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Spirituality in traditional water knowledge systems as a driver and barrier to aquatic ecosystem conservation in Zimbabwe

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Traditional water knowledge (TWK) compounds indigenous people's profound and inherent understanding, comprehension, and interpretation of natural processes with their ecological dependence on hydrological cycles and spiritual and religious cultural connections. TWK simultaneously coexists and conflicts with Western methods of water management in African landscapes. The objectives of this systematic literature review were to 1) synthesise the role of spirituality in TWK elements comprising spatial-based landscape knowledge, water use and management, and water values i) as drivers and ii) barriers to aquatic ecosystem conservation in rural and urban landscapes and 2) identify salient gaps for its integration in strengthening aquatic biodiversity, climate adaptation, resilience, and sanitation initiatives in Zimbabwe. A Scientific Procedures and Rationales for Systematic Literature Reviews (SPAR-4-SLR) literature review protocol and a Theories, Concepts, Characteristics; Methodology (TCCM) framework were adopted. TWK exhibits subtle variations related to the local geospatial cultural intricate perspectives on the sacredness of water sites. Informal traditional water knowledge networks predict wildlife and water system and rainfall dynamics akin to academic projections but pose unique governance and policy interventions. Gaps exist in studies on the origin of the evolution of mythical water spirits, spiritualism, moneyism, natural medicinal healing attributes, and the lure of water ecosystems as an epistemological aspect of TWK. Geospatial mapping and documentation of the localised contextual conservation astuteness of sacred water sites is a baseline and valid TWK for local conservation policy initiatives. Complementary integration of TWK and contemporary scientific methods will enhance national water policies and water conservation strategies in Zimbabwe.

KEYWORDS
hydrological cycles, landscape transformation, mythical beliefs, traditional water knowledge, water conservation, Zimbabwe

1 Introduction

Water is a basic human need, and every living being has an equal and unreserved right to it (Mapuva, 2024; Madzivanyika et al., 2026). A combination of climatic and non-climatic factors threatens the availability of freshwater resources (Kupika et al., 2019; Marambanyika et al., 2021; Musasa and Marambanyika, 2022, 2023). Rural, urban, and peri-urban wetlands

face threats from over abstraction, climate change, pollution, desiccation, and degradation, mainly from the same anthropogenic activities they sustain (Musasa et al., 2023a, b; Mandishona and Knight, 2019).

The United Nations Sustainable Development Goal number 6 (SGD 6) propounds that water is vital for human and wildlife survival and is a basic need, and every person and animal has a right to clean usable water, though this does not necessarily imply its gratuity (Asad et al., 2023; Madzivanyika et al., 2026). People have a physical and spiritual connection with water from Europe, America, Asia, South America, and Sub-Saharan Africa (Gandy, 2008; Asad et al., 2023). Most rural and urban dwellers are well connected to the natural water cycles irrespective of purported 'modern scientific' water management strategies (Su et al., 2018; Asad et al., 2023). This is often noticeable in periods of abnormal hydrological-induced vagaries such as floods, storms, cyclones, and sleet, where rural, urban, and Western world citizens recognise water as a significant entity (Al Jayyousi, 2007; Claxton, 2010; Su et al., 2018). Nevertheless, during a normal hydrological cycle—characterised by an abundant supply of good-quality water—city dwellers are less concerned with water-related issues (Al Jayyousi, 2007; Su et al., 2018).

Contrastingly, locals dwelling in rural and remote areas depend highly on and are spiritually and culturally attached to water (Dube, 2024). In rural and remote community setups, traditional ecological knowledge about water resources and hydrological cycles is paramount and important for basic survival (Asad et al., 2023). Together with sustaining water-dependent livelihoods such as fishing, abstractive irrigation, livestock rearing, and extractive alluvial mining, spiritual and religious undertones belie water values and use management (Matanzima, 2022). Water-dependent livelihoods, mainly farming, fishing, and alluvial mining, are intertwined with the natural hydrological vagaries underlined by traditional water knowledge and uses to conserve it as it is a scarce, delicate, and precious resource, especially for arid and remote rural areas in developing nations. Yet, traditional water knowledge (TWK) is hardly integrated in formulating water conservation policies for urban, peri-urban, and rural areas in developing nations and even for developed nations across the world.

Traditional ecological knowledge (TEK) and spiritual associations in tandem with religion are widely acknowledged as having important contributions to conservation practice, decision-making, and science in society across the world (Maposa and Mhaka, 2013; Asad et al., 2022; Kupika et al., 2025). Intertwining local and scientific knowledge is important to enhance understanding, practice, and ethics towards sustainable utilisation of natural resources such as water and water-dependent fauna in mesic regions in African countries (Kentula, 2000; Gadgil et al., 2003; Tarakini et al., 2020). Contemporary literature, e.g., Berkes (2012) and Asad et al. (2022, 2023), defined TWK as an intergenerational knowledge of living closely with local water system ecology to become potentially active and participatory agents of water change which transcends physical, tangible, practical relationships with water into contextual insight, belief, sense, and practices integrated with a culture in a specific location. Water conservationists utilise ideas from a local community perspective (*emic*) and elsewhere outside the concerned community (*etic*) (Morris et al., 1999; Tarakini et al., 2020). The term traditional water knowledge directly implies the local water knowledge developed by local communities (who share strong cultural and social ties) over a period of intergenerational interaction with the resource in a specific landscape (Asad et al., 2023). TWK exists as an integral aspect of TEK in society. Specifically, TWK is concerned with the conservation and preservation of finite water resources at local waterscape scales as it represents the interaction between water and society, encompassing its cultural, geographical, economic, and political dimensions.

The inclusion of aspects of local culture in the management of water and natural resources alike often helps sway local conservation perceptions (Muyambo and Maposa, 2014). Programmes involving TEK are more acceptable and inclusive of local needs and aspirations and accord respect to local beliefs and ethics, even in the absence of monetary and tangible benefits (Maposa and Mhaka, 2013). Consequently, this helps avoid the traditional 'top down' or paternalistic approaches in water management, which tend to be prevalent in pro-Western 'scientific' water management methods adopted by most local authorities in Zimbabwe (Muyambo and Maposa, 2014). However, rather than being accepted as an essential factor to be considered in project planning and execution of local projects, TEK (including TWK) has often been ignored and later blamed for the failure of most water projects (Muyambo and Maposa, 2013; Matsapa, 2023; Sunzuma et al., 2025). Thus, a sensible and pragmatic approach would be to infuse and integrate TWK and Western water hydrological management tools for sustainable water sanitation and hygiene propositions at local authority levels (Dube, 2024; Sunzuma et al., 2025). Contemporary water resource management policies and strategies barely infuse TWK as an operational component, thus masking its important intermediary role in complementary and inclusive holistic water management, as local communities and their water beliefs are excluded.

In Zimbabwe, most water bodies are considered sacred and revered, as the belief pervades that they are inhabited by spiritual forces (Muyambo and Maposa, 2014; Dube, 2024). This reverence for sacred water bodies stems from a mixed tinge of fear and respect for the ancestral spirits (Taringa, 2006; Muyambo and Maposa, 2014; Mutigwe and Chipfakacha, 2022). The fear or respect towards ancestral spirits by local communities does not imply that indigenous African religion per se is intrinsically ecologically friendly (Matanzima, 2022). The net effect of the nurturing attitude towards the environment is a salient driver of environmental management and wetland preservation and conservation for most rural and remote areas in Sub-Saharan Africa (Muyambo and Maposa, 2014; Marambanyika et al., 2021). Regardless, wetlands in Zimbabwe, both in rural and urban landscapes, still face threats of desiccation, degradation, pollution, and encroachment affecting ecosystem services provision (Mutandwa et al., 2006; Musasa and Marambanyika, 2020). The need to utilise water for survival, checked by a fear of spiritual reprisals if locals desiccate wetlands, presents a complex conundrum for conserving precious waterscapes, especially those located in close proximity to human communities.

Studies—e.g., Mutandwa et al. (2006); Musasa and Marambanyika (2020); Marambanyika et al. (2021), and Matanzima (2022)—examined the drivers and barriers to wetland

conservation in Zimbabwe. The authors found a concatenated repetitive pattern comprising the synergistic interaction of natural forces such as climate change, droughts, floods, and anthropogenic activities, mainly irrigation and wetland agriculture, extractive mining, manufacturing industry, and potable domestic water abstraction on wetland degradation (Magadza, 2003; Marshall, 2011a; Musasa and Marambanyika, 2020). The absence of strong institutional support for wetland conservation and drying up of funding for rehabilitative wetland habitat restoration drive wetland degradation (Marambanyika and Beckedahl, 2016; Marambanyika et al., 2016, 2017; Marambanyika and Sibanda, 2019; Marambanyika et al., 2021). There is a discernible undertone in the reporting of the impacts of natural and anthropogenic activities on wetland status in the country, which tends to highlight the negative impacts of anthropogenic activities more often (Magadza, 2003; Mabika and Utete, 2024). Relatively fewer studies—e.g., Matanzima and Saidi (2020); Matanzima, 2022), Matanzima (2022); Muyambo and Maposa (2013, 2014), and Muyambo and Maposa (2013)—highlighted exigencies of religion, spiritualism, and cultural beliefs as drivers of wetland conservation in Zimbabwe. Gaps exist on the positive and negative impacts of natural spiritual forces or spirits espoused by locals as custodians of water bodies in the wetland conservation narrative and discourse in the country (Taringa, 2006; Muyambo and Maposa, 2014; Matanzima, 2022).

Several TWK frameworks coexist with the majority conjoining aspects including a holistic understanding, long-term observation of water systems, resilience and sustainability of use, contextual local community physical location attributes, and sociodemographic, religious, practical, spiritual, and cultural aspects (Matanzima, 2022; Dube, 2024). Within Zimbabwe, the corpus of case studies on TWK is largely fragmented and examines assumptive assumptions of conflicts between modern western scientific water management systems and traditional conservation ideologies, constrained by knowledge plasticity in physical geography; traditional indigenous cultural, ethical, and religious values; and sustainable water-dependent livelihoods (Mapara, 2009; Matanzima, 2022).

This study adopted the TWK framework by Asad et al. (2022, 2023), which includes key aspects of i) specific location-based knowledge, ii) water use management, and iii) cultural and social values. Location or geographical positioning-based knowledge refers to specific localised intimate knowledge of water sources, hydrological cycles, and seasonal variations related to the connection between humans and the place and/or landscape where they live (Wilson et al., 2019). Water utility, storage, and management refer to the traditional ways and methods, equipment, instruments, and strategies associated with water knowledge in a specific location as guided by the need for sustainable conservation of water resources (Mavhura et al., 2013). Water values espouse the religious, ethical, socio-cultural perceptions, insights, views, attitudes, complex myths around their origins, and expressions towards water systems and inherent mythical or mysterious spiritual hydrobionts, such as the Nyaminyami River God in Lake Kariba (Matanzima, 2022) and sacred water wells in the Ndau community in Zimbabwe (Taringa, 2006; Muyambo and Maposa, 2014).

The objectives of this systematic review were to 1) examine the role of spirituality in TWK elements—spatial-based landscape knowledge, water use and management, and water values—i) as drivers and ii) barriers to aquatic ecosystem conservation in rural and urban landscapes and 2) identify salient gaps for its integration in strengthening water and sanitation initiatives and enhancing biodiversity conservation and climate adaptation resilience in Zimbabwe. The fundamental baseline presupposes spiritual, religious, mythical, and cultural beliefs as potent environmental tools to mainstream water management interventions through their incorporation of local indigenous values and perceptions. Involving the indigenous aspects of culture potentially assists locals in accepting and embracing water technological innovations with no scepticism, consequently enhancing water conservation (Mapara, 2009; Muyambo and Maposa, 2014; Sunzuma et al., 2025).

2 Materials and methods

The review explored the link between spiritualism and traditional ecological knowledge systems as drivers of water conservation in Zimbabwe. The study adopted the Scientific Procedures and Rationales for Systematic Literature Reviews (SPAR-4-SLR) literature review protocol and a Theories, Concepts, Characteristics, Methodology (TCCM) framework-based review to ensure a rigorous and transparent literature review (Paul et al., 2021). SPAR-4-SLR has three primary bigger stages (assembling, organizing, and evaluating) comprising the SPAR-4-SLR protocol and six distinctive phases (identification, acquisition, organisation, purification, evaluation, and reporting) within them (Machete and Marques, 2021).

2.1 Defining the search strategy, assembling, identification, and acquisition

This is the first stage of SPAR-4-SLR, which consists of the 'identification' and 'acquisition' of data (Figure 1). For item and document selection, the keyword search methods were limited to the title, abstract text and keywords, objectives, and research questions. The study search was limited to Scopus and Web of Science for a systematic review. Grey literature was obtained from Google Scholar, Bing, and GiveWater search engines due to the type of thematic analysis adopted, which was more qualitative and narrative in nature. The study explicitly searched for words and studies focusing on the key terms 'spirituality, myths, traditional methods, water spirits, sacred sites, mysteries, beliefs, folklores, and mermaids, in Zimbabwe'. Further searches for spiritualism in all coupled (using AND, NOT, OR) subgroups which comprised 'traditional water knowledge', 'ancestral spirits', 'mysteries', 'African traditional religion', 'water spirits-human activities', and water conservation researches including 'water-pans', 'water-ponds', 'mountain rivulets', 'mountain streams', 'modern water-management', and 'water conservation farming-regulations', together with technical reports on 'traditional soil water human interventions in water ecosystem conservation in Zimbabwe'. Some of the coupled terms, e.g., 'water-human activity', 'religion', and 'water resources conservation-aquaculture', produced a lot of background noise and conjoined other non-relevant information

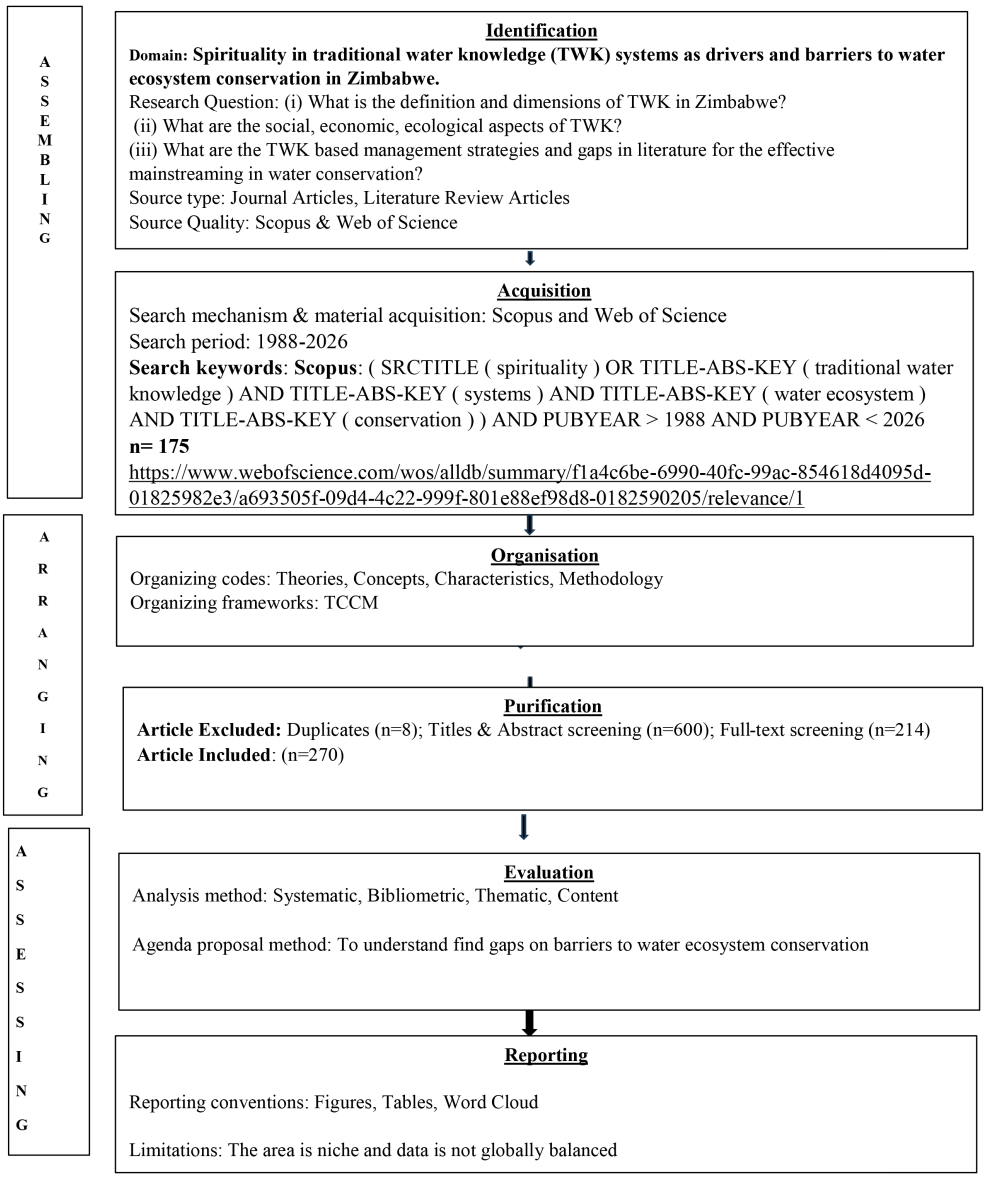

FIGURE 1
The SPAR-4-SLR framework used for data extraction. Source: Paul et al. (2021).

for the study and were excluded. Further search did not lead to the discovery of additional terms that relate to spiritualism and traditional water knowledge in Zimbabwe. The final search terms used were as follows: (spiritualism, mysteries, myths, African traditional religion, AND ('traditional water knowledge, mermaids, and water conservation policies in Zimbabwe *').

2.2 Inclusion and exclusion criteria

The search period was limited to 1988–2026, looking at research articles, literature reviews, and reports on spiritualism and water conservation published in the English language. The search from Web of Science and Scopus search engines (Scopus = 175; Web of Science = 917) yielded a total number of 1,092 articles (Figure 1). The TCCM concept of arranging the literature, guided by the keywords, was adopted, and then thorough cleaning was conducted. From an initial search list, 1,092 articles were obtained with the search engines. After cleanup as indicated in the flow diagram, 270 articles were eventually included in the final analysis (Figure 1). A PRISMA flow summary is provided as Supplementary Figure 1 to show the transparency of the literature review process. The keywords in the abstracts as well as the abstract text were screened for relevant items that could be classified under or that mentioned spiritualism, mermaids, religion, water conservation, and ancestral spirits in Zimbabwe from 1988 to 2026. The aim was to screen the dataset to a manageable and relevant size. An article was included if it met the following criteria: a) an Act or policy document on spiritualism, religion, ancestral spirits, water spirits, and traditional water conservation; b) publication in a reputable journal, international organisation technical report, or book; and c) relevant government and non-governmental conference proceedings on spiritualism, religion, and water conservation. The review excluded blogs and frivolous unverified media reports as they are not peer-reviewed to be valid and reliable, except when they were the only

credible source for vital developments and discourse in spiritualism and traditional water conservation in Zimbabwe.

2.3 Data analysis and visualisation

The analysis and visualisation were conducted in two phases. The first phase was the bibliometric analysis using Biblioshiny, an RStudio software package. This software programme was used to arrive at the descriptive statistics and visualisations about the growth, publication trend, and citation trends of water spiritualism and traditional water conservation studies. Furthermore, we used Biblioshiny (Bibliometrix, R package) to perform a bibliometric analysis of articles based on keywords, co-occurrence, and co-citation. The blue icon on the outputs is an acknowledgement of the software mark used.

3 Results and interpretation

This section presents the results and interpretation with references of the case study following the objectives.

3.1 Quantitative systematic review

In order to determine the knowledge base of the study area on a global scale, the study carried out an annual scientific production quantitative analysis. The results (Figure 2) showed that there was the least interest in the subject area during the 1991–2001 period. The publication trend showed an increase from 2002 to 2004, and a gradual increase was noted from 2005 to 2012. There was a downward trajectory in 2013, which was followed by a fluctuating trend from 2015 to 2023. The current trend from 2024 to 2025 shows that there is a renewed interest in this subject area as the trend graph is showing upward movement in the publication trend.

3.2 Bibliometric analysis

In order to determine the bibliographic framework of the data used in this literature review, this study performed a keyword co-occurrence analysis of the 270 articles included in the literature review. The keyword co-occurrence map (Figure 3) produced four links within the map. The first link included traditional knowledge, which is linked with biodiversity conservation, conservation management, forestry, climate change, and environmental management amongst other keywords within the map. The second linked keywords in the map are natural resources management, environmental protection, and natural resources conservation. The third link includes ecosystem, ecosystem services, water resources, sustainable development, sustainability, ecosystem management, water resources, and agroforestry. The fourth link of keywords includes water supply, water quality, water conservation, water management, and indigenous knowledge.

3.3 Thematic and content analysis

The study carried out trending topic analysis on the 270 articles from 2016 to 2024. The results showed that biodiversity and traditional knowledge have a term frequency ranked at 30 from the studies as shown in Figure 4. Topics including ecosystems, conservation, climate change, ecosystem service, and conservation of natural resources had a middle term frequency of 20. The least trending topics include indigenous knowledge, environmental change, and freshwater ecosystems, amongst other topics with a term frequency rank of 10.

The study carried out a thematic analysis on TWK using Biblioshiny in RStudio, from the 270 included articles. Themes were classified into four major relevancy thematic categories as emerging or declining themes, niche themes, motor themes, and basic themes (Figure 5). Themes included sustainability, alternative agriculture, and soil fertility. Motor themes included traditional

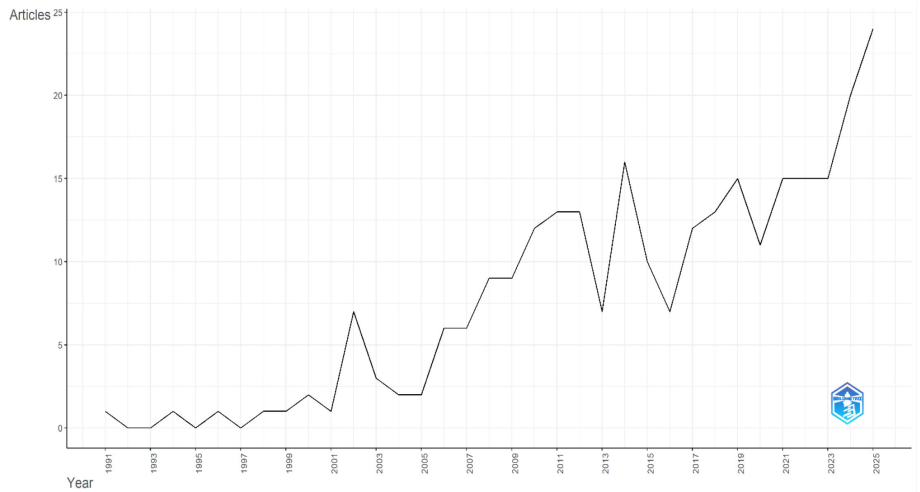

FIGURE 2
Annual global scientific production in the literature including aspects of TWK from 1991 to 2025.

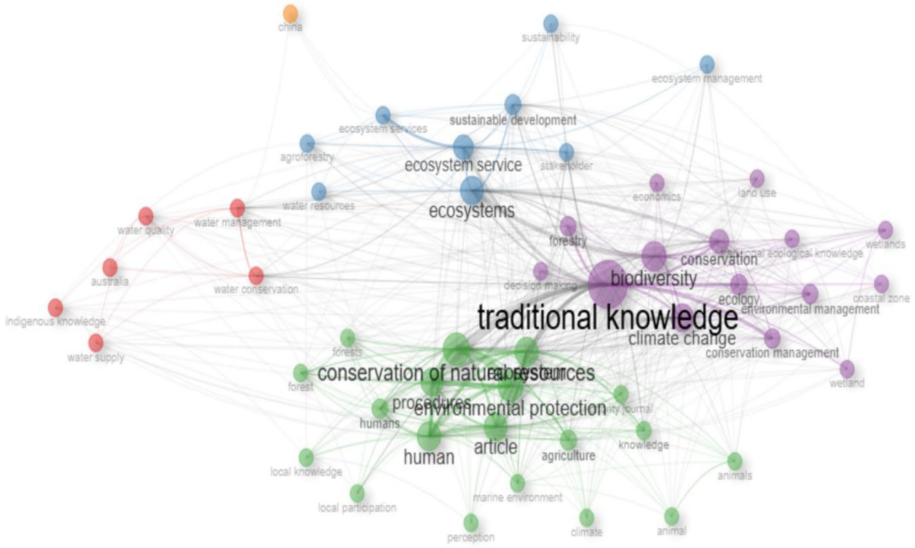

FIGURE 3
The keyword co-occurrence map output for literature including aspects on TWK analysis for 1988–2026.

knowledge, biodiversity conservation, natural resources conservation, climate change, and environmental protection. These themes contain the major knowledge base of the studies included in this review. Themes including ecosystems, water conservation, and water management form the basic themes of the included studies.

3.4 Spatial-based landscape knowledge in TWK aspects of Zimbabwe

Literature research results indicated that natural elements like wells, pools, mountains, and rivers are revered as deities, such as the Save River in Zimbabwe (Taringa, 2006; Mutigwe and Chipfakacha, 2022). This review indicated notable sites in different geographical settings as mapping of areas where TWK was reported. Analysis of the literature indicated that studies have been concentrated in Manicaland > Masvingo > Matebeleland North > Mashonaland West > Mashonaland Central > Midlands > Matebeleland South > Harare > Bulawayo, in that respective hierarchical decreasing order. TWK is context-specific and appears to dovetail more with the cultural ethos of the pertinent regions relative to the provincial socioeconomic development trends in Zimbabwe.

3.5 Water use systems and spiritualism

There is an application of integrated traditional and 'modern' water harvesting approaches and systems ranging from dams or

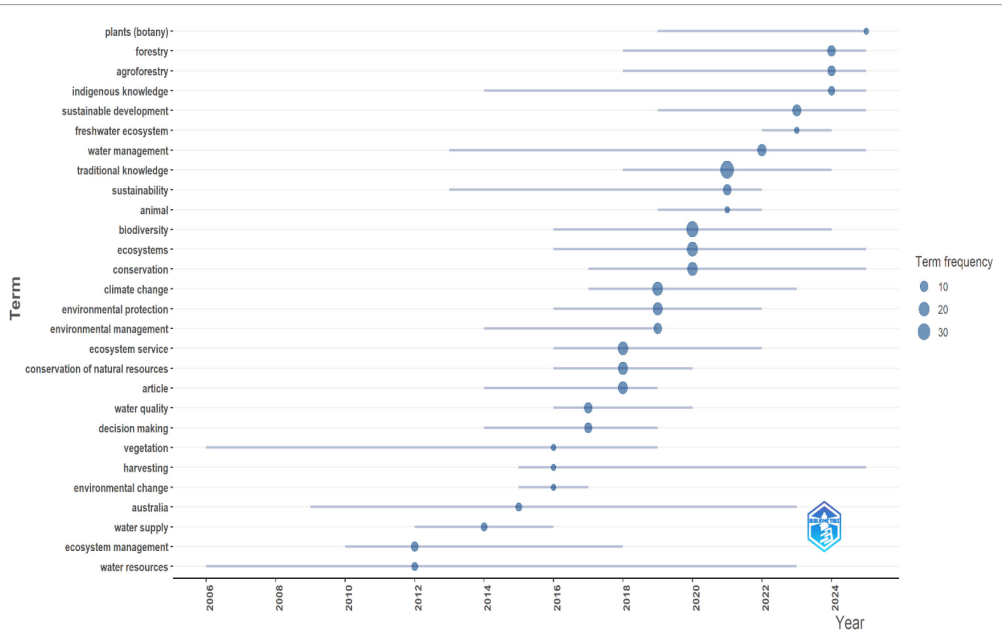

FIGURE 4
Most trending literature topics including aspects on TWK from 2006 to 2024.

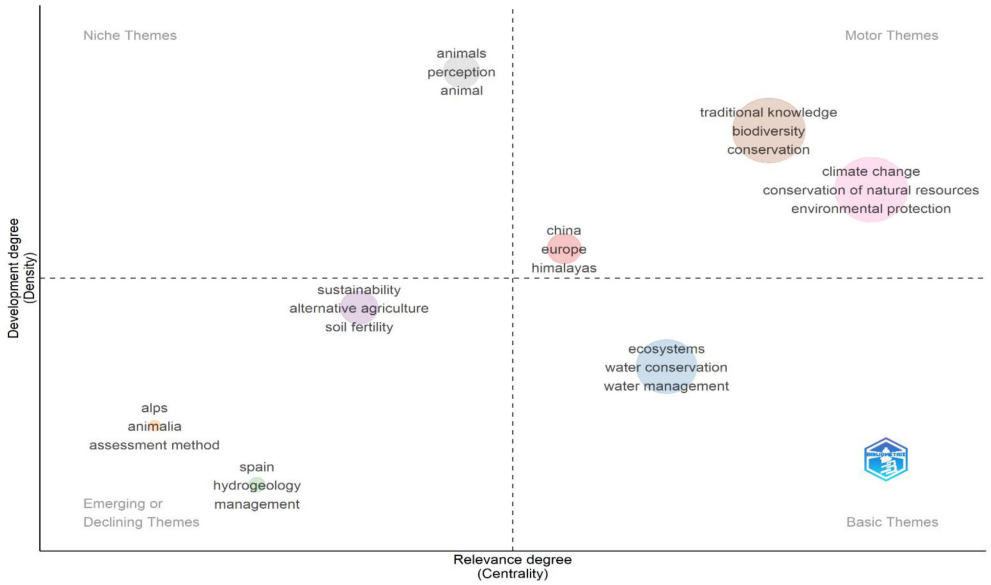

FIGURE 5
Thematic map for the studies including aspects of TWK from 1988 to 2026.

reservoirs (there are no natural lakes in the country), natural and artificial ponds, and wells to collect, store, and conserve surface runoff (Siambombe et al., 2018; Mabika and Utete, 2024). Across the different water use systems, there are varying degrees of involvement of religious beliefs and spiritualism (Table 1). From the initiation of water-related projects, cultural and spiritual and religious leaders alike are consulted, and they in turn consult traditional ancestral spirits and 'Mwari' or God for permission and location of areas with higher water tables (Kileff and Kileff, 1974; Machoko, 2013; Ushe, 2017). This practice, though prevalent, is not often recorded officially where even high-ranking government officials are involved in the process to appease and accord respect to ancestral spirits/water spirits regarded as custodians of the water bodies in the country (Mawere and Kadenge, 2010; Muyambo and Maposa, 2014; Ushe, 2017).

Intrinsic cultural connection with water spirits enhances care for the environment in Zimbabwe (Machoko, 2013; Matanzima, 2022). Water sites such as mountain pools/pans/springs or *Kubiri*, *Chitubu* (Shona) are considered sacred, as they are perceived to be guarded by ancestral spirits in the form of snakes (Muyambo and Maposa, 2014). Locals are prohibited from modifying the natural underground mountain irrigation system and fetching water in such sites using metal and charcoal black-coloured containers or pots (Muyambo and Maposa, 2014; Rusinga and Maposa, 2020; Dube, 2024). Defying such restrictions will anger the *njuzu* (mermaids or *Tsungumi*), representing a feminine ecological force with detestation for red, shiny, and black-coloured metallic objects and deities or God or 'Mwari' and spirits mediums, and will lead to drying up of the water sources with severe repercussions for the local communities (Mawere and Kadenge, 2010; Rusinga and Maposa, 2020; Mutigwe and Chipfakacha, 2022; Matsapa, 2023).

Some clans, e.g., Ndau and Musikavanhu, have the pool (*Dziva*) as their totem (Risiro et al., 2013; Sipeyiye, 2020; Dube, 2024). Similarly, communities in the western and northern parts of the country in Hwange, Binga, Kariba, and the Zambezi Valley either have totem or clan names related to water, e.g., the totem *Chiwena* (Tonga) with a clan name Munkuli for the Nile crocodile (Zivave and Muzamba, 2025). Cultural and religious rituals are conducted on the river banks, pools, and hot springs, and in such places, fishing is prohibited (Siambombe et al., 2018; Sipeyiye, 2020;

TABLE 1 **Interplay of traditional knowledge water use and systems in Zimbabwe.**

Water use systems/ spiritualism	Deity/God/Mwari/ religion	Totemism	Rituals	Mermaids	Revered hydrobionts, e.g., crocodiles, invertebrates
Rivers	✓	✓	✓	✓	✓
Mountain pools/*Chitubu*/spring (*Mabwea*/*Dziva*)	✓	✓	✓	✓	✓
Ponds	X	X	✓	✓	✓
Wells/*Kubiri*/Tsime	✓	X	✓	X	✓
Artificial lakes	✓	X	✓	✓	✓
Wetlands/marshes	✓	X	✓	✓	✓
Pans	✓	X	✓	X	✓

NB* Totemism extends across different water systems and hydrobionts such as crocodiles. √ = present, X = absent.

Mutigwe and Chipfakacha, 2022). Countrywide, water bodies are treated with great caution and respect, and the veneration of tributaries and pools along the Zambezi River is overt amongst the BaTonga and Shangani people along the Save and Limpopo Rivers and Pungwe and Odzi Rivers (Muyambo and Maposa, 2014; Siambombe et al., 2018; Chagonda, 2017; Matanzima and Saidi, 2020).

3.6 TWK values (perceptions) in Zimbabwe

The local Ndau and BaTonga communities indicated the gender dimension of TWK, as only elderly women past childbearing ages and sexually inactive young girls are allowed to fetch water and clean the sacred springs so as not to anger the water spirits or custodians, i.e., the mermaids *njuzu* (Muyambo and Maposa, 2014; Marango et al., 2016; Sipeyiye, 2020; Matanzima, 2022; Dube, 2024). Folklore indicated that spirits of dead people, e.g., liberation war fighters, colonial soldiers, and civilians alike killed during the freedom war, haunt the local dams and lakes where their bodies were thrown (Joost, 2006). Locals shun the so-called haunted waters, as they are associated with bad luck, evil spirits, or charms (Mutigwe and Chipfakacha, 2022). Subtly, these local perceptions limit and curtail anthropogenic activities and disturbances in water bodies, subconsciously abetting preservation and conservation of the supposedly haunted water systems (Matsapa, 2023; Dube, 2024; Marshall, 2011).

Water sources or bodies are perceived to be sacred (*kuyera* in Shona) and should not be trivialised (Kileff and Kileff, 1974; Taringa, 2006; Mutigwe and Chipfakacha, 2022). Fear and respect towards the sacred water bodies help minimise anthropogenic activities and disturbances in sacred water systems, inevitably aiding aquatic biodiversity conservation (Mutigwe and Chipfakacha, 2022). Appeasement ceremonies, e.g., (*maganzva*), and rainmaking rituals, including the annual (*Mukwerera*, *Mapfuve*, *Makasva*, *Mhande*) rituals and dances and September rituals at the Njelele Shrine/(Matonjeni/Mabweadziva) led by community elders or spiritual leaders, are performed to pray and appease and appeal to ancestral rain and water spirits, deities, or God (*Mwari*) for sufficient rainfall and successful harvest (Kileff and Kileff, 1974; Marango et al., 2016). Some of the TWK values and perceptions are indicated in Figure 6.

4 Discussion

4.1 Spatial-based landscape knowledge in the TWK aspects of Zimbabwe

Within TWK-specific activities like cultivation, bathing near sacred water sites are restricted, with violators facing physical and spiritual consequences (Mutigwe and Chipfakacha, 2022). Rivers, wells, pools, and lakes are revered as river gods and custodians and are feared and, consequently, conserved through cultural practices (Dube, 2024). These practices contribute to natural resource preservation and species protection (Taringa, 2006). The level of sacredness for water sites is location-specific and varies with geographical location in Zimbabwe. Regardless, the cultural restrictions serve as a complementary tool in water resources conservation. It necessitates location contextual TWK policy formulation and inclusion at a local level before cascading to the national level.

4.2 Traditional knowledge and water use systems and spiritualism in Zimbabwe

Modern water use and storage systems mainly relate to constructed artificial dams or reservoirs/lakes and natural features such as ponds, pans, pools, and mountain springs (Mabika and Utete, 2024). Locals involve spiritualism across different water systems, e.g., rivers, mountain springs, and ponds. Water animals, particularly the crocodile, and mermaids (*njuzu*) and the Deity, God, or (*Mwari*, Shona) assume superiority in TWK (Kileff and Kileff, 1974; Machoko, 2013; Ushe, 2017). Cases abound of excavating machines that have been rendered obsolete if no permission has been granted by the ancestors or mermaids to construct dams and boreholes in 'sacred' sites in rural, remote, and peri-urban areas in Zimbabwe (Tanyanyiwa and Chikwanha, 2011; Mawere and Kadenge, 2010; Muyambo and Maposa, 2014; Ushe, 2017; Sipeyiye, 2020).

Spiritualism helps prevent unregulated construction of numerous reservoirs and drilling of boreholes in low water table areas helping to conserve scarce water resources (Zivave and Muzamba, 2025). Regardless, there are connotations of anti-development sentiments entangled with interference by ancestral water spirits in some remote areas (Rusinga and Maposa, 2020; Mapira and Mazambara, 2013). Thus, TWK can be a driver or a barrier to water resources development in the modern scientific sentiment if the ancestral spirits of an area reject certain activities deemed beneficial to the local communities. Nonetheless, fear of consequences that can be experienced as a result of polluting water bodies, such as mysterious blindness, infertility, bad luck, and mental instability, serves as a deterrent to water habitat degradation (Matanzima and Saidi, 2020; Mutigwe and Chipfakacha, 2022; Zivave and Muzamba, 2025). Coupled with the belief that water bodies belong to ancestral spirits, this helps in conserving aquatic ecosystems (Matanzima and Saidi, 2020). Reverence for water spirits permeates across the whole

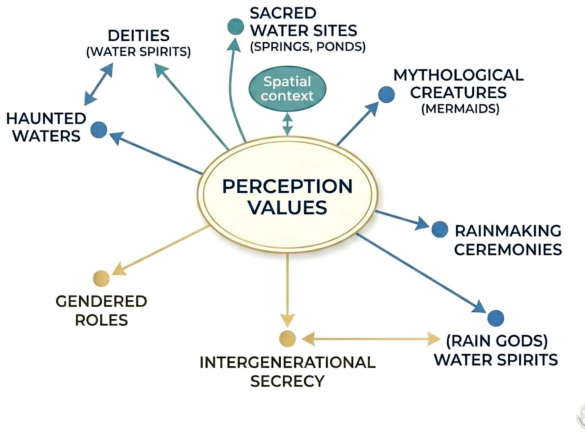

FIGURE 6
The TWK values and perceptions in Zimbabwe.

country and contributes significantly to the conservation of scarce water resources in arid and semi-arid areas alike.

Water folklores are indigenous traditional knowledge handed down through generations without proper documentation and validation (Mapara, 2009). This limits the incorporation of traditional customs into legal and 'modern' national water conservation practices and policies curtailing their espoused effectiveness (Sunzuma et al., 2025; Zivave and Muzamba, 2025). Paucity of scientific recording, proper traceable documentation, and validation of the importance of local ancestral spirits on water conservation hampers the integration of TWK in local water management policies and strategies in Zimbabwe.

4.3 Traditional water values (perceptions) in Zimbabwe

TWK values and perceptions relate to gendered roles and dimensions, according respect to sacred water sites and deferring reverence to water spirits such as mermaids and deities. The fear and/or respect accorded to the mythical and mystical water spirits limits human presence and curtails negative anthropogenic activities in water bodies, consequently abetting the preservation of subliminal states (Sipeyiye, 2020; Matanzima, 2022). Ritualistic uses of TWK in rainmaking ceremonies and shunning of haunted waters also shape local water value perceptions in Zimbabwe. TWK tenets, such as rainmaking ceremonies, serve multiple purposes, including appeasing rain gods, deities, and ancestral spirits; supporting water conservation; promoting social unity; and reinforcing connections between morality, community, and natural phenomena (Marango et al., 2016; Shoko, 2022).

Western or 'modern' weather forecast systems offer valid, tangible, documented, and evidence data-based predictions against spiritual-led traditional belief repositories of weather predictions (Brazier, 2015). However, both occidental Western and traditional weather monitoring and prediction systems are error-prone and not foolproof (Claxton, 2010). Thus, it is rather advantageous to institute a complementary approach integrating both systems in weather prediction and climate adaptation and resilience capacity strengthening for communities in predominantly arid and remote rural areas in Zimbabwe (Marango et al., 2016).

The gap is in the integration and mainstreaming of localised and often highly secretive traditional water knowledge into formal water resources conservation policies without risking the wrath of the ancestral water spirits ((Mutandwa et al., 2006; Gwenzi et al., 2016; Marango et al., 2016). Unscrupulous, traditional leaders have resorted to coercing locals to pay money for the rainmaking ceremonies, an illegal practice, which is perceived to have negative ramifications of angering the water spirits/rain gods, further exacerbating rainfall unpredictability and droughts in the country (Mutigwe and Chipfakacha, 2022). Other considerations include custodianship conflicts for the shrines and rainmaking sites, which have diluted the central importance and purposes of the ceremonies (Makwara, 2013). Systematic exclusion in the colonial educational curriculum (Whatman and Duncan, 2005) and deliberate disinformation (Kwanya et al., 2013) have induced a structured societal violence and negated the contribution of IKS and TWK in water conservation.

4.4 Challenges of infusing TWK and modern scientific water technologies

A rigid gendered perspective is pronounced in TWK in communities with defined roles for females and males differentiated along with age and sexual maturity with male predominance in water-related ritual performance (Marango et al., 2016; Sipeyiye, 2020). Gender inequality relegates females to peripheral roles in traditional water conservation, yet they bear the most consequences of water shortages in households.

The persistence (or erosion) of indigenous knowledge in high-income or developed contexts, including the role of historical processes such as colonisation and modernisation, has led to intergenerational knowledge loss (e.g., 'shifting baseline syndrome' of water knowledge amongst other phenomena such as wildlife species (Lyver et al., 2021). This loss of knowledge about historical environmental conditions and water resource abundance threatens how new generations potentially perceive their environment and take action, even in high-income countries (Lyver et al., 2021) as well as in developing nations (Kupika et al., 2019).

Research and dissemination of knowledge on indigenous rainmaking practices are currently inadequate in Zimbabwe (Makwara, 2013). Mafongoya et al. (2021) argued that coordinated research into the accuracy and reliability of indigenous knowledge on climate forecasting and systematic documentation of research outputs is lacking. The death of old people who are the main custodians of indigenous knowledge leads to the loss of crucial assets and traditional memory banks (Makwara, 2013). Conflict of interest amongst the young Christian converts and local traditional water beliefs, similarly for TEK, is prevalent in Zimbabwe (Claxton, 2010). Young Christian converts do not want to be seen practicing their tradition in public, yet privately, they would partake of the traditional (water) ecological and cultural rituals, rites, and ceremonies (Claxton, 2010). Some locals associate anything indigenous with derogatory connotations right from the beginning of European dominion in Africa (Claxton, 2010). This skewed perspective curtails efforts to study the origin and evolution and pros and cons of the traditional (water) and ecological knowledge, limiting its acceptance and mainstreaming into contemporary water conservation policies and practices (Dube, 2024). It is this regrettable association that seems to influence attitudes, lifestyles, and choices of water-related development techniques, models, and strategies in Africa (Claxton, 2010). For TWK, the crux is the contestation of beliefs from Christianity, ART, and local indigenous water conservation beliefs to contemporary occidental 'scientific' Western water conservation methods (hydrogeology, hydrobiology, and hydrodynamics) being exclusionary rather than being inclusive, complementary, and integrated (Claxton, 2010; Kwanya et al., 2013; Matanzima, 2022; Tarusarira, 2017).

4.5 Future research areas and signposting

TWK is the least and, in some cases, not even cited in low-income (least developed) countries in Sub-Saharan Africa. This indicates an underlying lack of documentation of its significance in a traceable form. TWK tends to be passed down through generations as secretive cultural rites that oftentimes inhibit its accessibility. Hence, deep environmental understanding encompassing flora, fauna, and natural phenomena as covariates in TWK is the missing link (Chibememe et al., 2014). It is imperative to map the geospatial locations and document the localised contextual conservation astuteness of the sacred water sites in the country. This serves as a valid TWK database useful for integrating it into national water policies (Dube, 2024). Traditional water knowledge is treated as a *post hoc* hydrological conservation tool after natural hydrological disasters (Whatman and Duncan, 2005; Wilson et al., 2019). Cultural beliefs, norms, and holistic perspectives complement conservation of scarce water resources (Dube, 2024).

It is of utmost significance to weigh reality against local beliefs, myths, mysteries, and folklores, because development may be delayed, wielding traditional beliefs that cannot be easily disproved, verified, and validated (Taringa, 2014). The variety and typology of punishments for intransigence and desecration of sacred water bodies is geospatially contextual and wide-ranging and needs proper review for validation (Mutigwe and Chipfakacha, 2022). Furthermore, the origin and evolution of the mythical water creatures is an area subject to validation (Matanzima, 2022). There is a need for adaptive resource utilisation methods, including biotic materials and conservation practices towards research on spiritualism, myths, folklore, and the conservation of carnivores in aquatic and terrestrial systems in Zimbabwe (Dube, 2024). More so, there is a glaring gap in ontological studies on spiritualism, moneyism, financial aspiration, natural medicinal healing attributes, and the lure of water ecosystems as an epistemological aspect of TWK (Machoko, 2013).

Local communities selectively conceal traditional water knowledge citing regulatory threats and unforeseen ancestral repercussions (Mutigwe and Chipfakacha, 2022). This presents a conundrum on whether to institute contextual site-specific interventions or spatially integrated multi-scalar and multi-landscape management that reconcile water ecology and sociocultural political realities (Mburu and Kaguna, 2017). Thus, participatory conservation must not be supplementary but rather foundational in TWK-aligned research and conservation planning (Mburu and Kaguna, 2017; Dube, 2024). Development of traditional water knowledge indices for mapping water conservation positivistic behavioural attitudes to explore nuanced local water conservation attitudes is important in the country (Adibe et al., 2020). More so, TWK-based conservation planning must adopt dynamic feedback looped systems wherein local ecological knowledge is continuously integrated into spatial modelling, surveillance, and policy refinement for holistic water conservation measures (Dube, 2024). Positioning TWK conservation as part of broader climate-resilient development is paramount for rural communities located in highly fragmented arid habitats (Brazier, 2015; Adibe et al., 2020; Tarusarira, 2017).

Informal traditional water knowledge networks can predict wildlife and water system and rainfall pattern dynamics comparable to academic projections but pose unique governance and policy interventions (Sipeyiye, 2020). Documentation of traditional indigenous water knowledge and its subsequent integration into seasonal rainfall and underground water supply forecasting is a promising initiative that needs to be further explored (Gwenzi et al., 2016). Rather than propagating exclusionary and divisive arguments pitting indigenous knowledge systems (TWK) in African environmental conservation and Western scientific systems (Whatman and Duncan, 2005; Chibvongodze, 2016), a complementary approach will enhance national water policies and water conservation strategies in Zimbabwe and Southern Africa (Matsapa, 2023).

Being devoted and religious, will Africans (Mbiti, 1969) accept artificial intelligence (AI), deep machine learning, (deoxyribonucleic acid) DNA, and acoustic system infusions into water conservation in sacred water sites at the local community level? Conversely, will Western scientific methods successfully consider and integrate mythical, mysterious, 'pagan', and 'backward' African spiritualistic beliefs and perceptions in water conservation techniques and tools for the foreseeable future at an equal footing with AI for instance? This review aligns with the sceptical variant that questions universalised models of water conservation and management development and recognises the values of alternative local water ecologies and knowledge.

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Supplementary material

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