

Research Article

Urban Riverside Area Development Study (Case Study: Bah Bolon River, Pematang Siantar City)

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Abstract: Urban riverbank areas are strategic spaces that hold ecological, social, cultural, and economic significance. In Pematang Siantar City, the Bah Bolon River has the potential to be developed as a sustainable urban ecotourism corridor. However, its current condition is marked by environmental degradation, infrastructure limitations, and poor spatial utilization. This study aims to identify development strategies that integrate environmental conservation, community-based tourism, and urban revitalization through placemaking and sustainable planning. This research adopts a qualitative descriptive approach focusing on the Bah Bolon River area in Pematang Siantar City. Data were collected through field observations, in-depth interviews with stakeholders, documentation review, and literature studies. The analysis involved descriptive mapping, SWOT analysis, community preference surveys, and land suitability assessments. Findings revealed that three key river segments—RINDAM I/BB area, Jalan Diponegoro–Jalan Jenderal Sudirman corridor, and the Quan Im Temple zone—exhibit varying levels of potential for ecotourism, cultural heritage, and public green space development. Key issues include pollution, informal land use, weak coordination, and insufficient infrastructure. Development opportunities include white-water rafting, thematic parks, spiritual reflection gardens, and creative economic zones. The study proposes an integrated riverbank development strategy, encompassing spatial zoning, ecological restoration, tourism infrastructure, community empowerment, and regional branding. It recommends the establishment of a multi-sector management agency, master planning, and cross-stakeholder collaboration to transform Bah Bolon River into a sustainable, inclusive, and resilient urban corridor.

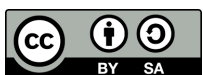
Keywords: Bah Bolon River; Community-Based Tourism; Ecotourism; Placemaking; Sustainable Planning

1. Introduction

Riverbank areas in urban areas are spaces that have strategic ecological, social, cultural, and economic value. They play an important role in the structure and dynamics of urban development, which is a connecting corridor between the environment and people's lives. In the context of increasingly rapid urbanization, the development of riverbank areas is a challenge as well as an opportunity in planning urban development to present inclusive, adaptive, and sustainable public spaces. However, many riverbank areas are faced with problems such as environmental degradation, flooding, slums, and uncontrolled land conversion. Therefore, the development of riverbank areas should not only focus on aesthetic aspects or commercialization alone, but more than that must pay attention to environmental carrying capacity, preservation of local culture, and the needs of the people living around it.

Good riverbank development can improve the quality of life, while poor management can cause problems such as flooding, environmental damage, and inability to optimally access water resources.

Received: August 22, 2025
Revised: September 06, 2025
Accepted: September 20, 2025
Online Available: September 22, 2025
Curr. Ver.: September 22, 2025



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Pematang Siantar City is the second largest city in the North Sumatra Province after Medan City as the provincial capital. In the city area, a river called Bah Bolon flows from north to south and empties into the Malacca Strait. It has a length of about ± 118 km with a width of 20-25 m (BPS, 2024). Divides the central area of Pematang Siantar City into two parts. One part, namely on the east side, is an indigenous settlement (inlander) and on the west side it has been a gemeente area since 1917 (Damanik, et al., 2020).

The phenomenon of high population growth rates in general has an impact on the problems faced by the city of Pematang Siantar. This condition causes an increase in the need for residential areas. Especially in development activities carried out by the non-formal sector, resulting in the emergence of dense and irregular slum housing environments, and do not have environmental facilities and infrastructure that meet technical and health standards (Yudohusodo 1991: 331). Settlements on riverbanks are generally a group of people who are marginalized by a social order both in terms of economy, education and culture that does not support them, and occupy land that should not be used for buildings (Sugiarto & Ramadania, 2024). Referring to the problem of slum settlements, a strategy is needed that can reduce or even eliminate slums in residential environments including settlements on riverbank areas (waterfront).

The central government's program to improve national transportation routes in the form of the construction of the Trans Sumatra route in the form of toll roads has had an impact on decreasing economic activity in areas along the national road. Several areas have felt the impact, including Deli Serdang Regency, Serdang Bedagai Regency, and Tebing Tinggi City. Since the operation of the Kutepat Toll Road (Kuala Namu - Tebing Tinggi - Parapat), at the end of 2024, the areas mentioned above have experienced a drastic decrease in visitors. This will of course have an impact on the community's economy. Until this article was written, Pematang Siantar City was still the final destination of the Kutepat Toll Road. It is believed that when this route reaches the Parapat area (Simalungun Regency), it is very possible that this obstacle will also be felt by the second largest city in North Sumatra. One anticipation that can be done is to create attractive destinations. So that the public's enthusiasm to continue to come to visit will always be there. Of course this will have an impact on the economy.

The realization of this destination can be done by developing the Bah Bolon River waterfront area as a recreational area. This is in line with the Pematang Siantar City Government policy in the field of spatial planning where one of the main directions of its management is the Protected Area and Development of Cultivation Areas. The position of the Bah Bolon River bank area as a green belt which is part of the Green Open Space (RTH) in Pematang Siantar City, has an important role in improving the quality and condition of the environment that is beautiful, comfortable, and clean. The development plan for this area will support the tourism program, which makes water tourism in the form of rafting activities an annual agenda. This water activity utilizes the rapids on the Bah Bolon River. Unlike the rapids in other areas, the rapids on the Bah Bolon River in Pematang Siantar City give a unique impression because it is located in a densely populated urban area. In addition, other supporting factors are the existence of superior agricultural and fisheries sectors along the area. What the Pematang Siantar City Government needs to do is develop infrastructure and design waterfront areas that can accommodate the activities of the community in this area and can also increase regional economic income.

According to Sulistyaningsih & Mentayani (2021), the application of the concepts and methods applied can be through: 1) Utilization of natural potential and restoration of river functions as an effort to improve environmental quality, 2) Riverside areas can be revitalized into recreational areas for children and families to relax, play, etc, 3) Provision of green open spaces and other supporting facilities that can generate positive community activities in the surrounding area..

In addition to the above, it is always necessary to carry out efforts to protect and rehabilitate rivers, including increasing public awareness of the importance of maintaining the cleanliness and sustainability of rivers (Sugiharto & Ramadania, 2024).

The development of riverbank areas in urban areas, in this case the Bah Bolon Riverbank Area in Pematang Siantar City, in order to provide a positive effect for the community and the city government, it is necessary to conduct an evaluation and design of a strategy for developing an area based on Green Open Space (RTH) that is optimal and relevant to the needs of tourists and the local community. To achieve the goal, it can be started from the

process of identifying the potential and prospects for developing the area and analyzing strategic steps to optimize the development of the Bah Bolon Riverbank area in Pematang Siantar City.

Formulation of the problem; The development of the Bah Bolon Riverbank Area in Pematang Siantar City faces various complex problems, including: 1) Environmental Pollution; Riverbank areas in some locations become dumping grounds for garbage, industrial waste, and dirty water. Water pollution can threaten environmental quality, public health, and river ecosystems, 2) Irregularity in Land Use; Land use along the river is not well coordinated. Unregulated land use has led to the emergence of unsuitable residential areas, dense commercial areas, and even illegal buildings that disrupt the ecological function of the river, 3) Floods and Disaster Risk; Areas along rivers are prone to flooding, especially due to inadequate drainage systems or development that damages water catchment areas. This is further exacerbated by climate change which increases rainfall intensity and flood risk, 4) Infrastructure Limitations; Riverbank areas have limited access and poor infrastructure, especially in areas that are already developing rapidly. This can hinder further development and reduce the quality of life of residents in the area, 5) Population Growth and Urbanization; Rapid urbanization processes drive high population growth around riverbank areas. This can lead to problems such as poverty, overpopulation, and pressure on natural resources and existing infrastructure, 6) Ecosystem Damage; Unfriendly development activities can damage the ecosystem along the river, such as destroying the habitat of local flora and fauna. Changes in water flow and deforestation can also affect biodiversity around the river, 7) Budget and Management Limitations; Sustainable management of riverbank areas is often hampered by government budget constraints and suboptimal coordination between parties. Without effective management, these areas could experience further degradation, 8) Conflict over Use of Space; Sometimes riverbank areas become a point of conflict between the interests of property developers, industry, government and the community. Unfair distribution of space can cause social tensions, 9) Imbalance between Economic Development and Conservation; Sometimes there is a dilemma between encouraging economic development, such as building commercial or residential facilities, and the need to maintain the sustainability of river ecosystems and green open spaces.

Research purposes; The study of urban riverbank development is related to management and design to maximize the potential of the area in a sustainable manner. The main objectives of this study include: 1) Improving Environmental Quality; Identifying ways to protect and improve the environmental quality of rivers and surrounding areas, including pollution control and maintenance of natural ecosystems, 2) Natural Resource Management; Assess and plan the use of natural resources around rivers, such as land, water and vegetation, so that they can be used wisely without damaging the environment, 3) Infrastructure Improvement; Planning the development of infrastructure that supports accessibility and the attractiveness of the area, such as roads, bridges and other public facilities, which can improve the quality of life of the people around the area, 4) Economic Development; Develop strategies to develop local economic sectors through tourism, fisheries, agriculture and other sectors based on the potential of riverbank areas, 5) Disaster Mitigation; Planning steps to reduce the risk of natural disasters such as floods or landslides that often occur in areas around rivers, 6) Social and Cultural; Respect and preserve the cultural heritage and social life of communities living around rivers, and strengthen community involvement in decision-making.

Benefits of research; Theoretically, this research will contribute to the development of science in the field of urban planning, especially in the management of green open spaces integrated with sustainable tourism development. Academically, this research aims to add to the academic literature related to the development of green open space-based tourism objects through the theory of development in sustainable water tourism planning (riverbank) with a socio-cultural approach. Practically, this research is useful in providing strategic input and recommendations for local governments and other stakeholders in managing and developing riverbank areas as green open space-based tourism destinations to be used as a basis for planning environmentally friendly tourism area development policies. In addition, this research is expected to be able to increase local community awareness of the importance of preserving green open spaces in supporting the tourism sector.

Previous Research Review; Previous studies provide an important foundation for this study. Tomigulung, et al. (2018) emphasized that optimizing the arrangement of riverbank areas, one of which is by making the river the front yard of buildings along the river. This condition is achieved by rearranging existing buildings and in preparing plans for facilities and

infrastructure that support the activities that occur. Further explained, to prevent the uncontrolled spread of residential buildings, it is necessary to plan the procurement of multi-residential buildings (flats) to meet the need for shelter for residents living along the river (relocation).

Sugiarto (2024) describes riverbank land management as being carried out through management, control, and supervision of riverbank land use for community welfare. Controlled riverbank land management will produce a fresh and healthy environment for the community and strengthen the land's carrying capacity from the threat of pollution and erosion.

Ginting and Ikhsan (2020) stated that the arrangement of the waterfront area should be carried out by providing a wider space for users to carry out waterfront activities. Buildings with a function to support activities should be relocated to areas that do not block access to the waterfront.

Siregar and Harahap (2022) found that the quality of green open space (RTH) significantly affects the level of visitor satisfaction and loyalty in the Sipirok nature tourism area. This finding is in line with a study by Putri and Siregar (2022) which evaluated the social function of RTH in urban areas, and concluded that RTH has a strategic role in supporting social interaction in the community while attracting tourist interest.

Furthermore, Lubis and Ritonga (2023) emphasized the importance of a participatory approach in developing community-based ecotourism in the Tapanuli area, which showed that community involvement is a key factor in the success of nature-based tourism destinations. The emphasis on strengthening collaboration is also seen in the research of Daulay and Hasibuan (2024), which suggests a strategy for developing rural tourism through strengthening infrastructure, digital promotion, and collaboration between stakeholders.

An addition, Harahap and Siahaan (2023) revealed that tourism infrastructure has a dominant influence on the level of tourist visits in the Mandailing mountainous area, emphasizing that the availability of facilities and infrastructure is an important element in supporting tourist attractions. All of these findings provide relevant theoretical and empirical support for this study, especially in understanding the relationship between environmental quality, social roles, community participation, and infrastructure support in the development of sustainable tourist destinations.

2. Preliminaries or Related Work or Literature Review

2.1 River Edge Areas

The riverbank area is an area along the river that has high ecological, social, economic, and cultural potential. Spatially, this area is included in the river boundary area that can be utilized in a limited manner in accordance with laws and regulations..

2.2 Sustainable Tourism Concept

Sustainable tourism is a form of tourism activity that takes into account environmental, economic and social aspects to ensure the long-term sustainability of the destination. The main principles in developing sustainable tourism include: (a) Protecting the natural environment and local culture. (b) Improving the welfare of local communities. (c) Providing authentic experiences to tourists.

According to Lubis and Ritonga (2022), in its development, environmental carrying capacity and community participation must be considered in each stage of development (Lubis and Ritonga, 2022).

2.3 Community Based Tourism

The emphasis on the active role of local communities in the planning, management, and supervision of tourism activities is the main characteristic of the concept of community-based tourism. The application of this concept by placing local communities not only as objects of activities, but as subjects who are empowered and have ownership of the process and benefits of tourism development (Sugiarto & Ramadania, 2024).

This concept allows communities to maintain local identity, build self-capacity, and improve welfare through direct involvement. The application of this concept can be applied in the study area considering the condition of the Pematang Siantar City community, especially those living along the Bah Bolon Watershed, who have local wisdom and strong potential to manage tourism independently if properly facilitated. Efendi & Rambe (2023) stated that the community-based tourism approach will be effectively applied to natural-based tourism areas that are still natural and unexploited (Efendi & Rambe, 2023). With this approach, a harmonious relationship between tourists and residents and economic equality can be realized.

2.4 Waterfront Area Development

Waterfront is a transition zone between land and water bodies (rivers, lakes, seas) that has the potential to become a center for social, cultural, and economic activities. The development of waterfront areas has the following principles: Terdapat akses publik ke tepi air: (a) Mixed-use function utilization. (b) Activation of public spaces. (c) Preservation of historical and cultural values.

2.5 Placemaking Concepts

Placemaking is an approach to the design and development of space that places people at the center of planning. The goal is to create meaningful, comfortable, and attractive spaces for people and visitors. The main characteristics of this concept are: (a) Has high accessibility. (b) Various activities. (c) Have a strong image and identity. (d) Community involvement.

2.6 The Concept of Experiential Tourism

Experiential tourism emphasizes direct interaction between tourists and the environment and the community. The emphases of this concept include: (a) There is an emotional and authentic experience experienced by tourists. (b) Dominated by participatory activities (culinary, crafts, nature exploration). (c) Cultural and social interactions.

2.7 Destination Image Concepts

Destination image is a tourist's subjective perception of a place, which influences the tourist's decision to visit. Included in the concept of destination image are: (a) Physical attributes (beauty, infrastructure). (b) Social attributes (safety, friendliness). (c) Emotional attributes (comfort, finance).

2.8 Concepts Relationship

Riverside areas can be developed as sustainable community-based tourism destinations through placemaking and experiential tourism approaches. Strengthening the destination image and implementing waterfront development will strengthen the attraction of tourists socially, economically, and ecologically.

3. Proposed Method

3.1 Research Approaches and Types

This study uses a qualitative descriptive approach, with the aim of gaining a deeper understanding of the existing conditions of the riverbank area and its potential for development as a tourism area. This approach is carried out to extract data based on perceptions, experiences, and social dynamics in the field that cannot be explained quantitatively alone (Yin, 2000 in Nuraini, 2024; Moleong 2000 in Nuraini, 2019; Creswel, 2000 in Nuraini & Suprayitno, 2021; Nuraini et al, 2024)

3.2 Research Location

The research location is the area along the banks of the Bah Bolon River in Pematang Siantar City which has the potential or has been developed as a tourist destination and/or activity center, both formal and non-formal

3.3 Research Focus

This research focuses on: (a) Natural, cultural and social potential of the Bah Bolon River area in Pematang Siantar City as a tourist attraction. (b) Local community needs and expectations regarding regional development. (c) Compliance of existing conditions with the principles of sustainable tourism, community-based tourism, and planning that places humans as the subject (placemaking).



Figure 1. Map of the Bah Bolon Watershed Route in Pematang Siantar City.

3.4 Collection Data Method

The required data, both primary data and/or secondary data, is collected using methods: (a) Literature Study, Carried out by reviewing theories, regulations and previous studies that are relevant to the topic. (b) Field Observation, Directly observe the physical condition of the riverbank area (accessibility, cleanliness, facilities and activities). (c) In-depth Interview, Carried out against: residents around the area, local tourism actors (traders, guides, communities), local government/tourism office. (d) Documentations, Documentation collection includes photos, maps, sketches, and field notes to support and strengthen findings.

3.5 Research Approaches and Types

This study uses a descriptive qualitative approach that aims to understand the existing conditions of the area and formulate a strategy for its development as a tourist destination. This approach is used to enable the acquisition of in-depth information related to the physical, social, cultural characteristics, and potential problems in the area.

This research is a regional development study, which examines the potential and opportunities for tourism-based spatial planning that involves community participation and various stakeholders.

3.6 Location and Time of Research

The research was conducted in the area along the Bah Bolon Watershed, which is located in Pematang Siantar City, North Sumatra Province. Based on the characteristic analysis, the concentration of the research area to be developed will then be determined. This location was chosen because it has attractive tourist attractions that have been ongoing and have become a new trend for tourists, namely white water rafting which has its own characteristics, namely rafting in urban areas. This research was conducted from January 2025 to March 2025, which includes the stages of data collection, analysis, and preparation of recommendations.

3.7 Data Types and Sources

3.7.1 Primary Data

Primary data is obtained through: (a) Field observations of physical conditions, land use, community activities, and infrastructure on the riverbank. (b) In-depth interviews with stakeholders, such as local residents, community leaders, local business actors, and representatives of related agencies. (c) Questionnaire to find out community and tourist preferences for regional development.

3.7.2 Secondary Data

Secondary data was obtained from: (a) Planning documents such as RTRW, RDTR, RPJMD, tourism masterplan, and other documents from government agencies. (b) Statistical and population data from the Central Statistics Agency (BPS). (c) Satellite imagery or area maps from technical agencies or open sources. (d) Literature study and relevant previous research references.

3.7.3 Data Collection Technique

Data collection techniques used include: (a) Direct observation in the field to record physical aspects and activities along the edge of the Bah Bolon watershed. (b) Semi-structured interviews with key informants to explore views and suggestions for area development. (c)

Documentation study, namely collecting planning documents, spatial data, and photo archives as supporting materials for analysis.

3.8 Data Analysis Techniques

Data analysis was carried out qualitatively through the following stages: (a) Descriptive analysis, to describe the existing conditions of the area based on the results of observations, interviews, and documentation. The aspects analyzed include physical, socio-cultural, economic conditions, as well as supporting tourism facilities and infrastructure. (b) SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis, to identify strengths, weaknesses, opportunities and threats in the development of tourism areas. The results of the SWOT analysis are used as a basis for compiling development strategies. (c) Analysis of community preferences to determine the perception and expectations of the community/tourists towards the development of the area. The results are analyzed in the form of simple tabulations or thematic categorization. (d) Land suitability analysis, carried out using a scoring method to determine suitable areas as tourist zones, open spaces, or supporting facilities. (e) Synthesis of regional planning strategies, the results of all analyses are synthesized into regional development directions, including spatial zoning, regional management, and proposals for the planning and development of tourism based on local potential.

3.9 Informant and Respondent Determination Techniques

Key informants were selected purposively, namely based on their role and knowledge of the study area (Yin, 2000 in Nuraini, 2024; Moleong 2000 in Nuraini, 2019; Creswel, 2000 in Nuraini & Suprayitno, 2021; Nuraini et al, 2024). Informants consisted of community leaders, local business actors, local residents, and officials/staff of the tourism or spatial planning office. In using the questionnaire, respondents were determined using the accidental sampling method, namely anyone who was at the location of the area when data was collected and was willing to fill in the questionnaire (Yin, 2000 in Nuraini, 2024; Moleong 2000 in Nuraini, 2019; Creswel, 2000 in Nuraini & Suprayitno, 2021; Nuraini et al, 2024).

3.10 Data Validity Test

The validity of the data in this study is guaranteed through triangulation techniques, namely: (a) Triangulate sources by comparing information from interviews, observations, and documents. (b) Triangulation techniques use more than one data collection model (observation, interviews, questionnaires). (c) Cross-check with previous planning or study data to avoid bias.

4. Results and Discussion

4.1 Existing Conditions of the Area

Geographically, Pematang Siantar City is located at 02°53'20"-03°01'00" N and 99°01'00"-99°06'35" E surrounded by the Simalungun Regency area, with a land area of 79,971 km² and located at 400-500 meters above sea level, consisting of 8 (eight) sub-districts and 53 (fifty-three) urban villages, a population of 279,198 people with a growth rate of 0.82% and a density of 3,491 people/km² (BPS, 2025).

The research area is the Bah Bolon Watershed which flows from the north to the south with a total length of ± 12 km with an average width of 20.5 m. It crosses 5 (five) sub-districts, including: East Siantar District, West Siantar District, South Siantar District, Siantar Sitalasari District, and Siantar Marimbun District. The length of the Bah Bolon Watershed which crosses Pematang Siantar City plus the green belts found in other watersheds, has an important role in contributing to the area of public green open space. When compared with the provisions of the River Boundary Line based on the Pematang Siantar City Spatial Plan 2012-2032 (Regional Regulation No. 1 of 2013), based on the limitations and conditions of the river boundaries, this area will contribute 909.18 Ha of green open space area from the target of 1,642.7 Ha of Public Green Open Space (20.54%) and 979.23 Ha of Private Green Open Space (12.25%). Meanwhile, the cumulative target of green open space until 2032 is 2,621.93 Ha or around 32.79% of the area.

Currently, the existing Public Green Open Space in Pematang Siantar City reaches $\pm 1,857.48$ Ha or around 23.22% of the sub-district area (Sihombing, et al, 2021). Based on the area of Public Green Open Space in Pematang Siantar City, it is currently considered to still meet the provisions of existing regulations. However, in the future, due to population growth, increased social and economic activities, it is possible that Green Open Space will experience a decline, especially due to the impact of development activities.

The area formed by the river boundary line along ± 12 km on the left and right sides of the Bah Bolon Watershed requires attention from all stakeholders to control its utilization.

Development activities to provide space to fulfill the need for housing, especially those carried out by the non-formal sector, will result in uncontrolled land cover activities, which will ultimately reduce the percentage of available public green open space. Controlling and managing land in the context of a river boundary along ± 12 km is not an easy thing, therefore it is necessary to determine the priority scale for handling it. As an initial step, the concentration of handling the area to be managed is carried out through considerations, including: (1) There are similarities in characteristics, this will make it easier to determine handling steps. (2) problems that must be addressed immediately, the degradation of the area's function due to uncontrolled development activities requires taking concrete handling steps. (3) Potential areas that can be developed, rafting activities that have been ongoing for some time, both those managed by the Pematang Siantar City Government through related agencies, and by the community, require support in the form of adequate facilities and infrastructure.

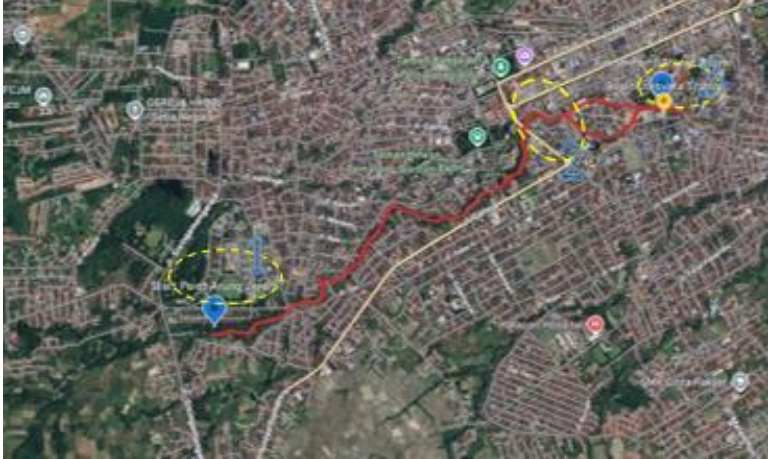


Figure 2. Existing Conditions of the Area
(Sources : Survey Result, 2025)

Based on the results of the field survey with an emphasis on the three factors above, 3 (three) areas were determined to be the focus of the research, including:

a. The boundary of the Bah Bolon River in the area of the Regional Military Main Regiment/RINDAM of the I/BB Military District in Setia Negara Village, Siantar Sitalasari District

Table 1. Boundary of the Bah Bolon River

	Existing Conditions:
	- River width : 12,0 – 18,0 m
	- Depth : 70 - 400 cm
	- Cliff/Embankment Height : 50 - 950 cm (sloping – steep)
	- Border : 2,0 – 15,0 m
	- High/Low Tide Elevation : ± 0 - 50 cm
	Land Use:
	Most of the river boundary areas in this segment are dominated by residential areas, educational facilities, and the rest is agricultural land for residents.

Sources: Survey Result

- b. The boundary of the Bah Bolon River in the area of Jalan Diponegoro - Jalan Jend. Sudirman - and Jalan M.H. Sitorus in Teladan Village and Timbang Galung Village, West Siantar District.

Table 2. Boundary of the Bah Bolon River

	Existing Conditions:
	- River width : 15,0 - 20,0 m
	- Depth : 300 – 600 cm
	- Cliff/Embankment Height : 250 - 900 cm (medium - steep)
	- Border : 0 - 15 m
	- High/Low Tide Elevation : ± 0 - 100 cm
	Land Use:
	Buildings with residential functions, both private residences (residents' houses) and commercial residences (hotels), public infrastructure (places of worship and educational buildings), business functions (kiosks/ shops/ supermarkets),

Sources: Survey Result

- c. The Bah Bolon River boundary in the area of the Goddess Quan In Temple in Simalungun Village, South Siantar District.

Table 3. Boundary of the Bah Bolon River

	Existing Conditions:
	- River width : 17,0 – 18,5 m
	- Depth : 3 - 6 m
	- Cliff/Embankment Height: 400 - 450 cm (medium - steep)
	- Border : 0 - 6,5 m
	- High/Low Tide Elevation : ± 0 - 100 cm
	Land Use:
	Buildings with private residential functions (residents' houses), public infrastructure (places of worship), business functions (kiosks/ shops/ supermarkets)

Sources: Survey Result

The selection of the three locations in sequence is the upstream - downstream route, the starting point (start) of rafting activities - check point - end point of rafting activities. The main problems found in the three selected areas include: (a) Physical: there is degradation of river banks, household waste, illegal occupancy, and border conditions that are not well organized and utilization is not yet clear. (b) Social: minimal community activity along the riverbank. (c) Infrastructure: limited road access and lack of supporting public facilities.

4.2 Development Potential

Before determining the potentials that can be developed for each research area, it is necessary to determine the delineation of the planning area. The planning area is the area on the left and right sides of the Bah Bolon watershed for the three selected locations, by utilizing the width of the space limited by the river boundary line in accordance with existing provisions. In sequence, the delineation of the planning area for the three specified areas is:

- a. The Bah Bolon River boundary in the area of the Regional Military Main Regiment/RINDAM Kodam I/BB in Setia Negara Village, Siantar Sitalasari District:



Figure 3. The delineation of the planning area.

(Sources: Analysis, 2025)

The potential development area is ± 16.43 Ha. This area is planned as an entry point or starting point for rafting activities. The potential in this area that supports it as an entry point includes: being in the upstream area of an urban river, having relatively fast and clean flow conditions, there are fairly wide and gentle riverbanks as a staging area, close to RINDAM I/BB and public open space (Rindam Park), and close to public vehicle routes.

- b. The boundary of the Bah Bolon River in the area of Jalan Diponegoro - Jalan Jend. Sudirman - and Jalan M.H. Sitorus in Teladan Village and Timbang Galung Village, West Siantar District. The area with potential for development is ± 24.88 Ha



Figure 4. Diponegoro Street Area.

(Sources : Analisis, 2025)

Diponegoro Street Area, It is a commercial zone (trade). Its existence as an economic and trade corridor (shopping and service center). The riverbank is still partly natural but not organized, and is close to dense settlements and traditional market areas

General Sudirman Street Area, It is an urban institutional and transit zone, close to the Mayor's Office, Bappeda Office, and educational facilities. This area is also the main access for vehicles and the city's transportation flow route. The Bah Bolon watershed that crosses Jalan Jendral Sudirman is connected by a bridge that can be used as a circulation landmark.

M.H. Sitorus Street Area, It is a historical and cultural tourism zone of the city because its location is close to the Pamatang Area which is the center of the Simalungun Kingdom, the Sang Nauluh Damanik Statue and the Thematic Park. The river border area has high cultural and spiritual value. Another potential for development is the existence of open space that has the potential for revitalization.

- c. The Bah Bolon River Boundary in the area of the Goddess Quan In Temple in Simalungun Village, South Siantar District. The area with potential for development is $\pm$ 7.47 Ha.



Figure 5. Diponegoro Street Area.

(Sources : Analisis, 2025)

It is a religious zone (Avalokitesvara Temple) and the most famous religious tourism in Pematang Siantar City. The calm water flow with a gentle contour of the border is suitable as an ending point (stop) for rafting activities. In addition, there is an open space around the temple building that has the potential to be developed as a spiritual and educational public space.

Table 1. Potential for Area Development.

AREA		POTENTIAL DEVELOPMENT
RINDAM	I/BB	<i>White Water Rafting Tour</i>
Area River Border		As an entry point for white water rafting because the water discharge is quite fast and vehicle access is adequate. It is necessary to build a pier, operator basecamp, equipment rental place and briefing
		<i>Green Open Space (RTH)</i>
		Development of Thematic City Parks, Educational Military Parks, Historical Parks, or Outdoor Sports Spaces
		<i>Environmental Education Center</i>
		Pilot area for river boundary conservation with educational function: ecopath, water education park, fishing area
		<i>Community Creative Zone</i>
		Youth expression space: murals, fine arts, open stage (amphitheatre), outdoor classes, environmental and arts communities
River Area	Boundary of Jalan Diponegoro - Jalan Jendral Sudirman - Jalan M.H. Sitorus	<i>Diponegoro Street Area</i>
		- Construction of pedestrian paths (jogging tracks) and bicycle paths on the river banks
		- Revitalization of river banks into environmentally friendly linear parks
		- Creative kiosks & UMKM in the connecting zone between the bridge and the sidewalk
		<i>General Sudirman Street Area</i>
		- Strengthening educational and conservative functions in the form of building water education parks, river history signage and ecotourism zones.
		- <i>Urban Rest Point in the form of public benches, mini parks and pedestrian shelters.</i>

AREA	POTENTIAL DEVELOPMENT
River Border of the Dewi Kwan Im Temple Area	- Festivals and community activities in the form of providing a space for riverside artistic expression.
	<i>M.H. Sitorus Street Area</i>
	- Ecological spiritual space by placing a reflection garden, silent walkway, and open prayer space. - Information center for city history and river culture.
	<i>Religion and Culture</i>
	Development of a spiritual reflection garden on the riverbank in the form of a footpath, stone seating and bamboo landscaping.
	<i>Rafting</i>
	The rafting end point is on the edge of the monastery as a symbol of the harmony of water and spirituality in the form of an environmentally friendly pier.
	<i>Education and Conservation</i>
	The information center for Chinese culture and the history of the temple, combined with river ecology education, can be in the form of an open space (amphitheatre).
	<i>UMKM and Culinary</i>
	Halal and vegetarian culinary zones, as well as stalls selling local and Chinese cultural souvenirs.

Sources: Analysis Results

4.3 Problems and Recommended Solutions

The problems and challenges faced in developing the Bah Bolon Riverbank Area in Pematang Siantar City into an educational, environmentally friendly tourist area that still maintains local wisdom so that it can provide a positive effect for the community and the city government, include weak regulations on river boundary management, lack of public awareness, and the absence of an integrated master plan design. In more detail, the problems faced are described in the following table below.

Table 2. Problems and Recommended Solutions

NO.	PROBLEMS	IMPACT	RECOMMENDED SOLUTIONS
1.	Unorganized river banks, used for illegal settlements and informal activities	Deterioration of the visual and ecological quality of the area	Reorganization of boundaries, gradual relocation with a social approach, and strengthening the function of public spaces
2.	Pollution of household and market waste into rivers	Declining water quality and ecosystems	Improvement of drainage system and communal wastewater treatment plant; community education about clean environmental behavior
3.	Erosion and river bank damage	Safety threats and destruction of natural landscapes	Planting of riparian vegetation, construction of gabions or reinforcement of natural banks
4.	Lack of pedestrian paths and public facilities	The area is not friendly to visitors and tourists	Development of community-based pedestrian paths, jogging tracks and riverside parks

NO.	PROBLEMS	IMPACT	RECOMMENDED SOLUTIONS
5.	Weak coordination between OPDs	The development program was partial and ineffective	Formation of cross-sector coordination team and preparation of riverbank masterplan
6.	Seasonal river water discharge fluctuations	Safety risks for water tourism and rafting	Whitewater rafting season scheduling, early warning system & safety officer training
7.	Lack of human resources and water tourism infrastructure	Failed to attract tourists and investors	Tour guide training, provision of standard piers, and promotion of thematic tourism (river adventure)
8.	There is no branding or strong image of the river as a destination	Lack of visits and community participation	Development of annual events (River Festival), naming of tourism zones, and collaborative digital promotion

(Sources : Analysis Results, 2025)

4.4 Development Strategy

Development strategies that can be applied for the short and medium term in the Development of the Bah Bolon Riverbank Area in Pematang Siantar City include:

- a. Arrangement of spatial zoning for public, conservation and economic purposes
 - Preparation of the Bah Bolon Riverbank Area Master Plan as a whole from upstream (RINDAM I/BB area) to downstream (Dewi Quan Im Temple area);
 - Arrangement of river boundaries as multi-function corridors such as green belts, tourist areas and city public spaces;
 - Construction of pedestrian paths, rafting piers, themed parks, and supporting infrastructure such as lighting, drainage systems, and safety signs;
 - Rehabilitation of cliffs and river borders with local riparian vegetation (water bamboo, river pandan, vetiver, etc.); and
 - Strengthening the waste management and sedimentation system, including the installation of communal wastewater treatment plants and water absorption zones.
- b. Increased accessibility and connectivity
 - Construction of new roads/access to the location;
 - Repair of existing roads/access;
 - Creation of public transportation routes to the location;
 - Provision of sufficient parking spaces, especially during events.
- c. Multi-party collaboration and empowerment programs.
 - Establish a collaborative Bah Bolon Riverbank Area Management Agency (cross-agency, community and private sector);
 - Encourage multi-stakeholder financing schemes (APBD, company CSR, village/sub-district funds, and community participatory funds);
 - Develop a public-private partnership model for the development and management of water tourism infrastructure.
 - Building regional identity through branding such as: “Siantar Waterfront”, or “Bah Bolon Eco-Cultural River”.
 - Organize regular events such as: Bah Bolon Festival, Traditional Boat Race, River Exploration, and Riverbank Creative Space.
 - Maximizing digital promotion through social media, the official website of the Pematang Siantar City Government, and collaboration with online tourism platforms.

Table 3. Development Strategy.

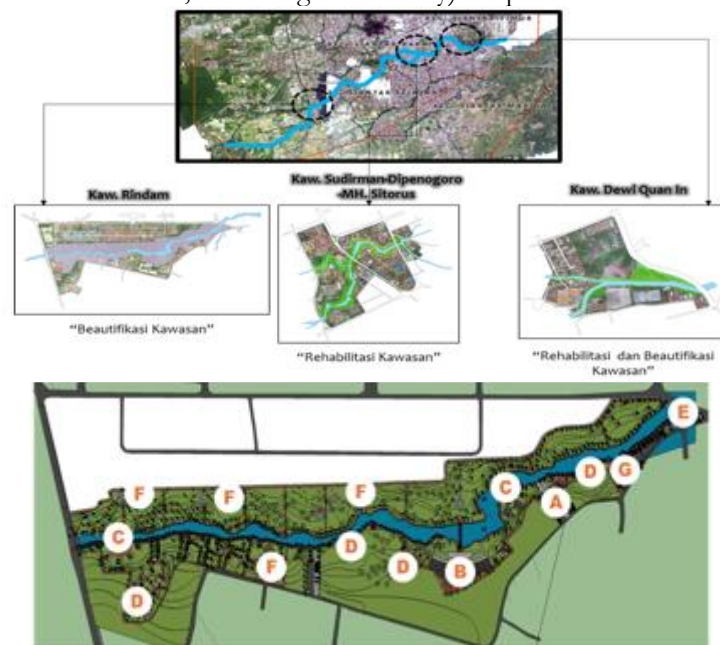
STRATEGY	OBJECTIVE	IMPLEMENTATIONS
Spatial Planning and Infrastructure	Making the riverside area a multifunctional city corridor	Preparation of masterplan; construction of pedestrian, park, and tourist pier
Environmental Conservation	Restoring environmental quality and ecological function of rivers	Cliff rehabilitation; riparian vegetation; waste management and environmental education
Tourism Development and Creative Economy	Enhancing the attractiveness of the area and the local economy	Development of white water rafting; cultural festival; culinary zone and UMKM kiosks
Institutions and Financing	Ensuring the sustainability of area management	Establishment of a management body; collaborative financing; PPP scheme
Promotion and Branding	Improving public image and participation	Regional branding; regular events; digital promotion and tourism cooperation

(Sources : Analysis Results, 2025)

Meanwhile, the long-term development strategy is to make the Bah Bolon River an icon of a water-friendly, green and inclusive city by encouraging the border area to become a sustainable economic and social corridor in order to realize the integration of cultural ecological-social-tourism functions in a strategic area.

4.5 Development Concept

The design recommendations of the Urban Riverside Area Development Study (Case Study: Bah Bolon River, Pematang Siantar City) are presented in the following figures.

**Figure 5.** Design directives for the three areas.

(Sources : Analysis, 2025)

Legends:

- A : Main Gate and Parking Area
- B : Amphitheater and Bridge
- C : Rafting Station
- D : Gazebo
- E : Regional Identity
- F : Public Toilets and Pedestrianization

G : Parking Area



Figure 6. Main Regiment Area of the Military Region/RINDAM Kodam I/BB.
(Sources : Analysis, 2025)

Legends:

A : Core Zone Area

B : Ecological Open Space



Figures 7. Diponegoro Street Area - General Sudirman Street - M.H. Sitorus Street.
(Sources : Analysis, 2025)

Legends :

A : Main Gate

B : Amphitheatre

C : Rafting Station

D : Gazebo

E : Bridge

F : Public Toilets

G : Parking Area

H : Multifunctions Open Space



Figure 8. Goddess Kwan Im Temple Area (1).
(Sources : Analysis, 2025)



Figure 9. Goddess Kwan Im Temple Area (2).
(Sources : Analysis, 2025)

5. Conclusions

The development of the Bah Bolon Riverbank Area in Pematang Siantar City must be carried out in an integrated manner by considering ecological, social, cultural, and economic aspects. The great potential must be balanced with participatory planning strategies and environmental preservation. The conclusions that can be summarized as a result of this series of studies include: (1) The Bah Bolon River is one of the main potentials of Pematang Siantar City to be developed as an urban ecotourism corridor, which can connect ecological, social, cultural and economic functions. (2) River boundaries that pass through strategic areas such as RINDAM I/BB, Jalan Diponegoro-Jalan Jenderal Sudirman-Jalan M.H. Sitorus and the Dewi Quan Im Temple have strategic value from both historical, religious and city recreation aspects. (3) The potential for urban rafting tourism, theme parks, tourist piers and riverside public spaces can be integrated as part of the transformation of the face of the city to be water-friendly and inclusive. (4) Despite having great potential, this area faces serious challenges such as pollution, limited infrastructure, inappropriate use of boundaries, weak institutional coordination, and minimal public awareness. (5) Development of riverbank areas requires an integrated and sustainable approach, which includes aspects of spatial planning, environmental conservation, local economic empowerment, institutions, and area promotion.

Recommendations that can be given to the Pematang Siantar City Government and/or other stakeholders in determining policies related to the development plan for the Bah Bolon River waterfront area, include: (1) Policy and Planning, The Pematang Siantar City Government needs to prepare a master plan for the development of the Bah Bolon River border area which functions as a cross-sector reference. (2) Physical and Environmental Revitalization, Organizing river boundaries by planting riparian vegetation, building pedestrian paths, thematic parks, and tourist pier zones. (3) Penguatan Kelembagaan, Establish a management body for the Bah Bolon River boundary area with a collaborative approach (government, private sector, and community). (4) Empowerment of Community and UMKM, Involving local communities in rafting tourism activities, environmental education, and management of UMKM kiosks in riverbank areas. (5) Regional Promotion and Branding, Creating regional identities such as “Siantar Waterfront” and holding annual river events to increase public participation and tourist attraction.

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