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Research Article

Spatial Dynamics and Social Interactions in Planning Open Spaces of Dense Riverside Settlements

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ABSTRACT

Providing open space in densely populated settlements is challenging due to the lack of open land. In contrast, open space is essential in these settlements as a place for social interaction in highly communal settlements. In addition to these challenges in riverbank settlements, planning open space is also necessary, considering the landscape's characteristics and the settlement's unique culture. This study investigates the potential of alternative spaces as a solution for providing open space. The study began by observing the population's activities to be mapped according to age group and gender. Data were collected in settlements along the banks of the Musi River in Palembang. Identification began by mapping open space on a spatial map showing the location and distribution and the type of open space in the settlement area. Open space is formed informally in various spaces in the settlement. Multiple demographic groups generally use six types of open space. Furthermore, the data was processed using contingency and distribution analysis to see the size of the group in activities in the open space, the activities carried out, and the location of the open space. The results of the analysis show that different needs and patterns of involvement in groups of adults, adolescents, and children must be considered in planning and design. This study concludes that optimizing open spaces according to residents' activity patterns can solve the limitations. Riverbanks have the potential to serve as open spaces, requiring further longitudinal and qualitative research to understand usage patterns and community perceptions.

Keywords: Urban Planning; Open Space Planning; Social Interaction; Riverside Settlement

INTRODUCTION

Various critical aspects are mentioned in research on the importance of open public spaces in dense urban settings. Open spaces are crucial for encouraging mental and physical health, social interaction within the community, and environmental sustainability [1]. Achieving a sustainable urban landscape requires integrating local wisdom, which is necessary for environmental resident involvement in socio-cultural aspects [2], environmental resident involvement and socio-cultural aspects are essential [3]. Most residential development projects ignore these benefits, primarily regarding infrastructure and building houses [4][5]. This lack of public space is particularly problematic in informal settlements, where community engagement and social interaction are vital [6].

In the case of highly dense settlements, people record communal space through creative usage of limited space. Thus, residents usually turn existing alleys, terraces, and vacant land into temporary public places [7][8][9]. These forms of non-formal shared public spaces play an essential

role in maintaining the social coherence of communal life [10][11]. However, in rapid urbanization, when many cities face land supply shortages, formalizing these spaces as an issue is gaining significant importance[12][13][14].

Research on riverside settlements has revealed that the practical design of public spaces must prioritize accessibility, diverse activities, and integration with the surrounding urban landscape [15][16][17]. Those areas along the riversides are up-and-coming for open public space, essential in an urban community, through which ecological, social, and recreational benefits can be derived. These open spaces serve as important green areas for improving environmental sustainability, fostering social interaction, and supporting recreational needs, both of which become significant where the population is highly dense [18][19]. To fully realize this potential, the design of riverside spaces must integrate these values while also addressing the socio-cultural dynamics of the local population [20][21]. Furthermore, by considering both ecological factors and the specific cultural characteristics of the community, riverside spaces can be transformed into multifunctional, accessible environments that meet the diverse needs of residents [22][23]. By thoughtfully integrating ecological, recreational, and cultural values, these areas can be transformed into multifunctional public spaces that enhance the quality of life for residents. The use of riverside spaces presents unique challenges and opportunities, as these areas often serve multiple functions, including recreation, social interaction, and environmental conservation [24][25]. These riverside open public spaces contribute to creating livable neighborhoods [26][27].

While numerous studies have emphasized the vital role that open spaces play in improving the quality of life in urban environments, including in dense and informal settlements [28][29], there remains a significant gap in understanding how different demographic groups utilize these spaces, especially in riverside settlement areas. Riverside settlements face overcrowding, environmental degradation, and limited access to public spaces. Increasing population pressures have accentuated these factors, necessitating more nuanced planning strategies to accommodate the diverse demographic profiles of residents. This research aims to highlight key considerations that will enable urban planners and policymakers to make informed decisions in the design and management of open spaces in densely populated riverside settlements.

METHODS

Study Area

The focus of the research on settlements along the Musi River in Palembang presents challenges and opportunities in urban development. This riverbank community has a history of development that has resulted in an area rich in cultural heritage and shaped its distinctive urban lifestyle [30]. However, most of the housing in this area was developed without planning, which caused various environmental and infrastructure challenges. These challenges include frequent flooding, pollution, and lack of essential services and open public spaces [31]. This condition makes providing public infrastructure such as sanitation, roads, and communal areas in this densely populated settlement very challenging. The landscape is dominated by haphazard residential development, which makes the building density increasingly dense. Although there is open space along the riverbank that has the potential to be an open space, this is still a challenge. Most of the riverbank area has also been encroached on by informal residential buildings.

Historically, the riverbank area is a strategic urban settlement that balances open and built spaces. However, this balance has been disrupted, with almost every available plot of land now occupied by densely packed housing units. Most houses are built on narrow, tightly packed plots, with each unit sometimes housing multiple families. The lack of indoor space forces residents to use whatever outdoor space is available for daily communal activities. This context underscores the urgent need for innovative urban planning strategies that address environmental and spatial challenges while considering this riverside community's cultural and social dynamics.

Research Framework

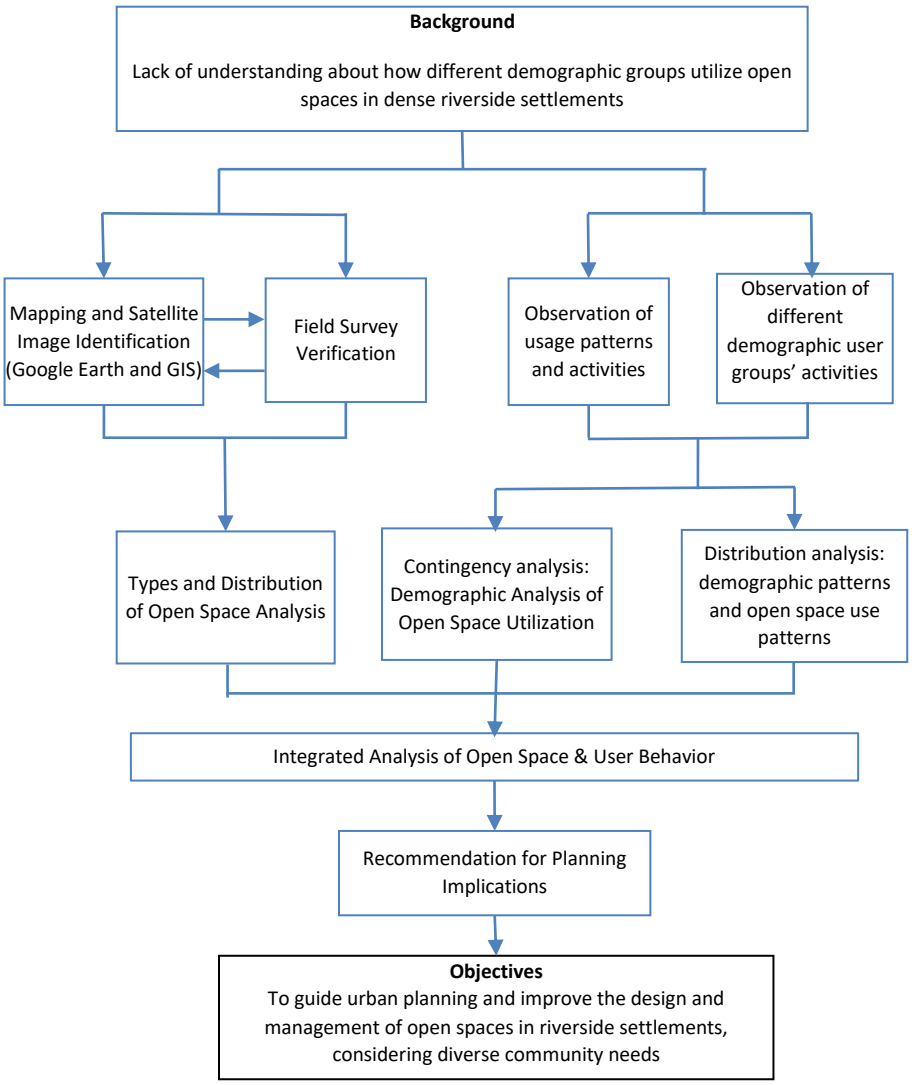


Figure 1. Research Framework

Figure 1 shows the research framework that follows a structured approach. Identifying the central issue starts with a lack of understanding of how different demographic groups use open spaces in densely populated riverside settlements. In this framework, two study areas are identified: Open Space Identification, which undertakes the mapping and categorization of available open space, and Demographic Usage Analysis, aimed at understanding how the different resident groups interact with these spaces. This study has two primary objectives: identifying and categorizing types of open spaces in highly dense areas. In contrast, the second involves assessing usage patterns by individuals in different demographic brackets. By doing so, an indication may be obtained as to how urban planners can adapt the design and management of open spaces to support heterogeneous community needs.

This research focuses on how residents in densely populated riverside settlements utilize open spaces. This cross-sectional study categorizes residents into five demographic groups: adult men, adult women, teenage boys, teenage girls, and children. This classification enables the research to effectively identify specific activities and space usage patterns within each group [32]. The study area covers approximately 238 hectares along the Musi River in Palembang. Observations were conducted visually and primarily took place during peak activity hours between 3:00 PM and 5:00 PM, which were

identified through a pilot test, as these were the times when most residents gathered in open spaces. Each activity was documented by taking photographs and recording the type of open space in use.

Data Collection

The study started with mapping all potential open spaces using Google Maps to generate a comprehensive overview of public and private spaces, including alleys, courtyards, vacant lots, and riverbanks. After mapping, the field survey followed to validate the GIS data by directly observing residents' utilization of these spaces. This allowed the researchers to document the land's informal and communal use. The identification results provide valuable insights for planners, including spaces beyond the formal category, capturing how residents utilize informal areas.

This cross-sectional study categorized residents according to demographic groups of age and gender. There are five demographic groups: adult males, adult females, adolescent males, adolescent females, and children. This grouping allows the study to effectively identify specific activities and patterns of space use in each group [32].The study area covers approximately 238 hectares along the Musi River in Palembang. Observations were carried out visually passively during peak hours of residents' activities in open spaces, namely between 3:00 p.m. and 5:00 p.m. This period was identified through pre-data collection trials. Each activity was documented by recording the location, type of open space, number of users according to their group, and the activities carried out. In addition to recording visual results, photos of activities and the physical form of open spaces were also taken during the survey. The initial stage of the study began by mapping all potential open spaces using Google Maps to produce a comprehensive overview of the study area. During the survey, observations were made at each open space, which was the place of residents' activities. The open spaces observed include informal, public, and private spaces used by residents for outdoor activities in groups. Data collected through surveys are inputted into the Geospatial Information System (GIS) by entering the location category, type, number, and user groups.

Data Analysis

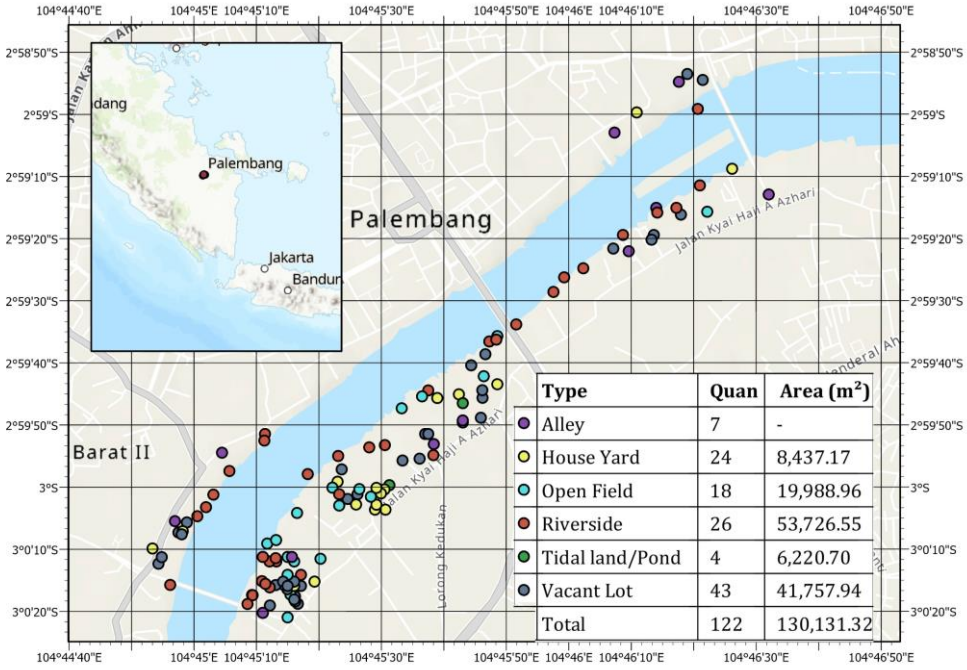
The results of processing this spatial data will show open spaces' location, number, and distribution according to their type. This allows researchers to document land use as open spaces that are formed informally and built with open space functions. The identification results provide valuable insights for planners, including spaces outside the formal category, which capture how residents utilize informal areas as gathering spaces.

Distribution analysis examines demographic patterns related to the size of user groups and their open space use patterns. This analysis reveals the involvement of residents with open spaces in groups, which adds insight into the space size needed to accommodate the needs according to demographic groups. These results contribute to understanding the spatial demands for open spaces and the specific requirements of each demographic group. Distribution analysis is also applied to identify activities carried out by the five demographic groups. Both findings provide a clearer understanding of how demographic groups interact in open spaces.

Contingency analysis was used to explore each group's different types of open space. Contingency analysis can be applied to nominal data. Data were collected from a representative sample and analyzed using frequency tabulation and chi-square tests to identify significant differences between categories. This approach allows researchers to measure community support and preferences for a project or policy without relying on numerical data [33]. Contingency analysis links the results of identifying group size to the type of open space where their activities occur. The three analyses, namely GIS, contingency analysis, and distribution, provide a comprehensive view of the activity patterns, group size, and types of open space used by each demographic group.

RESULTS

Types and Distribution of Open Space



Type	Quan	Area (m^2)
Alley	7	-
House Yard	24	8,437.17
Open Field	18	19,988.96
Riverside	26	53,726.55
Tidal land/Pond	4	6,220.70
Vacant Lot	43	41,757.94
Total	122	130,131.32

Figure 3. Type and Distribution of Open Space

The observation results are summarised in Figure 2, which describes the type, number, and area of various open spaces. A total of 122 open spaces were identified, covering an area of 130,131.32 square meters. Most of these open spaces are not explicitly developed as open spaces but play an essential role in providing public facilities for residents. These results explore open space types and availability in dense residential environments formed through adaptation and initiative within residents' limitations.

The most common type of open space is vacant lots, with 43 plots of land covering an area of 41,757.94 square meters. This type covers almost a third of all open space, although it is not the most significant open space. This empty land is usually found around the house on land between buildings. Their proximity to home and intimate scale makes them attractive for activities despite being privately owned. Riverside is the next most common type, with 26 sections totaling 53,726.55 square meters. These spaces have significant potential due to their large areas along the river, offering flexibility for development and the quality of the river views. House yards are another type, with 24 areas covering 8,437.17 square meters. Even though it is small, many residents use the yard for various activities because it is close to their house. The yard accommodates abundant indoor activities, making it a lively and functional

space. The open field consists of 18 plots with an area of 19,988.96 square meters. These fields are usually empty open land with minimal facilities intended for public use and provided by the local government. Apart from that, there are four tidal fields or pools with a total area of 6,220.70 square meters. These areas are often undeveloped land or ponds owned by residents who work by utilizing overflowing river water. Finally, there are seven alleys which are used as active open spaces. Like home gardens, alleys are also close to residents' homes and are often used for various activities because there is a resident agreement for shared use.

The Usage Patterns of Different Demographic Groups within These Open Spaces

Table 2. Demographic Group Size in Open Space Utilization

Resident Group	Number of people			
	1-3	4-6	7-9	10+
Adult Women	37	12	4	7
Adult Men	41	14	7	7
Teenage Girls	20	7	2	2
Teenage Boys	26	5	8	2
Children	15	18	1	15

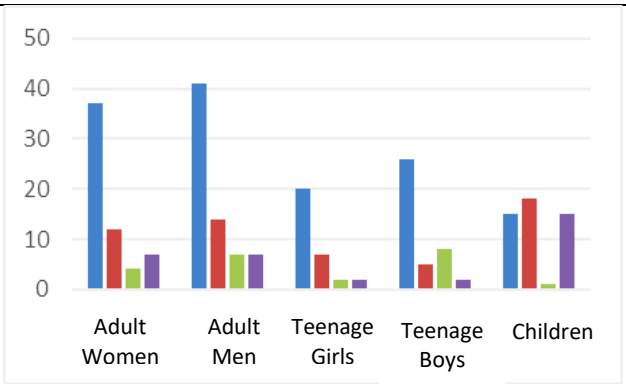


Table 2 provides an overview of how various demographic groups utilize open space. Adult women and men use these spaces in small groups and often socialize with 1-3 people. Adults may use outdoor spaces for solitary activities and intimate social interactions. Adolescents, both girls and boys, also tend to be alone, but their social dynamics often involve a small group of close friends. This is under the age of development for those starting to form independence. The nature of their activities differs more likely to be part of larger groups (4-6 people significantly from other age groups. In contrast, children display more diverse group sizes. They are and 7-9 people), although some children use open spaces in small groups or alone. Although children are sometimes seen alone, they mainly use open spaces for interactive and communal activities. This behaviour reflects the group-oriented nature of their activities, such as play and recreation, emphasising the importance of open spaces for their social and developmental needs. Children are the demographic group that most needs wide open spaces for various activities because their psychology benefits significantly from this environment.

Several activities occur in open spaces among different demographic groups (Figure 3). These activities include sitting, playing, smoking, chatting, working, washing in the river, bathing, swimming, fishing, waiting for the boat, and exercising. Among adult women, the two most common activities were sitting and chatting. They also frequently wash in the river.

Meanwhile, men often gather in small groups in house courtyards with neighbours. Occasionally, men gather alone or in groups by the riverside for solitude, to smoke, or to chat. They are also active in larger groups on settlement streets, chatting while sitting and observing, with some continuing their routine work. Teenage girls often sit and chat like adult women. This age group tends to separate from their parents, requiring a space with its character. This dedicated space must still be supervised, with security and comfort for their activities. Meanwhile, teenage boys do more of this and play regularly. Playing occupies the largest portion, followed by swimming and sitting.

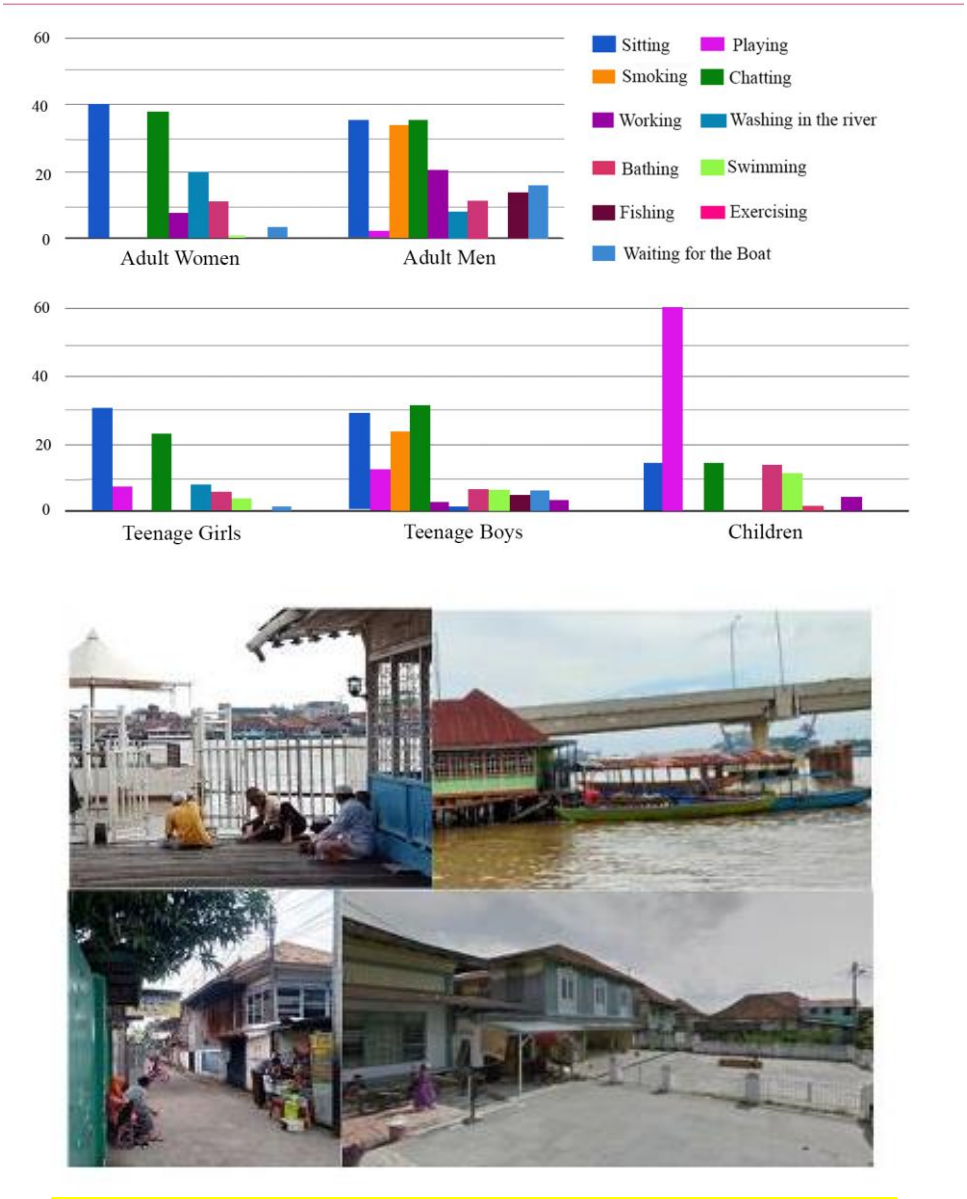


Figure 4. Activity Patterns and Public Space Usage Across Demographic Groups in Riverside Settlements

Sitting and playing were the two most common activities across all demographic groups, indicating most people's interest in rest and recreation. Sitting and chatting are popular among adult men and women, but men participate more in work and play. Adolescent girls preferred sitting and chatting, while adolescent boys had a higher propensity to play. The low involvement of teenagers, especially girls, in actively using open spaces implies the need for selective strategies to encourage their involvement. Creating safe and attractive socialisation and recreation spaces has the potential to increase the use of those spaces.

Table 3 contains the results of the contingency analysis of the use of different categories of open space by various demographic groups. The individual groups are classified according to the number of people in each group. All four user groups show significant results in all the statistical tests based on Chi-Square, Likelihood Ratio, and Pearson. Still, the correspondence analysis showed an insignificant result for the adolescent girls. This indicates that teenage girls are less involved in open-space activities, eventually leading to no proper correlation with their open-space-using behaviours.

Table 3. Contingent Analysis Result of Open Space Utilization by Different Residents Groups

Types Open space	Adult Women				Adult Men			
	1-3	4-6	7-9	10+	1-3	4-6	7-9	10+
Vacant Lot	9	2	1	0	12	1	0	0
Riverside	6	3	2	2	5	6	1	4
House Yard	7	1	0	2	9	2	1	1
Open Field	9	4	0	3	9	2	4	2
Tidal land/Pond	1	0	1	0	2	0	1	0
Alley	5	2	0	0	4	3	0	0
Sum	37	12	4	7	41	14	7	7
Test	ChiSquare		Prob> ChiSq		ChiSquare		Prob> ChiSq	
Likelihood Ratio	38.406		0.0079*		51.368		0.0001*	
Pearson	36.194		0.0146*		48.615		0.0003*	
Types Open space	Teenage Boys				Children			
	1-3	4-6	7-9	10+	1-3	4-6	7-9	10+
Vacant Lot	4	0	1	0	3	5	1	1
Riverside	8	3	2	1	2	5	3	5
House Yard	2	0	1	0	4	3	2	0
Open Field	8	2	2	1	3	4	3	6
Tidal land/Pond	1	0	0	0	3	0	0	0
Alley	3	0	2	0	0	1	1	3
Sum	26	5	8	2	15	18	10	15
Test	ChiSquare		Prob> ChiSq		ChiSquare		Prob> ChiSq	
Likelihood Ratio	35.037		0.0199*		42.207		0.0026*	
Pearson	33.854		0.0271*		45.445		0.0010*	

The more significant activity was found on riversides and in vacant lots, where residents of all ages most often congregated. This consistent use makes these areas evident as necessary, versatile, and accessible options for various uses. As for the range of people participating in open space activities, the active group outside the home is the adult group, as adult men are found in 69 open spaces and women in 60 spaces. While adults are the most active group outside the home, teenagers appear to be the least in open spaces, while male teenagers are in 41 open spaces. Meanwhile, children can be seen quite active in outdoor activities, such as fields with 16 and on the riverside with 15. Children mainly use such areas to play and swim, which only shows that they require open spaces for their playful activities.

Adult residents also show more diverse space use patterns. They are the group that utilises vacant land and house yards in small groups, indicating the need for shared spaces outside the house for more private and intimate socialising activities. However, open spaces have low involvement by teenagers in general and girls. This calls for customised strategies to motivate the use of such areas. Such spaces may be created that feel safe and appealing to youths; they should be spaces that address their interest, including sports amenities, social spaces, and programmed events for the youth. Because they are being highly used, urban planners should work on the bettering of riversides as well

as open fields. Children's active use of fields and riversides for playing and swimming shows the need for safe and well-maintained areas for recreational activities.

DISCUSSION

The results show that different open spaces cater to various needs and activities across demographic groups in riverside settlements—or multifunctional and inclusive design. The study reinforces the importance of designing open spaces that accommodate both solitary and social activities for diverse users. Previous research supports this, showing that well-designed open spaces enhance community engagement and quality of life in dense urban environments [34], thereby enhancing the overall quality of life in these densely populated areas [35]. In particular, open spaces in higher-density urban areas help alleviate crowding, making them essential for both mental and physical well-being [36].

Moreover, the discussion highlights the need for spaces supporting small and large group activities, especially for children, who benefit significantly from safe and affordable open spaces [37]. Creating such spaces requires integrating features like seating, shade, and lighting to support residents' activities, such as socializing, playing, or simply relaxing. Women often use house courtyards, gathering in small groups to chat while watching their children play. For young people, particularly teenage boys and girls, active and passive recreational areas that cater to their play and social interaction needs are essential [38].

While vacant lots and alleys serve as informal open spaces, the lack of proper facilities like seating and shading diminishes their full potential. These areas could be enhanced to serve as more permanent communal spaces, especially in communities with scarce formal open spaces. The proximity of vacant lots to homes makes them ideal for intimate gatherings, but improvements such as seating could further promote their use.

It also emphasizes the potential of riverside areas to become vibrant open spaces. Adding boat docks, pedestrian paths, and recreational facilities like fishing and swimming areas could transform these spaces into valuable community assets. Safe and accessible riverbanks would support recreational activities for children and provide areas for socializing and working. Such enhancements are vital for maximizing the functionality of these spaces [39].

The design should accommodate many possible user groups, from solitary to socially active. Therefore, the importance of grouping areas to facilitate solitary and group activities is based more on age groups [40]. Adult groups often socialise in these small groups [41]. Open spaces are sometimes used for large meetings or events that attract various groups of residents. The observation results also highlight the need for spaces accommodating large group meetings across all demographic groups, especially for children. Children need access to affordable activities in open spaces. City planners must consider the safety of children in open spaces, ensure safe access to rivers, and maintain clean and open fields [42].

Facilities in open spaces to support resident activities are still very lacking. Open spaces need to be arranged with seating, a comfortable and shady atmosphere, and adequate lighting. Women, for example, often gather in house courtyards or on settlement streets near stalls, chatting in small groups while observing their surroundings. Park planners and designers should prioritize the active social use of parks for young people by incorporating features like seating and terraces around street stalls, naturally attracting residents of all ages.

Although residents often use public spaces, vacant lots are privately owned properties. Their proximity to homes and the typically more intimate scale of these spaces make them attractive for small groups. Similarly, although primarily serving as pathways, alleys function as open spaces due to their closeness to homes and the limited availability of other open spaces. Adding seating facilities can enhance the function of alleys as social spaces for residents. Both open spaces serve as temporary alternatives.

All riverside settlements surveyed lack adequate open spaces in quantity, size, and supporting facilities. Various resident groups use the available open spaces along the riverbank differently. These riverside areas have significant potential to be developed to meet the basic needs for green and open

spaces [43]. It should be equipped with boat docks and pedestrian paths to optimize the riverbank as an open space. These piers and promenades should not only support accessibility but also serve as areas for socializing, playing, and working. Therefore, the piers must include waiting areas, seating, safety fences, and landscaping. Additionally, riverbank open spaces need to be equipped with facilities for recreational activities such as fishing, water play, and swimming. Children are very active in playing in open spaces. Their groups and locations vary. Lacking playgrounds, children often use settlement streets to play in large groups. By the riverside, they play and swim with a few friends. Children need open spaces for play with a variety of sizes and facilities. In the open riverside space, many activities can be accommodated. Children enjoy water play and swimming. Therefore, the riverside needs to be reorganized by adding play docks and barriers for boat-free areas and ensuring the cleanliness of the river water.

Apart from riverside areas, open fields in residential neighborhoods can be converted into multifunctional sports fields that cater to various demographic groups. These fields should be equipped with facilities to meet diverse needs. Adult women and men primarily use these areas for work or social events, requiring spacious, adaptable spaces for solo and communal activities. Teenage girls use the fields for play, sitting, and chatting, enjoying active and passive recreation, necessitating seating and chat areas. Teenage boys engage in sports and social interactions, highlighting the need for sports and play facilities with seating areas. Children typically use the fields for playing and sitting, emphasising the importance of safe, open areas. Overall, outdoor sports fields are vital community components, providing multipurpose facilities that enhance the quality of life for all residents by supporting various activities and interactions.

The yard, although narrow, is an important multifunctional space that serves the social needs of various groups. For adult women, the yard is mainly used as a sitting area and space for street vendors, offering a comfortable place to socialise, relax, and have a snack. Adult men use the yard as a place to sit and smoke. Snacks make this space attract many users. House yards with food stalls have become daily gathering centres for residents for informal economic activities and meetings. Adolescent girls and boys use home gardens primarily for seating, providing a safe and comfortable area for social interaction and passive recreation near their homes. Children use this space to play and sit, emphasising its versatility in supporting various activities. The yard's proximity to the house makes it ideal for a safe play area and social interaction.

Tidal fields and ponds in riverside settlements serve as unique open spaces. Adult women primarily use this area as a sitting room and enjoy the presence of the water landscape garden, which provides a tranquil atmosphere for relaxation and social interaction. The tidelands and pools offer seating areas, fishing spots, and landscaped water gardens for adult men, meeting their recreational and social needs. Teenage girls use this area primarily for seating, creating a calm environment for socialising. Teenage boys utilise this space for seating and fishing, supporting their need for recreational activities and social interaction. Children generally use tidal flats and pools to play and sit, taking advantage of the natural and adventurous environment for physical activity and social interaction. The proximity to water also allows children to engage in water-related activities.

CONCLUSION

The findings of this study highlight the diverse needs of different demographic groups in densely populated riverside settlements. Adults, adolescents, and children each exhibited distinct patterns of open space use. These results emphasize the need for planning and design tailored to the target user groups. Therefore, urban planners should prioritize the creation of inclusive, open spaces that serve both genders and all age groups. Design should ensure safety, accessibility, and the availability of facilities that support both solitary and group activities. Providing well-maintained playgrounds, social areas, and facilities for daily tasks will enhance the usability of open spaces for all residents. Given the limited availability of land in densely populated riverside settlements, optimizing the function of existing open spaces, especially riverbanks, is essential.

Riverbanks and open fields are open spaces that all residents actively use. Riverbank areas have the potential to be a multi-purpose open space option for various activities and need to be

supported by easy access. Enhancing riverbanks as natural open spaces can replace green spaces, providing areas for water absorption, natural habitats, and recreational activities. Riverbank landscaping with piers, walkways, and recreational facilities will enhance its function and appeal. Urban planners can design environments that support social interaction, physical activity, and overall well-being. The insights gained from this study provide a basis for developing open spaces that serve recreational and social purposes and contribute to the overall well-being of residents. This study has limitations in data collection, as it only takes data in a certain period, so it does not reflect seasonal variations or long-term changes. To address this issue, longitudinal studies are needed to understand how open space use changes over time. The focus of this study was limited to its geography, which may not apply to different geographical or cultural contexts. Future research can also be expanded to other locations with similar characteristics to strengthen external validity. Furthermore, the study can be complemented with the application of qualitative approaches such as in-depth interviews and focus group discussions to provide deeper insights into the motivations and perceptions of open space users.

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DECLARATIONS

Conflict of Interest

The authors declare no conflict of interest with any financial, personal, or other relationships with other people or organizations related to the material discussed in the article.

Ethical Approval

The research has been approved by the Universitas Sriwijaya. All research was carried out in accordance with Universitas Sriwijaya research ethics guidelines applicable when human participants are involved.

Informed Consent

On behalf of all authors, the corresponding author states that all participants have been given informed consent and agreed to take part in this study.

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