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Local Architecture Approach for River-Based Facility Development: A PRISMA-Based Literature Study

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***Abstract*—This study explores integrating local architectural concepts into the design of river-based facilities, focusing on the Walanae River in Paduppa, Wajo Regency, Indonesia. The area's rich cultural heritage and abundant natural resources offer significant potential for sustainable and community-centered development. Using a mixed-method approach that includes qualitative field observations, in-depth interviews with local stakeholders, and a systematic literature review guided by the PRISMA framework, the research identifies key traditional architectural elements. These elements encompass stilt house structures, the use of natural materials such as bamboo and wood, spatial layouts aligned with natural contours, and sustainable water management techniques. The findings reveal that incorporating these elements addresses critical environmental challenges, including flooding and erosion, while simultaneously enhancing ecological efficiency, cultural identity, and environmental sustainability. This integrative methodology provides a framework for harmonizing traditional and modern architectural practices. By synthesizing practical insights from field research with a robust literature analysis, the study delivers valuable guidance for urban planners and architects in designing river-based facilities that balance cultural relevance with ecological sustainability. Additionally, the research contributes to the global discourse on sustainable architecture by offering a replicable model for incorporating local architectural traditions into contemporary urban designs. This approach holds significant implications for similar ecological and cultural contexts worldwide, emphasizing the importance of preserving local heritage while addressing modern urban development challenges.**

***Keywords*—Sustainable architecture; river-based facilities; local architectural integration; cultural heritage; ecological design; PRISMA framework; Walanae river; environmental sustainability.**

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I. INTRODUCTION

The development of river-based facilities represents a crucial solution to the challenges posed by environmental degradation and urbanization [2]. Rivers, as ecological, social, and cultural elements, hold immense potential to address these issues when integrated into sustainable urban and regional planning [3]. This research underscores the significance of the Walanae River in Paduppa, Wajo Regency, South Sulawesi, as a model for sustainable development that incorporates traditional architectural elements and community-based approaches [4].

The Walanae River serves as an indispensable resource for the communities in Paduppa [5]. With its calm waters and lush vegetation, the river is not only an ecological asset but also a vital part of daily life, supporting activities such as washing, fishing, and recreation. Its natural features offer considerable opportunities for the development of public facilities that function as green open spaces, enhancing ecological balance while addressing community needs [6]. Proper planning and management of this resource can maximize its benefits for broader societal welfare, ensuring both sustainability and functionality [7].

Culturally, the river is deeply intertwined with local traditions and practices [8]. The architectural heritage of Wajo Regency, exemplified by traditional stilt houses, reflects the community's adaptive strategies to natural conditions, such as flooding [9]. These structures demonstrate an environmentally conscious use of natural materials like bamboo and wood, which are abundant in the region [10]. Such elements not only serve practical purposes but also reinforce the cultural identity of the area [11]. Integrating these architectural elements into modern development projects can strengthen the social and cultural fabric while ensuring the sustainability of river-based facilities [12].

Despite its potential, the Walanae River faces significant challenges due to environmental degradation [13].

Uncontrolled human activities, such as improper waste disposal and overexploitation, have severely impacted the river ecosystem [14]. Riverbank erosion, water pollution, and waste accumulation are pressing issues that threaten the river's sustainability and its capacity to support local livelihoods [15]. These challenges require urgent, comprehensive solutions that prioritize environmental preservation [16].

Beyond environmental concerns, degradation affects the social and economic activities of the local community [17]. Reduced agricultural productivity and fishing opportunities, coupled with health risks from polluted water, highlight the interconnectedness of environmental health and community well-being [18]. Addressing these issues requires a sustainable approach that integrates environmental, social, and cultural dimensions [19].

Local architecture in Wajo Regency, particularly the traditional stilt houses, offers valuable insights into sustainable development practices [20]. Designed to adapt to the region's natural conditions, these structures mitigate the risks of flooding and erosion while using environmentally friendly materials [21]. Incorporating such architectural elements into modern river-based facilities provides an opportunity to create designs that are not only functional and sustainable but also culturally relevant [22].

The inclusion of traditional architectural practices in development projects fosters a sense of belonging and strengthens community identity [23]. Designs that incorporate local elements enable residents to connect with their environment, encouraging active participation in the maintenance and utilization of public facilities [24]. Furthermore, utilizing indigenous materials and skills supports the local economy, aligning with global sustainability goals while preserving cultural heritage [25].

This research aims to develop a design concept for river-based facilities that leverages the potential of the Walanae River [26]. The primary focus is on creating sustainable solutions that address environmental challenges such as flooding and erosion while incorporating architectural elements that reflect local traditions [27]. By prioritizing ecological and cultural aspects, the proposed development seeks to generate positive impacts across functional, environmental, and social dimensions [28].

The facilities are envisioned to enhance the quality of life for communities living along the river by serving as public spaces that support social, cultural, and economic activities [29]. Responsive designs are expected to encourage community participation in the use and maintenance of these facilities, fostering a sense of ownership and responsibility [30] [31]. Ultimately, the outcomes of this research aim to provide a replicable model for other regions with similar ecological and cultural characteristics [32].

One of the key objectives of this research is to empower the local community by involving them in the planning, construction, and management of river-based facilities [33]. Integrating elements of local architecture ensures that the facilities resonate with the community's identity and traditions [34]. This approach not only strengthens cultural ties but also equips residents with skills in environmental management and cultural preservation [35].

Public spaces developed through this initiative are designed to support various community events, such as traditional ceremonies, art exhibitions, and environmental education programs [36]. Additionally, the facilities are expected to create new opportunities for community-based economic activities, such as cultural tourism and ecotourism, thereby improving overall well-being [37]. Environmental education initiatives conducted at these facilities will further raise awareness about the importance of preserving the river ecosystem [38].

This study contributes to the creation of a sustainable development model that integrates local architectural elements with modern approaches [39]. Emphasizing sustainability principles, the model prioritizes environmental preservation and the protection of cultural heritage [40]. By aligning designs with the natural characteristics of the area, such as using stilt houses to address flood risks, the model ensures a balanced approach to modernization and conservation [41].

The use of natural materials, such as locally sourced bamboo and wood, minimizes environmental impact while supporting the local economy [42]. This holistic approach addresses technical, social, and cultural aspects, providing a framework for sustainable development that can be adapted to other regions [43].

The sustainable development model proposed in this research is not limited to the Walanae River but is adaptable to other regions with similar ecological and cultural contexts [44]. It highlights the importance of sensitive planning that incorporates river ecosystems and local wisdom, serving as a guide for urban planners and architects in comparable environments [45]. The model also emphasizes community participation, ensuring that facilities are relevant to the needs and aspirations of the residents [46].

In a global context increasingly focused on sustainability and cultural preservation, this model offers a practical example of environmentally friendly, community-based development. By balancing modernization with the conservation of natural and cultural resources, the model provides a long-term solution that aligns with contemporary development goals [47]. This contribution enhances the discourse on sustainable development in Indonesia and beyond, demonstrating the potential of local architecture to address global challenges [48].

II. Materials and Methods

This research adopts a comprehensive qualitative approach to explore integrating local architectural elements into the development of sustainable, river-based facilities along the Walanae River in Paduppa, Wajo Regency. Employing the PRISMA methodology for structured and systematic data collection, the study unfolds through sequential phases of literature review; field observations; interviews; data analysis; and conceptual design development; culminating in a validation process to ensure community alignment and environmental responsiveness [3].

A. Literature Review

The study's foundation rests on an extensive literature review, including books, scientific articles, research reports, and other relevant documents. The review specifically focuses on three main themes: the principles of local architecture in Wajo Regency; river-based design concepts; and sustainable

development strategies. The review critically analyzes traditional architectural elements, such as stilt house structures and natural materials like wood and bamboo, for their cultural and functional significance. The literature review further incorporates best practices from other regions that have successfully integrated local architectural principles into sustainable, river-based developments. This phase establishes the theoretical underpinnings for the research and serves as a benchmark for identifying adaptable architectural features [7].

B. Field Observations

In the subsequent phase, field observations were conducted along the Walanae River in Paduppa. The primary objective of this phase was to gather empirical data on the river's physical and environmental conditions [9]. Observations included an assessment of vegetation, water flow patterns, soil composition, and the spatial arrangement of the surrounding community. The team collected visual documentation in the form of photographs and site sketches to capture the area's unique environmental and social dynamics. Additionally, the team examined how the local community interacts with the river, particularly in terms of daily activities and spatial use. These observations provided critical insights into the interplay between natural and human systems, shaping the contextual relevance of proposed designs [11]

C. In-Depth Interviews

To complement the observational data, in-depth interviews were conducted with key stakeholders, including community leaders, local residents, architectural experts, and urban planners. These interviews sought to capture a broad spectrum of perspectives on traditional architectural practices and their potential integration into modern, river-based facilities [14]. Questions explored cultural values, architectural aesthetics, and community expectations, focusing on how sustainable and functional designs could support social and economic activities. The interviews also addressed technical aspects of construction; material selection; and spatial configuration, ensuring that proposed designs align with both cultural and practical considerations [17].

D. Data Analysis

Data from the literature review, field observations, and interviews were synthesized using thematic analysis. This qualitative approach enabled the identification of recurring themes, including sustainability, aesthetics, functionality, and cultural preservation. Key architectural elements were extracted and categorized to inform the design process. For instance, the analysis highlighted the importance of incorporating traditional stilt house designs, natural ventilation systems, and locally available materials into the facility's framework [21]. Furthermore, the analysis underscored the need to integrate water management systems and energy-efficient features to enhance the environmental sustainability of the proposed designs.

E. Conceptual Design Development

Based on the findings, a conceptual design was developed to illustrate the integration of local architectural elements into functional and environmentally friendly river-based facilities. Preliminary sketches and models were created to visualize how features such as open spatial layouts, natural materials, and traditional stilt structures could be adapted for contemporary use [24]. The design emphasizes sustainability through innovative solutions, including water management systems, energy-efficient layouts, and natural ventilation. Cultural preservation is equally prioritized, ensuring that the facilities resonate with the community's heritage while serving practical needs [26].

F. Concept Validation and Revision

To ensure the relevance and feasibility of the proposed designs, a validation process was conducted involving local community members and subject matter experts. Feedback from these discussions informed iterative revisions to the conceptual design. This collaborative approach not only refined the technical and aesthetic aspects of the facilities but also reinforced their alignment with community needs and environmental characteristics. The iterative validation process ensured that the final design is both culturally sensitive and pragmatically viable, fostering a sense of ownership and acceptance among stakeholders [31].

G. PRISMA Approach

The PRISMA methodology provided a systematic framework for selecting and analyzing relevant studies. Articles were identified through database searches in Scopus, Google Scholar, and PubMed, using keywords such as "local architecture," "river-based facilities," and "sustainability." Inclusion criteria focused on studies discussing local architecture, natural building materials, and river-based design concepts, while exclusion criteria eliminated studies that addressed only technical aspects without considering cultural elements. Synthesized data were analyzed to extract key themes, supporting the iterative development of the conceptual design [35]

H. Materials and Tools

The study relied on a variety of materials and tools to ensure thorough data collection and analysis. Literature sources, including books and journal articles, provided theoretical insights [37]. Fieldwork tools, such as cameras and sketchpads, facilitated the documentation of environmental and spatial conditions. Interview protocols and audio recorders captured stakeholder perspectives. Analytical software supported the thematic analysis, enabling the categorization and synthesis of diverse data sets. These tools collectively ensured a rigorous and multifaceted approach to understanding and addressing the research objectives [41].

III. RESULTS AND DISCUSSION

This section synthesizes the results from the study on integrating traditional architectural elements with modern sustainability practices in the development of river-based facilities along the Walanae River in Wajo Regency. The discussion covers structural adaptations, material use, spatial layouts, water management, renewable energy, and community engagement, supported by tables and figures for clarity.

A. *Structural Adaptations*

1) Traditional Stilt Houses: The stilt house structure is a hallmark of traditional architecture in Wajo Regency, providing resilience against flooding and optimizing natural ventilation. Elevated on high pillars, these houses prevent floodwaters from damaging the main structure while maintaining a cool interior environment due to enhanced airflow beneath the house.

2) Modern Adaptations: In river-based facilities, this concept is translated into elevated platform designs. These platforms mitigate flood risks, support eco-friendly practices, and reduce dependence on artificial cooling systems. Integration of such designs preserves cultural heritage while improving functionality.

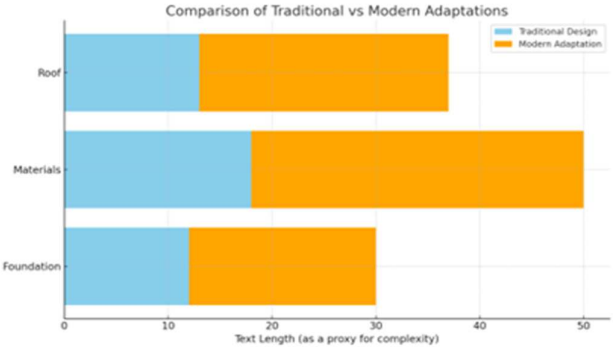

Fig. 1 Structural Adaptations

B. *Use of Materials*

1) Natural Materials in Traditional Architecture: Traditional Wajo architecture utilizes readily available materials like wood and bamboo. These materials are not only sustainable but also provide thermal insulation, maintaining comfortable temperatures without artificial cooling.

2) Modern Sustainable Materials: Modern adaptations incorporate composites and laminated bamboo, combining traditional aesthetics with improved durability and reduced environmental impact. This approach supports local economies by involving community skills in processing these materials.

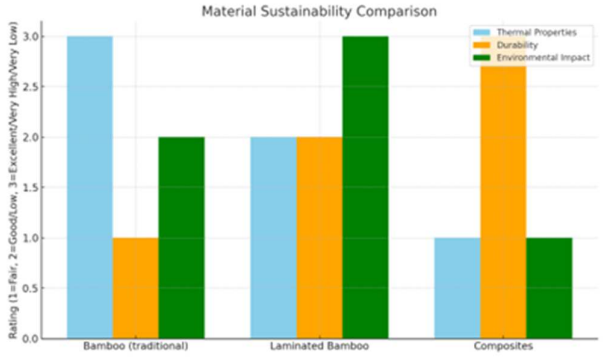

Fig. 2 Material Sustainability

C. *Sustainable Water Management*

1) Traditional Practices: Rainwater harvesting and vegetation along riverbanks have long been employed to manage water sustainably. These methods reduce erosion and enhance groundwater absorption.

2) Modern Integration: Modern solutions include advanced rainwater harvesting systems and sustainable drainage designs, combining traditional methods with contemporary technology.

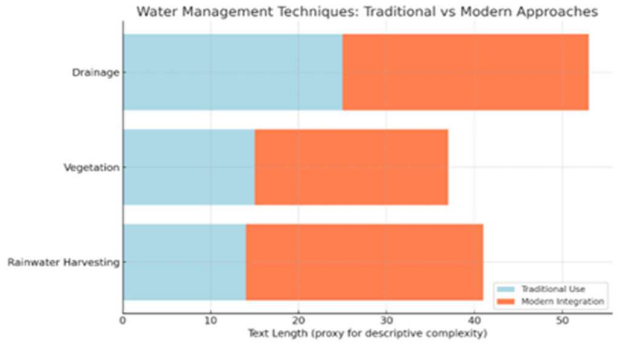

Fig. 3 Water Management Techniques

D. *Community Participation*

1) Involvement in Design and Management: Community engagement from planning to management fosters a sense of ownership, ensuring better maintenance and alignment with local needs.

2) Economic and Social Benefits: Skills training in areas like maintenance and waste management provides employment opportunities, contributing to local economic growth.

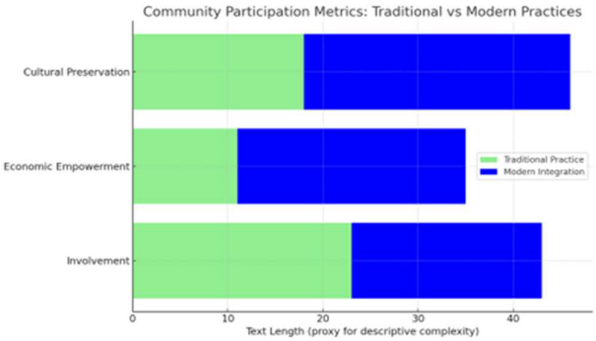

Fig. 4 Community Participation Metrics

E. *Cultural Identity*

Preserving cultural identity through architectural design is vital. Features like traditional carvings and motifs are incorporated into modern structures, maintaining cultural continuity while enhancing aesthetic appeal.

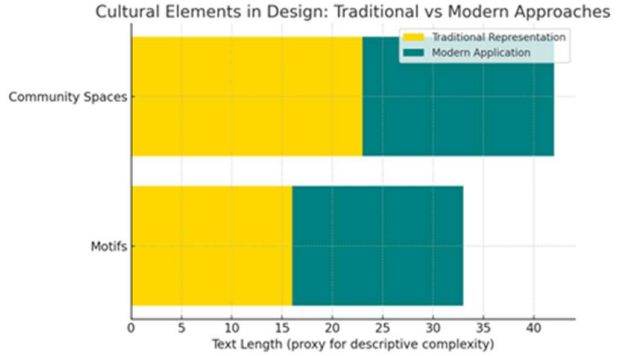

Fig. 5 Cultural Elements in Design

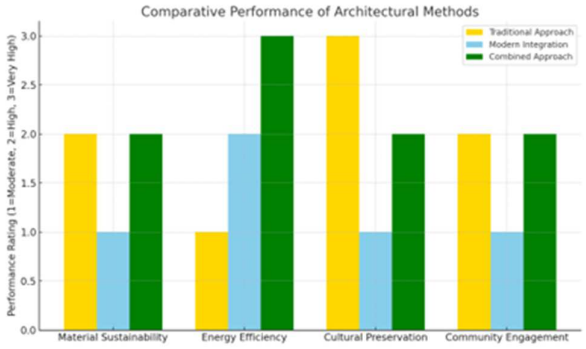

Fig. 6 Comparative Performance of Architectural Methods

Integrating traditional architectural elements with modern sustainability practices offers a holistic approach to developing river-based facilities. This synthesis balances environmental, cultural, and economic aspects, ensuring both functionality and preservation. Traditional designs, rich in cultural values, complement the technological advancements of modern practices, creating structures that are adaptive to dynamic environmental conditions. Incorporating natural materials, such as bamboo and wood, aligns with local availability and supports thermal comfort and ecological conservation. The strategic inclusion of renewable energy systems, such as solar panels, underscores the shift toward eco-friendly infrastructure that minimizes operational costs and carbon emissions.

The hybrid approach also strengthens community involvement by fostering ownership through participatory planning and management. This involvement builds local capacity, empowering residents with skills to sustain their facilities and environment. Additionally, cultural preservation is achieved by integrating artistic and traditional elements into design, ensuring the infrastructure resonates with local identity. Such integration attracts tourism and enhances social cohesion, making these facilities not only physical spaces but also cultural and educational hubs. Therefore, this balanced approach provides a replicable model for sustainable, culturally sensitive development tailored to local needs.

IV. Conclusion

This research highlights the significant role of integrating local architectural elements into the design of river-based facilities, particularly along the Walanae River in Paduppa, Wajo Regency. Traditional architectural features such as stilt houses, natural materials like wood and bamboo, and spatial layouts that align with the land's natural contours offer both ecological solutions and cultural reinforcement. These elements not only address environmental challenges, including flooding and erosion, but also promote long-term sustainability through optimized water management and renewable energy use.

The study underscores the dual benefit of such designs: enhancing environmental sustainability and preserving cultural identity. By adopting these architectural elements, facilities become symbols of cultural heritage, fostering pride and continuity within the local community. Community participation is essential, as it ensures the success of these projects by encouraging ownership and contributing to social and economic sustainability.

. The research recommends adopting a community-based development model; emphasizing local architectural adaptation and heightened environmental awareness. This approach is versatile and can be applied to regions with similar ecological and cultural contexts. Furthermore; the findings provide a framework for urban planners and architects to create river-based facilities that harmonize with the natural environment while preserving cultural heritage. This integration of ecological design and cultural preservation serves as a model for sustainable development, aligning architectural innovation with environmental and cultural resilience. The study thus contributes valuable insights for advancing sustainable, culturally rooted urban and regional planning practices

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