were grouped into 10 categories, detailed in Supplementary Table S4. Most informants highlighted the decline in fisheries and aquaculture as the most immediately tangible consequence of ecosystem deterioration. The second most significant consequence was biodiversity loss and species extinction, linked to severe events such as floods, droughts, and bushfires that can affect the entire system and lead to the loss of flora and fauna in the region. The third major impact was on agricultural production and the food supply. One informant echoed, *“Primary industries are the main economic driver of the South Coast, and their loss would generate cascading community impacts”*. Landscape resilience and microclimate loss were identified as another important consequence. Informants added, *“If the water ecosystem loses its function, it impacts the microclimate of the region, which is most important for the landscape functions, which are all interconnected”*. They also noted that erosion and sedimentation further contribute to ecosystem collapse. One informant noted the ongoing consequences of human intervention, *“Berry's Canal, a 19th-century human intervention that still influences the Shoalhaven River's channel behaviour, leading to ongoing silt build-up at the original river mouth and destabilising ecosystems more than a hundred years after the diversion”*. Most importantly, one informant

added a unique perspective on system perspectives: *"the significance of the Shoalhaven as a bioregion for the Sydney Basin, warning that the disruption of its wetland and salt marsh systems would have consequences extending into the metropolitan water supply context"*. This view clearly positions the Shoalhaven not merely as a rural concern but as a bioregion critical to water security in the Sydney Basin.

3.5 Rural SDG Awareness and Alignment

Findings on awareness and understanding of the SDGs revealed a significant gap in awareness in the rural Shoalhaven context, as summarised in Supplementary Table S5. More than a quarter of the participants had no proper understanding of the SDGs prior to the interview. Among the informants, a strategic planner with 20 years of professional experience stated directly, *"I've got no idea, never even heard of them"*. Furthermore, some informants explicitly stated that they had heard of the SDGs but expressed explicit scepticism about global frameworks. As one informant stated, *"I'm afraid I don't have a lot of faith in global framework approaches; it needs to be much more local. Really, it's our three levels of government and peer pressure that are the guiding forces"*. A senior informant, despite decades of practical environmental observation and community water advocacy, who had not encountered the SDG framework: *"No, no, I don't know. SDGs are really hard for third-world countries."* This response points out a misconception and suggests that the SDGs are solely a development framework for lower-income countries instead of a universal global agenda.

Almost half of the participants' reflections indicated they had only a basic understanding of the SDGs. A Landcare-based informant offered the most paradoxical response: *"SDGs, I used to know what sustainable development was. I wouldn't know now. But ironically, my whole job supports those goals; I'm telling you that now"*. This gap points to a significant missed opportunity for practitioners whose work genuinely advances the SDGs, who are not positioned to articulate, report on, or leverage the framework in funding applications, policy advocacy, or institutional collaboration. Informants also highlighted the structural reason for the SDG awareness gap in local government: *"Actually, these goals are not driven through the council, particularly since there is no mandatory engagement with these goals."* The absence of mandatory SDG reporting obligations for local government in Australia means the framework lacks an institutional entry point into the day-to-day operations of rural councils. This is a critical governance gap, given that local government is the tier closest to the water sustainability challenges identified in this study.

Only four informants provided a moderate to advanced understanding of the SDGs. Overall, this analysis reveals a striking cross-cutting finding across all four classification levels. The majority of participants whose work actively advances water-related SDGs do so without any conscious reference to the SDG framework. River Watch's mangrove restoration program, Landcare's catchment partnership model, Shoalhaven Water's supply reliability and fish restocking program, and the Mulloon Institute's landscape rehydration work all represent direct implementation of the SDGs in the rural landscape of the Shoalhaven. Most of them are not explicitly aware of this alignment with the SDGs. This gap between SDG-aligned practice and awareness of the SDG framework represents a significant opportunity. This suggests that institutional support structures, rather than practitioner values, are the binding constraint on progress towards the SDGs in rural water governance.

Despite the awareness gap, most informants expressed meaningful commitments to sustainability action through their professional and community roles. Once the SDGs were briefly explained, most of the informants expressed full support for their principles, noting that *"as an organisation, we were already performing well on water supply reliability"*. This statement shows that practical alignment with SDG goals can occur without knowledge of the SDG framework.

3.6 Pressures and Human Activities

Informants highlighted the major interconnected pressures that influence seven water sustainability domains, as shown in Fig. 4. Climate change and extreme weather events are the dominant, overarching pressures on water sustainability in the Shoalhaven region. Many informants described the sequential nature of recent climate shocks in the region, including drought, catastrophic bushfires, then unprecedented rainfall and landslides. As one participant noted, *"We've pretty much had everything in the last few years. The councils are now running out of money because of too much or too little water"*. Agricultural land use and grazing practices are the second most pressing pressure, historically affecting riparian and catchment health across the region. Urban development and land clearing have also become increasingly significant pressures in recent decades. They added that *"the spread of urbanisation, they don't seem to have any detention ponds. The water's coming straight off hard surfaces, straight into the creek systems and causing massive erosion"*. Water extraction for the Sydney metropolitan supply during drought was identified as a structurally unique and politically contested pressure specific to the Shoalhaven catchment. As one informant noted, *"There's tension between the two; at times, the Shoalhaven has been on water restrictions when Sydney has not, because our water has been prioritised for Sydney, not for the Shoalhaven"*. Informants also highlighted pressures from industry, infrastructure, and dam management that create substantial structural challenges on water quantity and supply security, as well as on the health of estuarine and coastal ecosystems. Few informants noted the management of Intermittently Closed and Open Lakes and Lagoons (ICOLLS) along the south coast as a specific governance and infrastructure pressure.

Governance fragmentation and policy impediments were identified by the informants as a systemic meta-pressure. As one informant described the pressure as *"There's so many different government departments that have got a little finger in the pie, but no one is looking after it, that's the real problem"*. This governance vacuum allows all other pressures to compound without coordinated oversight or response.

Key informants also ranked the prominence of specific human activities, as shown in Supplementary Figure S7. The seven most prominent categories were agricultural practices including grazing, runoff and chemical use; urban development and land clearing; PFAS and industrial contamination; stormwater and impervious-surface runoff; recreational boating and wave-induced bank erosion; sand dredging and quarrying; and dam and water-extraction operations. Recreational boating and wave-induced bank erosion stood out as significant and often debated issues unique to the Shoalhaven River. One senior informant said, *"River Watch has been advocating for a formal boating management plan since the late 1990s, designating separate zones for high-powered wake sports and non-motorised recreation, without success to date"*. Oyster farming was noted as well, especially the disturbance caused by heavy vessels

and equipment, which stirs up sediment in certain areas. Informants also pointed out pollution from tourism, such as overflowing bins on beaches, litter in recreational spots, and storm debris, all of which are increasing in the Shoalhaven's coastal areas and become worse during peak visitor seasons.

3.7 Initiatives, Actions and Collaborative Pathways

Key informants revealed a diverse range of successful initiatives driven by community organisations, water utilities, local and state governments, land care, and other regional institutions, as shown in Supplementary Figure S8. The community and volunteer sector was identified as the most visible and impactful driver of successful water sustainability initiatives in the Shoalhaven region, with the Shoalhaven River Watch organisation leading the way through riverbank restoration, mangrove planting, and collaboration with landowners, councils, and school students. The water utility sector is also a successful implementer, primarily through the Reclaimed Water Management Scheme (Perrone et al.) and water-sensitive urban design controls, and it supports water supply to various towns and cities across the region. As one participant noted, *"We've got the water reuse scheme where they treat water, and it gets sent out to the dairy farms for irrigation and management of riparian land across the whole landscape"*. Council-led programs were highlighted by many informants, particularly riparian management, erosion control, work with diverse communities, and Aqua data (water quality portal). Beyond these sectors, the local land service and landcare groups support land- and water-based activities in the region. Notably, Mulloon Institute's 'Rehydration Initiative' is complemented by a Communities of Practice program that combines education with on-groundwork, and by the more recent Water Stewardship Program, developed in partnership with WaterNSW. Industrial water sustainability was also highlighted as the facility achieves reverse osmosis recovery of approximately 70% of process water, with the concentrated brine by-product irrigated onto an environmental farm. The Bundanon Trust engages with water space through small-scale infrastructure improvements that slow water flow from the landscape to the river.

The responses from informants were grouped into short-, medium-, and long-term actions to improve water sustainability in the region. These categories were based on the type of action, the resources required, and the expected timing of results. Short-term actions were considered immediately achievable using existing resources, the current regulatory framework, and community capacity. These included fencing along riparian corridors, community participation and education, constructing detention ponds, monitoring water quality during construction, reducing chemical use, and maintaining equipment. Medium-term actions require two to five years and institutional commitment. These included restoring wetland and estuarine ecosystems, specifically tidal connectivity; improving water recycling technology; returning treated REMS water to the supply dam; and re-establishing a catchment-based coordination organisation for the Shoalhaven. As one participant questioned the present setup, *"I think the state government needs to do an absolute shift, regroup another catchment-based organisation or incorporate water into an existing one. DCCEEW is supposed to have the W for water, but as far as I'm aware, there's no one actually doing anything on catchment water management"*. Further, the informants added that implementing the Coastal management plan, the boating management plan, and additional water storage capacity are medium-term institutional actions to future-proof the region's water supply resilience. Finally,

long-term actions were framed as requiring deep cultural, structural, and regulatory change, with outcomes expected beyond five years. These included empowering communities to shift behaviour towards sustainable water management practices, from treating waterways as drainage channels to treating them as assets; water demand management with incentives; closed-loop industrial water systems; trust-based community environmental governance; sustainable rural water design; future-proofing water storage infrastructure; and technology for contaminant removal (PFAS, antibiotics, heavy metals).

Key informants stated that local government is the primary coordination hub for community water sustainability, but they also highlighted the various challenges from political pressures, resource limitations, and risk aversion. They further expressed frustration with the loss of the Catchment Management Authority (Coles et al.) model, which had provided an accountability structure above council level. They emphasised that the community and volunteer organisations are the most effective on-ground collaboration actors in the Shoalhaven, despite being the most severely under-resourced. Natural resource management bodies, particularly local land services and landcare groups, play an important role. However, these are essential intermediary actors whose collaborative function has been significantly weakened since the abolition of CMAs in 2014.

Across all stakeholder groups, the cross-cutting finding emphasised by the informants is the absence of a coordinating architecture that consistently brings them together and imposes binding accountability. The Shoalhaven catchment currently lacks a multi-stakeholder coordination mechanism, leaving a governance vacuum that no single subsequent initiative has filled. They framed a reinstated CMA, a new WaterNSW-hosted partnership program, or a legislatively mandated multi-stakeholder forum as the most important structural collaboration action for rural water sustainability in the Shoalhaven.

3.8 Governance Accountability: Sufficiency, Responsibility and Research Priorities

As shown in Fig. 5, no participant gave an unqualified assessment that current actions were sufficient to improve water sustainability in the Shoalhaven region. Two-thirds of participants (66.7%) assessed current actions as clearly insufficient, while the remaining one-third (33.3%) provided mixed or conditional assessments. Informants grouped their reasons around governance fragmentation and lack of coordination, under-resourcing and the funding gap, and the need to review current policy settings and regulatory barriers, particularly those affecting restoration activities. One participant echoed that, *“There are too many authorities that don't have a clear direction on what they're doing, the same with water”*. They also emphasised that the lack of future water security planning under uncertainty makes this planning gap especially dangerous. One informant further echoed, *“We don't know what the climate future is going to look like, and water resources are going to be extremely important to prepare; it is a major priority in Australia”*. Overall, the informants' perceptions clearly show that the zero result for ‘yes sufficient’ is not simply a criticism of current efforts but rather highlights a deeper need for structural reform in managing rural water sustainability in the Shoalhaven region.

Informants consistently rejected the idea that a single actor is responsible for all, instead revealing that primary responsibility is shared among three contributors, each with multiple stakeholders, as shown in Fig. 6. The first level comprises primary drivers such as local and state governments, ministers, utilities such as Water NSW, and the Federal government, which can mandate policies and legislation, provide funding, and have the authority to implement actions. The second category was condition implementers, such as community and volunteer groups, landholders, farmers, and natural resource management bodies, whose actions are directly and indirectly dependent on funding, resources and policies from the primary drivers. In this category, industries and the private sector play important roles, particularly in specific responsibilities for the circular economy and water recycling. Informants expressed the view that the policy mechanism needed to activate responsibility, not punitive enforcement alone, but a values shift supported by genuine incentives and trusted relationships between government and land managers. The final category was the essential contributors, including households, schools, education, and indigenous knowledge holders, who support water sustainability through behavioural change, water conservation, and household-level investment in water systems. Notably, the informants emphasised the role of research institutions, whose contributions should support taking on-the-ground decisions across all layers. However, the current distribution of resources, authority, and accountability does not match this shared responsibility. As a result, primary drivers are under-resourced and fragmented, whereas conditional implementers are willing but access-constrained and funding-dependent. Consequently, aligning responsibility with resource allocation, planning, and regulatory authority remains the main challenge for rural water sustainability governance in the Shoalhaven region.

Nine research priority themes were identified as shown in Supplementary Figure S9, categorised by urgency and detailed with participant codes in Supplementary Table S6. The most widely shared priorities were water quality and pollution monitoring, ecosystem health and biodiversity assessment, urbanisation and stormwater management, and governance fragmentation. Among these, they highlighted important research areas that require further study, such as ANZAC guideline thresholds for phosphorus and nitrogen in the Shoalhaven River, PFAS contamination, microplastic impacts, identification of common sustainability indicators, the governance and policy implementation research gap, floodgate management, behavioural change, recreation and land use impacts on water systems, and options for affordable water supply. Currently, research priorities are developed and pursued independently by individual agencies, community organisations, and researchers, lacking a shared framework or common platform for sharing results. In addition, the informants added, *“if there could be a framework/reporting platform that says these are the things you need to look at, these are the indicators, I don't think the work's been done to work out what those sustainability indicators are”*.

4. Discussion

4.1 Understanding Water Sustainability in a Rural Context: A Plurality of Meanings

The findings on how rural practitioners understand water sustainability are viewed through different lenses, ranging from ecology and landscape function to service delivery. These definitions clearly show plurality and represent fundamentally different ontological connections to water, shaped by professional roles, sectoral positions, and relationships with water. For example, water sustainability may be conceptualised differently by those concerned with agricultural production, environmental practitioners monitoring riparian biodiversity, and informants who emphasise relational or custodial understandings of water. Recognising these diverse perspectives is essential to rural water sustainability because they shape governance, coordination, and decisions about what should be sustained, by whom, and for what purpose. This research supports earlier studies showing that conflicting values, power dynamics, and competing goals can make water governance and collective action more challenging (Larson et al. 2009; Pahl-Wostl 2015; Taylor et al. 2019; Wyborn et al. 2023). However, the Shoalhaven findings extend this literature by revealing a distinctly rural dimension to definitional plurality, particularly the co-existence of agricultural productivity, ecological health, cultural custodianship, and metropolitan supply obligations within a single catchment. This means that no single definition of sustainability can cover all interests. Participants often described water sustainability as part of healthy landscapes, not just individual waterways, which adds a new perspective to the discussion. The lack of a shared definition across sectors is not just a theoretical problem; it leads to fragmented governance. This allows each agency to focus only on its own goals, leaving the broader goal of catchment sustainability, which everyone agrees is important, unaddressed.

4.2 The Rural Water Sustainability Condition

The Shoalhaven case reveals a distinctive and concerning approach to rural water sustainability governance in the region. In general, the catchment has historically had unique, pristine ecosystems well adapted to natural conditions, and around 50 per cent of the area has experienced relatively little disturbance despite agricultural and urban impacts. Therefore, water demand is not a major threat in the region, except during drought, flood, and bushfire periods. Over 200 years, this catchment experienced fewer than 9 instances of rainfall below 600 mm, yet in most years it received an average of more than 1600 mm, and 51 floods have been recorded since 1860 (Carvalho and Woodroffe 2015; Ji et al. 2025). Despite this status, water sustainability governance is characterised not by prevention and long-term planning but by crisis management. Funding, attention, and institutional energy flow to water issues only when a crisis demands them. For example, drought triggers drought management funds, bushfire triggers emergency water relief, and flooding triggers flood mitigation investment. Between these events, there is no steady funding, no ongoing monitoring beyond drinking water supply, and no dedicated institution with the power and resources to strengthen the catchment before the next crisis. This crisis-driven funding architecture means the Shoalhaven is perpetually recovering from one event rather than preparing for the next. As a result, rural water sustainability funding remains episodic, non-cumulative, and difficult to plan around, making it challenging for community organisations, agencies, or land managers to build the long-term catchment knowledge, monitoring capacity, and restoration programs that genuine water sustainability requires. This pattern is consistent with Radcliffe's analysis of Australian water policy, which warns that post-drought complacency can erode reform momentum and reduce the long-term

institutional commitment needed for preventive water sustainability management (Radcliffe 2015). As one informant noted, over the years, high rainfall and full dam levels have led people and authorities to think less about sustainability. This reflects a false sense of temporary security rather than long-term sustainability. This sentiment adds a further rural-specific dimension. Moreover, the Shoalhaven River simultaneously serves local agricultural, ecological, recreational, and community needs while transferring water to the Sydney metropolitan area during drought. This dual function creates structural tension between local and metropolitan water security, which no current governance arrangement is designed to manage consistently or equitably.

4.3 Understanding Water Sustainability Governance from the Rural Landscape Perspective

Governance fragmentation is a well-known challenge for water sustainability (Pahl-Wostl 2015). The Shoalhaven findings extend this literature through three case-based insights: a crisis-driven funding model that constrains long-term planning; a perceived rural prioritisation deficit that limits sustained attention and investment; and a landscape-specific governance gap arising from intersecting agricultural, estuarine and metropolitan pressures. The most significant and consistent finding across the 19 thematic areas of this study is a governance deficit, characterised not by the absence of governance structures but by the absence of a coordinating authority, sustained funding, and measurable accountability. The Shoalhaven water governance landscape involves WaterNSW, the Natural Resources Access Regulator (NRAR), Local Land Services (LLS), Shoalhaven City Council, Shoalhaven Water, the NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW), the EPA, and the National Parks and Wildlife Service and Fisheries, each are having own distinct mandates, funding cycles, and operational priorities. However, no single entity holds a catchment-wide mandate for water sustainability outcomes. The abolition of the Catchment Management Authority in 2014 removed the last formal institutional mechanism for coordinating these actors around shared catchment objectives, and no replacement has been established.

Integrated Water Resources Management (IWRM) principles emphasise the need for coordinated, cross-sector catchment governance as the foundation for sustainable water management (Global Water Partnership 2000; Whaley 2022). The Shoalhaven findings show that simply having many stakeholders involved does not lead to real coordination if there is no legal authority to bring different mandates together. This governance vacuum is most clearly expressed in the relationship between coordination authority and community organisations. Furthermore, volunteer groups like River Watch and Landcare groups are taking on governance, monitoring, and restoration roles that government bodies are not fulfilling. River Watch's 20-year mangrove restoration program, Landcare's wetland projects, and the Mulloon Institute's catchment rehydration work collectively constitute a community-led governance architecture. This only substitutes for state capacity rather than supplementing it. This institutional substitution is not a sustainable governance model because it heavily depends on volunteer labour, competitive grant funding, and individual commitment and is structurally vulnerable to burnout, funding discontinuity, and key-person departure.

A particularly significant finding was the perception among informants that rural landscapes receive less sustained governance attention, funding and policy priority than urban water systems, a pattern described here as a rural prioritisation deficit. This difference in priority between urban and rural governance is confirmed in several studies in rural policy literature, which highlight siloed governance, urban-centric priorities, and underinvestment in rural institutional capacity (Glass and Shucksmith 2025; Vasseur and Medouar 2026). Informants contrasted this situation with the greater visibility, infrastructure investment and policy attention associated with urban water systems in the Sydney Basin. In contrast, rural water sustainability in Shoalhaven depends on tight council budgets, community groups that rely on grants, and state programs with limited resources. As a result, the present system leaves rural water sustainability systematically under-resourced, under-monitored, and under-prioritised, despite rural landscapes providing the ecological services that contribute to metropolitan water security.

There is currently no integrated way to measure the impact of water sustainability efforts in Shoalhaven. Individual programs, mangrove planting, wetland reestablishment, riparian fencing, and the REMS scheme all operate without a coordinated evaluation framework. Without evidence of what works at catchment scale, funding bodies cannot allocate resources rationally, governments cannot justify ongoing investment, and local environmental groups cannot demonstrate the value of their volunteer effort. The OECD Water Governance Principles (OECD 2015), stress the need for clear roles, good coordination across levels, and suitable regulations as the basics for water governance. The Shoalhaven findings reveal deficits across all three dimensions simultaneously. According to polycentric governance theory (Ostrom 2010), having many actors should lead to adaptive, self-organising governance if resources and authority are shared fairly. In the study region, however, this complexity leads to activity without accountability. The findings suggest that multiple governance structures do not necessarily produce effective coordination when authority, accountability and resources remain fragmented.

4.4 Erosion, Landscape Degradation, and the Demand for a Landscape-Specific Governance Approach

Erosion is a persistent challenge for water sustainability in the region and was highlighted across all themes. Each year, on average, about 86,000 cubic metres of sediment are deposited from the Shoalhaven River, making sediment transport a key feature of the Shoalhaven coast (Carvalho and Woodroffe 2021). This convergence presents erosion not as an isolated environmental problem but as the physical process underlying the manifestation of agricultural legacy degradation, floods, development pressure, recreational disturbance, and hydrological modifications within the water system. These issues are also supported by regional reports and coastal management studies (Davey and Glamore 2013; Ocean Watch 2016).

In recent years, both the federal and state governments have allocated more than \$900,000 to manage and protect the Shoalhaven coastline, and \$1.5 million to restore Shoalhaven waterways (Shoalhaven City Council 2025). These initiatives indicate that multiple efforts are underway to mitigate damage. However, this study's findings suggest that funding remains largely directed toward post-impact management rather than toward consistent, preventive sustainability approaches. The deeper issue is not a lack of

isolated projects, but the absence of a dedicated water sustainability framework, despite the existence of broader sustainability and climate policy documents at the council level.

Furthermore, this finding supports a landscape-specific approach to rural water sustainability. This means treating the catchment as the fundamental unit of management rather than individual waterways, assets, or agency mandates. However, it is important to note that the tidal zone and estuarine dimensions of the Shoalhaven system add further complexity. In particular, the interaction among upstream agricultural runoff, Tallowa Dam hydrology, approximately 30 floodgates on the coastal floodplain, ICOLL dynamics, tidal salinity intrusion, wake-boating impacts, and Sydney metropolitan water extraction creates a governance challenge that requires simultaneous coverage of multiple jurisdictions, ecological systems, and temporal scales. Taken together, these cascading connections indicate that a catchment-scale governance response is likely necessary, as fragmented agency-based management efforts struggle to address interconnected social, hydrological, and ecological pressures in the Study region.

4.5 Communication, Prioritisation, and the Visibility Problem in Rural Water Sustainability

Communication was identified as a profound visibility problem in the region. Informants noted that it was inadequately communicated to the public and clarified the distinction between communication and community consultation. They further mentioned that the consultation is taking place in the region, but communication remains a problem. They cited additional reasons, including information complexity, lack of prioritisation in government funding decisions, and the absence of metrics that would clearly show the decline or improvement of any initiatives. A similar finding in a recent report also emphasised the need for a better communication strategy to improve visibility of environmental issues (Bezier et al. 2025). This visibility problem has three distinct but interrelated dimensions. First, there is no coherent public communication strategy for the sustainability of rural water in the region. The State of Catchments report, formerly the primary mechanism for publicly communicating catchment-scale water quality information, has been discontinued, and the AQUADATA website provides historical raw data without interpretation. In addition, individual community organisations communicate their programs effectively but without reference to a shared catchment narrative. As a result, the general public, including many of the landholders whose practices most directly determine water quality outcomes, cannot access a clear, current, and credible account of the state of water sustainability in the region.

Second, water sustainability is not currently a high policy priority in the rural Shoalhaven landscape, yet the evidence strongly suggests it should be. At present, the government's focus is mainly on biodiversity, net-zero emissions, and land management, with no equivalent attention to water-specific sustainability outcomes. Landcare receives investment for biodiversity and carbon sequestration outcomes; the water sustainability co-benefits of the same work are not counted, reported, or funded. Water is treated as a subordinate benefit of land management programs rather than as a governance objective. Third, there are plenty of reports, but they did not reflect on the decisions. Several participants identified the accumulation of assessments, strategies, plans, and reports that clearly document problems but fail to generate binding commitments, implementation funding, or accountable timelines for action as one of

the most demoralising aspects of rural water governance. This governance inertia, defined as the systematic failure to translate documented knowledge into institutional action, constitutes a governance failure that warrants theoretical attention as a distinct dimension of the rural water sustainability deficit.

Informants added that their view about the Indigenous knowledge integration in the Shoalhaven water sustainability space remains aspirational rather than operational. The pathway forward, as identified by the most experienced practitioners in this study, requires patient relationship-building and formal institutional commitment beyond statutory consultation. They further added that this requires dedicated resourcing for knowledge holders and the development of a water-specific Indigenous knowledge integration framework equivalent to the cultural burning model now operating in the fire management sector.

The majority of practitioners responsible for water sustainability were unaware of the SDG framework, which places the Shoalhaven study, which consistently identifies the gap between high-level SDG commitments and local-level action, as the defining challenge of the 2030 Agenda (OECD 2020). The paradox of SDG-aligned practice without SDG awareness is clear. Many groups, like River Watch and Landcare, are making progress on SDG 15 without realising it, while Shoalhaven Water is advancing SDG 6 and the Council is helping with SDG 11, but none of these efforts are formally recorded. These all confirm what this study terms the rural localisation deficit, the systematic failure to connect global water sustainability commitments to the frameworks, funding and performance measures that rural practitioners actually use. The absence of mandatory SDG reporting for local government means that the Shoalhaven's considerable practical contribution to SDG targets is currently invisible within national and global monitoring frameworks. This gap creates a missed opportunity both to recognise what is already being achieved and to leverage SDG commitments to drive the additional investment and coordination that practitioners consistently identify as lacking.

4.6 Rural Water Sustainability Governance: Reform Priorities and Implications

Three theoretical contributions emerge from this study that extend beyond the study region. First, it highlights a crisis-management funding model, in which post-crisis funds are used instead of steady investment in prevention. Informants demanded a consistent funding framework to support preventive water sustainability approaches that include social, environmental, cultural and technological areas. This adds institutional specificity to broader critiques of crisis-driven rural water governance. Second, it identifies a rural prioritisation deficit. Rural water-related ecosystems provide important ecosystem services locally and for urban areas. Yet, informants perceived rural landscapes as receiving considerably less sustained governance attention and investment than the urban populations that benefit from their ecosystem services. This gap raises concerns about uneven capacity in rural governance and differences between institutions at different levels. Third, the landscape-specific governance demand suggests that rural coastal water governance requires adaptation of IWRM principles to local institutional and ecological conditions rather than reliance on frameworks designed for urban or peri-urban settings. Although these issues are specific to the local context, they align with international findings that rural

water governance often faces fragmented funding, low prioritisation, and implementation gaps at various levels (Global Water Partnership 2000; Matimolane and Mathivha 2025; Morrison 2014).

The synthesis of findings across 19 thematic areas of this study points to six interconnected reform priorities for rural water sustainability governance in the Shoalhaven region, with broader relevance to rural coastal landscapes across New South Wales and Australia. First, the single most important structural reform is the establishment of an institution with a catchment-wide water sustainability mandate, sufficient authority to coordinate agency behaviour and direct investment, and accountability to both community and government for catchment-scale outcomes. Reinstating this authority, whether through a new statutory body, a WaterNSW partnership program, or a legislatively mandated multi-stakeholder forum, is the precondition for all other reforms. Second, Rural water sustainability requires a consistent, multi-year funding commitment that is not contingent on disaster events. Critically, this investment must include impact measurement, so that the cumulative effectiveness of interventions can be assessed, optimised, and reported at the catchment scale. The third one is regulatory reform. The current situation is that landscape rehydration, gully stabilisation, and wetland reconstruction require the same approval processes as development activities. This is a structural disincentive that prevents the catchment-scale restoration work on which all other reform priorities depend. Fourth, close the rural-urban governance funding disparity, which is a matter of both equity and strategically important rationality. Fifth, develop culturally appropriate and adequately resourced pathways for engaging First Nations knowledge holders in water governance, drawing lessons where appropriate from existing approaches in cultural land and fire management. Finally, embedding SDG localisation within rural water sustainability reporting would strengthen accountability, close the SDG data gap, and improve policy coherence without requiring additional on-the-ground investment.

These six reforms are interdependent. A catchment authority without sustained funding cannot achieve coordination. Coordination without regulatory reform cannot achieve restoration. Restoration without impact measurement cannot demonstrate value. Reporting without authority cannot generate accountability. Together, they constitute the minimum institutional investment needed to move rural water sustainability governance in the Shoalhaven from its current reactive, fragmented, and volunteer-dependent state to a proactive, coordinated, and institutionally grounded system capable of delivering water security for people and ecosystems across the full range of climatic conditions that the Shoalhaven catchment will face in the coming decades.

5. Limitations

This qualitative study involves 15 key informants consistent with accepted norms for purposive sampling in a single-site case study, though the sample does not statistically represent all rural landscapes. Despite deliberate efforts to achieve sectoral diversity, some groups remain underrepresented, notably direct farmer voices. Agricultural perspectives are captured primarily through extension officers and land managers rather than farmers themselves, and Indigenous knowledge perspectives are limited to

informant viewpoints rather than direct community consultation. This gap should be addressed in future research through targeted farmer and First Nations-specific KII or focus group methodology.

The findings reflect conditions as perceived during the interview period (September 2024 to September 2025). During a period of above-average rainfall and full dam levels witnessed in the Shoalhaven region. Therefore, perceptions of the current state, sufficiency of current actions, and priority research areas may differ significantly if interviews were conducted during drought conditions. This temporal limitation is inherent in all cross-sectional qualitative research and underscores the value of longitudinal follow-up studies that track perceptions of governance across climatic cycles.

The study focuses exclusively on the Shoalhaven LGA as the rural study site within the Sydney Basin. This region was selected as a contextually rich and policy-relevant case study, but its specific combination of coastal geography, metropolitan water-supply function, agricultural diversity, and Indigenous cultural significance may limit the direct transferability of the findings to other rural water-governance contexts in New South Wales, Australia, or any other countries. Comparing several rural catchments in future studies would help make the findings more widely applicable.

As a qualitative KII study, this research captures practitioners' and environmental group members' perceptions of water sustainability, rather than measuring water quality, ecological health, or governance performance data. While the richness of qualitative insight generated through this methodology is a strength, perceptions are fundamentally subjective and may reflect individual professional framing, organisational loyalty, or experiential bias. To address this, the broader research program combines these findings with data from monitoring, policy documents, and ecosystem assessments, addressing this limitation within the larger research framework. A reflexivity log was maintained throughout the analysis process, and themes were reviewed by the supervisory team to assess interpretive consistency. Nevertheless, the possibility that another researcher might have identified different themes or weighted the findings differently cannot be entirely ruled out and should be acknowledged. This is an inherent feature of reflexive thematic analysis rather than a methodological flaw.

6. Conclusion

The Shoalhaven case suggests that rural water sustainability can remain under-prioritised between crises despite its ecological, economic and social importance. Three main conclusions and six themes emerge from this study to inform governance of rural water sustainability more broadly. First, the Shoalhaven will not achieve genuine water sustainability under a crisis management governance model, and breaking that model requires institutional redesign, not incremental program adjustment. The evidence in this study is clear that rural water sustainability in the Shoalhaven is not hindered by a lack of ecological knowledge, community commitment, or technical skills. It fails because sustainability initiatives are understood through technological, social, ecological, cultural, and economic lenses separately rather than collectively. In particular, the funding, authority, and responsibility structures needed to translate these assets into sustained catchment-scale outcomes do not exist between disaster events. Crisis-responsive governance cannot build the monitoring systems, restoration programs, and institutional relationships that preventive

water sustainability demands, because none of these can be reliably planned, funded, or staffed when investment depends on the unpredictable arrival of drought, bushfire, or flood. The consequence is a catchment that is ecologically richer than its governance. Addressing this does not require more programs but a different funding system, one that treats rural water sustainability as a core infrastructure investment rather than an optional response to environmental emergency.

Second, the Shoalhaven's water governance challenges cannot be understood in isolation from the systematic under-prioritisation of rural landscapes. Informants consistently perceived rural water sustainability as receiving less explicit policy attention than biodiversity, net-zero and land management priorities, despite rural landscapes providing the ecological services that support urban water security. The result is a catchment in which extraordinary community effort compensates for the absence of institutions. This is not a sustainable solution, especially since rural dynamics keep changing and most volunteers are retired professionals. If this continues, the community knowledge, organisational strength, and ecological memory that keep the catchment functioning between government interventions will slowly disappear.

Third, the Shoalhaven rural coastal interface is complex, where agricultural legacies, estuarine dynamics, metropolitan extraction pressures, and Indigenous custodial relationships meet in a single catchment. This complexity demands a governance approach designed for this landscape rather than adapted from frameworks developed for other contexts. No individual policy instrument, program, or agency mandate can address this complexity in isolation. What is required is a catchment-scale institutional authority with the mandate, funding, and coordination capacity to align the diverse governance actors currently operating in parallel across the Shoalhaven, and to do so preventively rather than reactively. The findings indicate that, since the institutional changes of 2014, informants have perceived the absence of a sufficiently empowered catchment-scale coordinating mechanism as a major structural contributor to the governance deficits identified across the study.

Six interdependent reforms follow from these three conclusions, each with a precedent, a policy pathway, and a practitioner community ready to implement it. What they require is the political commitment to treat rural water sustainability as the foundational governance investment it has always been. Future research needs to examine whether the crisis management model, prioritisation deficit, and landscape-specific governance gap identified here characterise rural water governance across other coastal catchments in New South Wales and around the world. Future research should also explore whether the catchment-scale restoration models demonstrated in the Shoalhaven are scalable and transferable under different institutional conditions.

Water supports life, identity, the economy, and culture in Shoalhaven, but the problem lies in how it is managed, not in the water itself. The river continues to flow. Mangroves are coming back. Oyster farmers are still working by the water. Volunteer groups are planting, monitoring, and supporting ecosystems, but they lack sufficient institutional backing for the important work they do. What is missing is not the community's will, knowledge, or commitment, but the governance and institutional support needed to provide the steady investment that both the people and the catchment require.

Declarations

Competing interests:

The authors declare no competing interests.

Ethical Approval

and Accordance: This study was reviewed and approved by the Western Sydney University Human Research Ethics Committee (Approval Number: H16103) in accordance with the Declaration of Helsinki and the National Statement on Ethical Conduct in Human Research (2007, updated 2018) issued by the Australian National Health and Medical Research Council. All research procedures were conducted in accordance with the approved ethics protocol and the relevant ethical guidelines. Participation was voluntary, and all participants provided written informed consent prior to participation.

Consent to Participate:

All participants were provided with a detailed Participant Information Sheet prior to the interview and gave written informed consent before interviews commenced. It included agreement to audio recording, transcription, and the use of de-identified quotes in academic publications. No participants under the age of 16 were involved in this study.

Consent for publication:

All participants provided informed consent for the publication of de-identified data and anonymised quotes as part of this study. No individually identifiable information is included in this manuscript.

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Author Contribution

N.C.D.: Conceptualisation, Methodology, Software, Formal Analysis, Investigation, Writing-Original Draft, Writing-Review and Editing and Visualisation; B.M.: Conceptualisation, Methodology, Review and Editing, and Supervision; M.D.-M.: Editing and Review and Supervision; and S.H.: Review and Supervision.

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Data Availability

The interview data analysed in this study are not publicly available due to participant confidentiality and ethics approval conditions. De-identified extracts and summary tables supporting the findings are included in the article and supplementary material.

References

1. Alexandra J. Evolving Governance and Contested Water Reforms in Australia's Murray Darling Basin. *Water*. 2018;10:113.
2. Bezier E, Dechelete C, Podeprel M. (2025) Communication and visibility strategy. *Austria*, pp 1–26.
3. Bhatta R, Loc HH, Babel MS, Chapagain K. Assessment and enhancement of community water supply system sustainability: A dual framework approach. *Environ Sustain Indic*. 2024;24:100486. <https://doi.org/10.1016/j.indic.2024.100486>.
4. Campos M, Velázquez A, Gerardo B, Priego-Santander Á, McCall M, Boada M. Rural People's Knowledge and Perception of Landscape: A Case Study From the Mexican Pacific Coast. *Soc Nat Resour*. 2011;25:759. <https://doi.org/10.1080/08941920.2011.606458>.
5. Carvalho RC, Woodroffe CD. Rainfall Variability in the Shoalhaven River Catchment and its Relation to Climatic Indices. *Water Resour Manage*. 2015;29:4963–76. <https://doi.org/10.1007/s11269-015-1098-4>.
6. Carvalho RC, Woodroffe CD. Sediment budget of a river-fed wave-dominated coastal compartment. *Mar Geol*. 2021;441:106617. <https://doi.org/10.1016/j.margeo.2021.106617>.
7. Coles JF, McMahon G, Bell AH, Brown LR, Fitzpatrick FA, Eikenberry BCS, Woodside MD, Cuffney TF, Bryant WL, Cappiella K. Effects of urban development on stream ecosystems in nine metropolitan study areas across the United States. *US Geological Survey*; 2012. pp. 1–152.
8. Creswell JW, Poth CN. *Qualitative inquiry and research design: Choosing among five approaches*. SAGE; 2016.
9. Crispim DL, Pimentel Da Silva GD, Fernandes LL. Rural water sustainability index (RWSI): an innovative multicriteria and participative approach for rural communities. *Impact Assess Project Appraisal*. 2021;39:320–34. <https://doi.org/10.1080/14615517.2021.1911752>.
10. Curtis A, McDonald S, Mendham E, Sample R. *Understanding the social drivers for natural resource management in the Wimmera region*. Albury: Institute for Land, Water and Society; 2008.
11. Davey EK, Glamore WC. (2013) A tale of two rivers: Riverbank vulnerability and boat wake wave assessments along two Coastal Rivers. *Australasian Port and Harbour Conference (14th: 2013:*

- Sydney, NSW). Engineers Australia Barton, ACT, pp 256–261.
12. DPI NSW. (2020) Agriculture Industry Snapshot for Planning Illawarra/Shoalhaven Region. 1–21, pp.
 13. Evans AEV, Mateo-Sagasta J, Qadir M, Boelee E, Ippolito A. Agricultural water pollution: key knowledge gaps and research needs. *Curr Opin Environ Sustain.* 2019;36:20–7. <https://doi.org/10.1016/j.cosust.2018.10.003>.
 14. Glass J, Shucksmith M. Reimagining rural policy through mission-led governance. *Geographical J.* 2025;191:e70053. <https://doi.org/10.1111/geoj.70053>.
 15. Global Water Partnership. (2000) Integrated Water Resources Management. Stockholm, pp.
 16. Grouns I, Reinfelds I, Williams S, Coade G. Longitudinal effects of a water supply reservoir (Tallowa Dam) on downstream water quality, substrate and riffle macroinvertebrate assemblages in the Shoalhaven River, Australia. *Mar Freshw Res.* 2009;60:594–606.
 17. Guest G, Bunce A, Johnson L. How many interviews are enough? An experiment with data saturation and variability. *Field Methods.* 2006;18:59–82.
 18. Herrera V. Reconciling global aspirations and local realities: Challenges facing the Sustainable Development Goals for water and sanitation. *World Dev.* 2019;118:106–17. <https://doi.org/10.1016/j.worlddev.2019.02.009>.
 19. Holland M, Demaree K, Thomas E. Investigating technology opportunities toward improved Colorado water monitoring: Insights from key informant interviews and stakeholder surveys. *PLOS Water.* 2023;2:e0000054. <https://doi.org/10.1371/journal.pwat.0000054>.
 20. Hommes L, Boelens R, Harris LM, Veldwisch GJ. Rural-urban water struggles: urbanizing hydrosocial territories and evolving connections, discourses and identities. *Water Int.* 2019;44:81–94. <https://doi.org/10.1080/02508060.2019.1583311>.
 21. ID Community. (2026) Shoalhaven City Community Profile. <https://profile.id.com.au/shoalhaven/about>. Accessed 12/06/2026.
 22. International Labour Office. Water for Improved Rural Livelihoods. Switzerland: Geneva; 2019. pp. 1–12.
 23. Jackson S. Water and Indigenous rights: Mechanisms and pathways of recognition, representation, and redistribution. *WIREs Water.* 2018;5:e1314. <https://doi.org/10.1002/wat2.1314>.
 24. Ji R, Yang S-Q, Sivakumar M, Riaz MZB. Assessing monthly rainfall and runoff trends for sustainable water resource management in lower Shoalhaven river. *Discover Water.* 2025;5:20. <https://doi.org/10.1007/s43832-025-00200-6>.
 25. Kemter M, Fischer M, Luna LV, Schönfeldt E, Vogel J, Banerjee A, Korup O, Thonicke K. (2021) Cascading hazards in the aftermath of Australia's 2019/2020 Black Summer wildfires. *Earth's Future*, 9, e2020EF001884. <https://doi.org/10.1029/2020EF001884>
 26. Kiem AS. Drought and water policy in Australia: Challenges for the future illustrated by the issues associated with water trading and climate change adaptation in the Murray–Darling Basin. *Glob Environ Change.* 2013;23:1615–26. <https://doi.org/10.1016/j.gloenvcha.2013.09.006>.
 27. Kumar R. Research methodology: A step-by-step guide for beginners. London: SAGE; 2014.

28. Larson KL, White DD, Gober P, Harlan S, Wutich A. Divergent perspectives on water resource sustainability in a public–policy–science context. *Environ Sci Policy*. 2009;12:1012–23. <https://doi.org/10.1016/j.envsci.2009.07.012>.
29. Matimolane S, Mathivha FI. Tackling rural water scarcity in South Africa: climate change, governance, and sustainability pathways. *Front Environ Sci*. 2025;13–2025. <https://doi.org/10.3389/fenvs.2025.1550738>.
30. Mekonnen MM, Hoekstra AY. Four billion people facing severe water scarcity. *Sci Adv*. 2016;2:e1500323. <https://doi.org/10.1126/sciadv.1500323>.
31. Morrison TH. Developing a regional governance index: The institutional potential of rural regions. *J Rural Stud*. 2014;35:101–11. <https://doi.org/10.1016/j.jrurstud.2014.04.004>.
32. Muthukumaran K. (2026) Strengthening Rural Water Sustainability through Integrated Management and Stewardship: Evidence from Selected Rural Areas of Tamil Nadu. *Minn J Bus Law Entrepreneurship*, 1324–39.
33. Nelson-Nuñez J, Pizzi E. (2018) Governance and Water Progress for the Rural Poor. *Global Governance: A Review of Multilateralism and International Organizations*, 24, 575–593. <https://doi.org/10.1163/19426720-02404006>
34. Nowell LS, Norris JM, White DE, Moules NJ. Thematic analysis: Striving to meet the trustworthiness criteria. *Int J Qualitative Methods*. 2017;16:1609406917733847.
35. Noy C. Sampling knowledge: The hermeneutics of snowball sampling in qualitative research. *Int J Soc Res Methodol*. 2008;11:327–44.
36. Ocean Watch. (2016) Case study - The Shoalhaven River Catchment. pp 1–4.
37. OECD. Stakeholder engagement for inclusive water governance. IWA Publishing; 2015.
38. OECD. Rural 3.0: a framework for rural development. April: Policy Note edn. OECD; 2018. pp. 1–27.
39. OECD. A Territorial Approach to the Sustainable Development Goals: Synthesis report. Paris: OECD; 2020. pp. 1–230.
40. Ostrom E. Beyond markets and states: polycentric governance of complex economic systems. *Am Econ Rev*. 2010;100:641–72.
41. Pahl-Wostl C. Water governance in the face of global change. Switzerland: Springer; 2015.
42. Patton MQ. Qualitative research & evaluation methods: Integrating theory and practice. Sage; 2014.
43. Perrone D, Rohde MM, Hammond Wagner C, Anderson R, Arthur S, Atume N, Brown M, Esaki-Kua L, Gonzalez Fernandez M, Garvey KA, Heidel K, Jones WD, Khosrowshahi Asl S, Munill C, Nelson R, Ortiz-Partida JP, Remson EJ. Stakeholder integration predicts better outcomes from groundwater sustainability policy. *Nat Commun*. 2023;14:3793. <https://doi.org/10.1038/s41467-023-39363-y>.
44. Pigram J. Australia's water resources: from use to management. Australia: CSIRO; 2007.
45. Qu SQ, Dumay J. The qualitative research interview. *Qualitative Res Acc Manage*. 2011;8:238–64.
46. Radcliffe JC. Water recycling in Australia – during and after the drought. *Environ Science: Water Res Technol*. 2015;1:554–62. <https://doi.org/10.1039/c5ew00048c>.

47. Ragusa AT. We Have Plenty of Water, Don't We? Social Norms, Practices, and Contentions in a Drought-Ridden Country. *Hydrology*. 2021;8:161.
48. Rautanen S-L, Koppen B, Wagle N. Community-Driven Multiple Use Water Services: Lessons Learned by the Rural Village Water Resources Management Project in Nepal. *Water Altern*. 2014;7:160–77.
49. Ritchie J, Spencer L. Qualitative data analysis for applied policy research. In: Huberman M, Miles BM, editors. *The Qualitative Researcher's Companion*. USA: SAGE; 2002. pp. 173–94.
50. Sherval M, Askew L, McGuirk P. Not just drought'. *Drought, Rural Change and More: Perspectives from Rural Farming Communities*. In: Connell RD-JJ, editor. *Rural Change in Australia: Population, Economy, Environment*. Australia: Ashgate; 2014. pp. 235–53.
51. Shoalhaven City Council. (2025) Shoalhaven secures coastal projects funding. <https://www.shoalhaven.nsw.gov.au/News-and-feedback/News-and-media/News/Shoalhaven-secures-coastal-projects-funding>. Accessed 10/07/2026.
52. Taylor KS, Longboat S, Grafton RQ. Whose Rules? A Water Justice Critique of the OECD's 12 Principles on Water Governance. *Water*. 2019;11:809.
53. Vasseur L, Medouar S. *Urban-rural linkage: an ecosystem governance perspective*. Switzerland: IUCN, IUCN, Gland; 2026. pp. 1–112.
54. Whaley L. Water governance research in a messy world: A review. *Water Altern*. 2022;15:218–50.
55. Wilderer PA. Sustainable water management in rural and peri-urban areas: what technology do we need to meet the UN millennium development goals? *Water Sci Technol*. 2005;51:1–6.
56. Wu J. Landscape sustainability science: ecosystem services and human well-being in changing landscapes. *Landscape Ecol*. 2013;28:999–1023.
57. Wyborn CA, van Kerkhoff LE, Colloff MJ, Alexandra J, Olsson R. The politics of adaptive governance: water reform, climate change, and First Nations' justice in Australia's Murray-Darling Basin. *Ecol Soc*. 2023;28. <https://doi.org/10.5751/ES-13641-280104>.
58. Xi H, Huang C, Ou W, Li J, Wang F, Tao Q, Tao Y. An assessment framework for landscape sustainability based on ecosystem service supply-flow-demand. *Landscape Ecol*. 2024;39:57. <https://doi.org/10.1007/s10980-024-01855-7>.

Figures

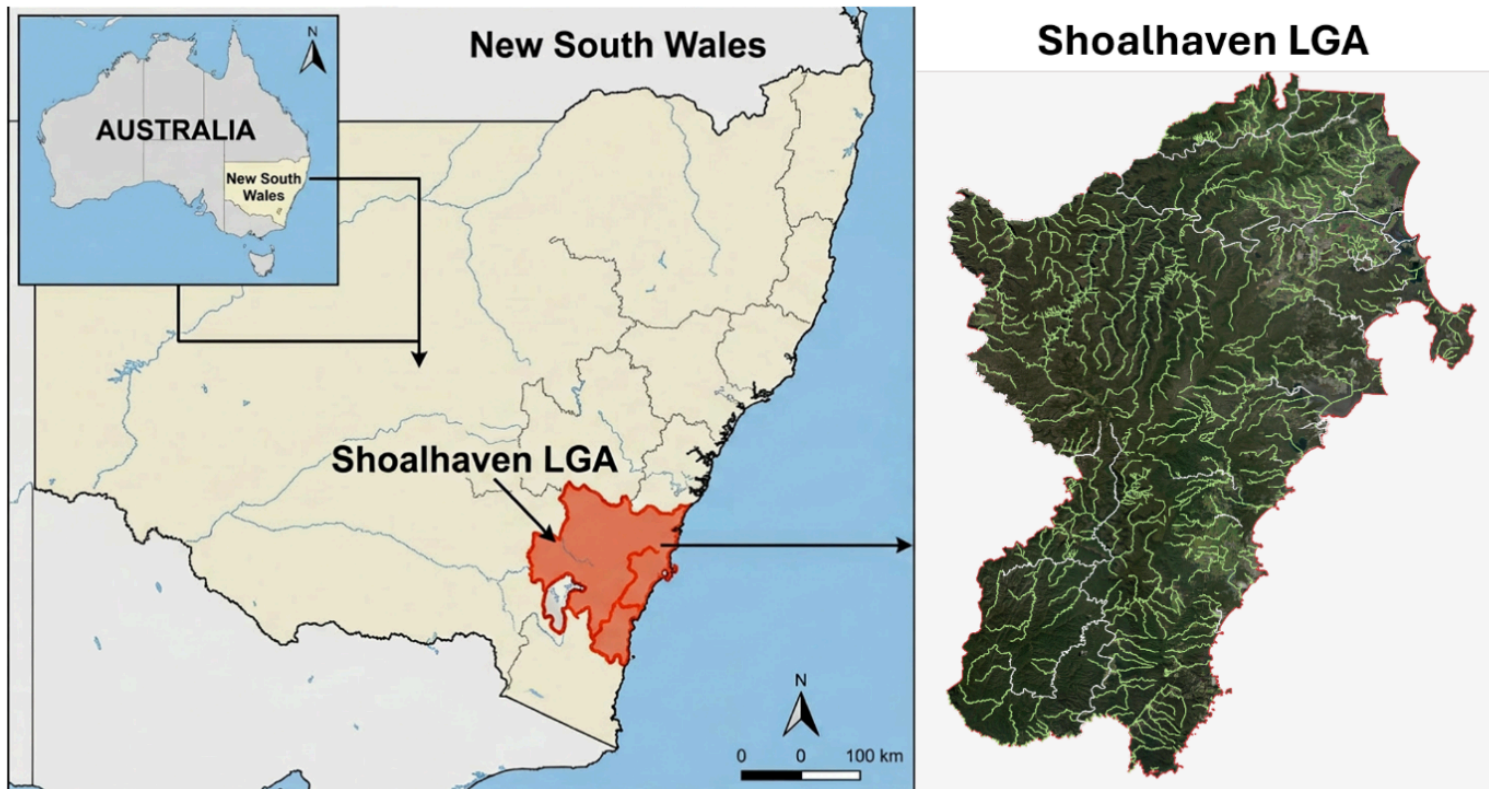


Figure 1

Location of the study area: Shoalhaven LGA, New South Wales, Australia

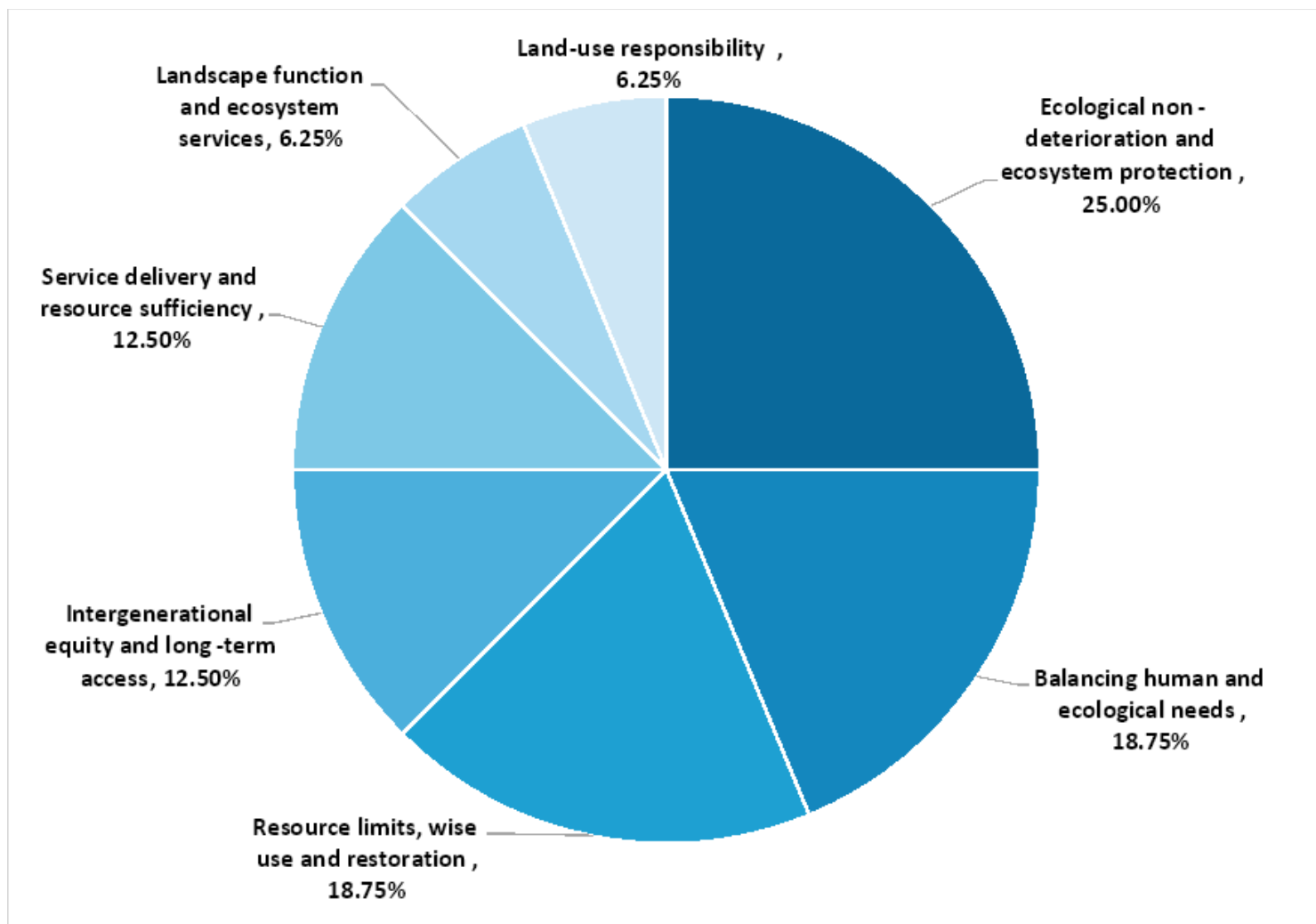


Figure 2

Seven dominant conceptual lenses through which key informants in the Shoalhaven rural landscape define water sustainability, derived from thematic analysis

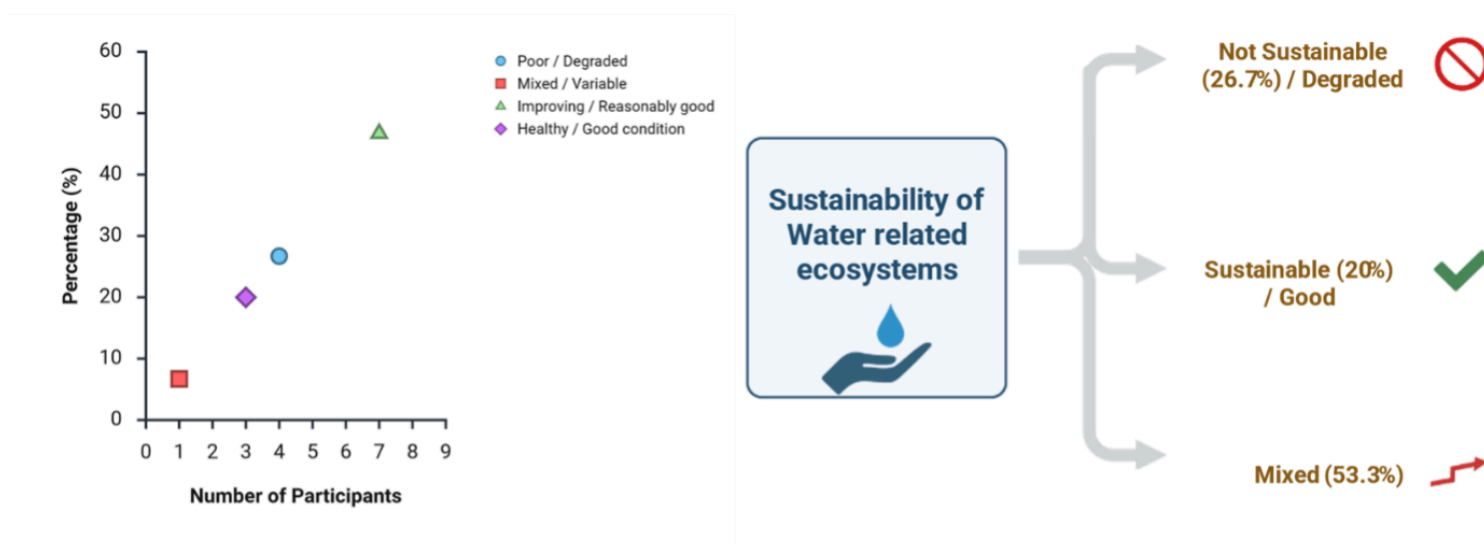


Figure 3

Key informant assessments of the current health status of water-related ecosystems in the Shoalhaven region

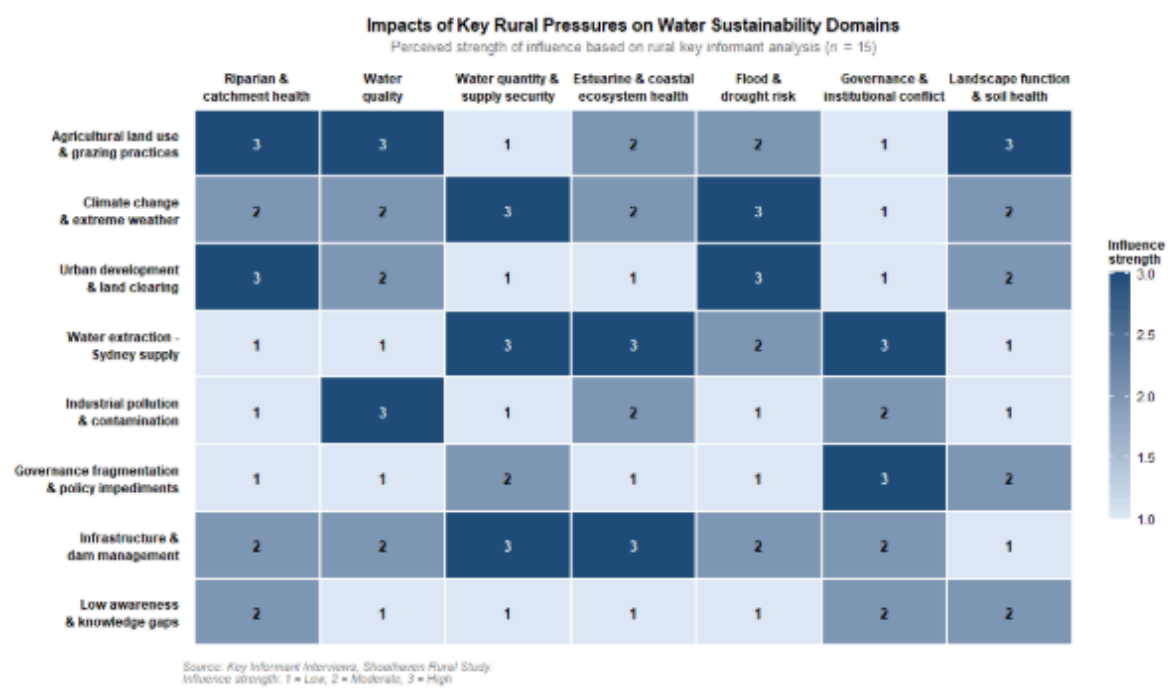


Figure 4

Heatmap showing the perceived influence of major pressures on seven water sustainability domains in the Shoalhaven region, based on key informant ratings

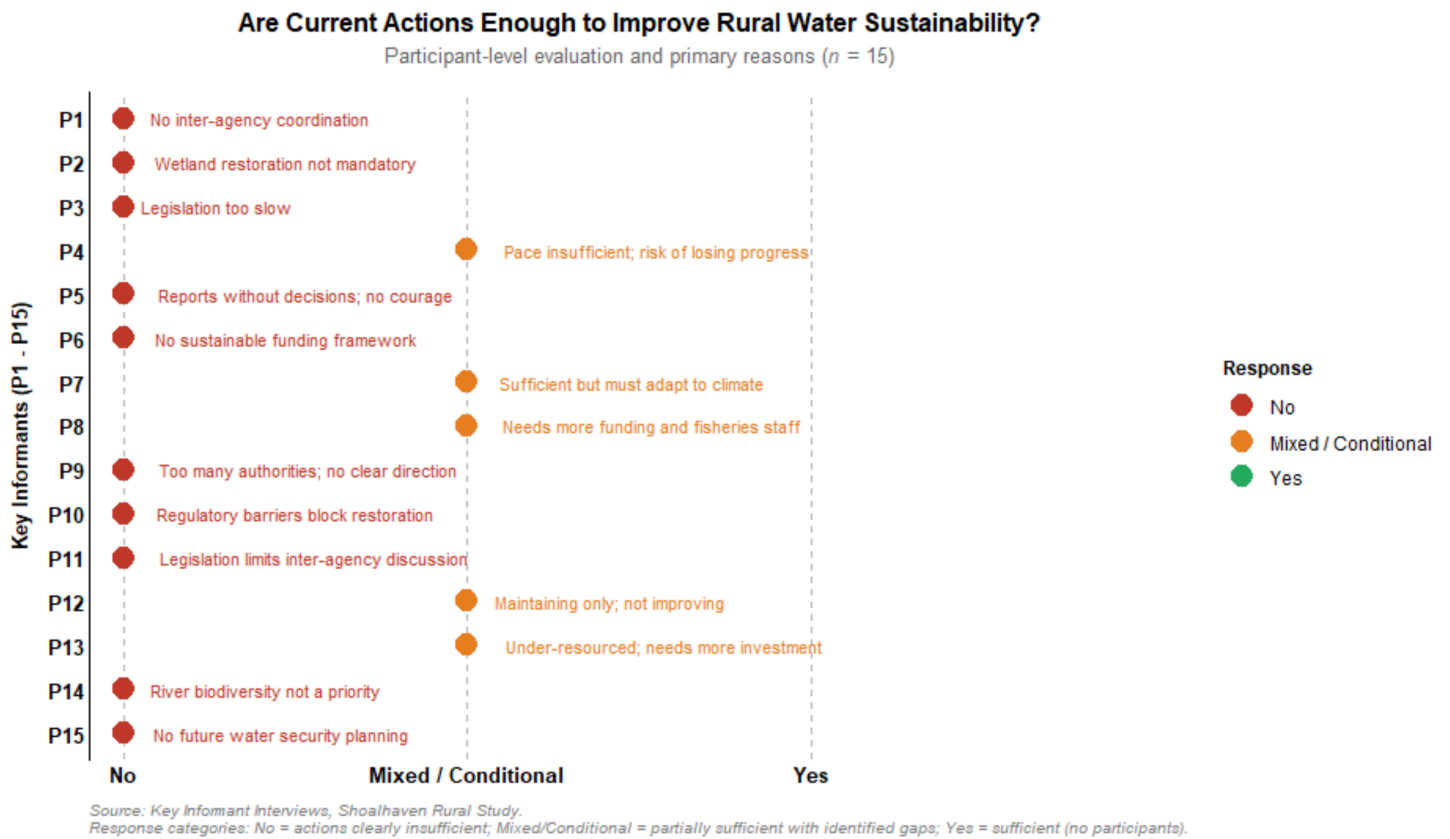


Figure 5

Key informant assessments of whether current actions are sufficient to improve water sustainability in the Shoalhaven region

Responsibility Framework for Rural Water Sustainability

Three-tier categorisation of stakeholder responsibilities - Shoalhaven Rural KI Study (n = 15)



Source: Key Informant Interviews, Shoalhaven Rural Study. A = Primary Drivers (mandate and policy authority); B = Conditional Implementers (action dependent on resources and policy); C = Essential Contributors (enabling and supporting roles). Numbers in parentheses = participant mentions.

Figure 6

Three-tier conceptual pyramid summarising key informant perceptions of which actors are most effective for improving rural water sustainability in the Shoalhaven region

Supplementary Files

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- [ShoalhavenSupplementaryFinalBM22082026.docx](#)