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Research paper

Integrating *Alájọbí* principles into the conceptualization of the water–energy–food (WEF) nexus for sustainable resource management in Yoruba communities

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This study explores integrating traditional *Alájọbí* principles into the water–energy–food (WEF) nexus framework for sustainable resource management in Yoruba communities. The study utilised a qualitative approach that involved interviews and community observations in Akure, Ibadan, and Ogbomosho. Participants included community leaders, elders, local farmers, and community residents. The study revealed that *Alájọbí* principles, such as non-maleficence, reconciliation, preservation, and collective responsibility, significantly influence resource management. These principles can enhance the sustainability and resilience of WEF resources. This research analyses the potential of traditional practices in addressing modern sustainability challenges, contributing a unique perspective to WEF nexus research. Integrating *Alájọbí* principles can foster community cohesion, respect for nature, and sustainable practices. The study recommends incorporating traditional practices into modern resource management frameworks and raising awareness about *Alájọbí* principles to enhance the sustainability of WEF resources.

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INTRODUCTION

The Sustainable Development Goals (SDGs) and the water–energy–food (WEF) nexus have emerged as critical paradigms in the global discussion because of their holistic approach to sustainable development. The SDGs, which were established by the United Nations in 2015, were aimed at addressing global issues such as poverty, inequality, and climate change, among other global challenges (Mishra et al., 2023). Eisenmenger et al. (2020) affirmed that SDGs 2 (zero hunger), 6 (clean water and sanitation), and 7 (affordable and clean energy) are especially important for economic growth and sustainability. SDG 2 aims to eliminate hunger, provide food security, and promote sustainable agriculture, while SDG 6 aspires to provide universal access to water and sanitation and sustainable management. SDG 7 aims to provide cheap, dependable, sustainable, and modern energy (Fader et al., 2018; Nallapaneni and Ordonez-Ponce, 2023; Su et al., 2022). These SDGs form the core concerns of a WEF nexus–based framework, seeking to adopt holistic policies and approaches that target the three sectors concurrently, increasing resource efficiency and supporting sustainable development.

Food, water, and energy are recognised as fundamental to the SDGs due to their essential role in achieving sustainable development (Esan et al., 2024). Consequently, these three pivotal sectors have established specific objectives and benchmarks. However, given the interlinked nature of these resources, the conventional business-as-usual method (sectoral approach) is insufficient to attain these resource securities (Adepoju et al., 2022; Esan et al., 2024). Instead, the water–energy–food nexus approach must be employed to effectively identify and address these resources' underlying hurdles and challenges (Fader et al., 2018; Molefe and Inglesi-Lotz, 2023). De Andrade et al. (2022) affirmed that disregarding this interdependence would only result in more inconsistencies and steer us away from the fundamental premise of sustainable development.

The WEF nexus concept is a systemic concept that recognises the relationship and interconnections between the water, energy, and food sectors, and calls for a comprehensive approach to manage these resources holistically (David et al., 2023). According to Esan et al. (2024), the WEF nexus underscores that the three vital resources are linked intricately and that their management should be done holistically to achieve sustainability. The fundamental premise of a WEF nexus approach is that the water, energy and food resources and systems should be managed concurrently, as actions taken in one sector can directly influence the others. The concept of the WEF nexus presents a framework for tackling WEF issues by recommending integrated solutions that enhance the efficiency of these resources while minimising trade-offs between them (Eriksson et al., 2025). Esan et al. (2024) have highlighted that water is necessary for food production, energy generation, and various industrial activities, while energy is essential for water pumping, purification, and irrigation. At the same time, food production is energy-intensive and often depends on available water resources. The WEF nexus promotes the implementation of policies and strategies that consider the inter-sectoral effects and strengthen resource security, advance sustainable development, and improve resilience in the face of climate change. The WEF nexus approach emphasises the interdependence of water, energy, and food systems, and calls for a systems-oriented approach which has proven critical for integrated management to achieve sustainability (Mohtar, 2022; Olawuyi and Oche, 2022).

Several studies have highlighted the various benefits of adopting a WEF nexus–based outlook, such as its ability to advance peace, foster regional collaboration, ensure resource security, and encourage alignment of laws, policies, and strategies in an area with shared resources across borders (Nhamo et al., 2018). However, despite the numerous benefits attributed to the WEF nexus approach, the integration and operationalisation of the WEF nexus concept have been hindered by factors such as resource scarcity, climate change, population growth, poor coordination among non-state entities, inadequate funds, and low investment (Adom et al., 2022; Naidoo et al., 2021; Nhamo et al., 2020). A lack of empirical evidence, insufficient analytical methods, an unclear understanding of the suitable geographical scale and insufficient incentives for coordinated planning and policymaking are impeding the utilisation of a WEF nexus–based approach (Mutanga et al., 2024; Senzanje et al., 2023). Adom et al. (2022) further emphasised that the adoption of WEF nexus thinking has been hindered by a lack of awareness of integrated practices and knowledge gaps, inadequate resource management practices, and the need for a practicable approach. Terrapon-Pfaff et al. (2018) also stated that the WEF nexus conceptual focus does not adequately incorporate local, community and household practices.

Drawing from the numerous challenges of the application of the WEF nexus and bearing in mind that water, energy and food insecurities begin with household practices such as water wastage and pollution, unrepaired leaks, excessive use of heating, cooling, and electrical appliances, food waste, deforestation, etc., it becomes clear that the operationalisation of the WEF nexus requires a multifaceted approach that identifies and combats resource challenges from the household level to the global stage. According to Bruce and Limin (2021), approximately 30% of the Earth's water is polluted, and more than 1.1 billion people worldwide lack access to safe water, with Asia and Africa accounting for 90% of this. It has been argued that this water pollution is caused by human activities such as the disposal of industrial waste, fertilisers, plastics, pesticides, or untreated sewage into water systems, and fossil fuel extraction (Ali and Gujiba, 2024; Nkatha, 2024; Onu et al., 2023). Similarly, Mmereki et al. (2024) pointed out that food waste per capita in Sub-Saharan Africa (SSA) ranges from 6 to 11 kg·capita^{-1}·year^{-1}. Post-harvest food losses cost about 4 billion USD annually, equivalent to around 37% or 120–170 kg capita^{-1}·year^{-1}, which is enough to feed at least 48 million people. He further revealed that post-harvest losses of food grains are about 25% of the overall crop production in several African nations. Jribi et al. (2020) revealed that food wastage could be attributed to in-store behaviour such as over-shopping and household management practices (poor planning/food management, storage difficulties), as well as psychosocial determinants (personal choice and lifestyle, dietary preferences, lack of culinary abilities). This implies that resource management and a WEF nexus–based approach must begin with individual and household changes.

Indigenous knowledge and traditional concepts have been stated to play an essential role in sustainable resource management as they provide time-tested techniques and principles based on a thorough grasp of local ecosystems (Hill et al., 2020). This knowledge and principles, accumulated over centuries, are profoundly ingrained in local ecosystems and cultures, fostering a healthy interaction between communities, individuals and their environment (Mazzocchi, 2020). Jessen et al. (2022) also hinted that Indigenous knowledge and traditional principles are consistent with social justice and sovereignty and provide complementary approaches to the management and conservation of resources. Olaopa and Ayodele (2022) discussed that most indigenous knowledge and traditional principles focus on the concepts, such as reciprocity and caretaking, that govern indigenous relationships with nature, and that these concepts are motivated by feelings of closeness and connectivity and emphasise the significance of giving back to nature. Mazzocchi (2020) revealed that indigenous knowledge has been used to facilitate shifting cultivation, rotation of hunting areas, terrace farming, wildlife conservation, and biodiversity preservation.

Similarly, proverbs, riddles, folktales, epics, and myths have been used to instil discipline, uprightness, cleanliness, wisdom, respect and responsibility and nature conservation in many African nations (Abas et al., 2022; Schroeder et al., 2019). Hill et al. (2020) also pointed out that indigenous knowledge has fostered the understanding of ecosystem function, community interactions and behaviours, habitat use, and population structure. Therefore, this study is built on the argument that, much more than solely focusing on policy implementation and framework developments, the use of indigenous principles, which the population are aware of and familiar with, will facilitate the operationalisation of the WEF nexus in African countries, particularly Nigeria.

Like many African societies, Nigeria depends on indigenous knowledge and traditional principles to solve their day-to-day socio-economic problems, address various environmental challenges, and adapt to change (Agada et al., 2022). Different traditional principles and practices govern various communities and tribes in Nigeria. For instance, the 'Esusu/Ajo' principle is a traditional savings and credit system popular among Yorubas and Igbos where members contribute to a common fund and take turns borrowing from it (Adeola et al., 2022; Temidayo and Peter, 2019). Temidayo and Peter (2019) concurred that this principle has been proven to provide financial support for community members, fostering economic stability and entrepreneurship. Similarly, the 'Igba-Boi' principle or model among the Igbos reflects a strong belief in collective enterprise and mutual assistance, which has promoted group investments and joint ventures, enabling the Igbos to pool resources and share risks in business ventures, fostering economic growth (Nkamnebe and Ezemba, 2020). Another traditional principle among the Yorubas is the *Alájọbí* principle, which emphasises the importance of family ties and communal living. This principle fosters a sense of collective responsibility and mutual support, ensuring that resources are shared and managed for the entire community's benefit.

Akinwowo Akinsola first used the concept of *Alájọbí* (consanguinity) in his inaugural lecture entitled 'Ájọbí and Ajogbe: variations on the theme of sociation' (Akiwowo, 1983). He said that the concept meant a lineal or collateral relationship based on blood birth. The African communal system, which views the family as the smallest unit and a cogent, integral part of the community, roots the concept. Imafidon (2021) discussed that the African community follows ethical frameworks and experiences an ontological bonding that extends beyond the living. Consequently, Africans maintain a symbiotic relationship with the environment and every component of nature (Lamola, 2016). Similarly, Tosam (2019), in what he described as 'Koh environmentalism', affirmed that the African community includes the living, the dead, the unborn, animals, and every component of nature. This African communal uniqueness serves as the basis of African intervention in environmental abuse. Consequently, the communal nature of *Alájọbí* can drive effective resource management and sustainability by promoting practices that protect and preserve the WEF resources, ensuring the well-being of both the community members and the resources. This concept can ensure that resources are managed responsibly and preserved for future generations.

The concepts and principles of *Alájọbí* in Yoruba culture offer profound insights into resource management and sustainability. As documented by Ogunade (2005), the principle of non-

maleficence extends beyond human relationships to include human–non-human interactions, advocating for minimal harm to all living things. He stated that the Yorubas treat even the smallest creatures carefully, emphasising an intrinsic respect for life and the environment. The principle of reconciliation is also integral to the Yoruba culture, highlighting the importance of resolving conflicts within the family and with nature. The Yorubas believe that, just as familial disputes must be reconciled, humans must strive to mend their relationship with the environment, viewing nature as a living entity with which they share a bond (Calcott and Earp, 2024). This reconciliation involves making amends for environmental harm, such as replanting trees, and reducing waste, thereby restoring balance. Another Yoruba belief is that one's action today will be what one will leverage tomorrow. Hence, they try as much as possible to prepare for the future by standing against anything that can jeopardise it. The Yoruba adage, '*àṣesíle làbowábá, ẹní bá ṣu síle á bo wá bẹ́ṣinṣin*' (one's actions today determine tomorrow's outcomes) reveals their belief in preservation, emphasising the need to prevent further degradation and prepare for the future. While it is true that humans depend on other living things in the ecosystem for their survival, failure on the part of humans to either repair or lessen the harm they cause would ultimately spell tragedy for all. This belief encourages sustainable practices to ensure long-term sustainability, which is the core value of WEF nexus–based thinking. Collective responsibility is also deeply embedded in Yoruba culture, fostering a sense of communal duty towards environmental stewardship. The consciousness that if a member of one's house falls into a pit, then other members of the house will not be at peace makes family members responsible towards each other and to seeing to the well-being of others in Yoruba land (Kelbessa, 2018). This consciousness, that the well-being of one affects all, drives collective action. If applied to the WEF nexus, this principle could significantly enhance efforts towards resource sustainability, making it a shared responsibility to protect and preserve the WEF resources.

The social–ecological systems (SES) theory serves as a fundamental framework and basis for integrating traditional practices and knowledge into the WEF nexus. Salgueiro-Otero and Ojea (2020) stated that the intricate connection between humans and the natural environment is best understood using the SES theory, developed by psychologist Urie Bronfenbrenner in the late 1970s. He considered the SES to be a co-evolutionary, interrelated, and complex adaptive system comprised of social and ecological elements that interact continually and at different scales in relation to sustainability. Zhang (2023) also highlighted that the SES theory supports adaptive practices and approaches to enhance resilience and sustainability. The WEF resources and human existence are interrelated and these resources' sustainability is hinged on these interactions. Furthermore, the depletion of water, energy, and food resources is often driven by unsustainable human activities and the mismanagement of natural systems. Integrating traditional practices based on the interaction between resources and man may address the root causes of resource depletion by fostering more sustainable interactions between people and resources.

Sinthumule (2023) affirmed that traditional knowledge and principles often include principles of conservation, respect for ecological limits, and community-based resource management, which are crucial for achieving WEF nexus goals. Hossain et al. (2024) researched the role of the social-ecological system in climate change, while Rodríguez et al. (2018) also built adaptive capacity using the SES theory to integrate knowledge into communal land use. Molajou et al. (2021) reported that there is a scarcity of WEF nexus research investigating anthropogenic systems' dynamic influence on the nexus. Humans are essential in driving innovation, implementing sustainable practices, addressing sustainability concerns, promoting resilience, and ensuring water, energy, and food resources are efficiently utilised. Since increased human influence in environmental processes has resulted in considerable variations in WEF resource availability, it becomes vital to address human interactions in the WEF nexus and seek human initiatives to overcome WEF issues (Pouladi et al., 2019).

This study argues that by blending traditional practices into WEF nexus frameworks, communities can develop more holistic and effective strategies for managing WEF resources, which will address both the environmental and socio-economic dimensions of sustainability. However, there has to date been no published research on how integrating traditional practices can impact the WEF nexus. Against this backdrop, this study aimed to integrate the traditional *Alájọbí* principles into the WEF nexus framework for sustainable resource management. To achieve the main aim of this study, this research sought to answer the following questions:

- What are the fundamental principles of *Alájọbí*?
- How are water, energy, and food resources currently managed in Yoruba communities?
- How can *Alájọbí* principles enhance the sustainability and resilience of the WEF nexus in these communities?

Conceptual framework

The conceptual framework for this study (Fig. 1) is built on the water–energy–food (WEF) nexus, which emphasises the interdependence of water, energy, and food systems as critical determinants of sustainable development. The WEF nexus framework argues that sustainable management cannot occur when these resources are considered in isolation, since water is essential for energy and food production, energy is necessary for water access and agricultural systems, and food systems are both water- and energy-intensive (Fader et al., 2018; Mohtar, 2022). This interconnectedness necessitates integrated approaches that optimise resource use, minimise trade-offs, and strengthen resilience in the face of climate change, population growth, and urbanisation. While the WEF nexus provides a strong systemic model, its operationalisation has been criticised for being overly technocratic, often neglecting cultural, social, and indigenous perspectives (Terrapon-Pfaff et al., 2018). To address this gap, this study integrates the *Alájọbí* principles of Yoruba communities into the WEF nexus framework. *Alájọbí*, which embodies communal

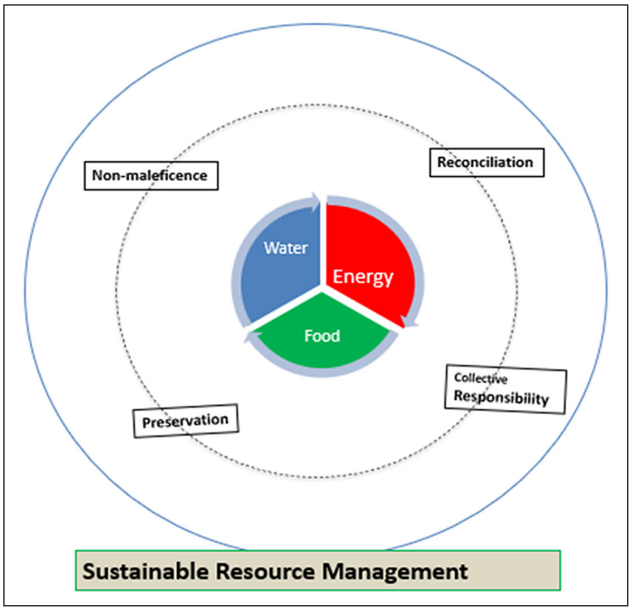

Figure 1. Conceptual framework for integrating *Alájọbí* principles into the WEF nexus

responsibility, non-maleficence, reconciliation, and preservation, provides a culturally embedded ethic of sustainability (Akiwowo, 1983). These principles shape behaviours around resource sharing, conflict resolution, and environmental stewardship, which provides a community-driven dimension to the WEF nexus.

The integration of *Alájọbí* into the WEF nexus is motivated by the social–ecological systems (SES) theory, which recognises that human and ecological systems are co-evolving and interdependent (Salgueiro-Otero and Ojea, 2020). The SES theory allows us to understand how traditional cultural principles can mediate the relationship between communities and natural resources, to improve adaptive capacity and resilience. For this study, the *Alájọbí* serves as a social mechanism that fosters collective responsibility and reciprocity, while the WEF nexus provides the structural framework for managing interconnected resources. The conceptual framework of this study demonstrates that sustainable resource management requires not only technological innovation and policy integration but also culturally grounded practices that align with community values. By embedding *Alájọbí* into the WEF nexus, this study proposes a hybrid model where modern sustainability frameworks are enriched with indigenous principles, ensuring that interventions are contextually relevant, socially accepted, and ethically grounded. This integration has the potential to enhance the resilience of water, energy, and food systems, particularly in Yoruba communities where communal values strongly influence daily practices.

MATERIALS AND METHODS

This study employed a qualitative research methodology, utilising key informant interviews and community observations to explore how integrating traditional *Alájọbí* principles can enhance the sustainability and resilience of water, energy and food resources in Yoruba communities in Nigeria. This methodology was chosen to capture the depth and complexity of indigenous knowledge and traditional practices and how these influence resource management, while trying to minimise human bias in self-reporting questionnaires. The study took place in three communities: Akure, Ibadan and Ogbomosho, in the south-western part of Nigeria. The study interviewed 10 community-titled leaders, elders, and members of traditional councils. These people were chosen because of their knowledge of traditional principles. This research focused on interviewing traditional leaders due to their role as the main custodians and interpreters of *Alájọbí* principles within Yoruba communities. These leaders represent the cultural authority to communicate the philosophical, ethical, and historical principles of *Alájọbí*, which is being passed on into everyday practices and influences communal behaviour. Although community members actively engage with these principles in their daily lives, most times their behaviours are influenced by mirroring what they see in the community and not based on an understanding of the principles behind their actions. Community leaders, on the other hand, maintain the collective memory, pass down values across generations, and provide authoritative interpretations that shape community behaviours. This made them the most suitable participants for examining the conceptual richness and normative aspects of *Alájọbí*. Semi-structured interview questions were developed to explore participants' understanding of *Alájọbí* principles, current WEF resource management practices, and perceptions on integrating these principles for sustainability and resource management. The interviews were conducted face-to-face to ensure a deep understanding of responses, observe non-verbal gestures and give room for follow-up questions and clarification. Each interview was audio recorded and translated, as the interviews were conducted in the indigenous Yoruba language.

Additionally, the community observations took place in 3 Yoruba communities to capture routine practices from various household and community practices, over 8 weeks. The authors prepared an observation checklist before the commencement of the study. The observation focused on food preservation, storage and management practices, water conservation and management practices, and energy usage practices. The interview questions (Table A1) and observation checklist (Table A2) are included the Appendix. Other data are available on request from the authors. The data obtained from the interviews and observations were analysed using thematic analysis.

RESULTS

Fundamental principles of *Alájọbí*

The fundamental principles of *Alájọbí* are deeply ingrained in Yoruba culture, and these principles have emerged as foundational elements that shape the social and environmental ethics of the many Yoruba communities, aligning human activity with the natural order. One of the respondents, Chief X, explained that *Alájọbí* is the bond and bedrock of Yoruba social structure. According to Chief X, "*Alájọbí jẹ ọmọ ilé àti àwọn àtẹ̀rìnwá wa.*" (*Alájọbí* refers to family members and our relatives.) Another respondent, Chief Y, corroborated this statement, stating that *Alájọbí* goes beyond immediate family but extends to the entire community, creating a vast network of familial relationships. This expansive view of the family ensures that every individual is treated with the respect and care typically reserved for blood relatives, fostering a sense of unity, support and collective well-being. According to Chief X, this sense of interconnectedness fosters a strong commitment to collective well-being. He stated that "*Ní ilé Yorùbá, gbogbo èèyàn jẹ́ ẹbí. A ko gbọ́dọ̀ ṣe ibi sí ẹnìkan.*" (In Yoruba households, everyone is considered family. We must not harm anyone.) This reflects the principle of non-maleficence, which dictates that harm should not be inflicted on any community member, whether human or non-human. He affirmed that this familiar belief was established at the creation of the Earth as written in Yoruba Ifa literary corpus, which is an envelope of Yoruba epistemic ground in the Odu-Irosu wori:

> *Nígbà tí àwọn ọmọ Odùduwà péjọ, Àwọn ti Odùduwà yàn láti kó ire náà wá òde ayé ni à ń pè ní ÈNÌYÀN. Àwọn ọmọ Odùduwà ní igi òpẹ, ẹranko, àti ekòló, ènìyàn, àti àwọn ohun miran bí i bẹ́ẹ̀.*

This is translated as follows: "When the children of Odùduwà gathered, those Odùduwà chose to bring good fortune to the world, which we call HUMANITY. The children of Odùduwà include the palm tree, animals, insects, humans, and other such things."

This statement is in alignment with the affirmations of Akinwowo (1983). Chief X explained, "Yoruba people believe that humans and other living creatures are siblings and everything in nature has a spirit, and we must respect it. "*Bi a ti n bá ilẹ̀, omi, àti ẹranko jẹ́ẹ, a ń bá àwọn ẹ̀mí wọn jẹ.*" (When we interact with the land, water, and animals, we are also interacting with their spirits.) This belief encourages a harmonious relationship with the environment, discouraging exploitation and abuse. Another respondent, Mrs O, added, "*O da le, ba le lo.*" (He who harms the land or other living creatures will pay for it.) This statement further establishes the principle of non-maleficence and the necessity of making amends for any harm caused to nature. Reconciliation is another critical principle that governs Yoruba interactions. As Mr L stated, "*A ní gbàgbé ìjà àti àríyánjiyàn. Bí ẹbí ba n jà, a máa pari ẹ. A máa tún mú ìtura wá.*" (We must forget disputes and arguments. If there is conflict within the family, we resolve it and bring peace back.) He explained that reconciliation is essential for maintaining familial bonds and community harmony. This principle extends to human–nature relationships, where conflicts arising from

resource scarcity or mismanagement must be addressed and resolved. "*A máa n fi ààbò fún ilẹ̀. Bí a bá ti n gba ilẹ̀ là, a máa gbọ́dọ̀ pa dájọ́.*" (We ensure the protection of the land. When we take from the land, we must make sure to restore it.) Mr L described how the community seeks to restore balance and prevent further harm.

Preservation, or *ìdàsi*, is another cornerstone of *Alájọbí*. According to Mrs O, "*A ní láti tẹ́siwaju, ká má fọwọ́ ṣàgbẹ́. Ọmọ Yorùbá gbọ́dọ̀ fi àánú hàn sí ayé tó bá lékè re.*" (A Yoruba person must show compassion towards the world that is under their care.) She described how preservation ensures that actions today do not jeopardise future generations. This principle promotes sustainable practices, as seen in traditional agricultural methods that preserve soil fertility and biodiversity. "*A máa n gbin àti dárúgbin nípasẹ̀ ètò ọlọ́kàndún. Eyí n yé wa pé ilẹ̀ yóò lè máa pèsè fún wa ní ọjọ́ iwájú.*" (We plant and cultivate through responsible methods. This ensures that the land will continue to provide for us in the future.) She explained that Yoruba communities are committed to sustainable resource management. Respect for ancestors, or "*ìbọwọ́ fún àwọn bàbá ńlá*" is intertwined with these principles. Chief X emphasized, "*Àwọn àtẹ̀rìnwá wa ní ọwọ́ kan nínú gbogbo ohun tí a ń ṣe. Wọn yóò máa dá wá lẹ́jọ́ bí a bá ṣẹ̀ṣẹ̀,*" (our ancestors have a role in everything we do; they will judge us if we act recklessly) suggesting that ancestral respect reinforces ethical behaviour. This reverence for the past shapes present actions, ensuring that resources are managed wisely to honour forebears' legacy. "*A gbọ́dọ̀ ranti pé àwọn ẹ̀dá àtẹ̀rìnwá n wo wa. Bí a bá bọ̀wọ̀ fún wọn, ayé wa yóò bọ̀wọ̀ fún wa,*" (we must remember that our ancestors are watching us; if we show respect to them, the world will also show respect to us) Mrs O added, indicating that this respect extends to all elements of the environment. The principle of collective responsibility, or *ìṣọ̀kan*, is also crucial in fostering community solidarity. As Mr A stated, "*Gbogbo ilé jẹ́ ọ̀kan. A máa n ríra kìí yẹra, a máa n dárí jì ara wa. Ẹni kan tí ó bá ṣẹ̀ṣẹ̀, gbogbo wa ló yẹ kó ṣe àdíyàn.*" (Every household is one. We always look out for each other and forgive one another. If someone makes a mistake, it is the responsibility of all of us to make amends.) This ethos of shared responsibility ensures that every community member contributes to the common good. "*Bí a bá ṣe pọ̀, a lè tì mí kọ́ àwọn ìsoro wa. Ààbò bá ilẹ̀ ńlá, gbogbo wa yóò rí ayọ̀,*" (if we come together, we can overcome our problems; when the environment is well taken care of, we all will find joy) Mrs O added, emphasising the collective effort in safeguarding the environment. These principles are held in high regard among the Yorubas and govern the daily activities and behaviour of community members.

Current water, energy, and food resource practices in Yoruba communities

Nigeria's WEF nexus routine practices are plagued with mismanagement and inefficiencies, significantly impacting these resources' availability and sustainability. This study discovered that water waste is rampant in Yoruba communities. One popular scenario that was visible in the three communities is the constant leakage from water pipes. In several parts of the city, broken pipes spill thousands of litres of water daily, often left unattended for weeks or even months. This results in water loss and also deteriorates the environmental condition of the communities, with some of this wastewater contributing to man-made erosion. Several households were also seen leaving taps running while performing chores such as washing dishes or brushing teeth, unaware of the cumulative effect of these habits. The communities were also plagued with inefficiencies and excessive water use for car washing, washing clothes using large amounts of water, open defecation, and inefficient irrigation without conservation practices. These findings align with the assertions of Arimoro and Musa (2020) that communities play a significant role in sustainable water management. Most residents also rely on wells as a source of water supply; however, the improper maintenance of these water sources often results in contamination and wastage. For example, open wells are common and frequently left uncovered, allowing debris and contaminants to enter. The study discovered that while a substantial percentage of residents practice rainwater harvesting, this water is eventually polluted and discarded as most do not store the water harvested. Most times, the water is left uncovered until it becomes polluted. Additionally, many residents have formed the habit of washing clothes and household items directly at these water sources, leading to significant water loss and pollution. Most residential apartments also lack water conservation measures, such as overhead tanks. Taps are often left running, and there is minimal use of water-saving devices, exacerbating water wastage.

Food waste is also a significant practice in the Yoruba communities. A lot of household traders discard varying quantities of food. Among the households, many families cook large quantities for meals without correctly estimating the correct quantity. This often results in excess food that eventually goes to waste. Additionally, the cultural practices among the Yorubas that encourage the preparation of different delicacies for events lead to considerable leftovers that are often discarded. From a commercial point of view, many farmers and traders often perpetrate food wastage due to poor storage facilities, which spoils a substantial amount of food before it can be sold. Traders and farmers often discard large quantities of tomatoes, peppers and leafy vegetables that have gone bad due to the lack of refrigeration, which many blame on the poor electricity supply. This finding is corroborated by Onyeaka et al. (2021). This problem is further exacerbated by poor transportation infrastructure, which leads to delays and further spoilage. Also, during peak seasons, inadequate processing and storage facilities lead to significant losses. Many planted crops often rot on the farm due to inadequate preservation methods.

Similarly, many households continue to perpetuate a continuous cycle of energy mismanagement, as many often have lights, electrical appliances, and systems running even when not in use. Illegal connections, and the use of multiple electrical appliances without energy-efficient practices, are also common. Many households use old, high-energy-consuming appliances, and there is minimal awareness or implementation of energy-saving practices. The lack of energy management policies exacerbates this problem, leading to unnecessary consumption and higher costs. Energy inefficiency is further compounded by the frequent use of generators due to unreliable power supply from the national grid. While providing necessary power, generators are often left running longer than necessary, consuming excessive fuel, releasing toxic emissions and contributing to energy waste. This inefficiency is costly and contributes to the broader energy crisis.

The routine practices observed in Yoruba communities in Nigeria reveal pervasive mismanagement and inefficiencies across the WEF nexus, with profound implications for resource insecurity and sustainability. The practices result in the depletion and degradation of WEF resources and compromise environmental integrity. These practices indicate stark developmental disparities in contrast with practices in developed countries. Unlike developed nations with stringent resource management policies and advanced infrastructure, Nigeria still struggles with systemic challenges. These shortcomings emphasise a less mature approach to sustainability and economic development. If not curbed, these practices will continue to perpetuate diminished resource availability, exacerbate poverty and inequality, impede economic growth, and heighten vulnerability to climate change impacts.

The role of *Alájọbí* principles in enhancing sustainability and resilience of the WEF resources

The principles of *Alájọbí*, deeply embedded in Yoruba cultural ethos, can influence human behaviour and address the mismanagement

and inefficiencies that affect water, energy, and food resources. *Alájọbí*, which signifies the concept of kinship and extends beyond immediate family to encompass the entire community, instils a profound sense of interconnectedness and collective responsibility. This comprehensive view of family fosters a culture of mutual respect and care, both among individuals and in interactions with the environment. According to Mr A, if every community member and resource is viewed as part of an extended family, there is a natural inclination to avoid actions that could harm others or the environment. People would live with the consciousness of their actions harming the WEF resources, and they can help curb resource wastage by promoting communal vigilance. Mr D also discussed that communities can establish collective norms for resource conservation, ensuring leaks are promptly repaired, taps are not left running unnecessarily, unused water and food are preserved and stored properly, and energy sources are put off when unused. This collective responsibility can also drive the adoption of water-saving practices, such as efficient irrigation techniques and proper maintenance of water sources. Applying the principle of non-maleficence, which emphasises avoiding harm to any community member, including nature, could prompt individuals to practice resource management, bearing in mind that the WEF resources belong to a familial community like them.

The principle of reconciliation in *Alájọbí* involves resolving conflicts and restoring harmony. This principle can be applied to address resource mismanagement by promoting dialogue and collaborative problem-solving within a WEF nexus framework. This principle might foster interrelatedness in managing WEF resources, leading to strategies that ensure sustainability. This might include improved storage techniques, better estimation of cooking quantities, and community-driven efforts to redistribute surplus food to those in need, aligning with collective responsibility and respect for ancestors by honouring the resources provided, as stated by Chief X. Reconciliation can also play a role in addressing conflicts related to resource allocation, ensuring that all community members have access to necessary resources while minimising waste.

Preservation, another core principle of *Alájọbí*, emphasises the importance of long-term planning and sustainability. By adopting a forward-thinking approach, Yoruba communities can mitigate the impact of current practices on future generations. This could involve investing in infrastructure improvements, such as repairing broken pipes and implementing rainwater harvesting systems that are properly maintained to avoid contamination. Mr S also stated that preservation can drive efforts to enhance agricultural practices, reduce food waste, and improve storage and transportation systems to prevent spoilage. He stated that collective responsibility, integral to *Alájọbí*, reinforces the idea that everyone in the community has a role in ensuring the well-being of others and the environment. This principle can drive initiatives to address inefficiencies in resource use. For instance, community-led campaigns could raise awareness about the WEF nexus, the importance of turning off unused appliances and adopting energy-efficient practices. Similarly, collective efforts could focus on improving waste management systems, such as proper disposal of organic waste and reducing reliance on harmful practices like open defecation.

When these principles are imbibed among residents, they can effectively address the inefficiencies and mismanagement of water, energy and food resources. This holistic approach will regulate anthropogenic activities, promote sustainability, and enhance the resilience of WEF resources, ensuring that resources are managed wisely and preserved for future generations.

DISCUSSION

The results of this research reveal how daily practices in Yoruba communities both mirror and differ from the fundamental *Alájọbí* principles that form the basis of social and environmental ethics. Although issues like water leaks, food waste, and energy inefficiencies expose shortcomings in effective resource management, the principles of non-maleficence, reconciliation, preservation, and collective responsibility continue to be integral to community life. The *Alájọbí* principles, when integrated into the WEF nexus, aim to improve sustainability and resilience. While the WEF nexus offers a systemic approach for managing the interconnections of resources, *Alájọbí* provides the ethical and social responsibilities that direct how communities should engage with these resources.

The principle of non-maleficence, which emphasises avoiding harm, applies to natural resources. This principle discourages practices like leaving taps open or using irrigation methods that lead to significant water waste. It also advises against careless deforestation for fuelwood and reminds communities that such actions can have long-term negative impacts on the ecosystem. The reconciliation principle also encourages balance and peaceful resolution of conflicts involving natural resources. For example, when farmers and households vie for limited irrigation sources, reconciliation would necessitate community conversations, facilitated by leaders, to equitably distribute water while safeguarding the resource itself. This approach would mitigate conflict and would support the nexus goal of integrated governance. Preservation also encourages community members to consider future implications when utilising resources. This could involve setting up communal rainwater harvesting systems, embracing renewable energy solutions, or enhancing storage methods to minimise food loss post-harvest. For example, rather than letting harvested maize spoil due to poor storage, preservation would advocate collective investment in shared silos to protect food security in the future.

The collective responsibility emphasises the interconnected nature of the WEF nexus by ensuring that every household views resource management as a shared obligation. For example, during festive occasions with surplus food, leftover meals could be distributed to vulnerable families rather than thrown away, ensuring that food resources benefit the entire community. By integrating these principles into the WEF nexus, resource management goes beyond just technical approaches and evolves into socially rooted practices that are recognised, accepted, and upheld by the community itself. This combination of structural frameworks and cultural ethics enhances both the effectiveness and legitimacy of sustainable resource management. Relating these findings to the WEF nexus framework reveals that solely technical solutions cannot attain sustainability without the social and cultural norms that govern behavior at both household and community levels. Incorporating *Alájọbí* into the WEF nexus provides a route from identified challenges to transformational practices, ensuring that resource management is both structurally effective and socially informed. This integration strengthens the notion that indigenous values are not only pertinent but also vital for implementing the WEF nexus approach for resilience and sustainability.

CONCLUSION AND RECOMMENDATIONS

The principles of *Alájọbí*, which are firmly ingrained in Yoruba culture, have a substantial impact on defining community behaviour and fostering sustainable resource management. This study emphasises the role of consanguinity, communal responsibility, non-maleficence, preservation, and reconciliation in promoting a comprehensive approach to managing WEF resources. The interconnectivity of Yoruba communities guarantees that environmental ethics are not only abstract concepts but are actively implemented daily. Implementing these principles can effectively tackle existing inefficiencies and mismanagement in WEF resources. This study highlights the capacity of traditional cultural principles in tackling current WEF nexus concerns, proposing a re-orientation towards *Alájọbí*-inspired practices to improve the resilience and

sustainability of WEF resources. Based on the findings of this study, it is recommended that:

- Traditional practices that align with sustainable resource management should be integrated into modern resource management frameworks/technologies to drive sustainability at the local/household level.
- Stakeholders should implement comprehensive awareness initiatives highlighting the principles of *Alájọbí* and their relevance to the WEF nexus in local communities.
- Stakeholders should invest in infrastructure and technologies that support sustainable resource management address in the WEF nexus.

CONSENT TO PARTICIPATE

Participants provided informed consent before the interview, acknowledging voluntary participation and confidentiality.

CONSENT TO PUBLISH

The study sought consent to publish from participants, stating that anonymity would be preserved and the information would be used solely for research purposes.

AVAILABILITY OF DATA

Data are available.

CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or interests that could have appeared to influence the work reported in this article.

AUTHOR CONTRIBUTIONS

Both authors contributed to the writing, data collection and editing of this manuscript.

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APPENDIX

Table A1. Interview questions for integrating *Alájọbí* principles in the WEF nexus

1	How would you describe the meaning of *Alájọbí* in Yoruba culture?
2	What are the important principles that guide *Alájọbí*?
3	How do *Alájọbí* principles influence how people treat land, water, animals, or other natural resources?
4	Do teachings from elders, proverbs, or ancestral beliefs encourage environmental protection?
5	How would you describe the way water, light and food are used or managed in your community?
6	In what ways do you think *Alájọbí* principles can help reduce water, energy, and food wastage?
7	Can collective responsibility in *Alájọbí* help people maintain shared resources?
8	What traditional practices would you recommend integrating into modern resource management to improve sustainability?

Table A2. Community observation checklist

	Observation	**Yes**	**No**
1	Leaking public or household pipes		
2	Taps left running during chores		
3	Open/uncovered wells		
4	Rainwater harvesting practiced		
5	Rainwater stored properly or left exposed		
6	Water used wastefully during car washing or laundry		
7	Excess food cooked leading to leftovers		
8	Leftover food discarded		
9	Poor preservation/storage methods		
10	Spoilage of vegetables, tomatoes, peppers		
11	Farm produce rotting due to lack of infrastructure		
12	Lights left on when not needed		
13	High-energy appliances used excessively		
14	Long generator usage even when not essential		
15	Illegal electrical connections		
16	Lack of energy-saving devices		